Coimisiún na Scrúduithe Stáit

State Examinations Commission

Leaving Certificate 2025

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.

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State Examinations Commission

Leaving Certificate Examination 2025

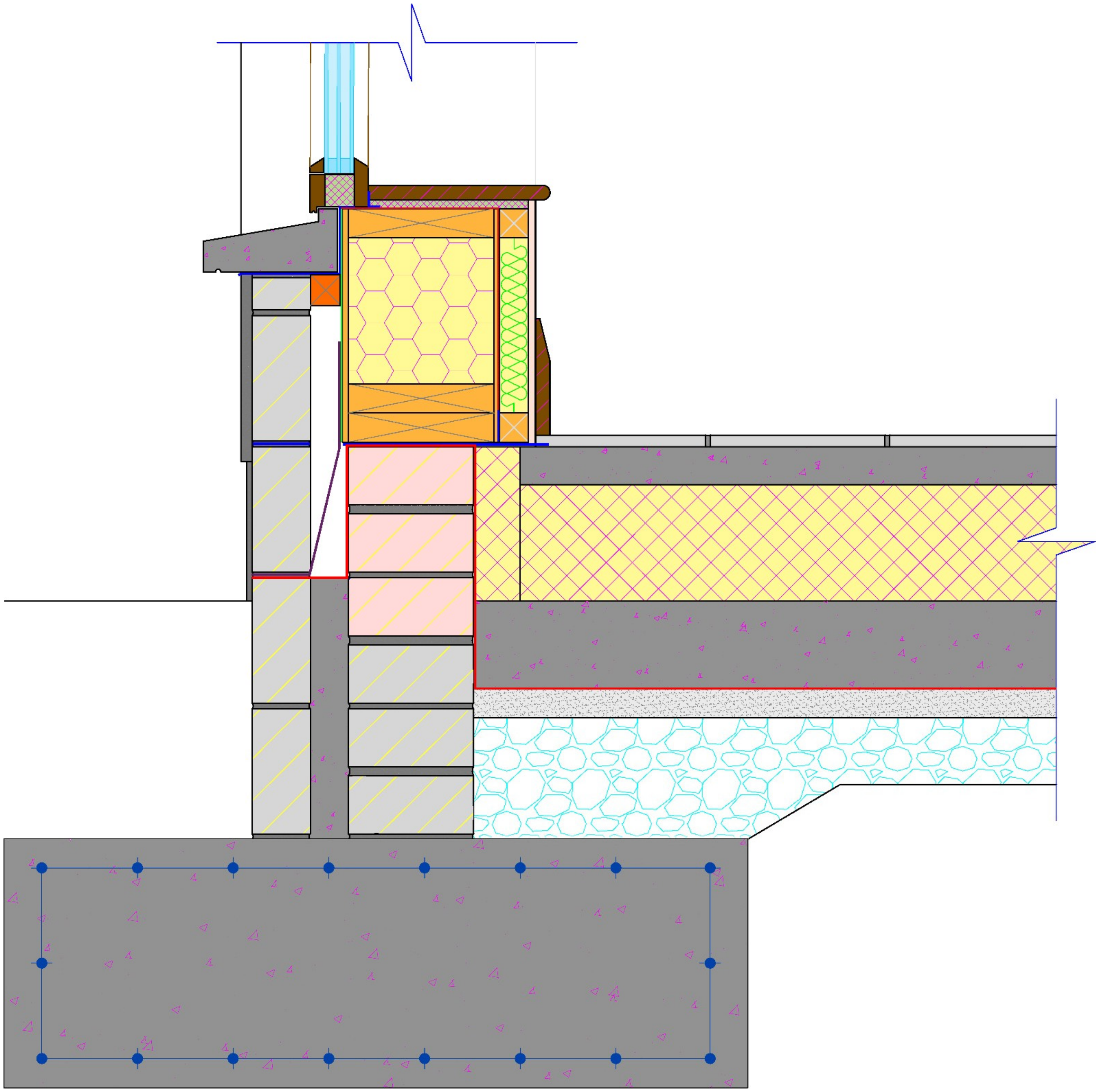
Construction Studies

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 the strip foundation, ground floor, external wall and window.



Any other relevant points

Typical best practice detailing of strip foundation with a solid concrete ground floor, external wall and window of a house.

Foundation and solid concrete ground floor – typical detailing

- R.C. strip foundation
- Dead blockwork and cavity wall above foundation
- Cavity infill
- Thermal blocks on inner leaf
- DPC
- Hardcore/Sand blinding/Radon barrier
- Subfloor
- Insulation
- Screed
- Airtightness barrier at floor and wall junction
- 20 mm quarry tile finish/Skirting board

External wall – typical detailing

- External render
- Concrete block outer leaf
- Air space / residual cavity
- Anchor strap
- Breather membrane
- Racking board
- 250 × 50 mm stud detail and insulation
- OSB sheeting
- Airtightness membrane
- 50 mm insulated service cavity
- Plasterboard and skim

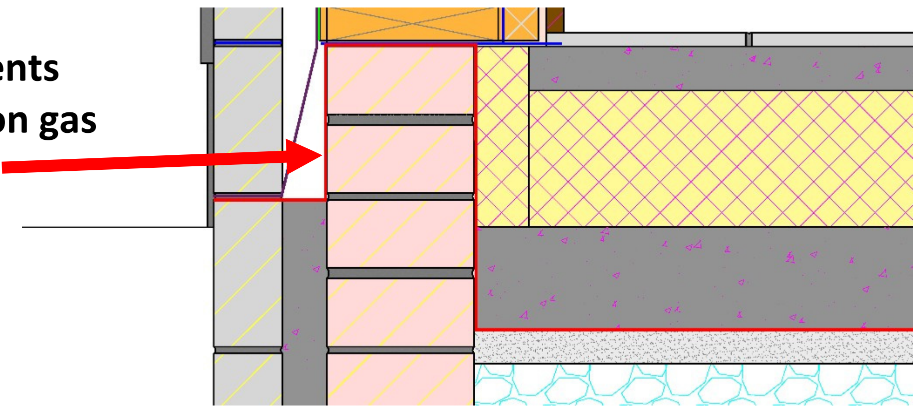
Window detail – typical detailing

- Cavity closer
- Concrete window Cill
- Cill wrapped in DPC
- Thermally broken window frame
- Window board
- Triple glazing
- Airtight barrier at junction

Any other relevant points

(b) Typical design detailing that will prevent the penetration of radon gas into the house.

(b) Radon Barrier prevents the penetration of radon gas



Question 2

(a) The importance of any two of the following in maintaining a positive health and safety culture among workers on a construction site:

Safety training

- A safe pass is mandatory for all workers on a construction site
- Safe pass certification must be maintained through refresher courses
- Training is essential in order to develop awareness amongst workers of possible risks on site
- Specialist training (tickets) is required for specific equipment used on construction sites such as machinery or vehicles
- Safety training is essential to help provide workers with a skillset to be able to identify potential risks on a building site and understand best practice approaches to minimise the risk of accidents
- Work practices should be regularly monitored to ensure all safety protocols are being followed
- Enforcement of all good safe work practices
- Safety training could be a condition of the insurance provider.

Any other relevant points

Health and safety officer

- Provides induction training for all new workers on a site
- Provides ongoing training in specific risks e.g. working at heights, machinery use
- Develop and implement emergency response plans e.g. fire, medical emergencies
- Ensure that first aid and other emergency equipment is available and in good condition
- Foster a culture where safety is prioritised at all times
- Ensures all workers are provided with and are wearing the correct PPE
- Carries out safety inspections and risk assessments to try to prevent workplace accidents
- Identifies new and ongoing safety training requirements
- Reviews the safety statement for the site
- Investigates, records and reports all accidents that may occur on a site.

