



*Leaving Certificate Examination, 2016*

# *Construction Studies*

## *Theory - Higher Level*

*(300 marks)*

*Friday, 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. A front porch with a flat roof projects 1.5 metres from the external wall of a house, as shown. The roof of the porch is insulated, and is covered with layers of bituminous felt, on plywood decking, on 200 mm × 40 mm roof joists. Insulated plasterboard is fixed to the underneath of the roof joists. The external wall of the porch and of the house is a 400 mm wall of concrete block construction with a full-fill insulated cavity. The window of the porch is triple-glazed, with a thermally broken wooden frame.



- (a) To a scale of 1:5, draw a vertical section through the porch, showing the external wall, the flat roof and the window of the porch. Show the typical construction details from a level 300 mm below the fixed frame of the porch window, through the walls, the window head, lintels and flat roof to a level 400 mm above the abutment of the flat roof and the front wall of the house. Include **four** typical dimensions.
- (b) Show on your drawing the design detailing to prevent the ingress of water at the junction of the flat roof and the main wall of the house.

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

- safety training
- collective responsibility.

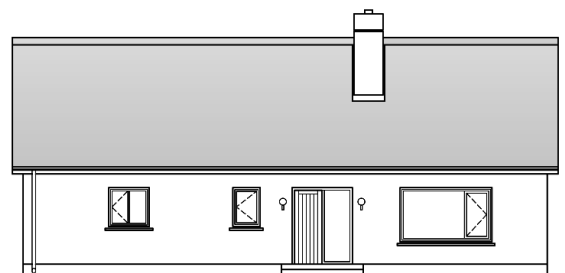
- (b) Discuss in detail the importance of **each** of the following when deciding if the use of a ladder is appropriate, or not, for a proposed task:

- level of risk
- duration of task.

- (c) Discuss in detail, using notes and freehand sketches, **three** specific best practice guidelines that should be observed when placing a ladder to access a scaffold platform on a construction site.



3. The drawing shows the plan and elevation of a two-bedroom bungalow built in the 1970s. The front elevation is south facing. The bungalow has a slated cut roof and a 300 mm external wall of concrete block construction with a full-fill insulated cavity. All internal walls are of 100 mm concrete block construction and the wall A-A is load-bearing. In the existing design, many of the rooms have low levels of natural light.

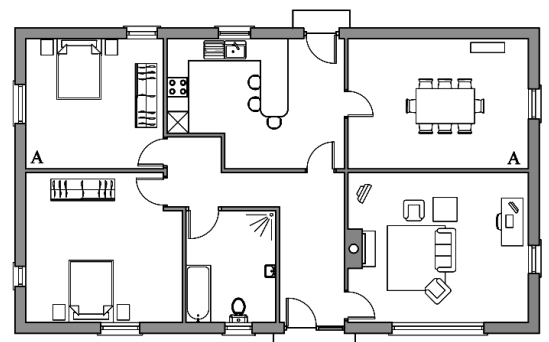


- (a) Show, using notes and freehand sketches, a revised design of the bungalow which will ensure a bright, light-filled interior.

In your revised design, you should consider:

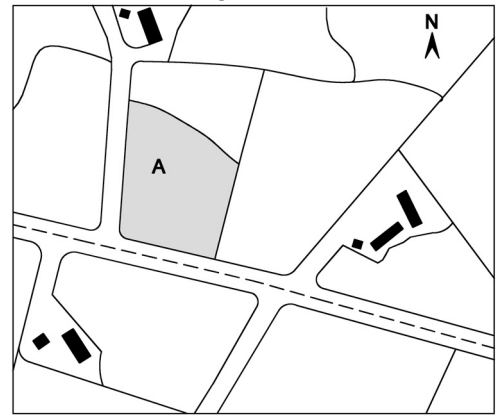
- modifying the external envelope to improve the penetration of natural light
- and**
- revising the internal layout to optimise natural light.

- (b) Discuss in detail the reasons for your proposed design choices in the redesign of the bungalow.



