



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2022

Construction Studies
Theory - Higher Level
(240 marks)

Friday, 17 June
Afternoon, 2:00 - 5:00

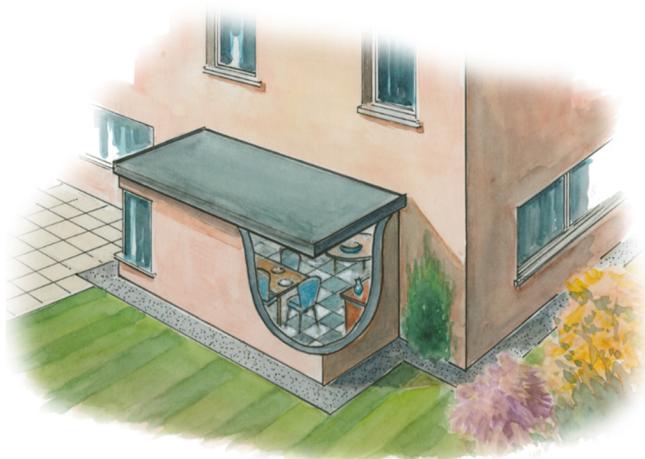
- (a)*** Answer ***any four*** questions.
- (b)*** All questions carry equal marks.
- (c)*** Answers must be written in ink.
- (d)*** Drawings and sketches are to be made in pencil.
- (e)*** Write the number of the question distinctly before each answer.
- (f)*** Neat freehand sketches to illustrate written descriptions should be made.
- (g)*** The name, sizes, dimensions and other necessary particulars of each material indicated must be noted on the drawings.

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1. A dining area has a flat roof section which projects 1.6 metres from the rear wall of a house, as shown. The flat roof is covered with a waterproof membrane, on 150 mm rigid insulation, on plywood decking, supported on 200 mm × 50 mm roof joists. Insulated plasterboard is fixed to the underside of the roof joists. The external wall of the house is a 450 mm rendered concrete block wall with a full-fill cavity.

- (a) To a scale of 1:5, draw a vertical section through the external wall of the dining area, the flat roof and the rear wall of the house. Show the typical construction details from a level 300 mm below the wallplate of the dining area wall, through the flat roof, to a level 400 mm above the abutment of the roof and the rear wall of the house.



- (b) On your drawing, indicate the typical design detailing to prevent the formation of a thermal bridge at the junction of the flat roof and the rear wall of the house.

2. Providing for lifetime use should be a key consideration at the design stage of a dwelling house.

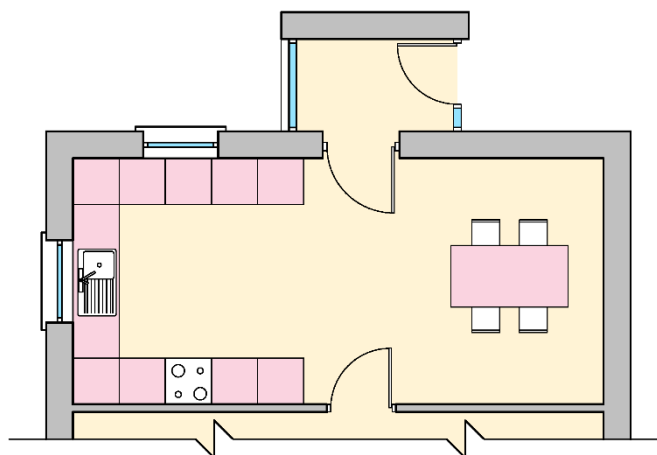
- (a) Using notes and freehand sketches, discuss **two** best practice guidelines that should be followed when designing for lifetime use at **each** of the following areas of a house:

- entrance access
- internal corridor.

- (b) The drawing shows the ground floor plan of an open-plan kitchen / dining space, that is to be used by a person in a wheelchair.

With reference to the design shown, discuss using notes and freehand sketches, **two** areas of the internal layout that require specific design detailing to ensure ease of use by a person in a wheelchair.

Indicate on your sketches typical dimensions as appropriate.