Any other relevant points

Risk assessment audit

- Provide a safe working environment for all individuals entering the building site
- Evaluate compliance with safety regulations and policies
- Recommend improvements that enhance engagement and safety attitudes
- To prevent and minimise accidents and injuries
- Identify any hazards and put in place control measures where the risk cannot be fully eliminated
- To reduce liability in the event of an accident
- To identify and select training requirements
- To help identify potential high risk / emergency situations and ensure that appropriate measures are in place e.g. the risk of fire may not be able to be eliminated so appropriate measures would need to be put in place such as fire alarms, signage showing evacuation plans, regular fire drills and fire extinguishers at key locations.

Any other relevant points

(b) Outline one possible risk to personal safety associated with each of the following:

Working in a deep trench

- Workers could be seriously injured or buried if the sides of the trench were to collapse
- Machinery or vehicles could fall into the trench which could kill or injure the driver or those in the trench
- If materials are placed too close to the side of the trench, it could cause the walls of the trench to collapse resulting in serious harm to those in the trench
- Risk of injury or death if a worker was to fall into an unguarded trench
- Risk of injury from materials falling into an unguarded trench
- The deep trench could undermine the integrity of nearby structures resulting in potential collapse which could cause catastrophic injuries to those close by.

Any other relevant points

Installing insulation in an attic space

- Risk of workers falling through the plasterboard ceiling if the worker was to misstep, this could lead to serious injury or death
- Risk of injury when cutting the insulation to size
- Risk of skin irritation if a hooded coverall and gloves are not worn
- Risk of injury to eye if safety goggles are not worn
- Risk of electrocution if the worker was to come in contact with the copper core of any exposed wires
- Risk of fire if exposed heat producing fixtures such as recessed lights are covered with insulation
- Risk of developing asthma or bronchitis which decreases lung function as a result of the inhalation of machine-made mineral fibres (MMMFs). To protect against these health issues respiratory protective equipment (RPE) should have a P2 particulate filter fitted to a half or full-face mask, disposable dust masks are not considered to be effective.

Any other relevant points

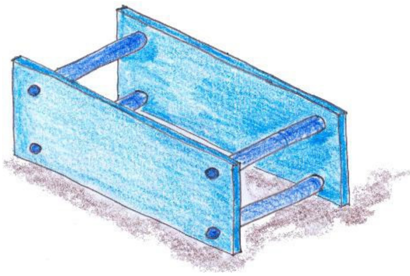
Repairing a chimney capping

- Risk of workers falling or slipping from the roof which could result in serious injury or death
- Risk of workers falling from the ladder when accessing the scaffolding
- Risk of harm to workers or structures underneath if equipment or materials were dropped
- Risk of scaffolding collapsing causing serious harm or death to the workers and those on the ground
- Risk of workers falling from lifting machinery e.g. cherry picker causing serious harm or death
- Risk of materials falling from lifting machinery causing serious harm to those below.

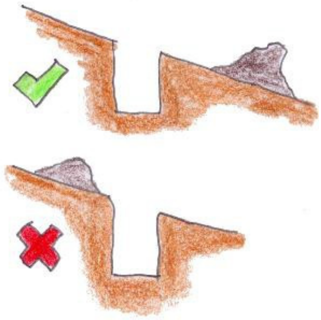
Any other relevant points

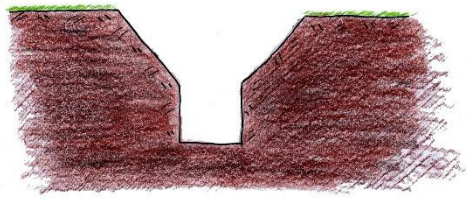
(c) Two best practice guidelines that should be observed to reduce the possibility of injury to a worker undertaking each task:

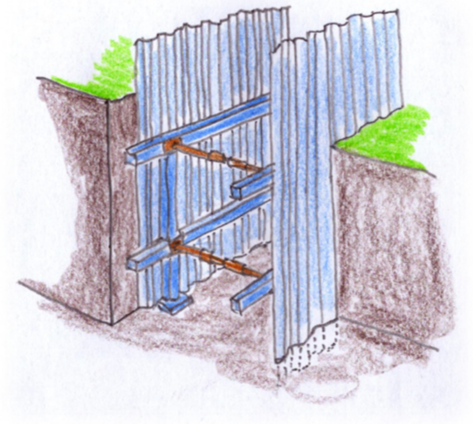
Working in a deep trench

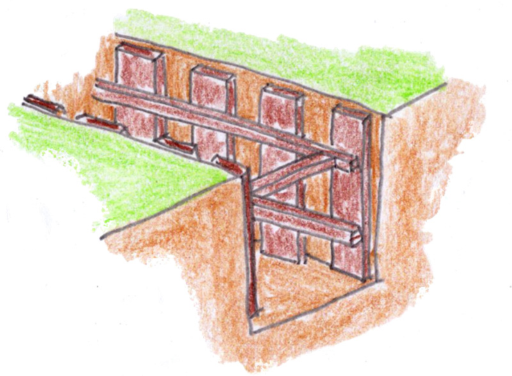


- Use of a trench box or shuttering to strengthen and stabilise the sides of the trench to prevent a collapse happening
- Install a temporary cover over a vacant trench
- Appropriate signage should be displayed around the trench to make everyone aware
- Use personal protection equipment (hard hat and eye protection, insulated footwear)
- Arrange a clearly marked exclusion zone – barrier and tape - around an open trench
- A barrier with a toe board should be installed around the open trench
- Do not pile any materials on the edge of the trench due to the risk of collapse or objects falling into the trench and injuring workers
- Batter back / slope back method when digging the trench
- Trench dug in suitable conditions. It should not be dug in wet conditions due to the risk of compromising the side walls
- Do not park any machinery or vehicles close to the edge of the trench
- An engineer would need to carry out surveys to determine if the proposed trench could compromise any nearby structures.



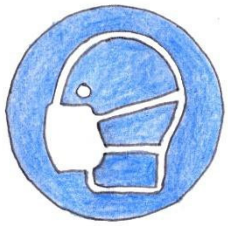


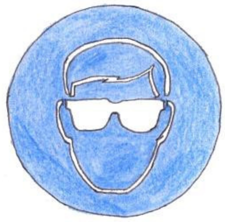




Any other relevant points

Installing insulation in an attic space

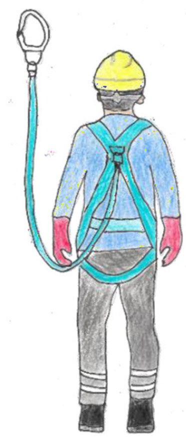




- A coverall with a hood as well as gloves should be worn to prevent any irritation to skin
- An appropriate dust mask should be worn to protect the workers lungs
- Heat producing fixtures such as downlighters should have non-combustible protection covers to prevent any risk of fire
- Safety goggles should be worn to ensure no foreign objects enter the workers eyes, potentially causing permanent damage to vision
- Crawl boards used to spread the load across joists, to safely move across the attic
- If crawl boards are not used the worker should always walk or crawl along the joists and never place any weight on the plasterboard ceiling
- Cut insulation in a well-ventilated area
- Kneepads should be worn to lessen the impact on the workers knees.

