Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2022

Marking Scheme

Construction Studies

Higher Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2022

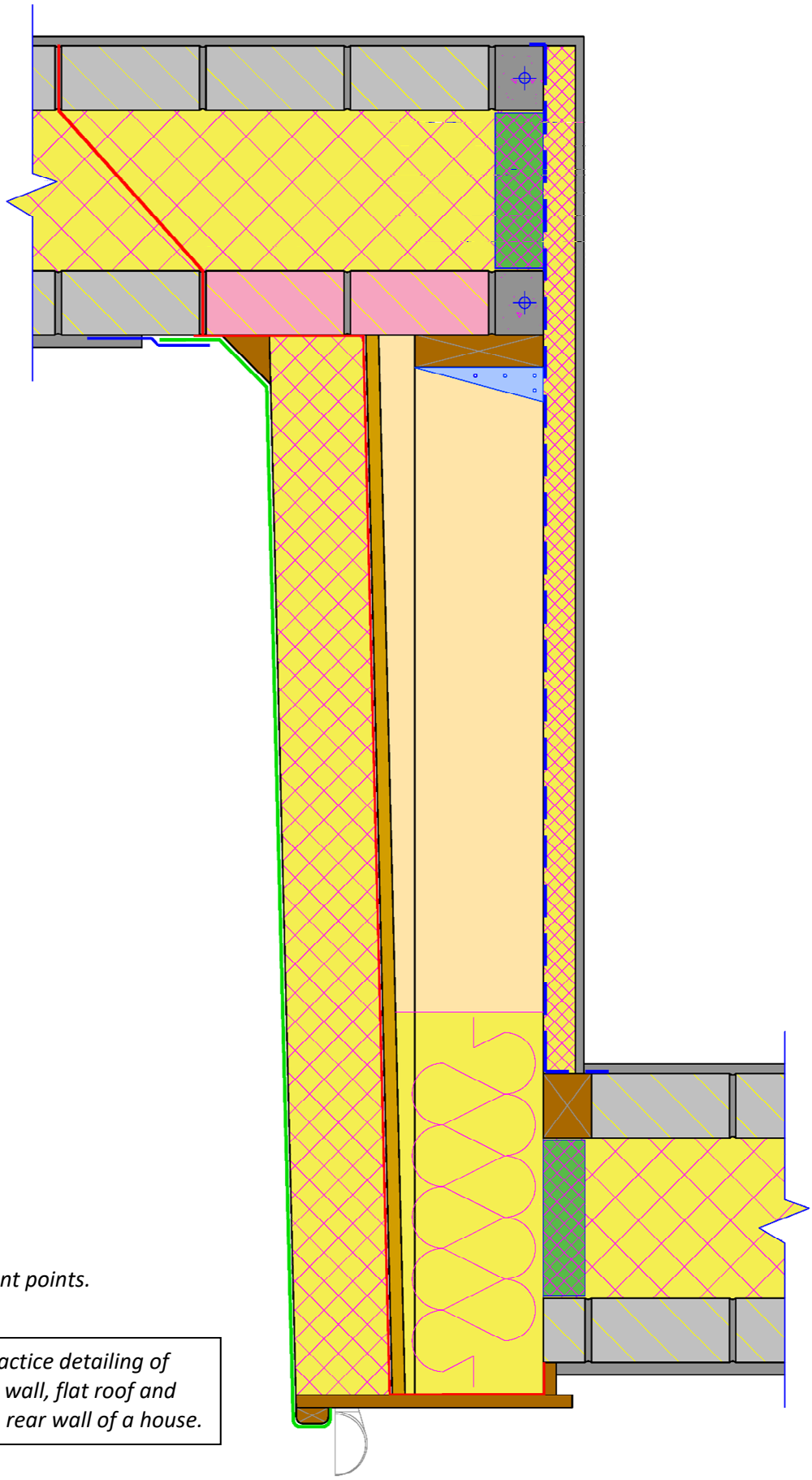
Construction Studies

Theory – Higher Level

Note: *Notes and graphics are for illustration and are not exclusive or exhaustive, other relevant notes and graphics are acceptable as responses and will be credited accordingly.*

Question 1

(a) Vertical section through external cavity wall, flat roof and abutment with rear wall of a house.



Any other relevant points.

Typical best practice detailing of external cavity wall, flat roof and abutment with rear wall of a house.

External wall & eaves - typical detailing

- External & internal render
- Cavity wall & wall ties - 100 mm external and internal leaf
- 250 mm Full-fill insulated cavity
- Cavity closer
- 100 mm × 75 mm Wallplate
- Fascia / soffit / gutter (any 2).

Flat roof - typical detailing

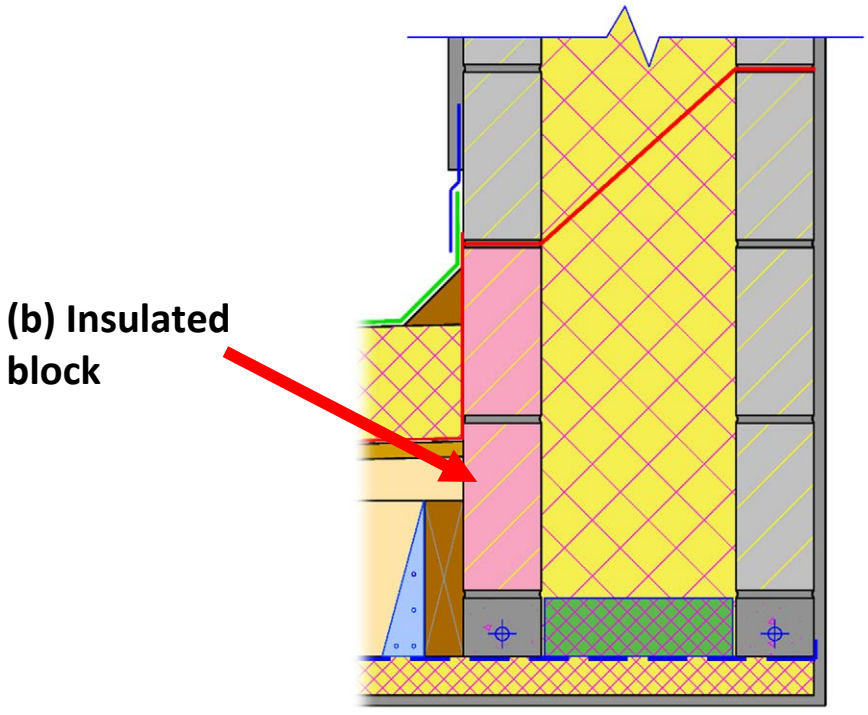
- Waterproof membrane
- 150 mm Roof insulation
- Breather membrane
- OSB / plywood decking
- Firing pieces (1:40 slope)
- 200 mm × 50 mm Roof joists
- Air-barrier / Airtightness membrane
- Insulated plasterboard (50 mm insulation + 12.5 mm plasterboard)

Rear external wall & abutment- typical detailing

- External & internal render
- Cavity wall & wall ties - 100 mm external and internal leaf
- 100 mm × 75 mm Concrete lintels
- Cavity closer
- 200 mm × 50 mm Wallplate & metal hanger
- Tilting fillet & lead flashing
- Stepped DPC.

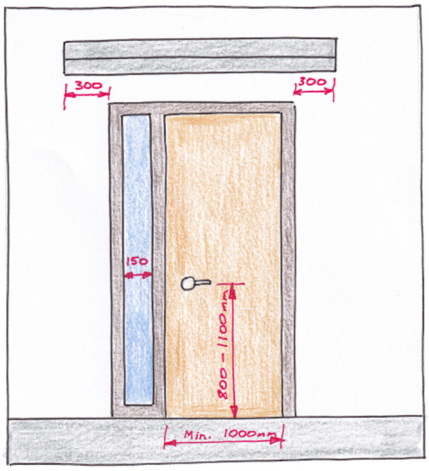
Any other relevant points.

(b) Typical design detailing that will prevent the formation of a thermal bridge at the junction of flat roof and rear wall.



Question 2

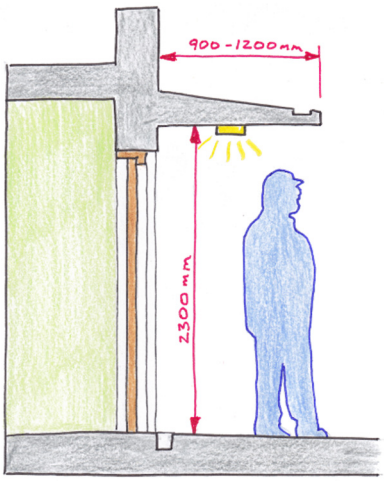
(a) Two best practice guidelines that should be followed when designing for lifetime use at each area of a house.



Entrance access

- Main entrance should provide a minimum clear opening width of not less than 1000 mm
- Provide level thresholds at all entrance doors - with maximum height of 15 mm upstand
- Level surface at the main entrance with maximum turning circle of Ø1800 mm
- Maximum gradient for an access ramp is not steeper than 1:50
- Provide a 300 mm clear space on the leading - edge side of the door externally and internally
- Provide a canopy of minimum dimensions 900 mm deep with a 300 mm overhang either side of the door at a height of maximum 2300 mm
- Internal and external lighting at main entrance activated by sensor or internal switch
- Position door handles between 800 mm and 1100 mm above floor level
- Provide a vision panel to create a clear view through the door for people at all eye levels.

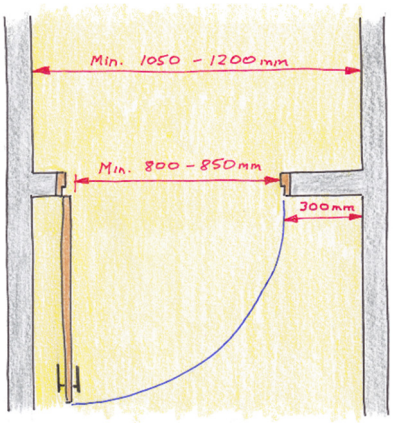
Any other relevant points



Internal corridor

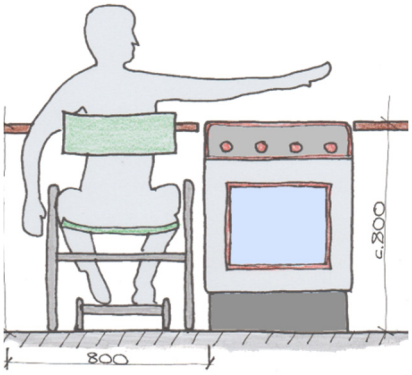
- Entrance hallway to have minimum space of 1500 mm width adjacent to the entrance door
- Provide a corridor width of 1050 - 1200 mm between walls – Universal Design Guidelines recommend a corridor width of 1200 - 1500 mm
- Internal doors to provide a minimum clear opening width of 800 - 850 mm
- Provide a 300 mm clear are beside the leading edge of all doors at entrance level
- Ensure that all doorways on the entrance level have a level threshold
- All sockets and switches installed at between 400 mm and 1000 mm above floor level
- Ensure that lighting levels are at 100 lux at floor level.

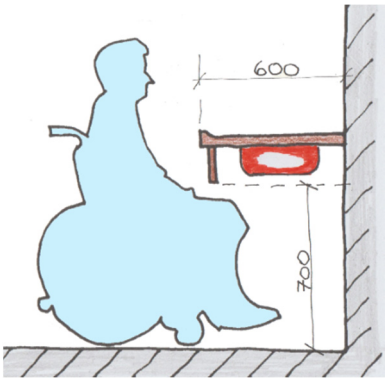
Any other relevant points



(b) Two areas of the internal layout that require specific design detailing to ensure ease of use by a person in a wheelchair.