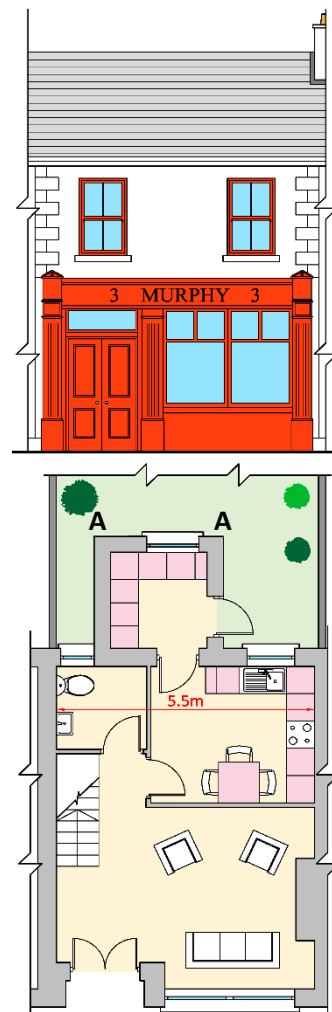


- (c) Discuss in detail **two** reasons why provision for lifetime use should be considered in the design of a house.

3. The drawing shows the elevation and ground floor plan of a terraced house which has been converted from a traditional town shop. Also shown is a portion of the rear garden. The rear wall **A-A** is south facing. The owners wish to build a single-storey extension to the rear of the property to include an internal courtyard. Internal courtyards draw natural light and air into the centre of a house. The extension should be not greater than 15 m² in area.

Consideration at the design stage is to be given to:

- providing a separate additional living space
 - optimising daylight into **both** the extension and the existing kitchen.
- (a) Using notes and freehand sketches, show a proposed design layout for the extension that incorporates **each** of the above requirements.
- (b) Discuss **three** reasons for your proposed design layout.
- (c) Discuss in detail **two** advantages of maintaining the vernacular heritage of the streetscape in a town.



4. (a) Discuss in detail, using notes and freehand sketches, **three** functional requirements of a foundation suitable for a dwelling house.
- (b) The owners of the site shown have been granted permission to construct a two-storey house. Site investigations have revealed moderately firm clay subsoil for the foundations. The external wall of the house is to be a 450 mm concrete block wall with a full-fill insulated cavity.

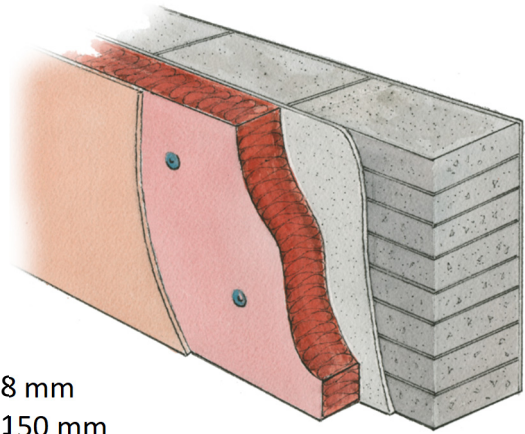
Using notes and freehand sketches, show the typical design detailing for **two** different foundations suitable for the proposed house.

Indicate the position of the reinforcement **and** the typical dimensions of each foundation.



- (c) Discuss **one** advantage and **one** disadvantage of **each** foundation you have shown at 4(b) above.

5. The proposed external wall design detail for a new house is a 215 mm single leaf wall of solid block construction with external insulation, as shown.



- (a) Calculate the U-value of the wall, given the construction has the following sequence and data:

Acrylic external render	thickness	8 mm
External insulation	thickness	150 mm
External scratch coat	thickness	10 mm
Concrete block	thickness	215 mm
Internal plaster	thickness	12 mm

Thermal data of the external wall:

Resistance of external surface	(R)	0.048	m ²	°C/W
Conductivity of acrylic external render	(k)	0.670	W/m	°C
Conductivity of external insulation	(k)	0.031	W/m	°C
Conductivity of external scratch coat	(k)	2.170	W/m	°C
Conductivity of concrete blockwork	(k)	1.440	W/m	°C
Resistivity of internal plaster	(r)	4.550	m	°C/W
Resistance of internal surface	(R)	0.122	m ²	°C/W

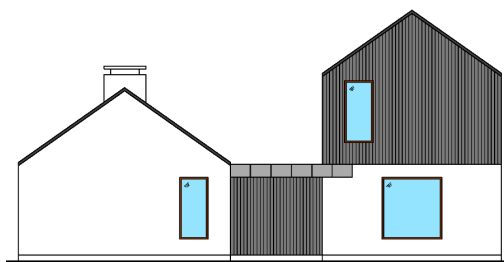
- (b) Using the U-value of the wall obtained at 5(a) above and the following data, calculate the cost of heat lost annually through this wall:

• area of external wall	144 m ²
• average internal temperature	20 °C
• average external temperature	5 °C
• heating period	10 hours daily for 37 weeks per annum
• cost of oil	97 cent per litre
• calorific value of oil	37350 kJ per litre
• 1000 watts	1 kJ per second.