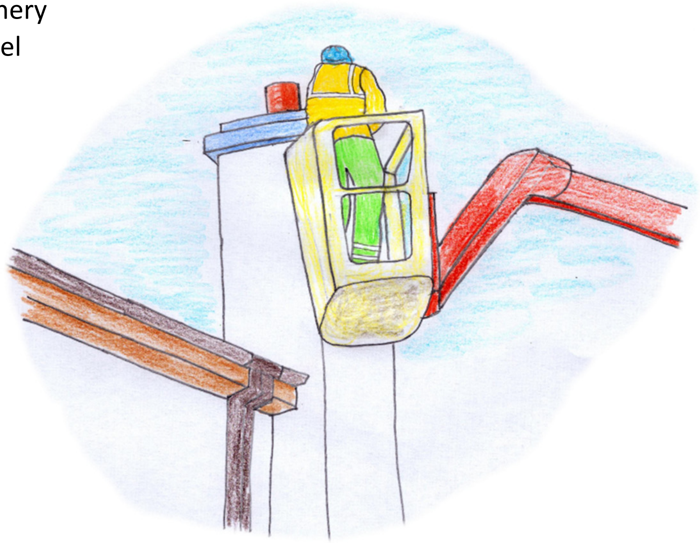
Any other relevant points

Repairing a chimney capping



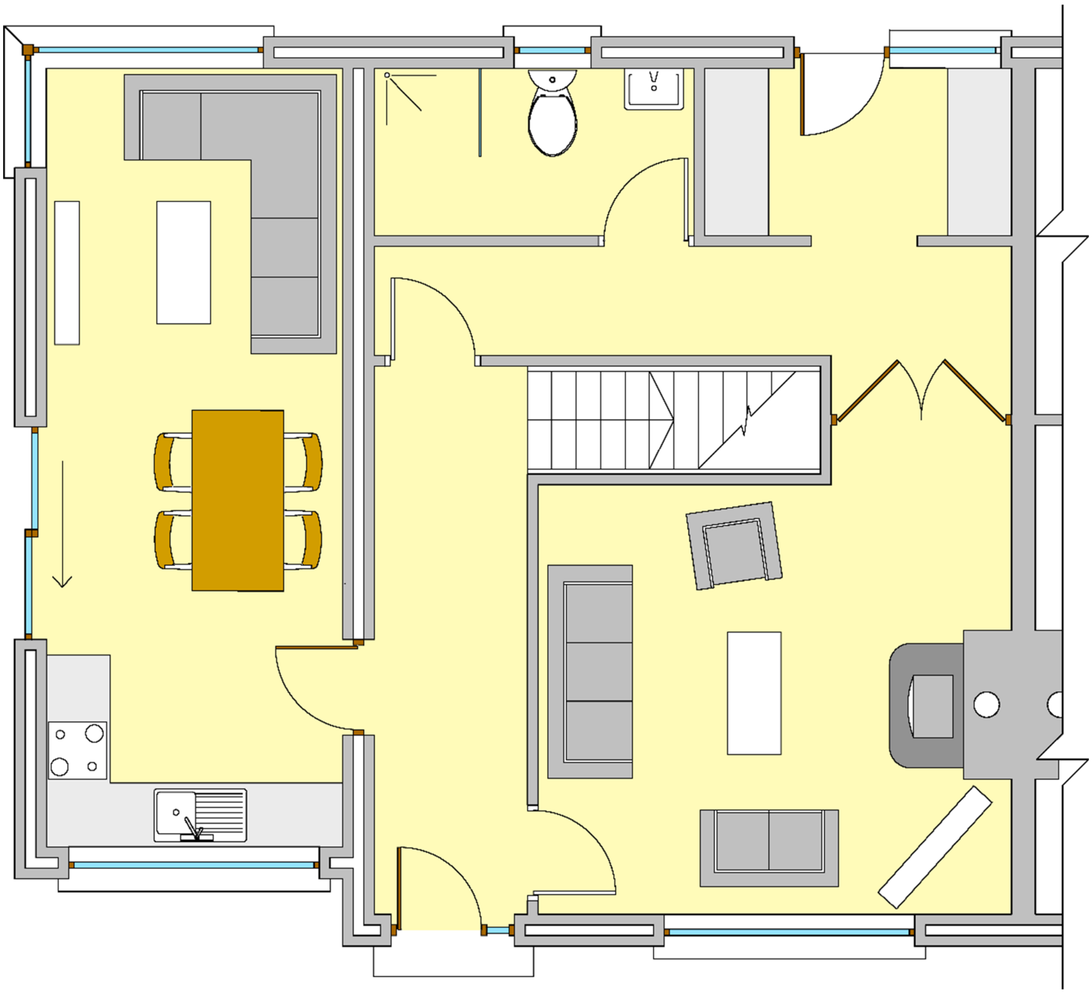
- A safety harness or other fall protection should be used
- A scaffolding should be erected around the chimney stack by certified personnel
- Scaffolding should be tied to the house / chimney
- Scaffolding should have the required safety rails and toe boards fitted
- Toe boards and netting all around the scaffolding should be used to protect against falling objects
- Ladders should extend 1 metre past the scaffolding platform
- Ladders should be properly secured on the scaffolding
- Use of lifting machinery e.g. cherry picker to allow workers safe access to the chimney stack
- Workers should be securely attached to any lifting machinery
- Only certified personnel to operate lifting machinery
- All lifting machinery should be operated off a level surface.