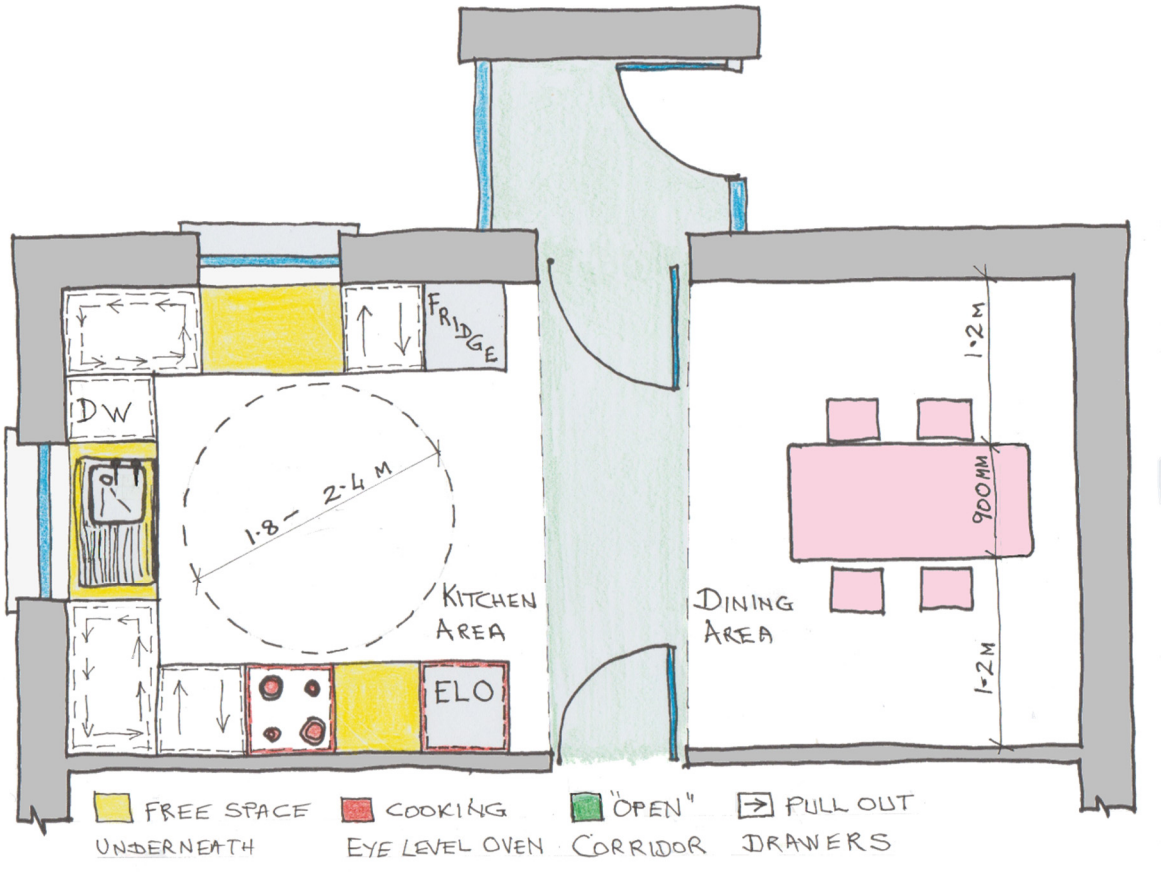
Kitchen





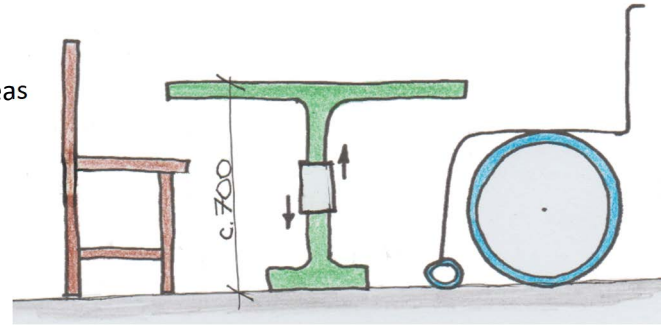
- Kitchen design the layout in a 'U' or 'L'-shape
- A turning circle of minimum Ø1500 mm - Ø1800 mm in the work area
- Provide between 1200 – 1500 mm to opposite work surfaces of the kitchen area
- A working countertop height of 900 mm with the potential to raise or lower the counters
- Providing clear knee-space beneath the sink, hob and other areas of the kitchen worktop will allow the full use of the kitchen by someone seated
- A clear knee space, 700mm high, 600mm deep and 800mm wide, beside ovens, washing machines, dishwashers, fridges and freezers
- Provide pull-out drawers with 600mm deep units, instead of internal shelves
- Provide a continuous worktop between sink and hob with at least 300mm on either side
- Wall units at a maximum height of 450 mm above worktop level with pull-down mechanism for bringing shelf contents within reach
- Tall units, like the oven and fridge freezer housings are located at the end of a run of worktop to avoid interrupting the work space
- Flooring material installed, level, non-slip, easy to clean and continued under kitchen base units
- Kitchen base units to have a plinth of 250mm high to suit wheelchair users.

Any other relevant points



Dining

- Room layout clearly defined passage for guests to move out or into the dining/kitchen areas
- Dining table is best located close to the kitchen to minimise the distance for carrying food and drinks
- A clear space of 1200mm minimum on at least two sides of the table
- Dining table supported on central pedestal which enables easy seating for all diners
- Dining table with corner legs widely spaced/ absence of bottom rails/ stretcher
- External corners of table slightly rounded to avoid injury
- Dining chairs to be stable, lightweight and easily moveable
- Height of table electronically adjustable c. 700 – 900mm
- A clearly defined space between the two areas to enable diner's guests adequate space prevent accidents
- Level floor surface between the kitchen and dining area
- Floor material which is slip-resistant and easy to clean.



Any other relevant points

(c) Two reasons why provision for lifetime use should be considered in the design of a house.

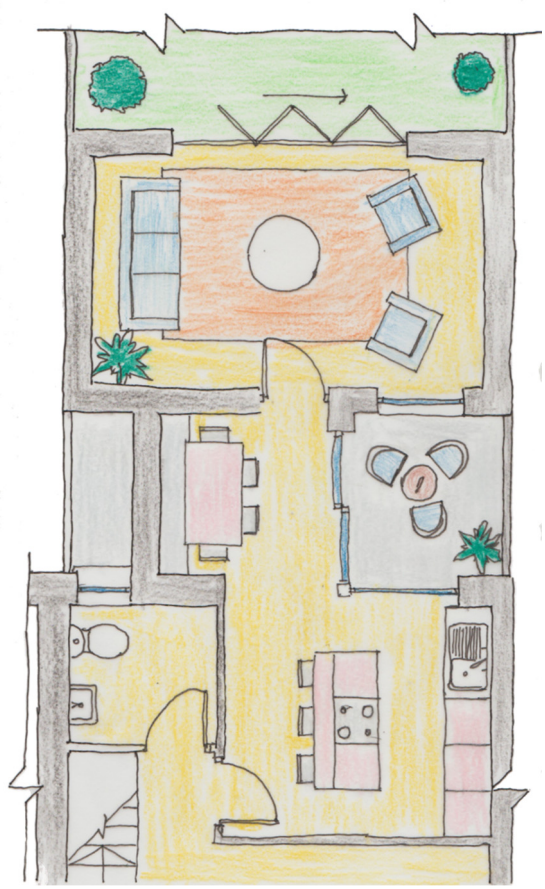
Advantages

- Flexibility and ease of adaptability to meet people's changing needs over time in a cost effective way
- Sustainable design to improve comfort and energy efficiency
- Allows for cradle-to-grave living with minimal interventions
- Unexpected lifestyle changes may be accommodated with minimum disruption to other inhabitants and with limited increases in associated costs
- Avoid the need for re-location or costly building works as you or your family's needs change over time
- Enables the widest possible number of people to participate at home, in society, and to live independently
- A house is instantly resalable and ready to live in without incurring substantial increased reconstruction costs
- Integration of smart infrastructure at the outset of home design avoids costly re-fits and also benefits everyone in terms of comfort, efficiency and quality of services.

Any other relevant points

Question 3

(a) Proposed design layout for the extension that incorporates each of the requirements.



Internal courtyard

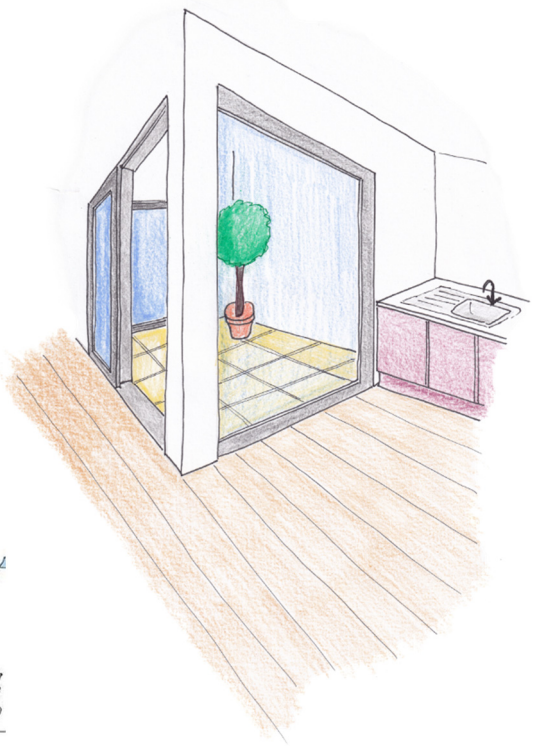
- Provide an internal courtyard at the rear linking the house the new extension
- Installation of sliding, folding or swing doors to the courtyard to bring outside in for wellbeing of occupants
- Provide outdoor living/dining space in the courtyard for occupants
- Glazing on three side of the courtyard to link the house, courtyard and extension for occupants
- Large south facing windows to maximise light, solar gains and create a visual connection with nature
- Internal planting in the courtyard to bring nature into the house.

Separate additional living space

- Open-plan layouts so the daylight and sunlight can penetrate into the house
- Kitchen to remain at the rear of the house with new living space in the extension – dining area provided in the link corridor
- New extension to contain the kitchen with additional living space at the rear of the house.

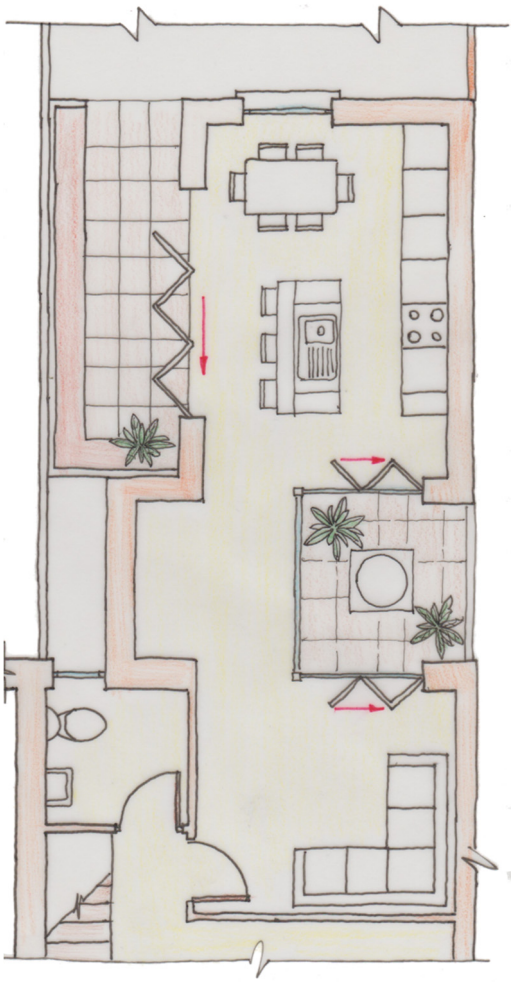
Optimising daylight

- Large south facing windows to maximise light, solar gains and create a visual connection with nature
- High performance - triple and quadruple low-e glazing - maintains thermal comfort internally and reduces glare
- Remove large section of rear wall of house and install glazing to allow light into the rear of the house
- Lower cill levels to allow daylight and sunlight to penetrate deeper into the house.



Any other relevant points

(b) Three reasons for your proposed design layout.



- Natural light can flood all living spaces in the house throughout the day
- Light filters into areas of the home that may not otherwise have natural light
- The extension does not block light getting into the deep narrow plan
- A living space is provided that is slightly separated from the rest of the house – reducing noise levels
- The separate living space has dual aspect windows
- A planted courtyard brings the outside in more effectively creating an oasis of calm for the occupants
- The window on the kitchen is maintained by having the open courtyard on this side
- The courtyard can contain plants and a water feature therefore enhancing the visual and auditory experience of the occupants
- The courtyard is an ideal solution as the site size is limited and the building footprint either extends to or is close to boundaries
- Convert utility room into a new bigger dining area which has glazed doors out to the courtyard filling the space with light
- Separate dining area leaves for a bigger kitchen
- Convert the new extension into the kitchen/dining area which opens out to the garden and has dual aspect windows – still provides separate second living space.

Any other relevant points

(c) Advantages of maintaining the vernacular heritage of the streetscape in a town.

Advantages

- Historic buildings are an important contributor to the local character of a town
- Existing vernacular buildings are often undervalued in terms of their architectural potential
- Maintaining existing buildings is an approach which underpins sustainable development in that it retains our built heritage while bringing empty structures into use
- The reuse of these buildings can help to reduce the demand for new housing while also preserving the vernacular design of the area
- Maintain communities in town centres – more people/families living in town centres
- Less building materials needed to make the building habitable which has a positive impact on the environment.

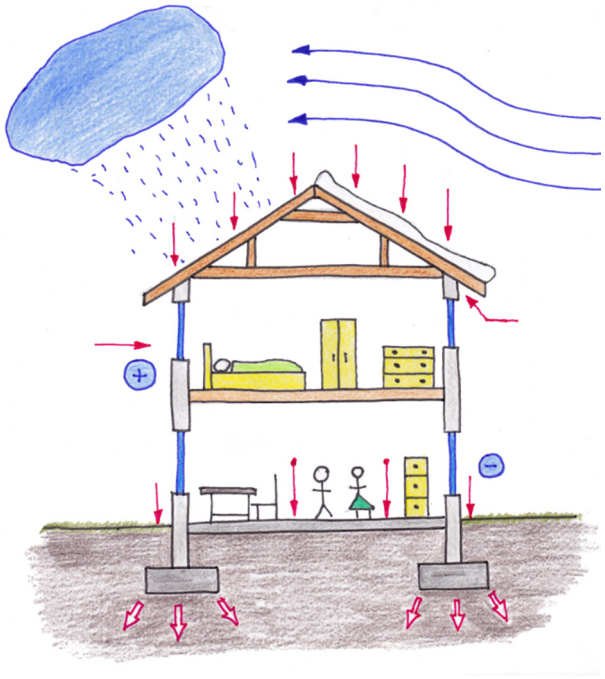
Any other relevant points

Question 4

(a) Three functional requirements of a foundation suitable for a dwelling house.

- To safely distribute all live loads and dead loads evenly over the entire foundation to the ground
    - Live loads – Environment loads such as wind, rain, storms, snow and ice, these may vary over time. Variable loads such as all moveable items like furniture and people to transfer to the foundation
    - Dead loads – the building self-weight of all materials transferred directly onto foundations
- To anchor the building in the ground against wind or weather loads
- To establish a level flat surface on which to commence building
- To limit differential settlement or subsidence of a building
- To resist and prevent failure of the foundation from any applied stresses
- To withstand an pressure imposed by surround soil – swelling or contraction of the ground due to weather conditions
- To provide stability to a building.

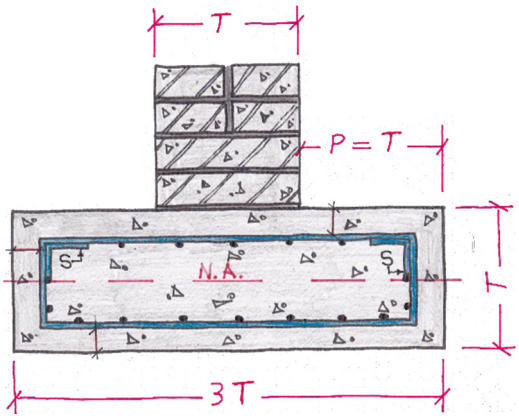
Any other relevant points



(b) Design detailing for two different foundations suitable for the proposed house. Indicate the position of the reinforcement and typical dimensions of each.

