Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2013

Construction Studies

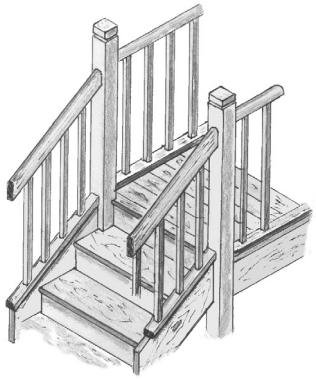
Theory - Higher Level

(300 marks)

Friday, 14 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 closed-string wooden stairs leads to a landing with balustrade, as shown in the sketch. The landing has a hardwood tongued and grooved floor, on 200 mm × 50 mm joists with a plasterboard ceiling beneath. The newel post is 100 mm × 100 mm and the rise of a step should not exceed 175 mm.



(a) To a scale of 1:5, draw a vertical section through the centre of the stairs and through the landing. The section should show the typical construction details through the top three steps of the stairs and the landing, showing the newel post, balusters and handrails to the stairs and landing. Include the typical dimensions of **three** structural members of the stairs. Show the typical handrail height to stairs ***and*** landing.

Note*: On your drawing, show a 500 mm length of landing.*

(b) Indicate on your drawing **two** design features that ensure that the stairs is safe for all users.

2. **(a)** Discuss in detail the importance of **each** of the following in the development of a safety culture amongst workers on a construction site:

- training
- vigilance
- teamwork.

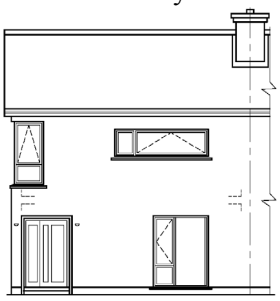
(b) Identify **two** possible risks to personal safety associated with **each** of the following:

- using a ladder on a construction site
- fitting a window in the second storey of a dwelling house.

Using notes and freehand sketches as appropriate, outline **two** specific safety procedures that should be observed to eliminate **each** risk identified at **2(b)** above.

(c) Recommend **three** best practice guidelines that should be observed when using electrical tools on a construction site.

3. The drawing shows the elevation, ground floor plan and portion of the rear garden of a two-storey semi-detached house. The rear wall **B-B** of the house is south facing.
The external walls are 350 mm concrete block walls with an insulated cavity.
All internal walls are of 100 mm solid block construction and the internal wall **A-A** is load-bearing.

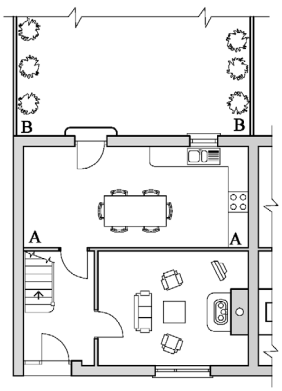


It is proposed to build a single-storey extension to the rear of the house to:

- allow increased sunlight into the interior of the house

and

- improve the view to the rear garden.

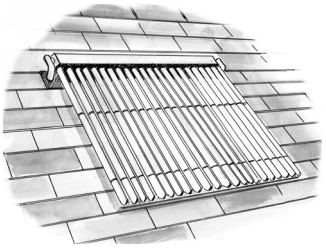


(a) Show, using notes and freehand sketches, a proposed design for the extension to the rear of the dwelling house ***and*** a revised layout for the ground floor to include the extension.

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

4. It is proposed to use a wood-burning stove combined with a solar collector 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 the heating system and the domestic 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.



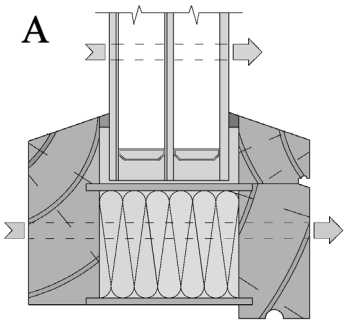
(b) Using notes and freehand sketches, discuss **two** design considerations that should be taken into account when siting a solar collector, as shown, to ensure maximum efficiency.

(c) Discuss in detail **two** advantages and **two** disadvantages of the heating system outlined at **4** above.