Any other relevant points



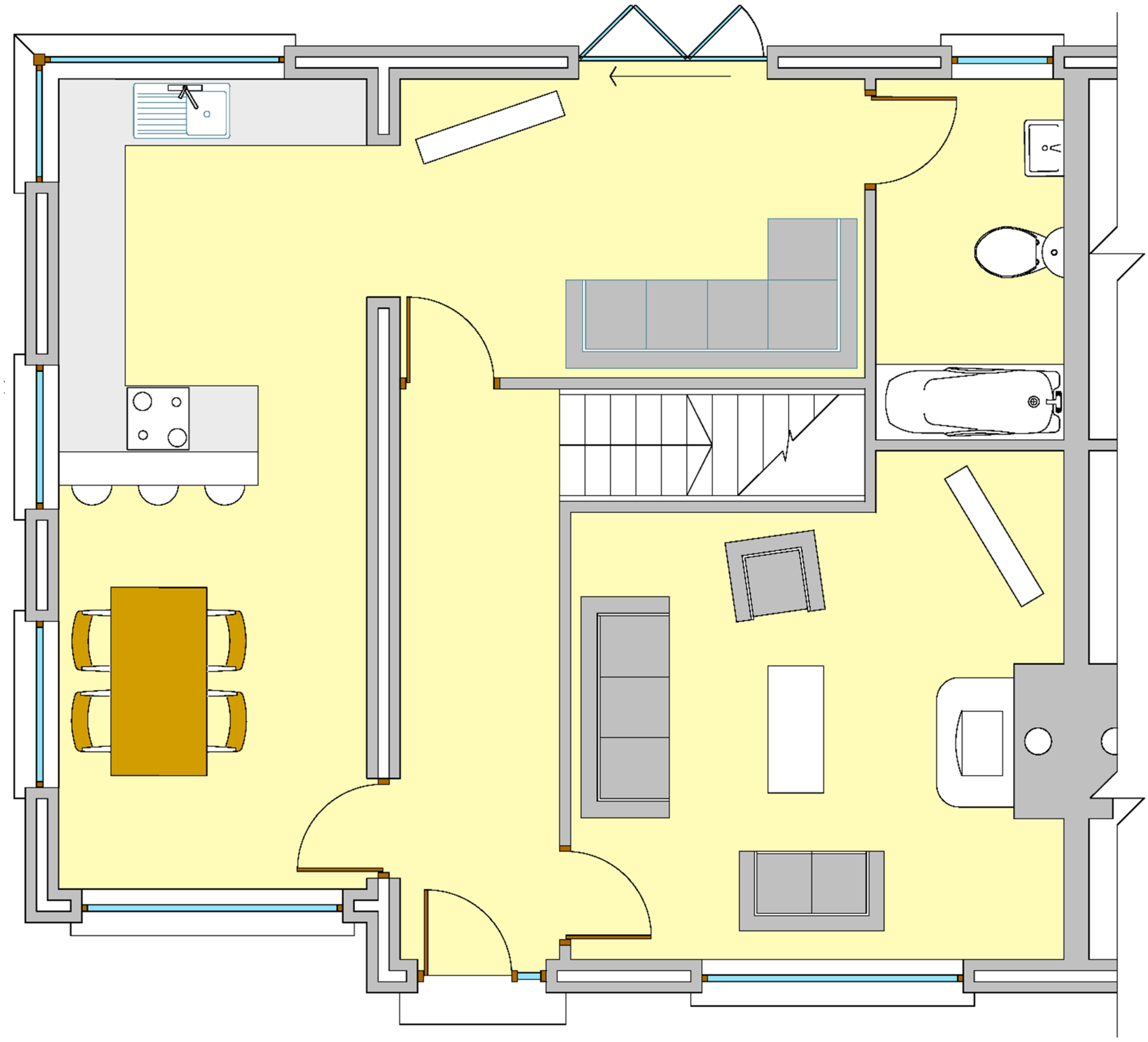
Question 3

(a) Revised internal layout for the ground floor that incorporates each of the above design requirements.



- Remove the wall dividing the garage and the utility to make a large space capable of catering for an open plan kitchen/dining and living space
- Large narrow open plan space will optimise day light
- Create an entrance into this new space by putting a doorway into the corridor off the new kitchen location
- To create a link with the outdoors, use a sliding door in this new space on the south facing wall
- Sliding glass doors could allow access onto a patio area for outdoor dining
- Replace the garage door with a high-performance glazed window to maximise morning light. This will be just above counter height
- Install a corner window on southwest side of the house to maximise light and heating from afternoon and evening
- A large bathroom to be installed where the kitchen was previously. This is an external wall and will have access to wastewater as the kitchen sink was previously connected
- The back door will be moved to the opposite corner of the dwelling on the west side, it will have a window to its side to maximise light into the utility room
- Glazed double doors have been installed between the new utility room and the sitting room to assist with optimising day light into the downstairs of the dwelling
- Install roof lights on the garage roof to optimise unobstructed natural light throughout the day.

Any other relevant points



- Remove the wall dividing the garage and the utility to make a large space capable of catering for a spacious open plan kitchen/dining room
- Install lots of high-performance glazing on the south side of the dwelling to maximise solar gain
- Replace the garage door with a floor to ceiling triple glazed window to maximise morning light into the dwelling
- Install a corner window on southwest side of the house to maximise light and heating from afternoon to evening
- The dining room table, island seating and kitchen sink should all be close to the south facing windows to reduce the need for artificial light
- Create entrances at both ends of this new space. Appropriately sized steel beams will need to be used as this is a load bearing wall
- Moving the living room to the rear of the house will create privacy between the spaces while still allowing heat circulation and light flow
- Adding a bi-fold door to the west façade in the living room will allow easy access to outdoors and allow the opportunity to create a private outdoor space
- A large family bathroom has been installed on the north side of the house where previously the dining room was located. There is a frosted window on the west side of the house. As it is at the rear of the house the waste pipes can be easily routed through the external wall.

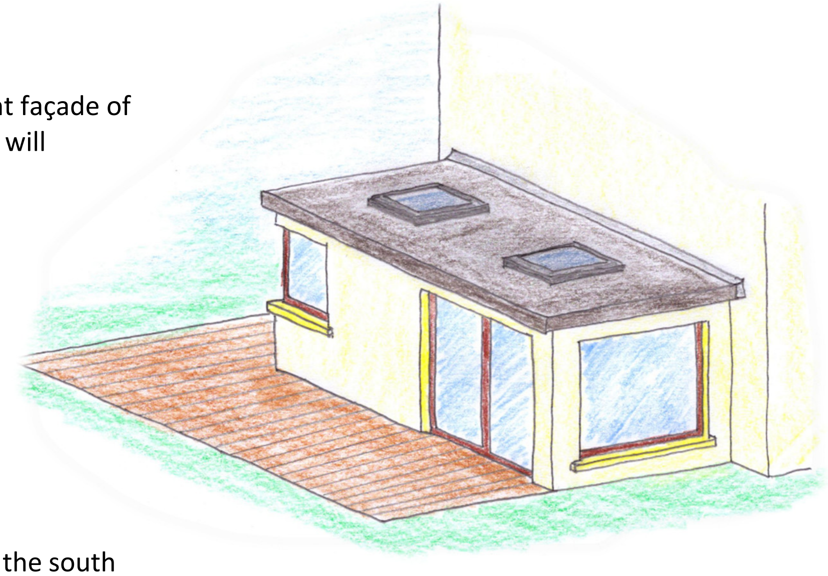
Any other relevant points

(b) Three reasons for your proposed layout:

- By combining the garage and utility it gives the owners a large south facing space where they can create a spacious open plan kitchen/dining and living space
- Replacing the garage door with high performance glazing will improve the solar gains and thermal performance of this space
- Installing high performance glazing on the south side of the house will maximise the light into this new space. This will ensure the open plan space is bright and warm
- By putting glazed doors into the sitting room, light from the west can shine into this room in the evening
- By creating a large family bathroom which is wheelchair accessible, the occupants will have a bathroom suitable for lifetime use
- Optimising light into the ground floor will lessen the need for artificial lights this will reduce the energy bills being paid by the occupants
- Changing the roof from a flat roof to a sloped roof will lessen any potential issues with moisture penetration and lower home insurance costs
- Using the same brick which is used on the existing house will help to retain the character of the converted garage space
- Adding glazed areas to the rear of the dwelling will help to optimise daylight into the ground floor Since this façade is at the rear of the house it will gain warm evening sun while offering privacy to the occupants
- Addition of roof lights on the garage roof will allow light to flood into this new space, this will help to improve the wellbeing of the occupants.

Any other relevant points

(c) Revised external design for the garage that will enhance the overall visual appearance of the house.



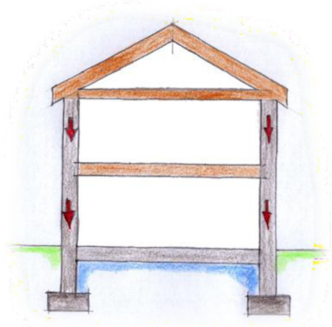
- No changes will be made to the front façade of the house however the garage door will need to be replaced with high performance glazing. This could be full height or installed above worktop level
- The exterior could utilise the same plaster finish of the house or it may add brick to strengthen its connection with the existing house
- Adding high performance glazing to the south and west side of the house will help optimise daylight into the building
- Adding roof lights on the roof of the garage will help to ensure the interior is flooded with natural daylight. This will enhance the wellbeing of the occupants
- Use of solar shading to prevent over-heating
- The roof of the garage could be kept as a bitumen flat roof, or it could be replaced with a metal such as zinc for aesthetics
- Alternatively, the angle of the roof could be increased, and it could be slated to strengthen the connection with the existing house.