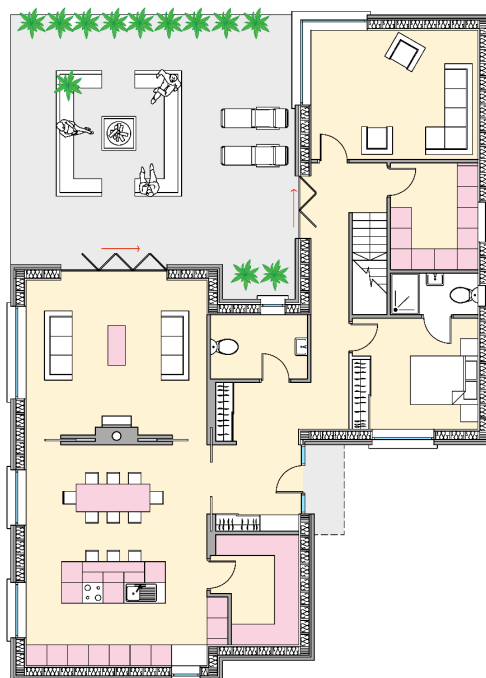
- (c) It is proposed to redesign the above external wall and upgrade its thermal properties to meet the Passive House standard by increasing the width of external insulation in the design.

Calculate the thickness of additional external insulation required to achieve a U-value of 0.12 W/m² °C.

6. The elevation and ground floor plan of a house are shown. The house has additional living space upstairs. The external walls are of timber frame construction with a rendered concrete block and charred timber cladding finish. The house is designed to enhance the health and wellbeing of the occupants and to have a low environmental impact.



- (a) With reference to the design shown, discuss using notes and freehand sketches, **three** features of the design that contribute to the house having a low environmental impact.
- (b) Using notes and freehand sketches, discuss the importance of providing for **any two** of the following in the design of a house, to enhance the health and wellbeing of the occupants:
- internal air quality
 - thermal environment
 - social interaction.
- (c) Discuss in detail **two** advantages of designing a house that will enhance the health and wellbeing of the occupants.



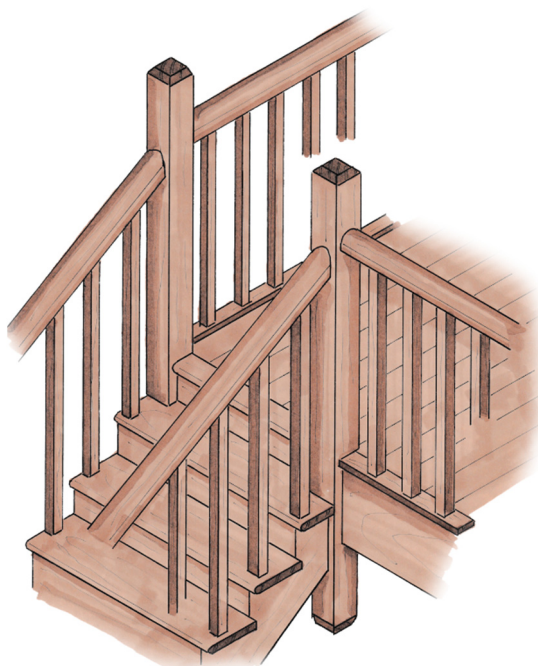
7. A cut-string wooden stairs leads to the first floor of a house, as shown. The first floor landing has a hardwood tongued and grooved floor, on 225 mm × 50 mm joists with a plasterboard ceiling beneath. The newel post is 110 mm × 110 mm and the rise of a step should not exceed 175 mm.

- (a) To a scale of 1:5, draw a vertical section through the centre of the stairs and first floor landing. The section should show the typical construction details through the top **three** steps and the first floor landing, showing the newel post, balusters and handrails.

Include the typical dimensions of **three** structural members of the stairs.

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

- (b) On your drawing, show **two** design details that ensure the safety of users on the first floor landing.