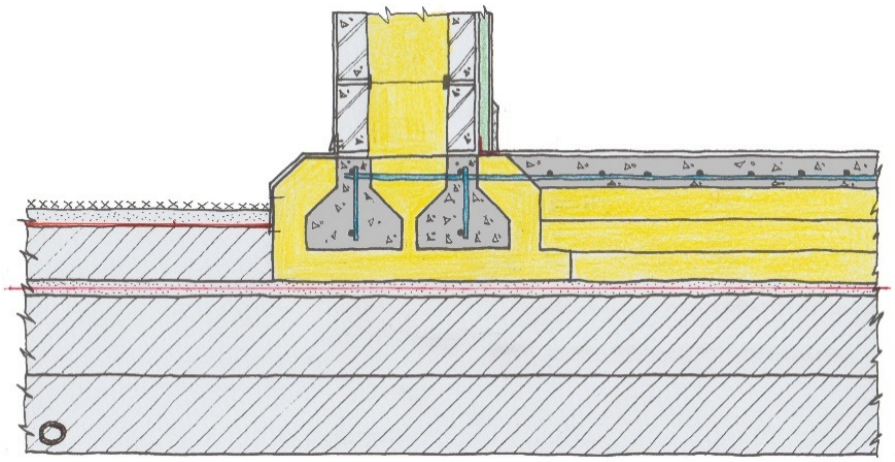
Strip Foundation

- External wall thickness (T) of 450 mm:
    - Depth of foundation = T (450 mm)
    - Length of foundation = T × 3 = 1350 mm
    - Projection beyond wall = T (450 mm)
- Minimum distance below ground level to top of foundation = 600 mm
- Distance below existing ground level to firm subsoil at bottom of foundation trench c.1000 mm
- Depth of cover to steel = 80 mm
- Steel welded mesh = 10 mm
- Longitudinal bars and transverse bars of steel
- Steel stirrups used to provide rigidity to steel cage
- Neutral axis passes through centre of strip foundation
- Strength of concrete to structural engineer specifications (25N20)
- Width, depth of concrete and steel may be different as specified by structural engineer.



Any other relevant points and details

Passive Raft Insulated foundation



- Subsoil excavated to depth of 1000 mm below existing ground level and at least 1000 mm beyond the footprint of the building
- Hardcore - clean, and crushed stone 100 mm, laid in layers of 225mm and compacted
- Drainage pipes laid deep to facilitate rapid removal of ground rainwater
- Blinding sand 50 mm laid on hardcore and compacted
- Damp proof / Radon gas membrane laid on blinding sand 25mm in depth
- Sand of round river pebble 5-8 mm only laid on DPM/RGM 25mm in depth
- Edging Formwork consisting of high density - rigid insulation EPS 300N/mm
- Rigid EPS Insulation, formwork shaped to engineers' specification to allow concrete be poured inside to carry the load bearing concrete cavity wall (450 mm)
- Steel reinforcement to engineers' specification placed inside rigid EPS insulation edgings with steel bars connecting the outer load bearing concrete edge beam to the steel mesh reinforcement laid in the concrete floor slab
- Steel mesh reinforcement (10 mm @ 200mm cc) to be raised above rigid floor insulation using patented plastic risers
- Concrete poured with a high workability slump and to strength as specified by engineer (40N20)
- Passive raft foundation having rigid EPS 100/N mm to a depth of 300 mm below concrete floor slab
- Reinforced concrete floor slab to a depth of 100 or 150 mm as per engineer specification (load bearing or non-load bearing)
- Patented trim PVC or allow fitted to the external edge of Rigid EPS Formwork Edgings to prevent damage to insulation by vermin.

Any other relevant points and details

(c) One advantage and one disadvantage of each foundation shown at 2(b).

Traditional Strip Foundation

Advantages:

- Traditional method which is well understood by contractors - no specialist training required
- Strip foundations are shallow in depth therefore little excavation needed
- Economically cheap to construct due to the narrow and shallow design
- Quick to construct
- Reduced volume of subsoil excavated - reducing transport costs for land fill.

Disadvantages:

- Requires large volume of concrete in their construction which leads to a higher embodied energy and increased CO_2 emissions - cement production
- Limited load carrying ability due to foundation depths and design - only suited to small or medium buildings
- Strip foundation results in loss of heat from the building as the concrete strip is uninsulated
- Only suitable to be used in certain soil types - medium bearing capacity.

Passive raft - insulated foundation

Advantages:

- Minimal excavation required for the foundation therefore less impact on the environment
- Lower embodied energy than traditional strip foundations as much less concrete is required – lower CO_2 emissions – less cement
- Very quick to construct
- Prevents all thermal bridging at the wall/floor junction
- Super insulated foundation which saves / reduces cost of heating.

Disadvantages:

- A high level of workmanship is required to detail the installation of the foundation
- Specialist training for workers required for installation
- Specific design detailing required for each house which must be completed by a structural engineer – increase cost associated
- Increased capital costs associated with specialised components required in construction.

Any other relevant points

Question 5

(a) Calculate the U-value of the external wall.

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
External resistance				0.048
Acrylic render	0.670	1.493	0.008	0.012
External insulation	0.031	32.258	0.150	4.839
Scratch coat	2.170	0.461	0.010	0.005
Blockwork	1.44	0.694	0.215	0.149
Internal plaster		4.550	0.012	0.055
Internal resistance				0.122
			Total R =	$R^t = 5.229$
Formulae: **R=T/k** **R=T × r** **U= 1/R^t** **U-value:** U = 1 / 5.229 = 0.191 W/m^2 ^{0}C				
			U-value =	**0.191 w/m^2 ^{0}c**

(b) Cost of heat lost annually through the wall.

- Heat lost through wall
  Heat loss formula: = U -Value × area × temp. diff
  0.191 × 144 × (20 – 5) = 413.068 Watts (Joules / sec)
- Heating period p/a:
  60 × 60 × 7 × 10 × 37 = 9,324,000 seconds (2,590 hours)
- Kilo joules p/a:

$$\frac{9{,}324{,}000 \times 413.068}{1000} = 3{,}851{,}446.032 \text{ kJ/sec}$$

- Litres p/a: (Note: Calorific value of 1 litre oil = 37350 kJ)

$$\frac{3{,}851{,}446.032}{37{,}350} = 103.118 \text{ litres}$$

- Cost p/a: (Note: 1 litre of oil costs 97c)

  103.118 **× 0.97 = €100.02**

Cost of heat loss annually through wall = €100.02

Alternative method:

Formula: $\frac{\text{U-value} \times \text{Area} \times \text{Temp Diff.} \times \text{Time (secs)} \times \text{Cost (Euros)}}{\text{Calorific value} \times 1000}$

$$= \frac{\mathbf{0.191} \times 144 \times 15 \times 9{,}324{,}000 \times 0.97}{37{,}350 \times 1000}$$

$$\frac{3{,}735{,}747{,}000}{37{,}350{,}000} = \mathbf{€100.02}$$

(c) Thickness of additional external insulation required to give a wall U-value of 0.12 w/m^2 ^{o}c.

Determine the Resistance for a U-value of 0.191 w/m^2 ^{0}c

Use formula U= 1/Rt. & solve for R.
R = 1/ U-value R = **1/ 0.191** = 5.229 m^2 °c / W
Resistance for required U-value of 0.12 = 1/0.12 = 8.333 m^2 °c / W
Difference in Resistance = 8.333 – 5.229 = 3.104 m^2 °c / W

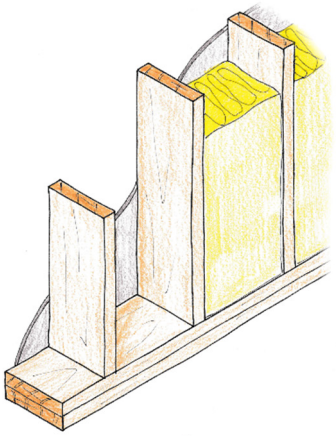
Use the formula R= T/k & solve for T.
3.104 = T/0.031
T = 3.104 × 0.031 **= 0.096 metres** to achieve U value of **0.12 W/m^2 ˚C.**

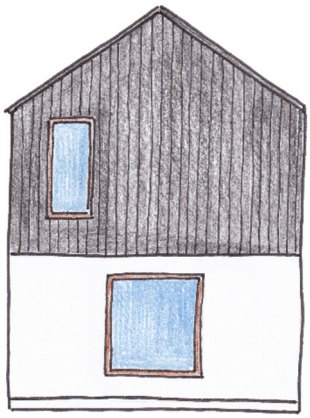
Thickness of required Expanded Polystyrene insulation = **96 mm -** accept **95/97 mm.**

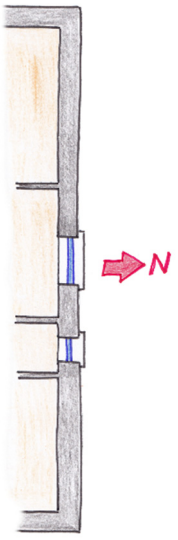
Alternative calculation methods acceptable.

Question 6

(a) Three feature of the design that contribute to the house having a low environment impact

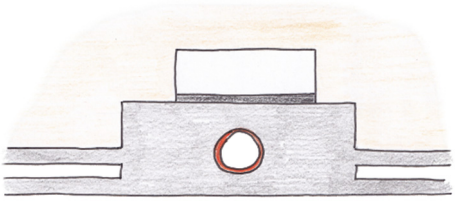


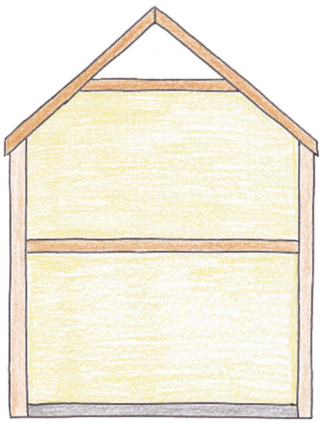


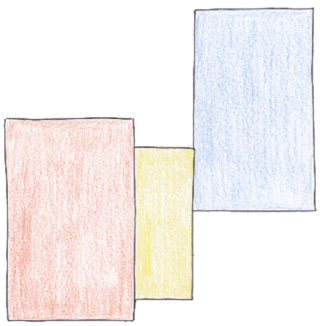


- Timber frame construction from local sources which reduces transport movements; has lower carbon emissions and a reduction in localised air pollution
- Less embodied energy required to produce timber frame construction compared to a double leaf, concrete block, cavity wall construction design detail
- Flame charred larch cladding required no harmful preservatives, is available in Ireland and is naturally durable
- Locally sourced timber cladding (from Ireland) from FSC certified forests are lower in embodied energy than imported timber – suitable for a low environmental building
- Locally sourced timber contributes to carbon sequestration (creates a carbon store/sink) in direct contrast to concrete production
- The house has large south facing glazed openings which fill all main living spaces with natural light – electric light bulbs only needed at night
- Most rooms have dual aspect openings so they utilise the suns benefits throughout the day
- The heat from the sun entering through the large openings reduces the need for using non-renewable methods of heating theses spaces
- Small windows on the north side reduces heat loss and saves energy
- The chimney stack is centrally located - the large thermal mass chimney stack releases heat back into the living space on all four sides
- The woodburning stove inset into the chimney reduces draughts and heat lost through the chimney - stoves are also more efficient than open fires
- The house is constructed using low carbon materials which are both locally sourced and are renewable
- Simple building form that takes advantage of the orientation of the sun
- High levels of insulation in the floor, walls and roof construction
- Additional upstairs living areas reduces the need for additional concrete foundations which is a high embodied energy material
- One room deep design enables light and heat from solar gain to enter the single space building via the south, east, and west
- High-performance glazing (U-value at least 0.8 w/m^2 k) will significantly reduce heating costs
- High levels of insulation used in the construction will reduce heat loss through the exterior envelope.

Any other relevant points/sketches



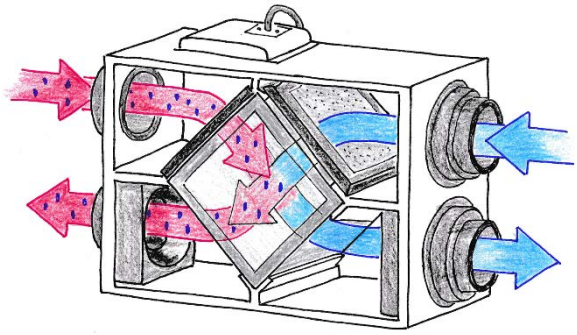




(b) Discuss the importance of providing for any two of the following in the design of a house to enhance the health and wellbeing of the occupants

Internal air quality

- Natural – ensure that all rooms have glazed manual openings so that air can naturally circulate bringing in fresh air from the outside and removing stale moist air from the inside
- Mechanical - Install a Mechanical Heat Recovery Ventilation (MHRV) system during the construction of the house
- A MHRV system works by providing a constant supply of fresh, warm air into the residence while also extracting the inherent heat from the warm, moist stale air from rooms within the house having a high moisture and odour content – kitchen, bathroom, and utility space
- Improves indoor air quality for occupants
- The MHRV system must be capable of year-round operation

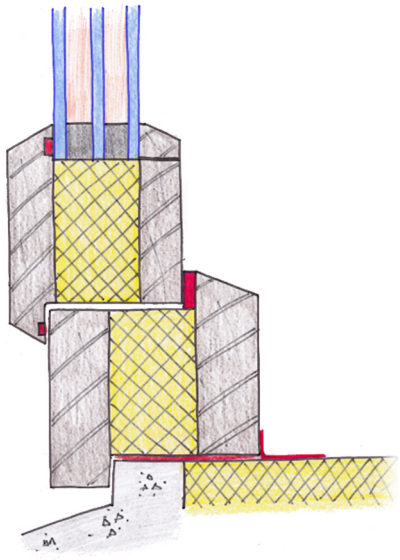


- 95% of the heat contained in this stale warm air is extracted and used to heat the entering cold fresh air that passes through the heat exchanger without the two air flows ever mixing
- The incoming fresh, warm air passes through a "particle filter" which stops and traps all pollen and dust – allowing only clean, fresh heated air into the dwelling
- A MHRV system guarantees a constant supply of fresh warm air free of contaminants throughout the dwelling achieving a high-quality fresh air supply to all occupants
- This provides high quality, clean air supply to all occupants but especially to those with underlying medical (respiratory) issues.

