Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2009

Construction Studies

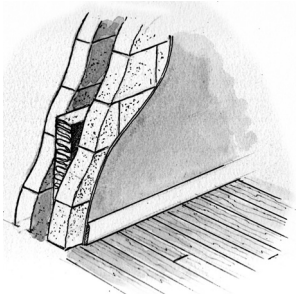
Theory - Higher Level

(300 marks)

Wednesday, 17 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. An insulated suspended timber ground floor abuts the external wall of a dwelling house, as shown in the accompanying sketch. The external wall is a 350 mm concrete block wall with a 150 mm cavity. Rigid insulation board is fixed in the cavity. The suspended timber floor has a 25 mm tongued and grooved hardwood finish.



(a) To a scale of 1:5, draw a vertical section through the external wall and the suspended timber ground floor. The section should show all the construction details from the bottom of the foundation to 400 mm above finished floor level. Include **four** typical dimensions on your drawing.

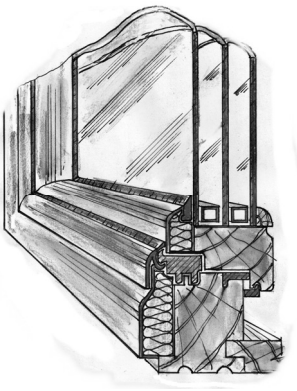
(b) Indicate clearly the position of a barrier that would prevent radon gas entering the dwelling.

2. **(a)** Discuss in detail **two** functional requirements of a foundation for a dwelling house.

(b) Using notes and ***freehand sketches*** show **three** different foundation types suitable for a dwelling house. Show the position of the reinforcing and indicate typical dimensions of each foundation type.

(c) Discuss **two** factors that must be taken into account to ensure the maximum strength of concrete in a foundation.

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



(b) The sketch shows a portion of a high performance wooden window with an aluminium external cladding. Discuss the design of the window with reference to:

- environmental considerations
- thermal properties.

(c) Recommend a preferred window frame and glazing system for a new house and give **two** reasons in support of your recommendations.

4. A main bathroom, as shown in the sketch, is located on the first floor of a dwelling house.

(a) Using notes and ***freehand sketches*** show **two** design considerations that should be taken into account when locating the bathroom on the first floor of a dwelling house.

(b) Using notes and ***freehand sketches*** show the above-ground pipework necessary for the safe discharge of waste from the following fittings:

- wash hand basin
- bath.

Include in your sketch typical sizes of the waste pipe for each fitting.

(c) Using notes and ***freehand sketches*** show the design detailing necessary to prevent the penetration of sewer gases into the bathroom at the W.C.

5. **(a)** Calculate the U-value of the external wall of a new dwelling house, given the following data:

External render	thickness	12 mm
Concrete block outer leaf	thickness	100 mm
Cavity	width	150 mm
Insulation	thickness	100 mm
Concrete block inner leaf	thickness	100 mm
Internal plaster	thickness	15 mm

Thermal data of external wall of new house:

Resistance of external surface	(R)	0.048 m^2 °C/W
Conductivity of external render	(k)	1.430 W/m °C
Conductivity of concrete blocks	(k)	1.440 W/m °C
Resistance of cavity	(R)	0.170 m^2 °C/W
Conductivity of insulation	(k)	0.018 W/m °C
Conductivity of internal plaster	(k)	0.430 W/m °C
Resistance of internal surface	(R)	0.122 m^2 °C/W

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

- the new house specified at **5(a)** and
- a house built in the 1970s with an external wall U-value of 1.80 W/m^2 °C.

Thermal data:

Area of external wall	152 m^2
Average internal temperature	17 °C
Average external temperature	6 °C
U-value of wall of new house	as calculated at **5(a)** above
U-value of wall of 1970s house	1.80 W/m^2 °C
Heating period	11 hours per day for 41 weeks per annum
Cost of oil	65 cent per litre
Calorific value of oil	37350 kJ per litre
1000 watts	1kJ per second.

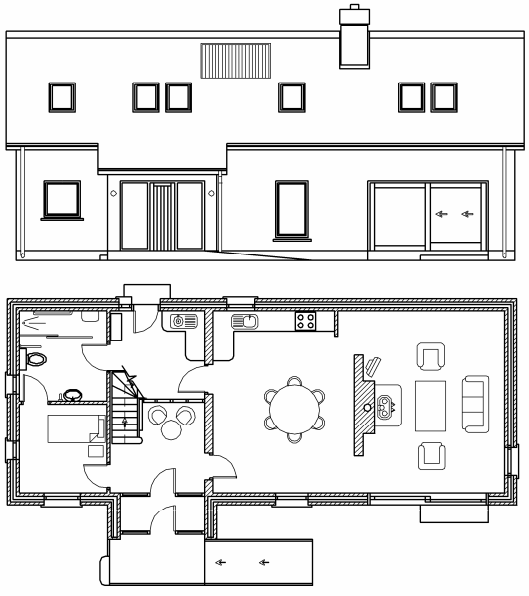
(c) Using notes and ***freehand sketches*** show **one** method of upgrading the thermal properties of the external wall of the house built in the 1970s to meet the requirements of the current Building Regulations.