Any other relevant points

Question 4

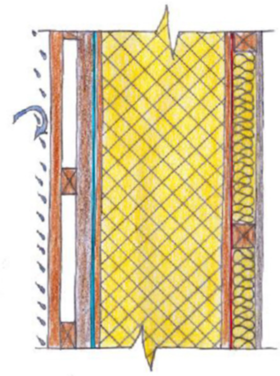
(a) Three functional requirements for an external wall suitable for a new dwelling house:

Structural Stability



- Anchor roof to walls and support the floors/upper floor(s) and roof
- Spread the superimposed loads evenly over the foundations
- Provide robust openings for doors and windows
- Have sufficient structural integrity to avoid cracks or other failure under load
- Prevent access of vermin to the building and the roof space
- Be aesthetically pleasing and be in keeping with the surroundings of the dwelling.

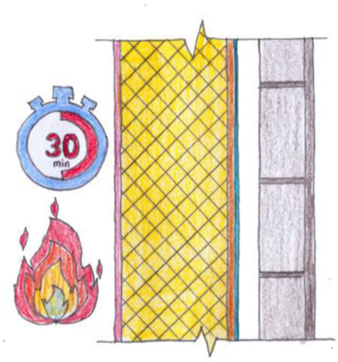
Thermal Comfort



- Should be able to install thermal insulation in the external wall to maximise its efficiency
- A high thermal mass is preferrable to provide a comfortable interior environment for the occupants.

Weather Resistance

- Should protect the occupants from the weather e.g. no moisture ingress from wind driven rain
- The structure or aesthetics of the walls should not be negatively affected by the weather
- Provide low-maintenance, climate-proof exterior surfaces and finishes
- Have no cold bridges and be designed to have low embodied energy
- Prevent the formation of condensation and dampness
- Prevent interstitial dampness.



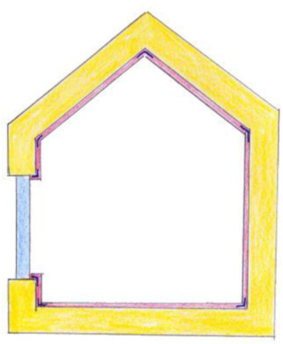
Acoustic Resistance

- Should provide sound resistance from external sources
- Can add acoustic insulation to some external wall types.

Fire Resistance

- Should be able to withstand fire for a minimum of 30 minutes before its structural integrity is compromised
- Should resist the spread of fire.

Sustainability



- Where possible materials chosen should be locally sourced and environmentally friendly
- Materials chosen should have a long lifespan and need minimum maintenance
- Consider the use of recycled/recyclable materials where available
- Provide a means of carbon sequestration.

Airtightness

- Wall structure should be able to be made airtight
- Depending on the external wall type, this can be achieved by using sand cement plaster, airtightness membranes, airtightness tapes, airtightness paint or airtightness foam.

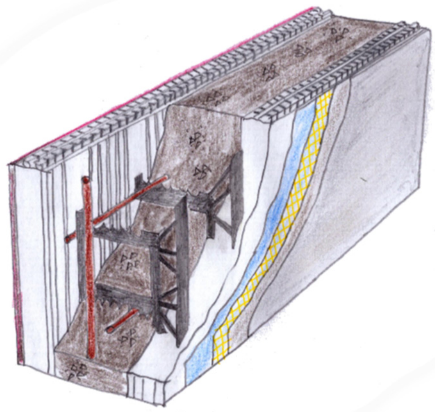
Any other relevant points

(b) Design detailing for two different external wall construction types that can achieve a high-performance for their house:

Block cavity construction

- Concrete block construction has a high thermal mass which helps to maintain a comfortable living environment
- This external wall is usually finished with a sand cement render which is low maintenance
- The internal leaf is usually plastered with sand cement plaster and then skimmed. This makes the wall airtight
- Blocks absorb moisture so DPC needs to be used in the rising wall and at junctions
- The cavity can be filled or partially filled with insulation to improve its thermal performance
- If thermal blocks are not used in the internal leaf rising wall there will be a linear thermal bridge down the inner leaf
- Stainless steel wall ties which are the most common approach in cavity block construction create point thermal bridges
- Typical dimensions 100mm outer leaf, 200mm cavity and 100mm inner leaf.

Insulated concrete forms

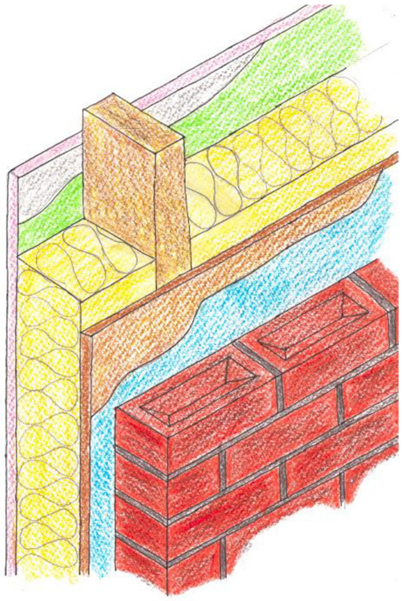


- Insulated concrete forms are constructed with expanded polystyrene, then external and internal shuttering is used so concrete can be poured into the cavity left in the centre
- For structural stability the insulated expanded polystyrene panels are connected by polypropylene webs
- The concrete which is poured into the shuttering is reinforced with steel rebar as it will become the loadbearing aspect of the wall
- This wall type is completely airtight
- Acrylic render is commonly applied to the external EPS insulation leaf for weather proofing and aesthetics. Other external finishes include brick, zinc or timber cladding
- Standard sizing is 300mm comprising of two EPS panels 75mm each and 150mm concrete core.

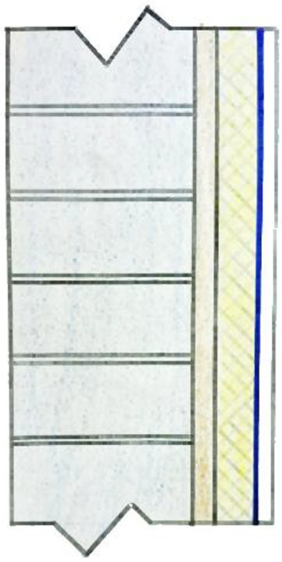
215mm single leaf solid concrete block with external insulation

- This is where the inner leaf is concrete block on the flat
- The block wall has a high thermal mass so helps to keep a steady temperature in the dwelling
- Thermal blocks will need to be used in the inner leaf rising wall to prevent thermal bridging
- The block wall can be plastered with sand cement plaster and a skim coat to make it airtight
- External insulation board is fixed to the block wall and finished with an acrylic render finish. This helps with durability and weatherproofing
- Thickness of insulation varies, up to 150mm.

Timber frame wall with brick outer leaf



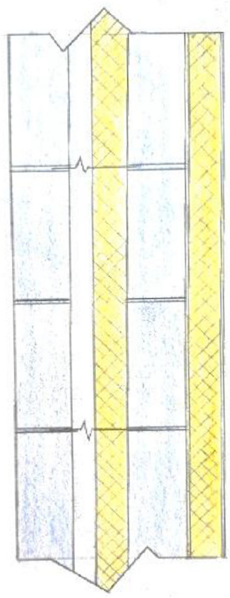
- Timber has a low embodied energy and can be sourced locally This means it is a very sustainable approach
- The timber studs can be filled with thermal insulation to improve its efficiency
- Airtightness membrane is used on the warm side of the insulation to create an airtightness barrier
- A breather membrane would be installed on the outer side of the insulated stud wall. It allows water vapour to escape while repelling any water e.g. rain
- Different types and colour of brick can be chosen to suit the aesthetic requirements of the dwelling
- Brick outer leaf typically 100mm, 50mm cavity is common, 140mm deep studs & 12mm sheathing.