Any other relevant points/sketches

Thermal environment

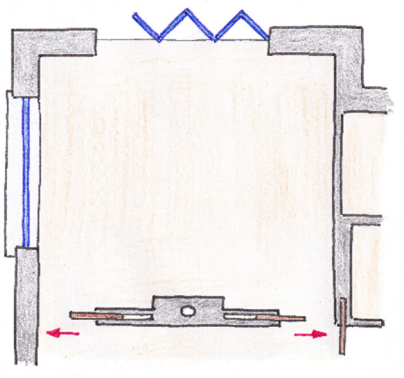
- Use high quality insulation to ensure the building envelope meets the current building standards and maintains a high level of thermal comfort for the occupants
- Install of high-performance glazing / door systems in external envelope which will minimise heat loss and retain airtightness
- Less heat loss through the windows will reduce operation energy usage
- Adequate glazing systems on the southern, eastern and western elevations to increase solar gain
- Maintain a constant temperature in living areas of 20 ^{o}C and 18 ^{o}C in sleeping areas
- Incorporate overhangs into the design to prevent glare and overheating internally – extended roof overhangs, brise soleil, shutters, dynamic glass, pergola, etc.



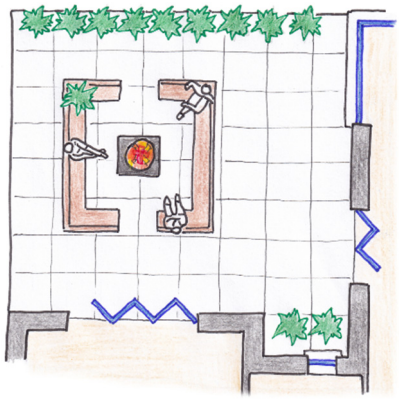
- Plant deciduous trees in the garden along the south façade - the leaves will provide natural shade during the summer so that the internal spaces do not overheat
- Install a Mechanical Heat Recovery Ventilation (MHRV) system during the construction of the house to regulate the temperature internally
- Install thermostats in each room to meet the needs of the occupants
- Appropriate air barrier membrane installed to the inside of timber frame wall, keeps cold air out and warm air in – improving thermal environment of the home
- Open plan layout in living spaces enable the transfer of heat – maintaining a comfortable 20 ^{o}C.

Any other relevant points/sketches

Social interaction



- Multifunctional rooms - provide spaces where people can talk and interact with each other in the one space while carrying out day to day tasks - e.g. having the table in the kitchen space so people can be eating/doing homework while chatting to those preparing food or cooking
- Incorporate seating areas into the kitchen space so that people are not isolated in separate rooms - this can be done through window seats, counter seats, tables etc.
- Have separate quieter spaces so the occupants can be removed from noise and activity if they want to relax
- Open plan living is very popular – it is important to be able to perhaps close off these open plan spaces too into separate smaller units – use of pocket doors
- Outdoor living spaces for social gatherings during milder weather
- Separate living / social space for small groupings interactions such as living room, snug or outdoor living space
- Large areas of glazing / natural light /with views out to a green landscaped area/garden
- Comfortable seating beside windows and sound proofed from vehicular traffic/noise
- Sunspace easily accessible and with comfortable seating.



Any other relevant points/sketches

(c) Two advantages of designing a house that will enhance the health and wellbeing of the occupants.

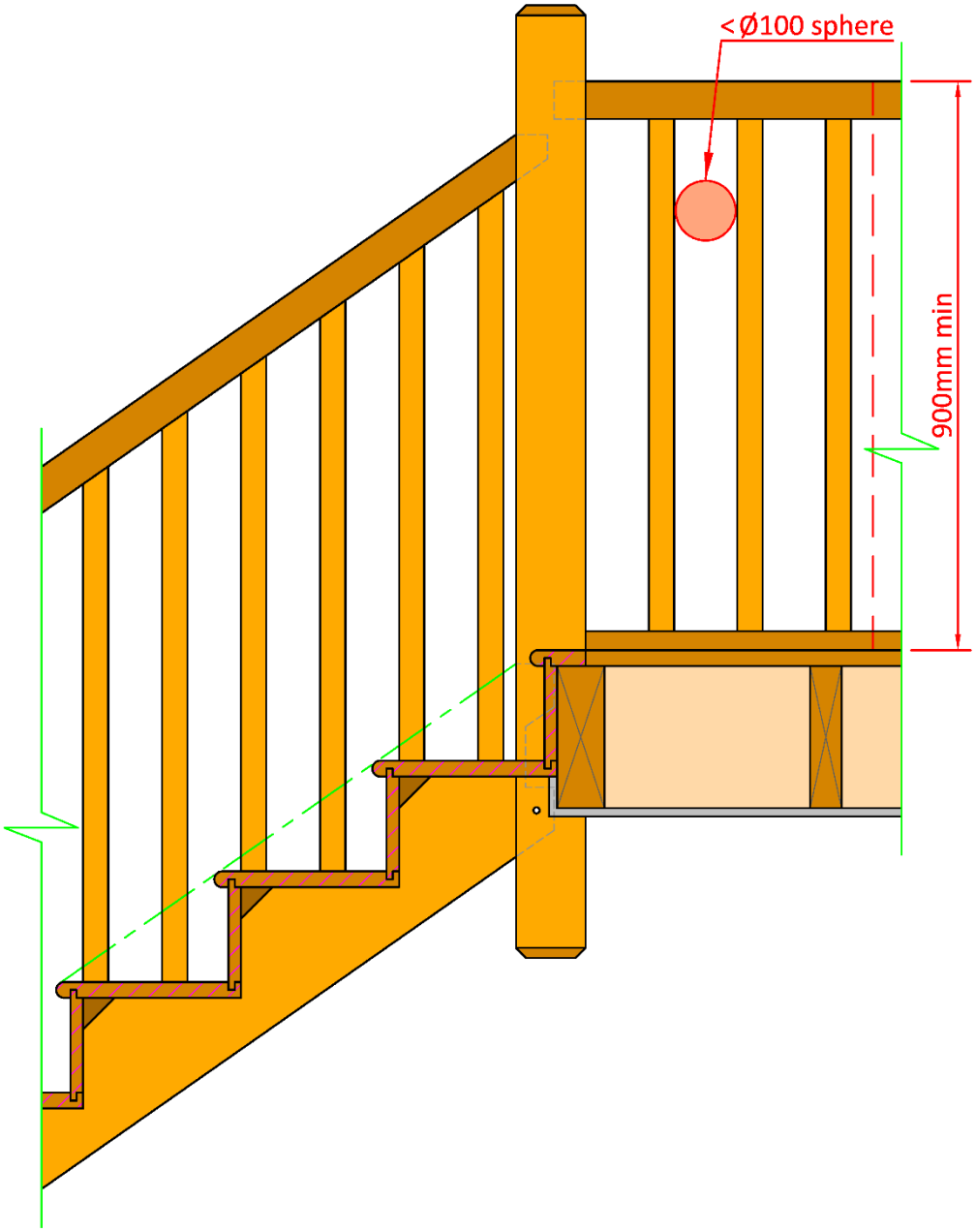
Advantages:

- The design of a house has a huge impact on the mental health and wellbeing of the occupants
- Reduces stress levels for occupants of the house
- Provides a calm, secure, private space for occupants – better for health and wellbeing
- Adequate natural light encourages occupants to appreciate nature - improved wellbeing
- Natural light enhances occupants comfort level and enables a positive mental attitude
- Natural light enhances colour definition and seasonal changes perceptible
- Plentiful fresh air invigorates occupants - good for health and wellbeing
- Being surrounded by nature reduces stress and improves mental health - connect the indoor and outdoor spaces with large glazing and opening doors out to the garden
- Opening windows so the sound of nature can be heard inside calms the occupants
- Using materials that are locally sources helps to link the occupants with their community giving them a sense of place and belonging
- Designing a space with good air and thermal quality can be both comforting and refreshing
- Improves and encourages sound sleeping - essential for rest and wellbeing
- Combinations of biophilic design, natural light and sound proofing will lead to improved wellbeing.

Any other relevant points

Question 7

(a) Vertical section through centre of a wooden stairs and first floor landing.



Cut string stairs – typical detailing

- String 250 mm × 50 mm (or similar)
- Newel post 110 mm × 110 mm
- Thread 250 mm × 25 mm (or similar)
- Riser 175 mm × 20 mm (or similar)
- Balusters 40 mm × 40 mm (or similar)
- Handrail 60 mm × 60 mm (or similar)
- Glue block 60 mm × 60 mm (or similar)

First floor landing – typical detailing

- Trimmer joist 225 mm × 75 mm
- T + G flooring 25 mm
- First floor joists 225 mm × 50 mm
- 12.5 mm Plasterboard.

Any other relevant detail

(b) Two design details that ensure the safety of users on the first floor landing.

- Sphere Ø 100 mm not to pass between balusters
- Min. handrail height 900 mm

Any other relevant detail

Question 8

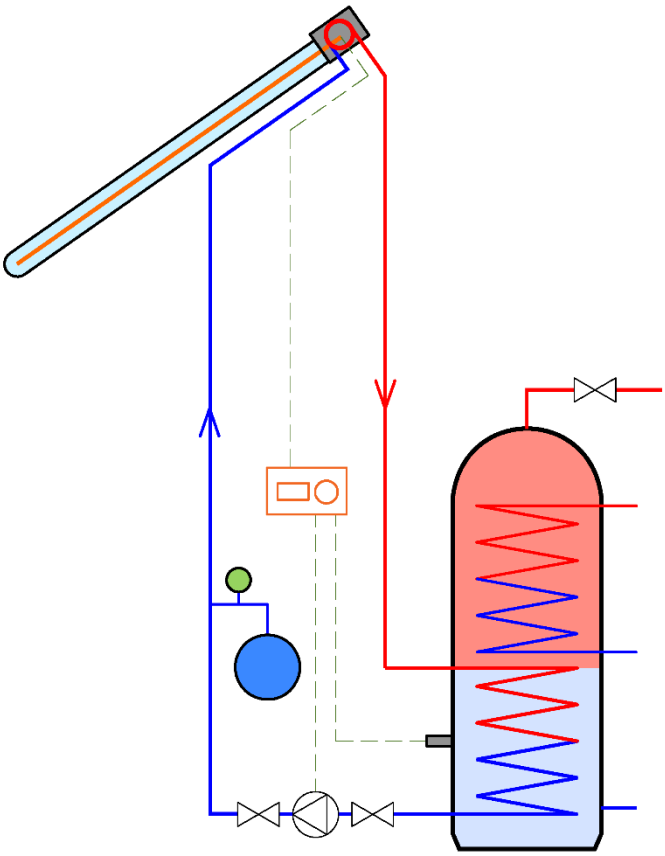
(a) Three considerations when installing a solar collector for heating hot water.

Considerations:

- The optimum location for solar collectors for all year-round energy collection is south facing and at an angle of 30^{o} - 45^{o} to the horizontal
- Collectors are positioned so there are no shadows on them during the middle of the day - from trees, chimneys, part of the building or adjacent buildings
- The solar collector should be ideally located on a roof surface – orientated south
- Is roof area large enough to install the solar collector panel
- The roof will require additional work to install the collector brackets and fittings – additional expense
- An appropriately sized cylinder should be chosen for the household hot water requirements
- The volume of your solar hot water cylinder is related to the maximum cylinder temperature
- Position of the hot water cylinder in relation to the solar collector – pipework should kept as short as possible to reduce heat loss
- The solar collector area should meet the hot water needs of the household
- The installation may require a planning application to the local county council – check with planning department
- The cost of purchase and installation of the solar collector – could be substantial
- SEAI grant application to offset the costs of purchase and installation (https://www.seai.ie/grants/home-energy-grants/solar-water-heating-grant/).

Any other relevant points

(b) Typical design layout for a solar collector that will connect with an existing system to supply hot water.



Typical size of pipework:

- Ø22 mm pipe - 10 to 20 m^2
- Ø28 mm pipe - 20 to 30 m^2

How the system works

- Sunlight hits the solar collector and the solar energy is absorbed by the tubes
- The solar energy (heat energy) is transferred to the solar collector fluid in the tubes
- The heated solar fluids travel to the manifold at the top of the solar collector to heat the fluids circulated from the hot water cylinder coil
- The cold fluid coming from the cylinder is heated up as it travels through the solar collector manifold - heat exchange
- The heated fluid is circulated back to heat the hot water cylinder through the coil
- The cooled heat transfer fluid is then returned to the solar collector for reheating
- The control panel controls the hot water temperature in the system and pumping when the required temperatures are reached
- The expansion vessel absorbs any excess fluid pressure caused by thermal expansion in the system.

Any other relevant points

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

Advantages:

- Reduces the heating cost and increase energy efficiency heating a house
- Low level of maintenance required for the solar panel system
- There are grants and tax incentives for households in Ireland to install solar panels
- Reduces dependency on fossil fuel - the more solar energy is used, the less we will rely on the world's finite fossil fuels

Disadvantages:

- Initial upfront costs for equipment and installation are high for homeowners
- The system is weather dependent – requires sunny weather for maximum efficiency
- The system requires a lot of roof surface area and internal space
- Require a specialist to install and carry out any maintenance.

Any other relevant points

Question 9

(a) Two advantages of an airtight house.

Advantages:

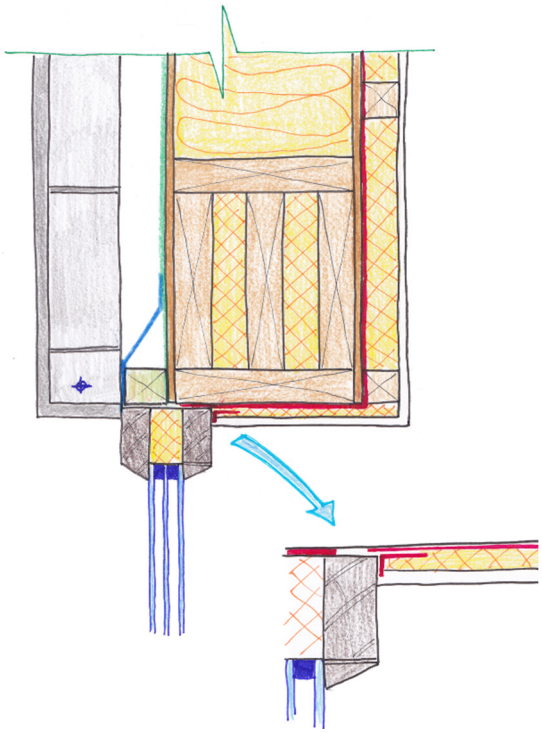
- Improve comfort for the occupants' by keeping out unwanted draughts
- Reduce heat loss through gaps in the building fabric
- Better indoor air quality (reduced dust, pollen, odours) – less pollutants from outside
- Reduces moisture from entering the fabric - protecting it from damage such as rot
- Improve the performance of insulation, thus reducing heat loss further
- Mechanical ventilation systems will work more efficiently
- Reduce noise pollution in the house
- Reduce carbon emissions – less CO_2 emissions.