6. **(a)** Discuss in detail **three** advantages of designing a house to have low environmental impact.

(b) The accompanying drawing shows the elevation and ground floor plan of a house. The house has two additional bedrooms and a bathroom in the attic space.

With reference to the design shown, discuss in detail, using notes and ***freehand sketches,*** the importance of **each** of the following in ensuring that the house has low environmental impact:

- scale and layout
- selection of materials
- energy requirements.

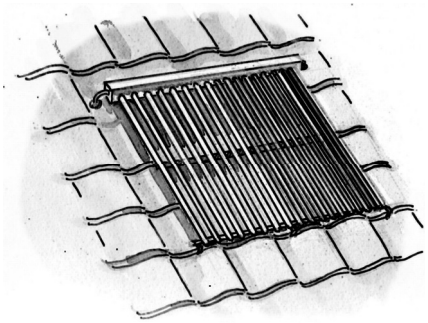


7. A new house with an internal width of 7.0 metres, has a traditional cut roof which is slated and has a pitch of 45 degrees, as shown in the accompanying sketch. The roof is designed to incorporate bedroom accommodation in the attic space.
The external wall supporting the floor joists of the attic is of timber frame construction with a concrete block outer leaf. The floor joists are supported internally on a centrally located load-bearing wall.

(a) To a scale of 1:10 draw a vertical section through one half of the roof structure from eaves to ridge, showing one external wall and one rafter length. Show all the construction details from 400 mm below the floor joists to the ridge and include three courses of slate at eaves. Include **four** typical dimensions of the roof structure.

(b) Indicate clearly on the drawing the design detailing to show the continuity of insulation from the wall to the roof structure.

8. **(a)** An oil-fired boiler is used to heat two independently controlled heating zones, one on each floor, in a two storey dwelling house. Using notes and a ***single-line diagram,*** show a design layout for the pipe work necessary for each zone. Show **three** radiators on each floor, indicate the control valves and give the typical sizes of the pipework.



(b) A roof mounted solar collector, as shown in the accompanying sketch, is to be connected to the system at **8(a)** above, to heat domestic hot water only. Show the pipework necessary to connect the solar collector to the above system.
Outline **two** advantages of connecting a solar collector to the system.

9. Careful design detailing is required to improve the air-tightness performance of a dwelling house.

(a) Identify **three** possible air leakage routes in a dwelling house and, with the aid of notes and ***freehand sketches,*** show clearly the correct design detailing that will improve the air-tightness level at each air leakage route identified.

(b) Discuss in detail **two** advantages of improving the air-tightness performance of a dwelling house.

10. **(a)** Using notes and ***freehand sketches*** discuss in detail the importance of **any two** of the following in the design of a passive solar house:

- insulated building envelope
- controlled air changes
- optimum benefit from passive solar gain.

(b) The accompanying sketch shows a terrace of houses with fully glazed façades. Using notes and ***freehand sketches*** show the preferred orientation of the houses to maximise passive solar gain. Justify your choice of orientation.

(c) Overheating may occur in summer as a result of glazing the full façade as shown. Using notes and ***freehand sketches*** show, for one of the houses, **two** design details that would help prevent such overheating.

OR

10. "I think the next challenge for Ireland is not about house building but about remedying a lot of mistakes made at all scales, from regional planning down to house design. Architects should be leading the way and demonstrating how the green agenda can become a very attractive way of thinking about architecture. If we stick to the elements of architecture – light, form and space – and look to the sun as a 'planet' that almost gives life, we can find very interesting ways of using light. You can argue that the bulk of housing stock in Ireland took no cognition of orientation; where the kitchen area was facing - simple things like that coincide with architecture and green design. A lot of these things were forgotten and not questioned, probably because we got used to the idea of being able to cancel out poor orientation with heating."

Extract from interview with Seán Ó Laoire, President RIAI in: *House* (2008). Nova Publishing Ltd, 9 Sandyford Office Park, Sandyford, Dublin18.

Discuss the above statement in detail and propose **three** guidelines that would help create more environmentally sustainable housing in Ireland.

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