5. A section through a triple-glazed, high performance wooden window is shown at **A**. The frame is a thermally broken, insulated frame as shown. Two of the panes of glass have a low-emissivity (low-e) coating and the spaces between the panes are filled with argon gas.
A section through a traditional single-glazed solid wooden window is shown at **B**.

(a) For window **A**, using the given data, calculate the U-value of **each** of the following:

- the thermally broken wooden frame
  and
- the triple glazed argon-filled glazing unit.



Glass	thickness	4 mm
Space between panes of glass	each space	20 mm
Wood in thermally broken frame	each piece	30 mm
Rigid urethane insulation in frame	thickness	60 mm

Data for thermally broken wooden frame:

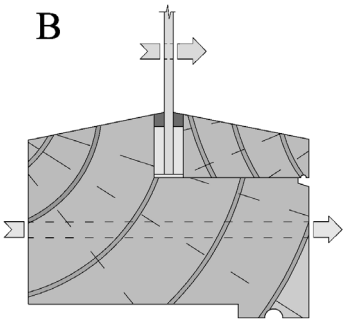
Conductivity of wood	(k)	0.150	W/m °C
Conductivity of rigid urethane insulation	(k)	0.021	W/m °C
Resistance of external surface of frame	(R)	0.950	m^2 °C/W
Resistance of internal surface of frame	(R)	1.400	m^2 °C/W

Data for triple-glazed unit:

Conductivity of glass	(k)	1.050	W/m °C
Conductivity of argon gas	(k)	0.160	W/m °C
Resistance of external surface of glass	(R)	0.075	m^2 °C/W
Resistance of internal surface of glass	(R)	0.110	m^2 °C/W
Total resistance of the low-e panes of glass	(R)	3.400	m^2 °C/W

(b) The traditional single-glazed solid wooden window shown at **B** has the following U-values:

- U-value of the solid wooden frame 0.317 W/ m^2 °C
- U-value of the single glazing 5.300 W/ m^2 °C



Using the U-values of the high performance window frame and glazing unit obtained at **5(a)** and the U-values of the traditional single-glazed wooden window given at **5(b)** above, discuss the performance of both windows under the following headings:

- thermal properties
- environmental considerations.

(c) Using notes and freehand sketches, show the design detailing of a window which is fixed in a 350 mm concrete block wall with an insulated cavity, to ensure minimum heat loss.
Note: *Show design details at the window head only.*

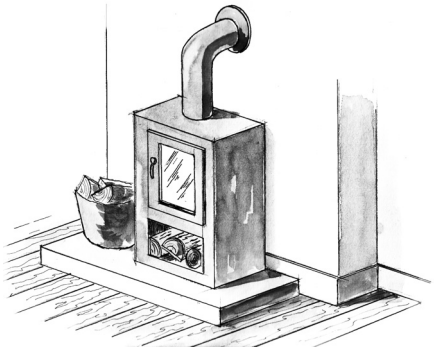
6. The elevation and ground floor plan of a house are shown. The house has three bedrooms and a bathroom in the attic space. The external wall is of timber frame construction with a rendered concrete block outer leaf. The house is designed to have low environmental impact and be suitable for first-time buyers.

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

(b) Discuss in detail the importance of **each** of the following when designing a house suitable for first-time buyers:

- modest in scale
- easy to modify
- proximity to services.

7. A chimney is designed to accommodate a modern wood-burning stove, as shown in the accompanying sketch. The chimney is located on an internal 215 mm solid concrete block wall between the living room and the kitchen. The flue from the stove to the main flue liner is 150 mm in diameter. The floor is an insulated solid concrete ground floor with a 20 mm floating hardwood finish.
The dimensions of the stove are: height 700 mm, width 550 mm, depth 450 mm.



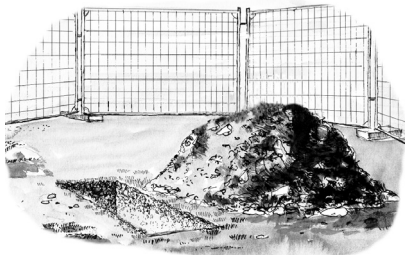
(a) To a scale of 1:5, draw a vertical section through the ground floor, hearth and chimney. The section should show the typical construction details from 400 mm below the finished floor to a level 300 mm above the top of the flue from the stove, and include the connection to the main flue liner in the chimney. Include **three** typical dimensions on your drawing.