Any other relevant points

(b) Best practice design detailing that will prevent air leakage at any two locations circles.

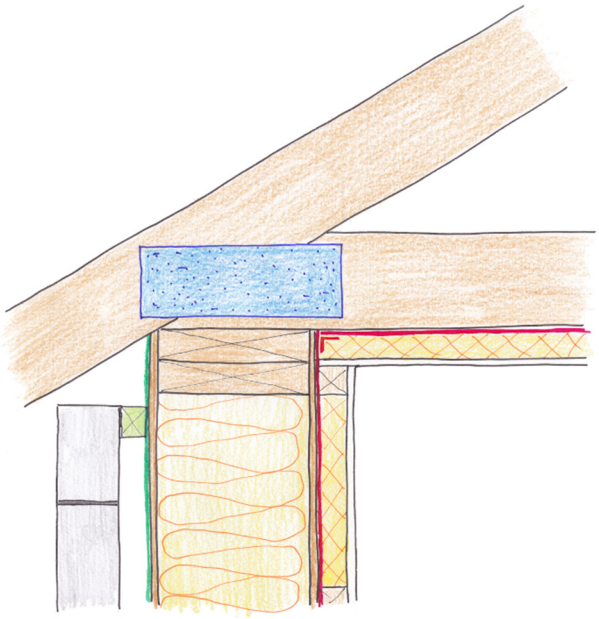
Head of window:

- The inner surface of the timber frame is fitted with an airtight membrane
- The thermally broken window frame is sealed to the internal timber frame
- The junction between the window frame and the wall airtightness membrane is carefully tapped using an airtightness tape.



Wallplate level:

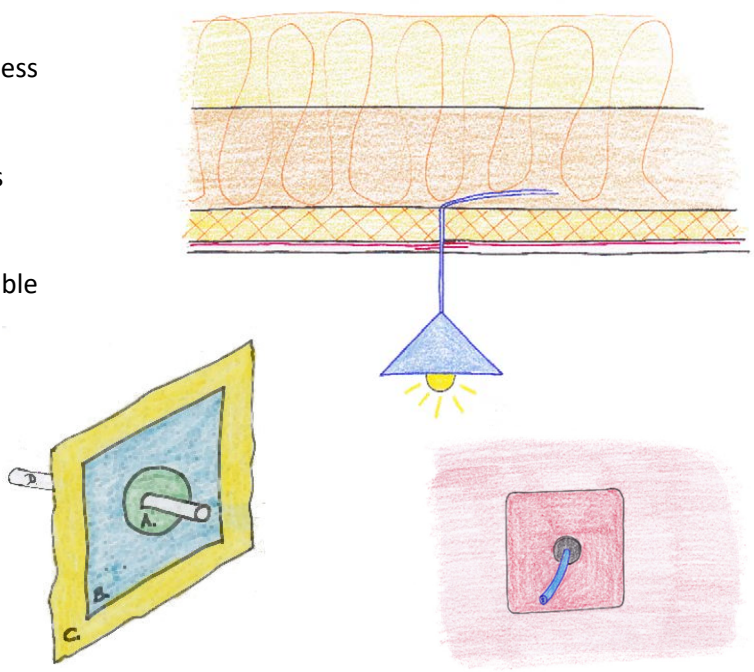
- The inner surface of the timber frame is fitted with an airtight membrane
- A service cavity is installed inside the wall membrane
- An airtight membrane is fitted to the underside of the ceiling joist
- The junction between the wall airtightness membrane and ceiling membrane is carefully tapped using an airtightness tape.



Ceiling light fitting:

- The ceiling is fitted with an airtightness membrane to the underside of the ceiling joist
- The electrical cable which protrudes through the airtightness membrane is sealed to the membrane using an airtightness grommet around the cable
- Reducing any air leakage about the cable.
  A = Integrated Grommet
  B = Self Adhesive Patch
  C = Air Barrier Membrane
  D = Electrical Cable

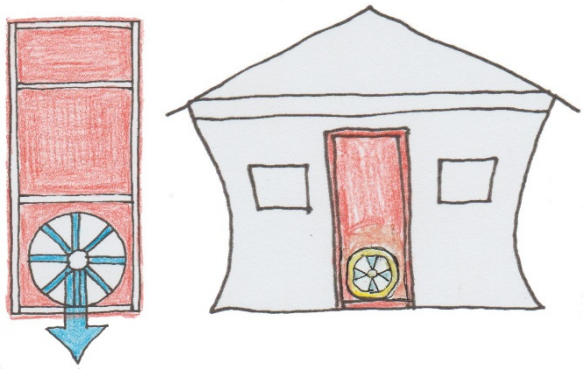
Any other relevant points

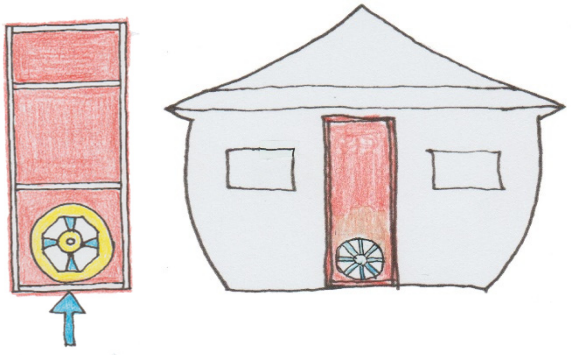


(c) Describe one test that is carried out to determine the airtightness of a house.

The **blower door test** for airtightness:

- The blower door test is carried out by a trained energy professional
- Blower door test consist of:
  - a frame and flexible panel that fits into a doorway
  - a variable speed fan
  - a digital pressure gauge to measure the pressure differences inside and outside the house
  - a device for measuring airflow, known as a manometer
- A powerful fan is mounted into the frame of an exterior doorway
- After calibrating the device, the fan pulls air out of the house, lowering the air pressure inside
- The higher outside air pressure then flows in through all unsealed gaps, cracks, and openings such as gaps, cracks, or wiring penetrations
- If conditions do not allow for lowering the pressure in the home, the fan may also be operated in reverse, with air pressure increased inside the home





- While the blower test is being conducted, the analyst may use an infrared camera to look at the walls, ceilings, and floors, to find specific locations where insulation is missing, and air is leaking
- The tester may also use a nontoxic smoke pencil to detect air leaks
- This determines the air infiltration rate of the house, and the results are recorded on a laptop.

Any other relevant points/sketches

Question 10

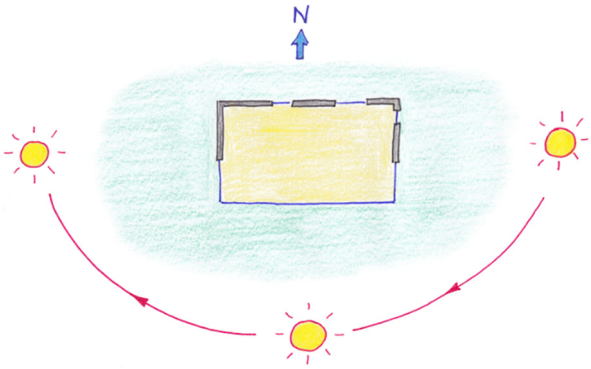
(a) Three benefits to occupants of considering the orientation of a house at the design stage.

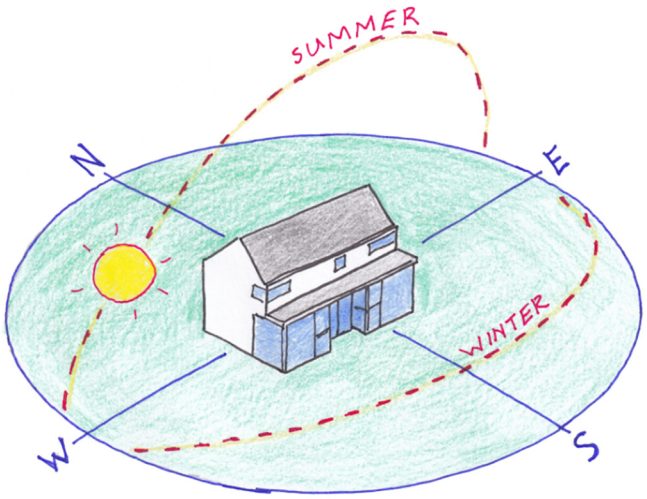
Benefits

- Improve the comfort of the house by the use of the sun to heat the house – solar gain/passive heating
- Reduce heating and cooling needs of the house – reduce heating costs
- Plan the positioning of the windows in the house to:
    - to make the most of the sun in the living areas of the house
    - create pleasant views from the house for occupants
- Create privacy and security for the occupants by orientating the house to avoid overlooking neighbours or busy roads/streets
- Use or plan to use natural shading (trees, hedgerows) on the site for the house
- Plan the garden layout and planting.

Any other relevant points

(b) Suggest a preferred orientation for the house, include the sun path and discuss how optimum thermal performance ensured.



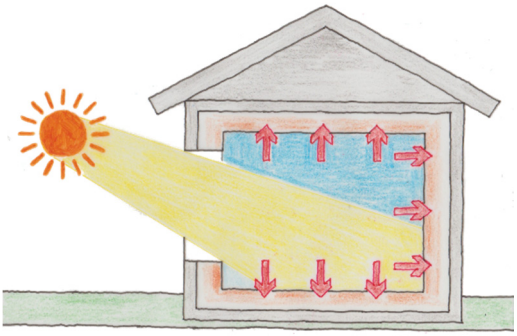


- Large glazed area to the South or South-West leads to greater solar gain and decreased thermal energy demand
- Solid stone wall along the north elevation for shelter and reduced heat loss through the building fabric
- Greater solar gains achieved by facing the large glazed façade towards the south or south-west resulting in decreased thermal energy demand – not more than 30^{o} off the East-West axis
- Glazing along south-west axis enables solar gains to still benefit the internal space late into summer evenings
- Overhang facing south to reduce internal overheating and glare
- Minimal glazed opening on the north wall to reduce heat loss and potential draughts.

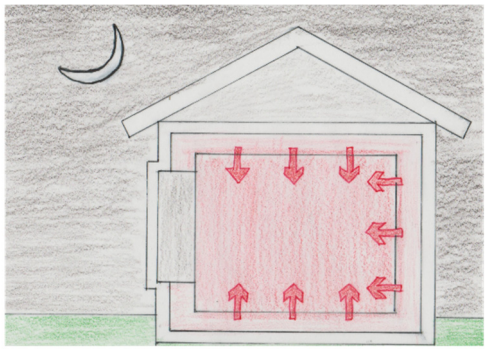
Any other relevant point

(c) Discuss the importance of thermal mass and two ways in which thermal mass could be incorporated into the house. Suggest a material choice for each and justify choices.

Importance of Thermal Mass



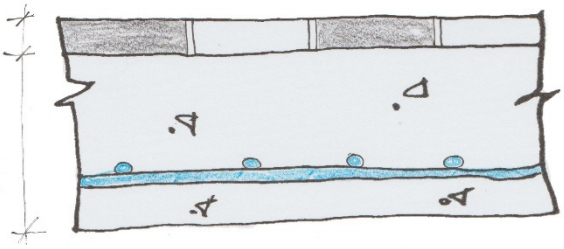
- Thermal mass is the ability of a material to absorb, store and release heat the sun's heat energy
- Solar radiation comes in through large south-facing windows and is absorbed and stored by the heavy materials of the building
- The cheapest and most sustainable energy for space heating comes from the sun in passive solar design
- Materials that absorb and store heat have a high thermal mass – concrete, brick, tiles
- These materials combine a high storage capacity with moderate thermal conductivity
- Materials that do not absorb and store heat have a low thermal mass - for example timber or cloth



- Thermal mass regulates indoor temperature
    - Reducing the peak temperature by absorbing the sun's energy at peak temperature in the house
    - Releasing the stored heat back into the house at a later time - thus reducing the heating demand
    - During the summer, this helps to stabilise the internal temperature and reduce overheating
- Thermal lag is also linked to the thermal mass of materials – this is the rate at which heat is absorbed and released by a material
- Materials with long thermal lag times (for example, brick and concrete) will absorb and release heat slowly; materials with short thermal lag times (for example, steel) will absorb and release heat quickly.

Any other relevant points

Two ways Thermal Mass could be incorporated

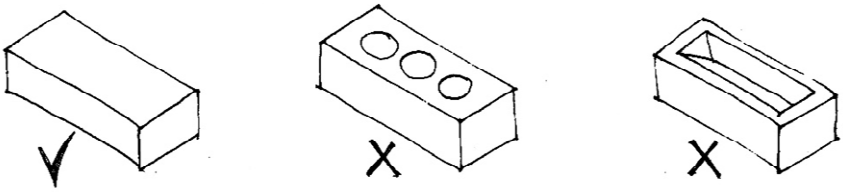


- The solid ground floor could be constructed from concrete – concrete subfloor and concrete screed
- Ground floor constructed from rammed earth
- Upper floor of the house to be a concrete hollow-core floor
- Floor surfaces finished with polished concrete or tiled finish
- All internal walls to be constructed from concrete blocks with sand/cement and skim finish
- Concrete chimney and/hearth within the house
- Use of internal brick or stone finished walls.

Any other relevant points

Materials:

- Concrete
- Brick
- Stone
- Earth.



Any other relevant sketches

Question 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.