*Note: It is not necessary to show the furniture in your design sketches.*

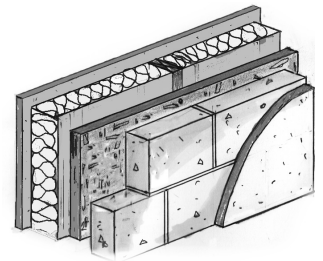
4. This site location map shows field boundaries, roadways and some domestic buildings. It is proposed to build a new house on the site marked A.



- (a) Discuss in detail **three** reasons why site A may be considered suitable for a new house.
- (b) Using a well proportioned freehand sketch, redraw the given site and the immediate surrounding boundaries. On your sketch show a proposed:
- location and orientation for a house on site A
  - entrance gateway and access road to the house.
- For **each** of the above, justify your design choices.
- (c) Discuss in detail **two** advantages and **two** disadvantages of building one-off houses in the Irish rural landscape.

5. The external wall of a house of timber frame construction has the following specification:

External render	thickness	19 mm
Concrete block outer leaf	thickness	100 mm
Oriented Strand Board (OSB) sheeting	thickness	18 mm
Timber stud inner leaf	thickness	120 mm
Mineral wool insulation between studs	thickness	120 mm
Plasterboard	thickness	12.5 mm



**Thermal data of outer leaf and cavity:**

Resistance of the external surface	(R)	0.048	m <sup>2</sup>	°C/W
Resistivity of the external plaster	(r)	2.170	m	°C/W
Conductivity of concrete block	(k)	1.320	W/m	°C
Resistance of the cavity	(R)	0.170	m <sup>2</sup>	°C/W

**Thermal data of inner leaf:**

Conductivity of OSB sheeting	(k)	0.130	W/m	°C
Conductivity of mineral wool	(k)	0.040	W/m	°C
Conductivity of plasterboard	(k)	0.160	W/m	°C
Resistance of the internal surface	(R)	0.104	m <sup>2</sup>	°C/W

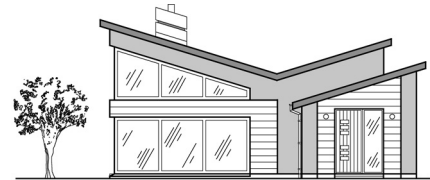
*Note: The timber studs of the inner leaf need not be considered in your calculations.*

- (a) Calculate the U-value of the above external wall.
- (b) Calculate the cost of heat lost annually through this wall, using the following data:

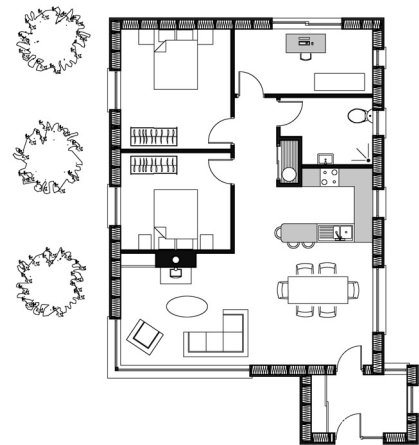
Area of external wall	150 m <sup>2</sup>
Average internal temperature	18 °C
Average external temperature	6 °C
U-value of wall	as calculated above
Heating period	8 hours per day, every day for 38 weeks per annum
Cost of oil	96 cent per litre
Calorific value of oil	37350 kJ per litre
1000 Watts	1 kJ per second.

- (c) It is proposed to upgrade the thermal properties of the above wall to meet the 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<sup>2</sup> °C.

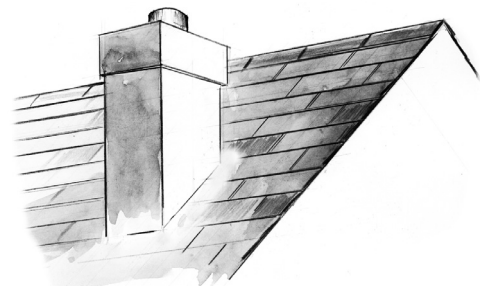
6. The drawing shows a single storey house. The external walls are of insulated timber frame construction and are finished externally with rendered cement board and cedar cladding, as shown. All internal partitions are of timber frame construction. The house is designed to have low environmental impact.