215mm single leaf solid concrete block with Internal insulation

- This is where the external leaf is a concrete block on the flat
- The block wall has a high thermal mass to help keep a steady temperature in the dwelling
- A treated 25mm timber batten is mechanically fixed to the interior to provide an airspace
- 50mm of insulation is attached to the batten
- A vapour barrier is attached to the inside of the insulation
- 12.5mm plasterboard slab is then attached after the vapour barrier
- The slab is then plastered with a skim coat to make it airtight.

Concrete block insulated cavity wall construction with internal insulation



- Concrete block construction has a high thermal mass which helps to maintain a comfortable living environment
- The external wall is usually finished with a sand cement render which is low maintenance
- Blocks absorb moisture so DPC needs to be used in the rising wall and at junctions
- The cavity can be filled or partially filled with insulation to improve its thermal performance
- If thermal blocks are not used in the internal leaf rising wall there will be a linear thermal bridge down the inner leaf
- Stainless steel wall ties which are the most common approach in cavity block construction create point thermal bridges
- A 52mm insulated slab is directly attached to the inner leaf. There is no need for a vapour barrier as the foil back on the plasterboard slab meets the requirements.

Any other relevant points

(c) Discuss **one** advantage and **one** disadvantage of **each** wall type you have shown at **4(b)** above:

Concrete block insulated cavity wall construction (Advantages)

- Improved thermal insulation - the cavity between the inner and outer concrete block walls provides an insulating air gap that enhances the thermal performance of the building. This leads to lower energy costs and improved comfort inside the building
- Increased durability and strength - concrete blocks are durable, robust, and fire-resistant. The building will have a longer lifespan, require less frequent maintenance, and be safer in the event of fire or extreme weather
- Sound insulation and noise reduction - the combination of concrete block walls and the cavity helps to dampen sound transmission between rooms or from external noise sources. This results in better acoustic performance
- Moisture protection and reduced risk of damp penetration - the cavity in concrete block insulated cavity wall construction provides a barrier that helps prevent moisture from penetrating into the inner walls of the building. This improves the building's resilience to damp and mould and ensures a healthier indoor environment
- Energy efficiency and sustainability - concrete block cavity walls contribute to energy efficiency by improving thermal insulation, reducing heat loss, and lowering the energy required for heating and cooling. Buildings constructed with insulated cavity walls are more sustainable, meet modern building regulations, etc.
- Cost-effectiveness - concrete block insulated cavity wall construction reduces the need for extra insulation materials, combined with the long-term energy savings, makes this type of construction economically viable in the long run.

Concrete block insulated cavity wall construction (Disadvantages)

- Skilled labour required – highly skilled workers are required for the construction of the cavity block wall. Currently there is a huge shortage of these skilled workers making the construction of these walls challenging
- Penetration of dampness – the cavity may become bridged as a result of improper fitting of insulation. This can lead to moisture penetrating the inside cavity which may result in mould or structural damage
- Cold bridging – if the cavity becomes bridged for whatever reason, this can lead to a path for heat and cold to travel. This will result in cold traveling in to the house and heat escaping increasing energy bills
- Complex – cavity wall construction is more complex than solid block walls making the need for care and attention greater at the construction phase.

Insulated Concrete Forms (ICF) wall construction (Advantages)

- Superior energy efficiency - ICF walls provide excellent thermal insulation. This leads to significant energy savings over the life of the building and helps reduce the building's carbon footprint
- Increased strength and durability - ICF walls are extremely strong and durable. ICF construction results in a building that is resistant to mould, and weathering, ensuring long-term durability
- Excellent sound insulation - ICF walls have superior soundproofing capabilities due to the thick foam core and concrete layers, resulting in a quieter indoor environment
- Faster construction time - ICF construction typically takes less time compared to traditional masonry or wood-frame buildings. This shortens construction time, leading to cost savings on labour and materials while allowing for quicker occupancy
- Improved fire resistance - ICF walls offer excellent fire resistance. Buildings constructed with ICF walls offer enhanced safety, with a high fire rating
- Sustainability and eco-friendliness - ICF construction is environmentally friendly. ICF walls contribute to sustainable construction practices, reducing a building's overall environmental impact.

Insulated Concrete Forms (ICF) wall construction (Disadvantages)

- Expensive to construct – ICF construction will result in a large initial economic cost to construct
- Specialised labour required - ICF construction requires trained specialised people. As this is a relatively new type of construction, these workers can be difficult to source
- Modification challenges – changing the ICF design after the initial construction can be difficult due to the reinforced concrete core. It is essential that careful planning is considered to avoid these issues
- Ingress of water – improper construction and sealing can lead to moisture travelling from the exterior inwards
- Heat transfer – ICF construction offers excellent thermal insulation. However, the concrete core has the potential to conduct heat.

Solid concrete block with external insulation wall construction (Advantages)

- Enhanced thermal insulation - The external insulation significantly improves the thermal performance of the wall. This leads to lower heating and cooling costs, making the building more energy-efficient and environmentally friendly by reducing its carbon footprint
- Improved energy efficiency and comfort - the combination of solid concrete blocks and external insulation provides a consistent indoor temperature throughout the year. Solid concrete acts as a thermal mass, absorbing and releasing heat, while the external insulation prevents heat from escaping or entering the building
- Moisture protection and reduced risk of condensation - the external insulation layer helps to keep the interior surface of the concrete wall warm, reducing the likelihood of condensation. This reduces the risk of damp, mould, and decay within the building, improving indoor air quality and enhancing the overall health of the building structure
- Improved sound insulation - The mass of the concrete blocks helps to block external noise, while the external insulation helps to dampen sound transmission through the walls creating a quieter indoor environment
- Increased durability and structural integrity - solid concrete blocks provide a strong, durable, and fire-resistant structural element. This results in a long-lasting building that requires less maintenance, is more resistant to extreme weather conditions, and provides better protection against fire hazards
- Aesthetic flexibility and external design options - external insulation systems can be finished with a wide variety of materials, such as render, cladding, or brick slips, allowing for greater design flexibility and the ability to enhance the building's aesthetic appearance.

Solid concrete block with external insulation wall construction (Disadvantages)

- Skilled Labour Required – highly skilled workers are required for the construction of the block wall. Currently there is a huge shortage of these skilled workers making this type of construction challenging
- Expensive to construct – solid block construction will result in a large initial economic cost to construct
- Dampness – if not constructed properly there is the potential for moisture to travel from the external to the internal leading to mould and dampness in rooms
- Potential for thermal bridging – as there is no cavity there is a huge risk that cold will bridge to the inside of the structure. As a result, it is essential that proper detailing is employed to prevent this from occurring.

Timber frame with brick outer leaf wall construction (Advantages)

- Energy efficiency - timber frame construction allows for excellent thermal performance, especially when combined with high-quality insulation materials within the frame. The brick outer leaf adds an additional layer of thermal mass, helping to regulate indoor temperatures by absorbing and releasing heat
- Fast construction - timber frame construction is typically faster to erect compared to traditional brick-and-block construction because the frame components are pre-manufactured off-site, reducing on-site construction time
- Visual Appeal - the brick outer leaf provides a highly aesthetic, durable, and low-maintenance finish, while the timber frame allows for flexibility in design
- Durability - the timber frame provides a strong, lightweight structure, while the brick outer leaf offers excellent protection against the elements. Brick is known for its durability, weather resistance, and fire resistance, while timber is carefully treated to prevent rot and pests, ensuring the longevity of the structure
- Improved Sound Insulation - the combination of a timber frame with a brick outer leaf enhances the soundproofing qualities of the wall. The brick layer acts as a solid barrier, helping to block external noise, while the timber frame, particularly when filled with insulation, dampens sound transmission between rooms
- Sustainability and Environmental Benefits - timber is a renewable resource with a lower carbon footprint compared to materials like steel or concrete. When sourced sustainably, timber provides a more eco-friendly construction solution. Additionally, the brick outer leaf helps improve the energy efficiency of the building, reducing the long-term environmental impact.