Discussion of the above statement– such as

- Older model boilers that run off kerosene or gas are only about 65 to 75% efficient
- Even more modern condensing boilers are at best 80% efficient
- All these boilers run on fossil fuels like gas and kerosene which generate large volumes of CO_2
- The release of this Carbon into the atmosphere is immensely harmful to the Ozone layer
- Recently the cost of fossil fuels has increased significantly due to reductions in supply
- Carbon Dioxide and Sulphur Dioxide emissions are the primary harmful source of damage to the Ozone layer / environment / planet and are generated by the burning of fossil fuels
- Fossil fuels like oil and natural gas are finite resources and only available in limited locations on the planet earth. Consequently, the search for these fossil fuels requires exploration in parts of the planet that are pristine in terms of their environmental qualities, however, the demand for such fossil fuels is such that these environmental oases are under threat of exploration and consequently the risk of catastrophic environmental disasters
- The consequence of this increase is that home heating and cooking costs have increased substantially
- Persons on lower incomes experience "fuel poverty" and are having to make choices between purchasing fuel for heating or food
- Most of these persons are obliged to live in cold spaces to use their low incomes on food
- Heat pumps significantly reduce Carbon emissions by as much as 70% when compared to standard fossil fuel boilers
- The installation of air to water heat pumps are now grant aided by SEAI
- Air to water heat pumps use the ambient temperature of the air down as far as -15 degrees C and using a heat exchanger - refrigerant liquids that have an exceptionally low boiling point when subjected to pressure
- This higher or increased temperature is circulated and transferred to water and the heat is dispersed using low water volume radiators manufactured mostly using aluminium.
- Aluminium is a super conductor and enables the rapid transfer of heat
- Air to water heat pumps are highly effective in houses that are super airtight and super insulated
- While air to water heat pumps have a substantial capital cost their running costs are equally low
- Air to water heat pumps require minimal maintenance and are operationally quiet
- They are fitted externally and require minimal intervention for retro fit projects
- Air to water heat pumps are ideally suited to new build - super air tight and super insulated buildings
- Air to water heat pumps have a Coefficient of Performance factor (COP) + 3.0 or even 4.0
- This COP factor means that for every unit of energy it uses to operate it generates three and four times more than inputted.

Any other relevant, cogent, well-argued points

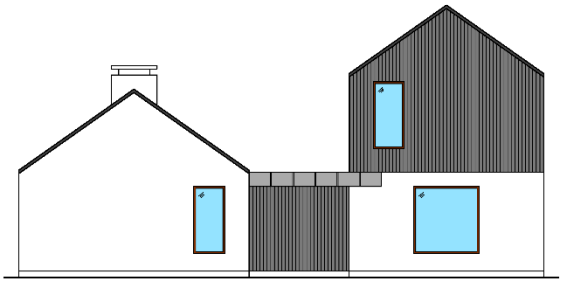
(b) Propose three best practice guidelines that would promote the installation of air source heat pumps in dwelling houses.

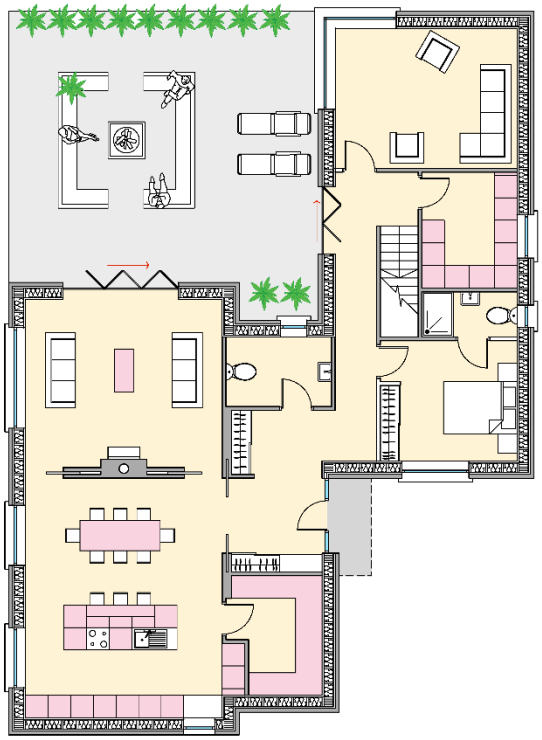
- Increase grants for their installation in new build homes
- Substantially larger grants to enable air to water heat pumps be installed in older houses undergoing a deep retro fit
- Central government to allocate substantial grants / monies in a decentralised manner to every local authority.
- These monies should be "ring fenced" for energy upgrades only and refunded by local authorities should they not be distributed / spent at the end of each financial year
- Information/education of the public of the advantages re – Air-to-water heat pumps
- Fast tracking planning applications for deep retro fit projects that involve energy conservation
- Renovation of older dwellings is more sustainable as is the reduction in Carbon produced / released due to the building already existing
- Legislation - continuously amended on a planned - phased basis to enable and oblige the construction industry to use every available technology to reduce the energy needs of new buildings
- Giving adequate notice to the public, homeowners, building developers, contractors that the use of fossil fuel boilers will be no longer legally acceptable from a certain specified date
- Ireland is perceived, correctly as a nation with a well-educated population and with expertise in research / development
- Funding by the government to third level institutions prepared to invest in energy conservation and all the available new technologies to develop new sources of energy and or renewable energies.

Any other relevant, cogent, well-argued points.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2022





Construction Studies

Theory – Higher Level

Marking Scheme

Question 1

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Vertical section through external wall, flat roof and abutment with rear wall ***External wall + eaves*** ***Flat roof*** ***Rear wall + abutment*** ***4 × 4 marks*** ***4 × 4 marks*** ***4 × 4 marks*** (3 for drawing, 1 for annotation)	
External wall and eaves • External & internal render • Cavity wall blockwork & wall ties • Full-fill insulation • Wallplate • Cavity closer • Fascia / soffit / gutter (Any two)	**4** **4** **4** **4**
Flat roof • Waterproof membrane • Roof insulation • Breather membrane • OSB / plywood decking • Firing pieces • Roof joists • Air-barrier / airtightness membrane • Insulated plasterboard	**4** **4** **4** **4**
Rear wall and abutment • External & internal render • Cavity wall blockwork & wall ties • Concrete lintels • Cavity closer • Wallplate & metal hanger • Angle fillet & Stepped DPC • lead flashings (2)	**4** **4** **4** **4**
Scale - 4 marks **Drafting** - 4 marks *Excellent Good Fair* *8 6 4*	**8**
(b) Design detailing to prevent a thermal bridge at abutment	***(4 marks)***
Design detailing to prevent a thermal bridge	**4**
TOTAL	**60**

Question 2

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Two best practice guidelines when design for lifetime use	***(8 x 3 marks)***
Entrance access - (2 details) **Detail 1** Notes (3) Sketches (3) **Detail 2** Notes (3) Sketches (3)	**3** **3** **3** **3**
Internal corridor - (2 details) **Detail 1** Notes (3) Sketches (3) **Detail 2** Notes (3) Sketches (3)	**3** **3** **3** **3**
(b) Two areas within internal kitchen layout to ensure ease of use by person in a wheelchair	***(24 marks)***
Area 1 Notes Sketches	**5** **5**
Area 2 Notes Sketches	**5** **5**
Dimension(s)	**4**
(c) Two reasons why lifetime use should be considered in house design	***(2 × 6 marks)***
Reason **1** (3 for point, 3 for discussion) Reason **2** (3 for point, 3 for discussion)	**6** **6**
TOTAL	**60**

QUESTION 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Design layout for the extension	***(30 marks)***
Proposed design layout sketch for extension to include separate living space, optimise daylight and internal courtyard	**15**
Note for separate living space	**5**
Note for optimising daylight	**5**
Note for internal courtyard	**5**
(b) Three reasons for your proposals	***(3 × 6 marks)***
Reason **1** (3 for point, 3 for discussion)	**6**
Reason **2** (3 for point, 3 for discussion)	**6**
Reason **3** (3 for point, 3 for discussion)	**6**
(c) Two advantages of maintaining the vernacular heritage of the streetscape	***(2 × 6 marks)***
Advantage **1** (3 for point, 3 for discussion)	**6**
Advantage **2** (3 for point, 3 for discussion)	**6**
TOTAL	**60**

Question 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three functional requirements of a foundation	***(6× 4 marks)***
Functional requirement 1	**4**
Notes	**4**
Sketches	
Functional requirement 2	**4**
Notes	**4**
Sketches	
Functional requirement 3	**4**
Notes	**4**
Sketches	
(b) Two foundations suitable for proposed house	***(24 marks)***
Foundation design 1	**4**
Notes	**4**
Sketches	**4**
Reinforcement (2) + dimensions (2)	
Foundation design 2	**4**
Notes	**4**
Sketches	**4**
Reinforcement (2) + dimensions (2)	
(c) One advantages and one disadvantages of each foundation	***(4 × 3 marks)***
Foundation design 1	**3**
Advantage (1 for point, 2 for discussion)	**3**
Disadvantage (1 for point, 2 for discussion)	
Foundation design 2	**3**
Advantage (1 for point, 2 for discussion)	**3**
Disadvantage (1 for point, 2 for discussion)	
TOTAL	**60**

QUESTION 5

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) U-value of external wall	***(10 × 3 marks)***
Tabulation/methodology	**3**
External surface resistance	**3**
Acrylic render	**3**
External insulation	**3**
External scratch coat	**3**
Concrete blockwork	**3**
Internal plaster	**3**
Internal resistance	**3**
Total resistance	**3**
Calculation of U-value (w/m^2 °c or w/m^2k)	**3**
(b) Cost of annual heat loss through wall	***(5 × 3 marks)***
Heat loss formula and calculation	**3**
Heating duration for one year	**3**
k/Joules calculation for one year	**3**
Litres of oil for one year	**3**
Annual cost of heat loss	**3**
(c) Required thickness of insulation for U-value of 0.12 W/m^2 °c	***(5 × 3 marks)***
Resistance for U- value for 0.12 W/m^2 °c (using R=1/U)	**3**
Resistance from calculated U-value from part (a)	**3**
Difference in resistances (required resistance)	**3**
Application of formula R = T/k	**3**
Required thickness of insulation in mm.	**3**
TOTAL	**60**

QUESTION 6

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Three features of low environmental impact***	***(6 × 5 marks)***
Design Feature 1	**5**
Notes	**5**
Sketches	
Design Feature 2	**5**
Notes	**5**
Sketches	
Design Feature 3	**5**
Notes	**5**
Sketches	
(b) **How each could be incorporated to enhance health and wellbeing**	***(4 × 5 marks)***
Internal air quality	
Notes	**5**
Sketches	
Thermal environment	**5**
Notes	
Sketches	**5**
Social interaction	**5**
Notes	
Sketches	
(c) Two advantages of designing to enhance health and wellbeing	***(2 × 5 marks)***
Advantage **1** (2 for point, 3 for discussion)	**5**
Advantage **2** (2 for point, 3 for discussion)	**5**
TOTAL	**60**

Question 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Vertical section through centre of a wooden stairs and first floor landing ***9 × 5 marks* + 3 marks** (4 for drawing, 1 for annotation)	
• Cut string	**5**
• Newel post	**5**
• Riser	**5**
• Tread	**5**
• Glue blocks	**5**
• Handrail (stairs + landing)	**5**
• Balusters (stairs + landing)	**5**
• Nosing line/pitch line	**5**
• Jointing - hand rail to newel post (stairs + landing)	**5**
• Jointing - string to newel post	**5**
• Trimmer joist	**5**
• Tongue + groove flooring	**5**
• First floor joists - 500 mm	**5**
• Plasterboard ceiling	**5**
Three dimensions of the stairs	**3**
Scale - 4 marks **Drafting** - 4 marks E*xcellent, Good, Fair* *8 6 4*	**8**
(b) Two design details that ensure the safety of users on first floor landing	***(2 × 2 marks)***
Design detail **1**	**2**
Design detail **2**	**2**
TOTAL	**60**

Question 8

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three considerations when installing a solar collector	**(3 × 5 marks)**
Consideration **1** *(2 for point, 3 for discussion)*	**5**
Consideration **2** *(2 for point, 3 for discussion)*	**5**
Consideration **3** *(2 for point, 3 for discussion)*	**5**
(b) Typical design layout for solar collector	**(5 × 4 marks) + 4 marks + 5 marks** (3 for drawing, 1 for annotation)
Solar panel	**4**
Flow pipe to solar panel	**4**
Return pipe from solar panel	**4**
Cylinder with twin coil	**4**
Pump	**4**
Control panel and wiring	**4**
Expansion vessel	
Pressure relief valve	
Control valves and typical size of pipework (any 2)	**4**
Description of how the system works	**5**
(c) Two advantages and two disadvantages of installing solar collector	**(4 × 4 marks)**
Advantage **1** (2 for point, 2 for discussion)	**4**
Advantage **2** (2 for point, 2 for discussion)	**4**
Disadvantage **1** (2 for point, 2 for discussion)	**4**
Disadvantage **2** (2 for point, 2 for discussion)	**4**
TOTAL	**60**

Question 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Two advantages of an airtight house	***(2 × 6 marks)***
Advantage **1** *(3 for point, 3 for discussion)*	**6**
Advantage **2** *(3 for point, 3 for discussion)*	**6**
(b) Best practice design detailing to prevent air leakage	***(4 × 9 marks)***
Head of window detail	
Notes	**9**
Sketches	**9**
Wallplate position detail	
Notes	
Sketches	**9**
Light fitting detail	**9**
Notes	
Sketches	
(c) Test to determine the airtightness of a house	***(2 × 6 marks)***
Notes / discussion	**6**
Sketches	**6**
TOTAL	**60**

Question 10

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three benefits to occupants of considering orientation	**(3 × 6 marks)**
Benefit **1** *(3 for point, 3 for discussion)*	**6**
Benefit **2** *(3 for point, 3 for discussion)*	**6**
Benefit **3** *(3 for point, 3 for discussion)*	**6**
(b) Preferred orientation for house	**(24 marks)**
Sketch	**12**
Orientation	**4**
Sun path	**4**
Optimum thermal performance	**4**
(c) Importance of thermal mass and how incorporated into house	**(18 marks)**
Thermal mass	
Notes	**5**
Sketches	**5**
Design Feature 1	
Notes, material and justify	**4**
Design Feature 2	
Notes, material and justify	**4**
TOTAL	**60**

Question 10 (Alternative)

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Discussion of Statement (Older gas and oil-fired boilers are wasteful…) (3x10 marks)	
Discussion Point **1** *(4 for point, 6 for discussion)*	**10**
Discussion Point **2** *(4 for point, 6 for discussion)*	**10**
Discussion Point **3** *(4 for point, 6 for discussion)*	**10**
(b) Three best practice guidelines to install air source heat pumps (3 × 10 marks)	
Guideline **1** *(4 for point, 6 for discussion)*	**10**
Guideline **2** *(4 for point, 6 for discussion)*	**10**
Guideline **3** *(4 for point, 6 for discussion)*	**10**
TOTAL	**60**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