- (a) Discuss in detail, using notes and freehand sketches, **three** features of the design that contribute to the house having low environmental impact.
- (b) To meet the Nearly Zero Energy Building (NZEB) requirements, the production of on-site renewable energy is recommended. Using notes and freehand sketches show **one** means of generating on-site renewable energy for the dwelling house.
- (c) Discuss in detail **two** advantages of generating renewable energy on-site.



7. A chimney stack projects through the pitched roof of a house as shown. The chimney stack is of solid concrete block construction with an external sand / cement render. The roof is a slated cut roof and is pitched at 45°.



- (a) To a scale of 1:5, draw a vertical section through the chimney stack and roof structure. Show the typical construction details of the chimney stack, flue, chimney capping and portion of the adjoining roof structure. Include the design details to prevent the penetration of rainwater between the chimney stack and the adjoining roof surface.
- (b) On your drawing, show **two** considerations to be taken into account in the design of the chimney stack shown which will help prevent a downdraught. Include typical dimensions as appropriate.

8. The sketch shows a semi-detached house with a storeroom in the rear garden. The owners wish to undertake an eco-refurbishment of the storeroom to make it suitable for use as a home office.

- (a) Discuss **two** advantages and **two** disadvantages of refurbishing the storeroom for use as a home office.
- (b) A survey of the storeroom reveals:
- walls: random rubble, unrendered, 450 mm thick
  - roof: uninsulated, traditional cut roof with natural slate
  - floor: stone flags on earth.



Select any **two** areas from the above and, using notes and freehand sketches, show the design detailing necessary to upgrade the storeroom to make it suitable for use as a home office. The refurbishment should be eco-friendly and should respect the character and appearance of the original storeroom.

Justify your design choices.

9. (a) State where the following electrical circuits are typically used in a domestic dwelling:

- ring circuit
- radial circuit.

(b) Two electrical light points, as shown, are controlled by a single switch. Using an annotated freehand sketch, show the design of a typical electrical circuit for the lights. Show the circuit from the consumer electrical distribution board to the light points and switch. Indicate the typical sizes and colour coding of the electric cables. In your sketch, show **two** safety features in the design of the lighting circuit to ensure that it is safe for all users.

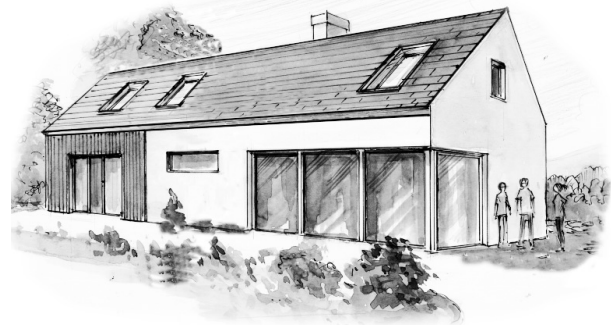


(c) Show **two** features that could be incorporated into the design of a lighting system to ensure the economical use of electricity in the house.

10. (a) Minimising heat loss and storing heat gain are important considerations in Passive House design. Using notes and freehand sketches, show best practice design detailing to minimise heat loss and maximise heat storage in a Passive House for any **two** of the following:

- foundations
- ground floor
- walls.

(b) The Passive House shown overheats in summer. Discuss **two** reasons why overheating occurs and, using notes and freehand sketches, show **two** design details for the house that would reduce the possibility of overheating.



(c) Discuss **two** advantages and **two** disadvantages of making the Passive House standard a planning requirement for all new housing in Ireland.

**OR**

10. One of the greatest challenges and opportunities for sustainable development is the reuse of our existing buildings for multiple uses. This gives vitality, density, security, utility and beauty to our countryside, villages, towns and cities.

**Repairing and Reusing an 18th Century House** – Report by Robin Mandal Architects.  
Issue 283 - The Journal of the Royal Institute of the Architects of Ireland, 2015.

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

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