Timber frame with brick outer leaf wall construction (Disadvantages)

- Skilled labour required – highly skilled workers are required for the construction of the timber frame wall. Currently there is a huge shortage of these skilled workers making this type of construction challenging
- Expensive to construct – timber frame construction will result in a large initial economic cost to construct. However, there is the possibility to recoup a portion of this cost with faster construction times than the cavity block wall
- Moisture ingress – the design if constructed properly will ensure that moisture does not reach the interior leaf. However, if there are any mistakes in the detailing it will lead to rot and decay of the timber stud
- Sound proofing – as timber is a light weight structure, it will not offer the same level of acoustic performance as a cavity block wall.

Other relevant information

Question 5

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

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
External surface				0.048
Acrylic render	0.670	1.493	0.008	0.012
External insulation	0.030	33.333	0.100	3.333
Sand cement render	0.461	2.170	0.016	0.035
Hollow concrete block			0.215	0.210
Insulation	0.037	27.040	0.025	0.676
Plasterboard	0.160	6.240	0.0125	0.078
Skim coat	0.180	5.550	0.003	0.017
Internal surface				0.122
			Total R =	R^t = 4.531
Formulae: R=T/k R=T × r U= 1/R^t **U-value:** U = 1 / 4.531 = 0.221 W/m^2 °C				
			U-value =	**0.221 w/m^2 °C**

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

- Heat lost through wall

  Heat loss formula: = U -Value × area × temp. diff

  0.221 × 144 × (19 – 6) = 413.712 Watts (Joules / sec)

- Heating period p/a: 60 × 60 × 7 × 7 × 33 = 5,821,200 seconds (1,344 hours)

- Kilo joules p/a: $\frac{5{,}821{,}200 \times 413.712}{1000}$ = 2,408,300.29 KJ/ second

- Kg p/a: *(Note: Calorific value of 1 Kg of wood pellets = 17350 kJ)*

  $\frac{2{,}408{,}300.29}{17{,}350}$ = 138.810 kilograms

- Cost p/a: *(Note: 1 Kg of wood pellets cost €0.55)*

  138.810 × 0.55 = €76.34

  Cost of heat loss annually through wall = €76.34

<u>Alternative method:</u>

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

$$= \frac{\mathbf{0.221} \times 144 \times 13 \times 5{,}821{,}200 \times 0.55}{17{,}350 \times 1000}$$

$$= \frac{1{,}324{,}565{,}161.92}{17{,}350{,}000}$$

= **€76.34**

(c) Thickness of additional insulation required to give the external wall a u-value of 0.11 w/m^2 ^{0}C.

Determine the Resistance for a U-value of 0.221 W/m^2 K

Use formula U= 1/Rt. & solve for R.

R = 1/ U-value   R = **1/ 0.221** = 4.525m^2 K / W

Resistance for required U-value of 0.11 = 1/0.11 = 9.091 m^2 K / W

Difference in Resistance = 9.091 – 4.525= 4.566 m^2 K / W

Use the formula R= T/k & solve for T.

4.566 = T/0.030

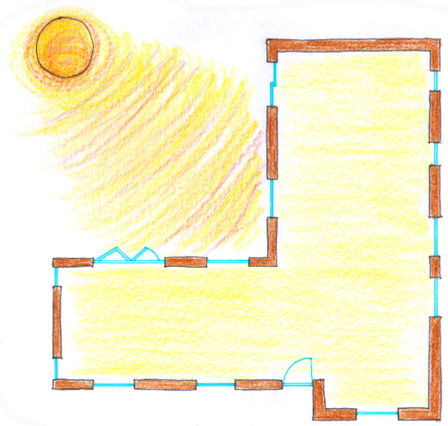
T = 4.566 × 0.030 **= 0.137 metres** to achieve U value of **0.11 W/m^2 K**

Thickness of required insulation = **137 mm**

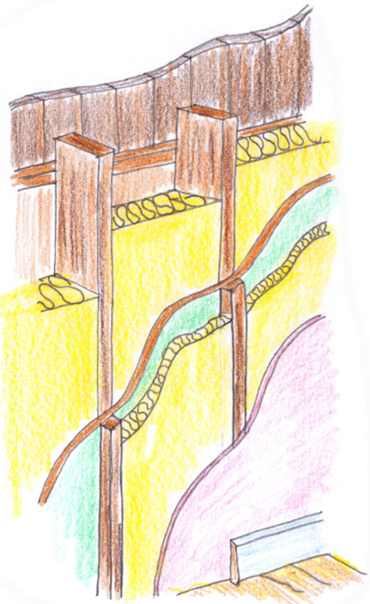
Alternative calculation methods acceptable.

Question 6

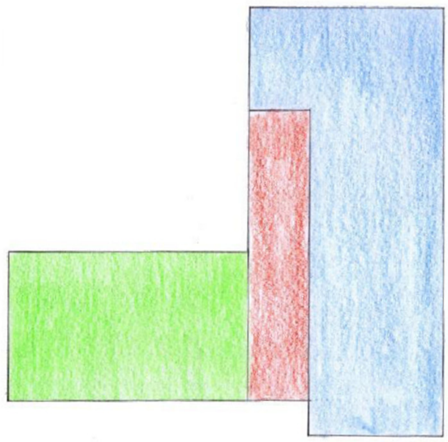
(a) Three features of the design that contribute to the house having a low environmental impact:



- Assuming the largest glazed area is facing south, this maximises solar gain into the dwelling
- Harnessing the suns energy can help to heat the house, this reduces the need for artificial heating methods, reducing the effect on the environment
- Glazing used should be high performance glazing to maximise solar gains made (U-value at least 0.8 w/m^{2}k)
- Timber frame construction has a lower embodied energy than concrete construction
- Timber can be native and sourced locally which reduces the product miles which reduces unnecessary pollution
- The timber stud walls can be filled with thermal insulation, this helps to retain the heat which is gained during the day from solar gain



- The external rainscreen of larch cladding should need very little maintenance compared to other timber cladding options
- The larch cladding chosen has been locally sourced, this ensures that it has low product miles and hence this will have a positive effect on the environment
- The space heating is provided using a renewable heat source, this will improve the sustainability of the house as it is minimising its effect on the environment by choosing an alternative heating method to fossil fuels
- The plan of the house has a narrow plan, which allows the sun to shine deep into the house
- The open plan layout of the kitchen / dining / living will reduce the need for artificial lighting which will lower electricity bills for the occupants
- The deciduous trees are planted on the south side of the dwelling. This means that they will help to prevent the mid-day summer sun from overheating the dwelling
- The bi-fold door off the kitchen leads on to a patio, this is a good use of space, and it could be optimised as an outdoor living area when weather allowed.



Any other relevant points/sketches

(b) Discuss in detail, how each of the following contribute to the creation of a healthy indoor environment:

Indoor air quality

- Airtight buildings will suffer with poor air quality if there is not a ventilation system in place
- To prevent mould growth in an airtight house it is important to maintain optimal humidity levels of between 30-50% to prevent any issues with indoor air quality. This can be an issue in kitchens and bathrooms due to stale moist air
- An NZEB house benefits from utilising a mechanical ventilation with heat recovery system (MVHR). An MVHR system supplies constant fresh air to “dry rooms” while recovering heat from stale moist air taken from wet rooms, maintaining energy efficiency. The stale air and fresh air do not mix
- An MVHR uses filters to prevent allergens entering the dwelling, however regular maintenance and filter changes are needed to ensure fresh air circulation
- Regular maintenance and monitoring of indoor air quality through sensors ensure issues with ventilation systems are recognised and resolved quickly
- Install glazed manual openings in all rooms, rather than fixed windows so that air can naturally circulate bringing in fresh air from the outside and removing stale moist air from the inside.