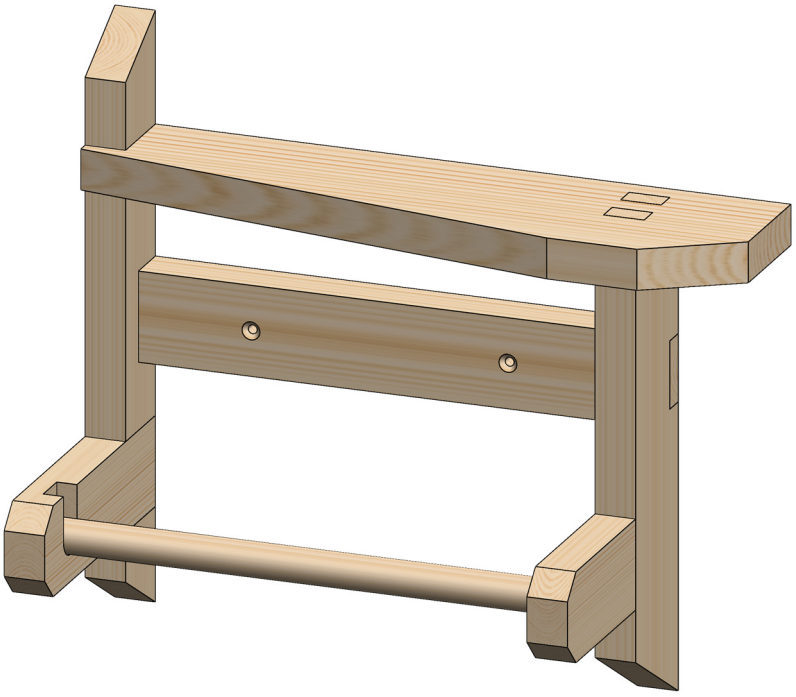
Leaving Certificate Examination, 2022

Construction Studies

Practical Test

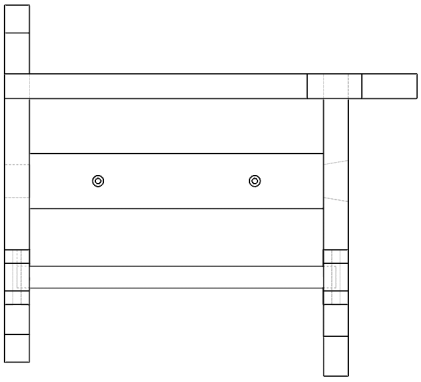
Common Level

(150 marks)



Marking Scheme

Day 1



Marking Scheme – Practical Test

Note:

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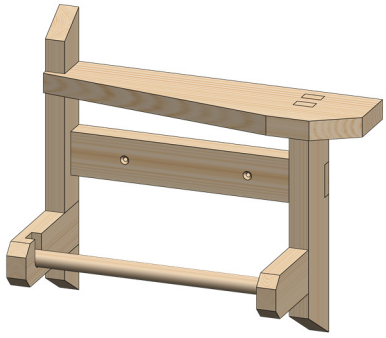
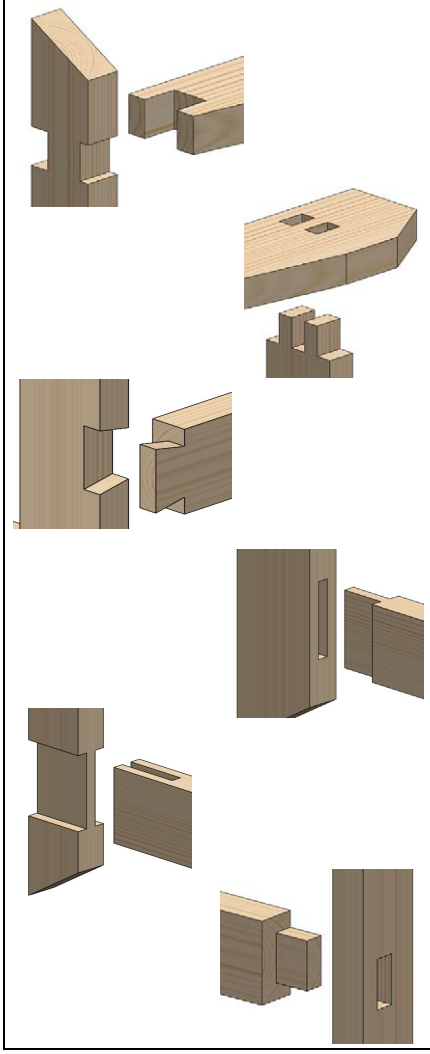
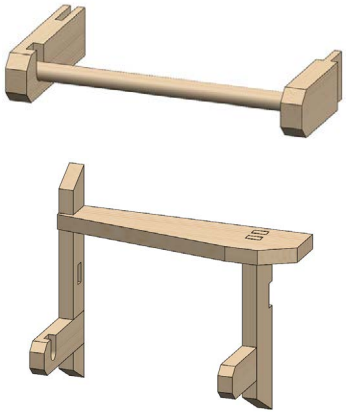
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that procedure.

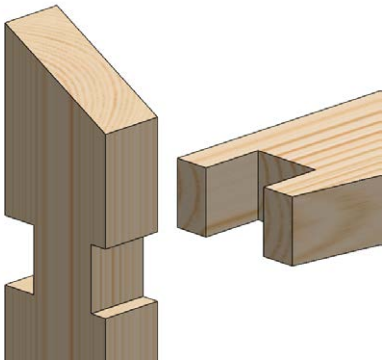
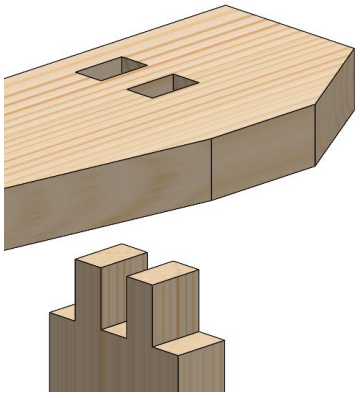


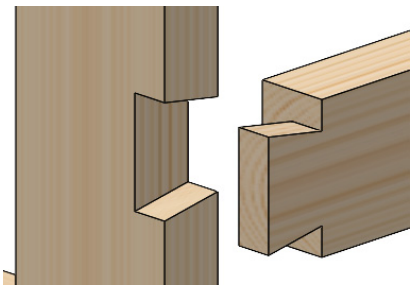
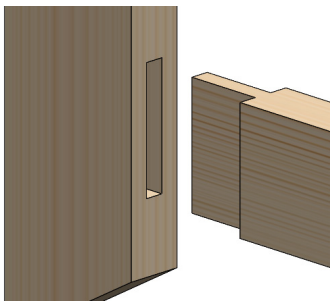
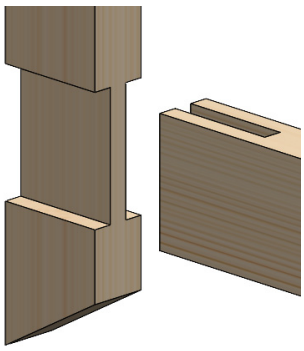
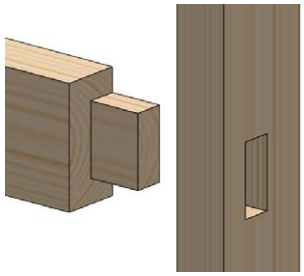
(i)	OVERALL ASSEMBLY	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edge • design *2 marks* • shaping *2 marks*	**4**
	Total	**14**

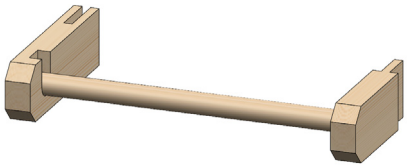


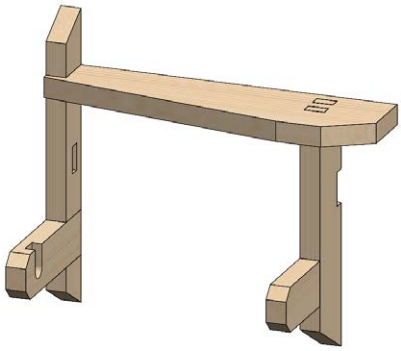
(ii)	MARKING OUT	Marks
a.	Top bridle joint • trenches *2 × 2 marks* • bridle 3 *marks*	**7**
b.	Double mortice and tenon Joint • Mortices *2 × 2 marks* • tenons *2 × 2 marks*	**8**
c.	Dovetail joint • tail 3 *marks* • trench *3 marks*	**6**
d.	Stopped mortice and tenon Joint • mortice *2 marks* • tenon *2 marks*	**4**
e.	Bottom bridle joint • trenches *2 × 2 marks* • trench *2 marks*	**6**
f.	Bare faced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**

	g.	Dowel holder • centre for holes *2 × 1 mark* • trench *2 marks*	**4**
	h.	Slopes • slopes *9 × 1 mark*	**9**
		Total	**50**

Processing of wash station			
Top bridle	**(iii)**	**PROCESSING**	**Marks**
	a.	Trenches • trenches *2 × 3 marks*	**6**
	b.	Bridle • sawing with the grain *2 × 1 mark* • vertical paring *2 marks*	**4**
		Total	**10**
Double mortice & tenon	**(iv)**	**PROCESSING**	**Marks**
	a.	Tenons • sawing with the grain 4 *× 1 mark* • sawing across the grain 2 *× 1 mark* • vertical paring 2 *marks*	**8**
	b.	Mortices • remove mortices *2 × 3 mark*	**6**
		Total	**14**

Dovetail joint	(v)	PROCESSING	Marks
	a.	Dovetail • saw of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring of trench *2 marks*	**4**
		Total	**12**
Stopped mortice & tenon	**(vi)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon • sawing with the grain 2 × *1 mark* • sawing across the grain 2 × *1 mark*	**4**
		Total	**7**
Bottom bridle	**(vii)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(viii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon 6 *marks*	**6**
		Total	**9**

Dowel holder	(ix)	PROCESSING	Marks
	a.	Drill holes to depth *2 × 2 marks*	**4**
	b.	Remove dowel trench *3 marks*	**3**
	c.	Cutting dowel to length *1 mark*	**1**
		Total	**8**

Shaping & drilling	(x)	PROCESSING	Marks
	a.	Short slopes *8 × 1 marks*	**8**
	b.	Long slope *2 marks*	**2**
	c.	Drilling and countersinking holes accurately *2 × 2 marks*	**4**
		Total	**14**

	OVERALL COMPLETION OF PIECE	Marks
	Grand Total	**150**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2022

Construction Studies

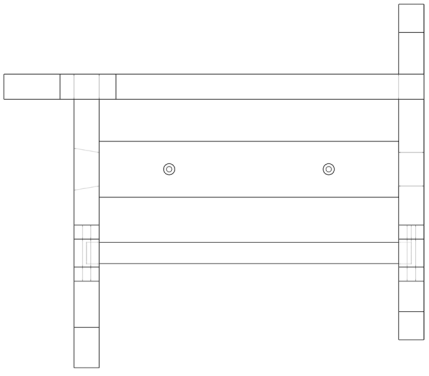
Practical Test

Common Level

(150 marks)

Marking Scheme

Day 2



Marking Scheme – Practical Test

Note:

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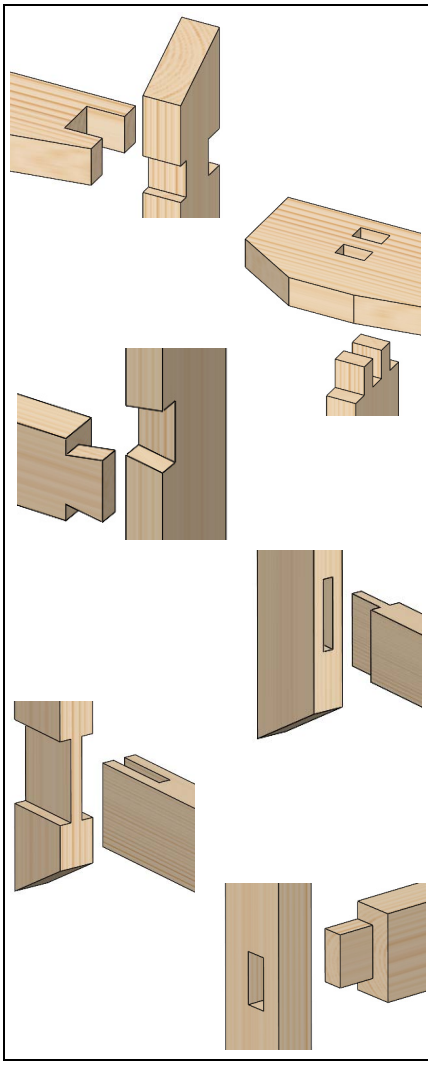
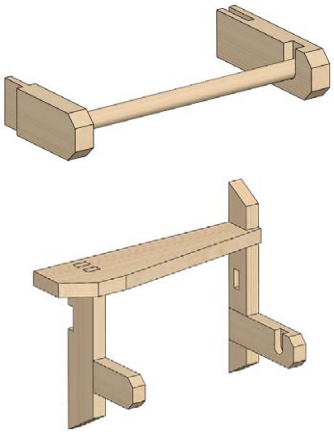
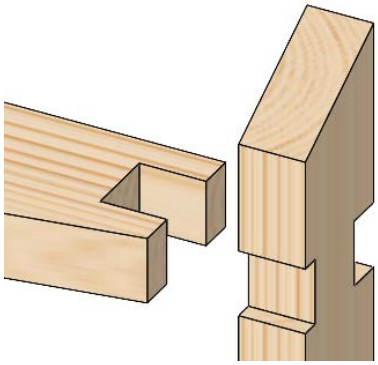
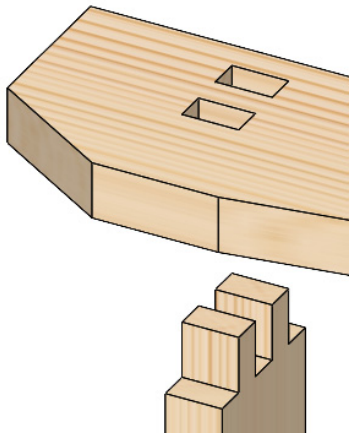
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that procedure.