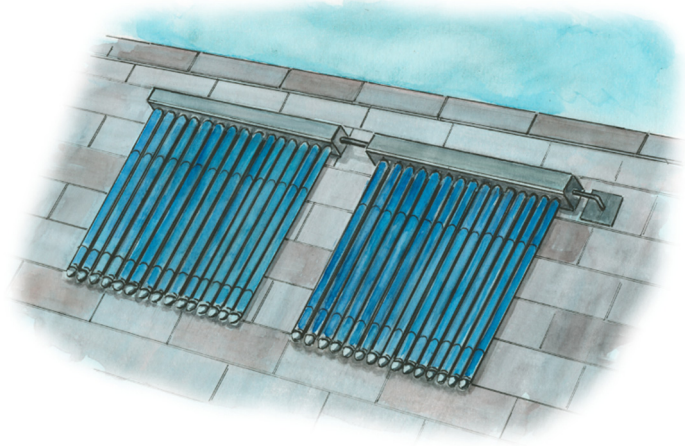
8. The owners of a house wish to upgrade the energy efficiency of their home by installing a solar collector on the roof, as shown, to provide hot water for the house.

(a) Discuss in detail **three** considerations when installing a solar collector for heating domestic hot water.

(b) Using notes and a single-line diagram, show a typical design layout for a solar collector that will connect with an existing system to supply domestic hot water.

Indicate the location of all control valves and give typical sizes of pipework.

Describe how the system works.



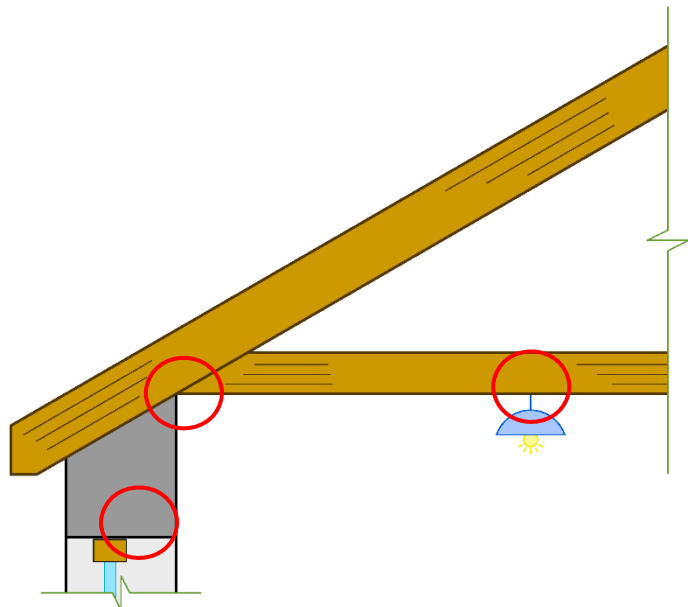
(c) Discuss **two** advantages and **two** disadvantages of installing a solar collector system in a domestic house.

9. An airtight external building envelope is vital in the design of a nearly Zero Energy Building (nZEB).

(a) Discuss in detail **two** advantages of an airtight dwelling house.

(b) The drawing shows an outline section through a portion of a house. The house has a truss roof. The wall is of timber frame construction with an external concrete block leaf and the window frame is thermally broken.

Using notes and freehand sketches, show best practice design detailing that will prevent air leakage at **any two** of the locations circled on the drawing.



(c) Describe using notes and freehand sketches, **one** test that is carried out to determine the airtightness of a house.

10. The sketch shows the proposed design of a Passive House which is to be constructed in a rural setting.

(a) Discuss in detail **three** benefits to the occupants of considering the orientation of a house at the design stage.

(b) Using notes and freehand sketches, suggest a preferred orientation for the house shown.

On your sketch include the sun path and discuss how your preferred orientation ensures the optimum thermal performance of the house.



(c) Using notes and freehand sketches, discuss the importance of thermal mass **and** show **two** ways in which thermal mass could be incorporated into the house shown. Suggest a material choice for each, **and** justify your choices.

OR

10. “Older gas and oil-fired boilers are wasteful of energy and costly to run because of the amount of fuel needed to maintain adequate comfort levels and hot water in the home. Replacing a conventional heating system with an air source heat pump system can transform the comfort levels in your home while reducing running costs, energy usage and harmful greenhouse gas emissions.”

Adapted from: **Home Upgrades.**
Sustainable Energy Authority of Ireland
Published on: www.seai.ie

(a) Discuss the above statement in detail.

(b) Propose **three** best practice guidelines that would promote the installation of air source heat pumps in dwelling houses.

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