(b) Indicate clearly on the drawing how the flue liners in the chimney are joined to ensure the safe removal of smoke and flue gases.

Note: *Show an outline of the stove only; it is not necessary to show a detailed drawing of the stove.*

8. **(a)** Discuss in detail, using notes and freehand sketches, **two** functional requirements of a foundation suitable for a dwelling house.

(b) A trial hole, as shown in the sketch, indicates a moderately firm clay subsoil for the foundations of a dwelling house. The external wall of the house is a 350 mm solid concrete block wall with an insulated cavity.
Consideration is being given at the design stage to using either:

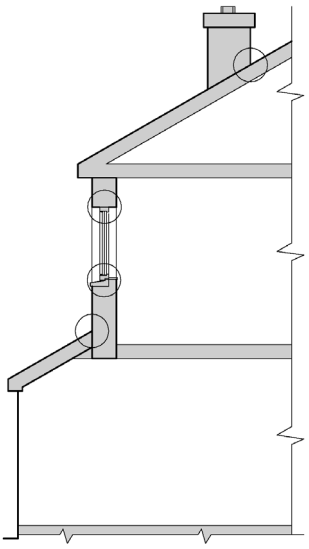


- a traditional strip foundation ***or***
- a raft foundation.

Show, using notes and annotated freehand sketches, the typical design detailing for **each** type of foundation.
Recommend a preferred foundation for the house and give **two** reasons for your recommendation.

(c) Discuss in detail **three** best practice guidelines that should be observed to ensure the maximum strength of concrete in a foundation.

9. A two-storey house, as shown in the drawing, is of timber frame construction with a rendered concrete block outer leaf. The chimney is also of rendered concrete block construction and both roofs are slated. Careful design detailing is required to prevent the penetration of dampness at the critical junctions circled in the drawing.



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

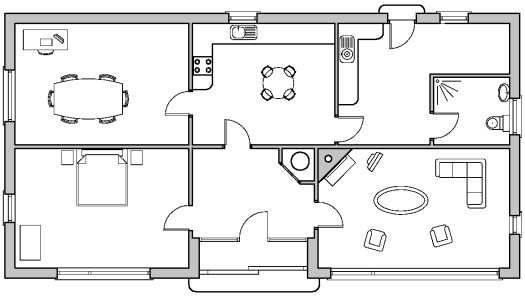
(b) Select any **two** junctions and specify a damp-proofing material suitable for each junction. Discuss the advantages of each material for the specified junction.

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

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 orientation
- thermal mass
- primary energy demand.

(b) It is proposed to install a Mechanical Heat Recovery with Ventilation (MHRV) system in a Passive House, as shown in the drawing.
Draw a single line diagram of the given room layout and indicate a preferred location for the MHRV unit. Show a typical design layout for the ducting to the MHRV unit and indicate clearly the direction of airflow in all the ducts. Describe how a Mechanical Heat Recovery with Ventilation (MHRV) system works.



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

(c) Discuss in detail **two** design considerations that should be taken into account when deciding a preferred location for the MHRV unit in a Passive House.

OR

10. "It is worth questioning whether a large house built to passive standards but remote from schools, shops or workplace, may in the long term be less sustainable than a modestly-sized home built within walking or cycling distance from daily destinations. The cost of energy required to power but also to transport goods and people from place to place will increasingly form part of the debate on sustainability. Passive living is not just a factor of the energy rating of the fabric of the house, but of an holistic approach to how we as a society think about dwelling, about the reuse of existing space in the first instance and about the appropriateness of scale".

From House to Home: a long conversation - Orla Murphy, School of Architecture, UCD
HOUSE - AN EXHIBITION OF 21ST CENTURY HOMES IN THE WEST OF IRELAND (2012)
AVAYA: 25-29 Mervue Business Park, Mervue, Galway

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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