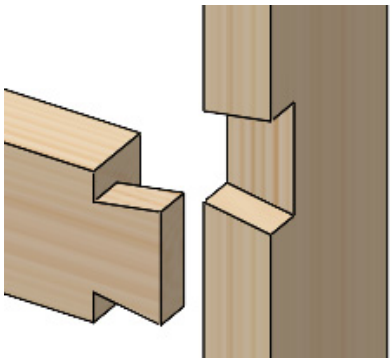
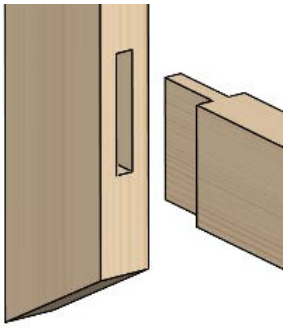
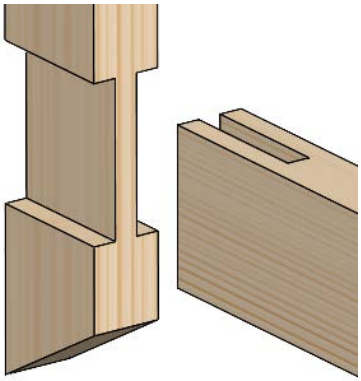
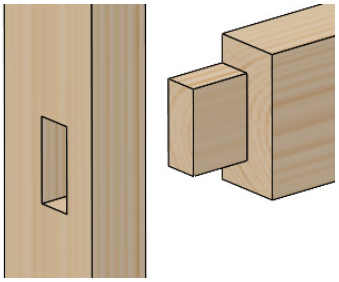
(i)	OVERALL ASSEMBLY	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edge • design — *2 marks* • shaping — *2 marks*	**4**
	Total	**14**

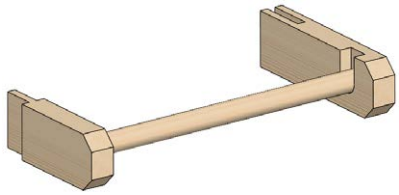


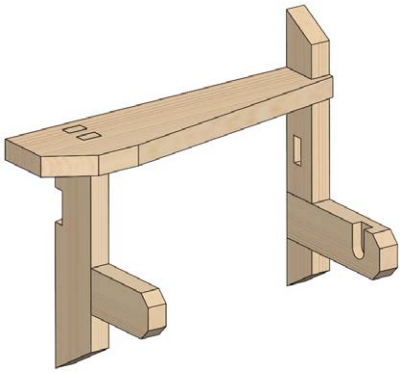
(ii)	MARKING OUT	Marks
a.	Top bridle joint • trenches — *2 × 2 marks* • bridle — 3 *marks*	**7**
b.	Double mortice and tenon Joint • Mortices — *2 × 2 marks* • tenons — *2 × 2 marks*	**8**
c.	Dovetail joint • tail — 3 *marks* • trench — *3 marks*	**6**
d.	Stopped mortice and tenon Joint • mortice — *2 marks* • tenon — *2 marks*	**4**
e.	Bottom bridle joint • trenches — *2 × 2 marks* • trench — *2 marks*	**6**
f.	Bare faced mortice and tenon joint • mortice — *3 marks* • tenon — *3 marks*	**6**

	g.	Dowel holder • centre for holes *2 × 1 mark* • trench *2 marks*	**4**
	h.	Slopes • slopes *9 × 1 mark*	**9**
		Total	**50**

Processing of wash station			
Top bridle	**(iii)**	**PROCESSING**	**Marks**
	a.	Trenches • trenches *2 × 3 marks*	**6**
	b.	Bridle • sawing with the grain *2 × 1 mark* • vertical paring *2 marks*	**4**
		Total	**10**
Double mortice & tenon	**(iv)**	**PROCESSING**	**Marks**
	a.	Tenons • sawing with the grain *4 × 1 mark* • sawing across the grain *2 × 1 mark* • vertical paring *2 marks*	**8**
	b.	Mortices • remove mortices *2 × 3 mark*	**6**
		Total	**14**

Dovetail joint	(v)	PROCESSING	Marks
	a.	Dovetail • saw of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring of trench *2 marks*	**4**
		Total	**12**
Stopped mortice & tenon	**(vi)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon • sawing with the grain 2 × *1 mark* • sawing across the grain 2 × *1 mark*	**4**
		Total	**7**
Bottom bridle	**(vii)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 x 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(viii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon 6 *marks*	**6**
		Total	**9**

Dowel holder	(ix)	PROCESSING	Marks
	a.	Drill holes to depth *2 × 2 marks*	**4**
	b.	Remove dowel trench *3 marks*	**3**
	c.	Cutting dowel to length *1 mark*	**1**
		Total	**8**

Shaping & drilling	(x)	PROCESSING	Marks
	a.	Short slopes *8 × 1 marks*	**8**
	b.	Long slope *2 marks*	**2**
	c.	Drilling and countersinking holes accurately *2 × 2 marks*	**4**
		Total	**14**

	OVERALL COMPLETION OF PIECE	Marks
	Grand Total	**150**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2022

Construction Studies

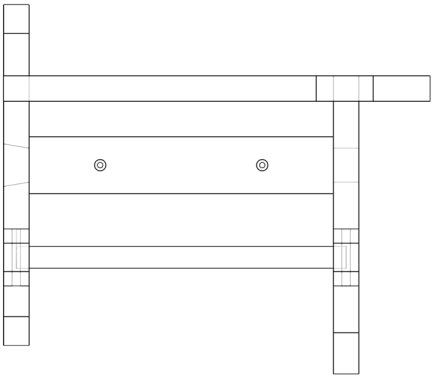
Practical Test

Common Level

(150 marks)

Marking Scheme

Day 3

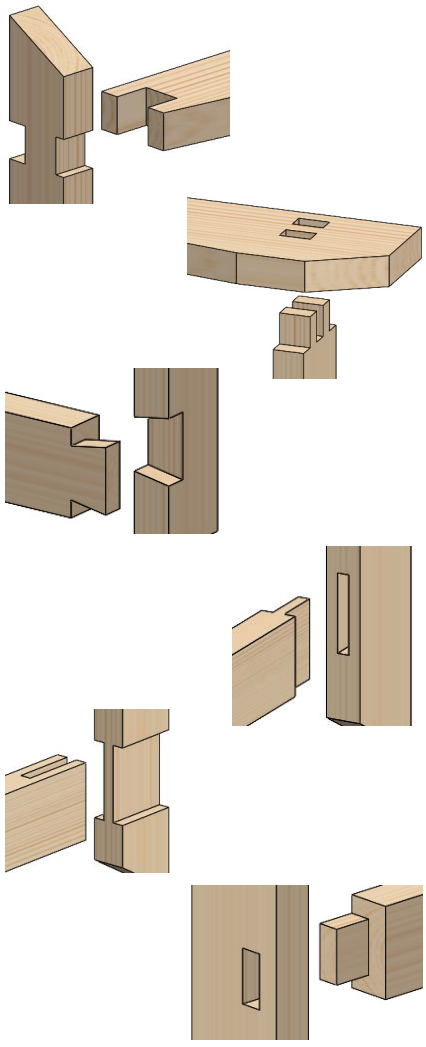


Marking Scheme – Practical Test

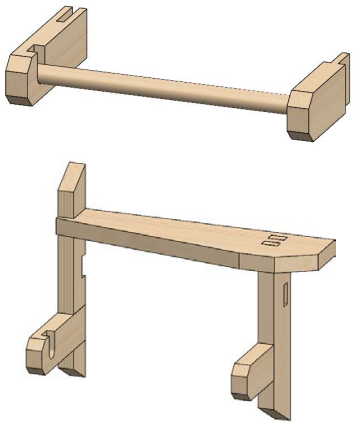
Note:

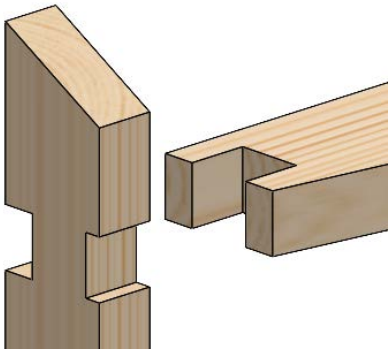
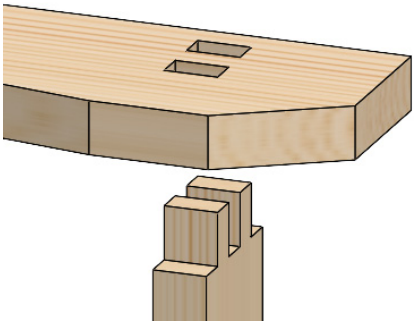
- The artefact is to be hand produced by candidates without the assistance of machinery.
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that procedure.

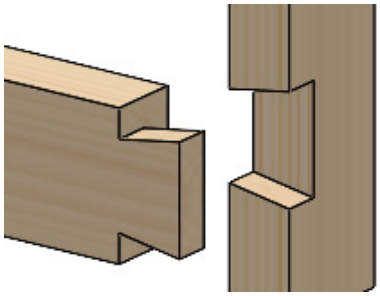
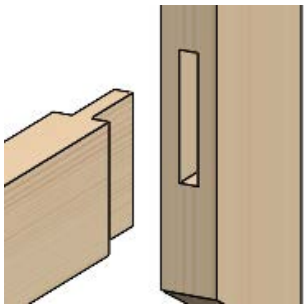
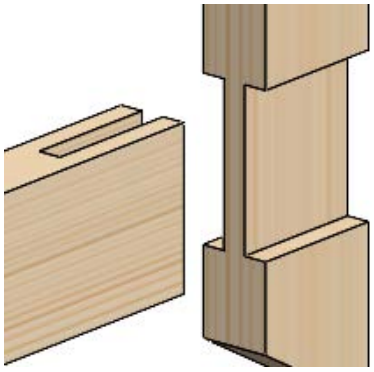
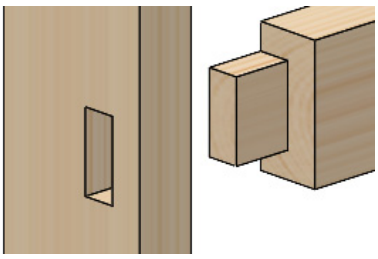
(i)	OVERALL ASSEMBLY	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edge • design — *2 marks* • shaping — *2 marks*	**4**
	Total	**14**

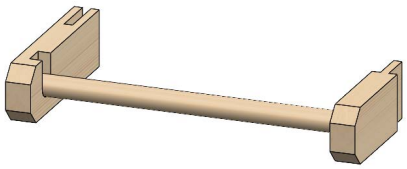


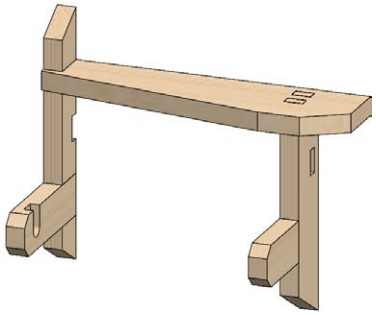
(ii)	MARKING OUT	Marks
a.	Top bridle joint • trenches — *2 × 2 marks* • bridle — 3 *marks*	**7**
b.	Double mortice and tenon Joint • Mortices — *2 × 2 marks* • tenons — *2 × 2 marks*	**8**
c.	Dovetail joint • tail — 3 *marks* • trench — *3 marks*	**6**
d.	Stopped mortice and tenon Joint • mortice — *2 marks* • tenon — *2 marks*	**4**
e.	Bottom bridle joint • trenches — *2 × 2 marks* • trench — *2 marks*	**6**
f.	Bare faced mortice and tenon joint • mortice — *3 marks* • tenon — *3 marks*	**6**

	g.	Dowel holder • centre for holes *2 × 1 mark* • trench *2 marks*	**4**
	h.	Slopes • slopes *9 × 1 mark*	**9**
		Total	**50**

Processing of wash station			
Top bridle	**(iii)**	**PROCESSING**	**Marks**
	a.	Trenches • trenches *2 x 3 marks*	**6**
	b.	Bridle • sawing with the grain *2 × 1 mark* • vertical paring *2 marks*	**4**
		Total	**10**
Double mortice & tenon	**(iv)**	**PROCESSING**	**Marks**
	a.	Tenons • sawing with the grain *4 × 1 mark* • sawing across the grain *2 × 1 mark* • vertical paring *2 marks*	**8**
	b.	Mortices • remove mortices *2 × 3 mark*	**6**
		Total	**14**

Dovetail joint	(v)	PROCESSING	Marks
	a.	Dovetail • saw of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring of trench *2 marks*	**4**
		Total	**12**
Stopped mortice & tenon	**(vi)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon • sawing with the grain 2 × *1 mark* • sawing across the grain 2 × *1 mark*	**4**
		Total	**7**
Bottom bridle	**(vii)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 x 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(viii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon 6 *marks*	**6**
		Total	**9**

Dowel holder	(ix)	PROCESSING	Marks
	a.	Drill holes to depth *2 × 2 marks*	**4**
	b.	Remove dowel trench *3 marks*	**3**
	c.	Cutting dowel to length *1 mark*	**1**
		Total	**8**

Shaping & drilling	(x)	PROCESSING	Marks
	a.	Short slopes *8 × 1 marks*	**8**
	b.	Long slope *2 marks*	**2**
	c.	Drilling and countersinking holes accurately *2 × 2 marks*	**4**
		Total	**14**

	OVERALL COMPLETION OF PIECE	Marks
	Grand Total	**150**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Form A

Leaving Certificate Examination

Construction Studies

Practical Coursework
Marking Scheme

Marking Criteria		Marks
A	**Planning of Project** • Coursework selection, exploration and management planning • Investigation and relevant research • Design development through annotated sketches, with working drawing(s) and/or models	**40**
B	**Report** • Sequence of manufacture including photographic evidence and/or sketches • Critical appraisal and conclusions from coursework experience • Overall quality of communication and presentation of the design folio	**35**
C	**Manipulative Skills** • Marking-out of materials • Processing and assembly of materials • Range and depth of skills evident in the artefact	**40**
D	**Completion of Project** • Artefact well finished • Creativity and appropriateness of coursework • Overall quality, coherence and presentation of coursework	**35**
	Total	**150**

Note*: While the general headings and marks above will largely remain the same, breakdowns may vary for any given year.*