Any other relevant points/sketches

Natural light

- Natural light will benefit the wellbeing of the occupant by enhancing their mood and increasing energy
- Our circadian rhythms are regulated by exposure to natural light
- Large glazing to optimise natural light will also create a connection to nature
- Sunlight provides heat and warmth which will assist with the thermal comfort of the dwelling
- Sunlight will naturally provide light and heat to the dwelling, this reduces the need for artificial heating and lighting methods. This will in turn reduce the size of the bills faced by the occupants
- Natural light helps with vitamin D synthesis and for overall health.

Any other relevant points/sketches

Materials and finishes

- Selecting building materials and finishes that have low levels of volatile organic compounds (VOCs) and other pollutants can significantly contribute to a healthy indoor environment. This includes flooring materials, paints, adhesives, and sealants which are designed to emit minimal toxins
- Utilising natural materials where possible such as solid timber instead of manufactured boards with formaldehyde-based adhesives will reduce the amount of harmful VOC’s released
- Timber is a tactile material which can provide warmth and texture
- Cedar timber has antibacterial and antifungal properties
- Hardwood can last for decades with proper maintenance
- Using natural finishes such as bees wax, linseed oil, tung oil, etc. on timber products means minimal toxins will be released
- Laying tile flooring with VOC-free grout. Tile has a high thermal mass so will also help with thermal performance
- If choosing carpet opt for natural options such as wool carpets and ensure that there is not a synthetic backing with a chemical adhesive
- Using zero-VOC paints or low-VOC paints to minimise the release of harmful fumes that would negatively affect the indoor air quality
- Using sealants such as silicone with low odours.

Any other relevant points/sketches

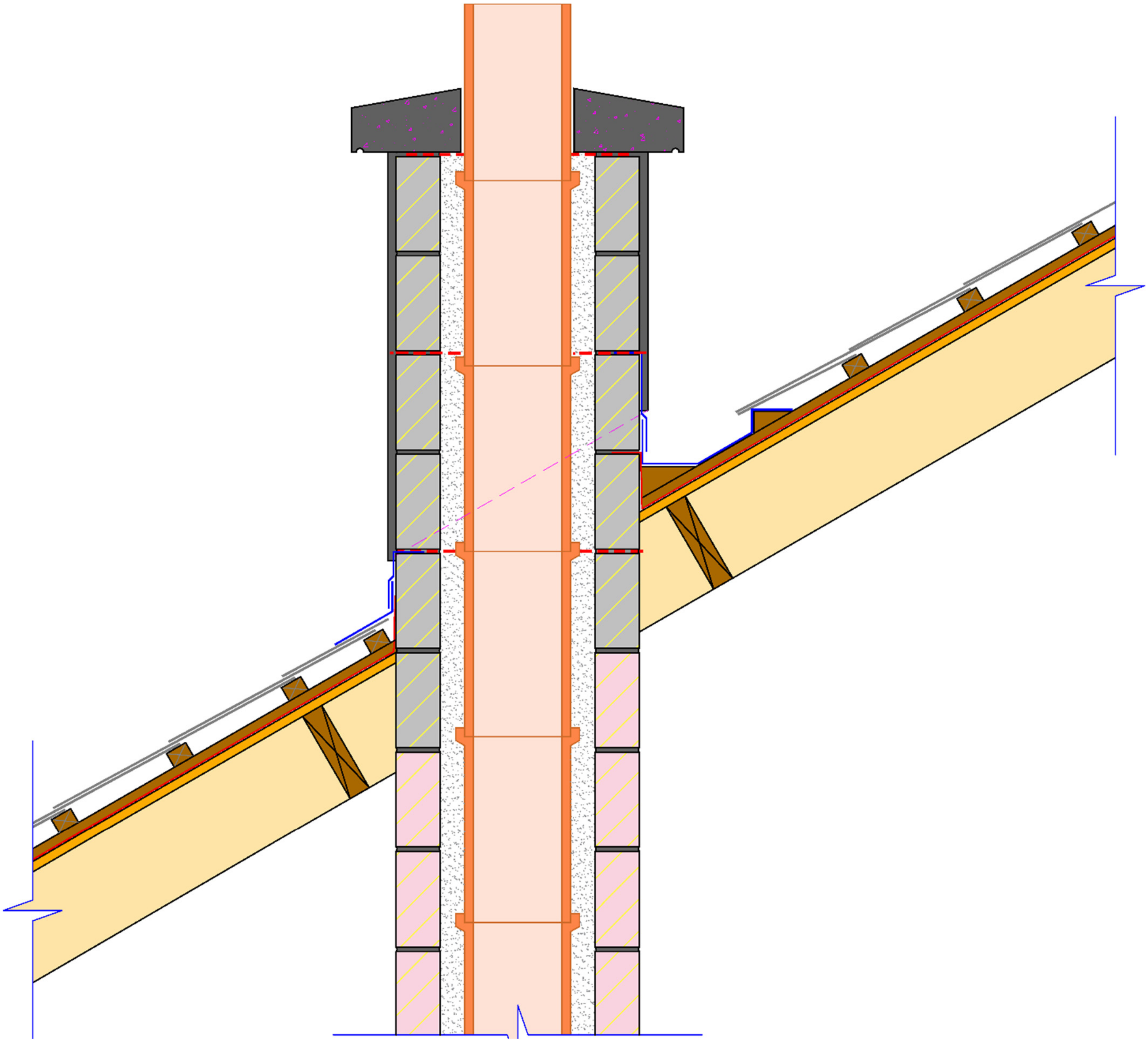
(c) Discuss two benefits of using locally sourced materials in the construction of a dwelling house:

- Buying locally sourced materials will support the local economy, including small businesses, quarries, and craft industries. This helps to create jobs and supports local supply chains
- Should ensure that there are low product miles, this will reduce the carbon emissions and transportation energy on the delivering of these materials
- Using locally sourced materials such as stone or timber cladding may help the dwelling to fit in aesthetically with the other houses in the area
- Materials that are sourced locally are often better suited to the local climate and environmental conditions. For example, building materials that are traditionally used in the area (e.g., limestone, clay, or timber) may have qualities that make them more suitable for local weather patterns, such as moisture resistance, insulation properties, or thermal mass
- Using locally sourced materials often encourages the use of sustainable practices, such as reclaimed wood, recycled stone, or natural, renewable resources. Local sourcing can also promote the use of materials that are harvested responsibly and are more abundant in the area
- Locally sourced materials are often better suited to the specific geological, geographical, and climatic conditions of the region. For instance, certain types of stone, clay, or timber may perform better in the local environment, providing greater resilience and comfort over the long term
- The cost of delivery should be reduced due to the distance to be travelled
- Local materials are generally more readily available, reducing lead times and the risk of delays caused by shipping or supply chain issues. Building projects can often proceed without the wait for long-distance deliveries of materials
- Local suppliers, craftsmen, and builders often have extensive knowledge and experience working with locally sourced materials. This can lead to better quality control, construction techniques, and advice on the best materials for the project. This also provides a local economic benefit
- Preservation of local craft practices.

Any other relevant points

Question 7

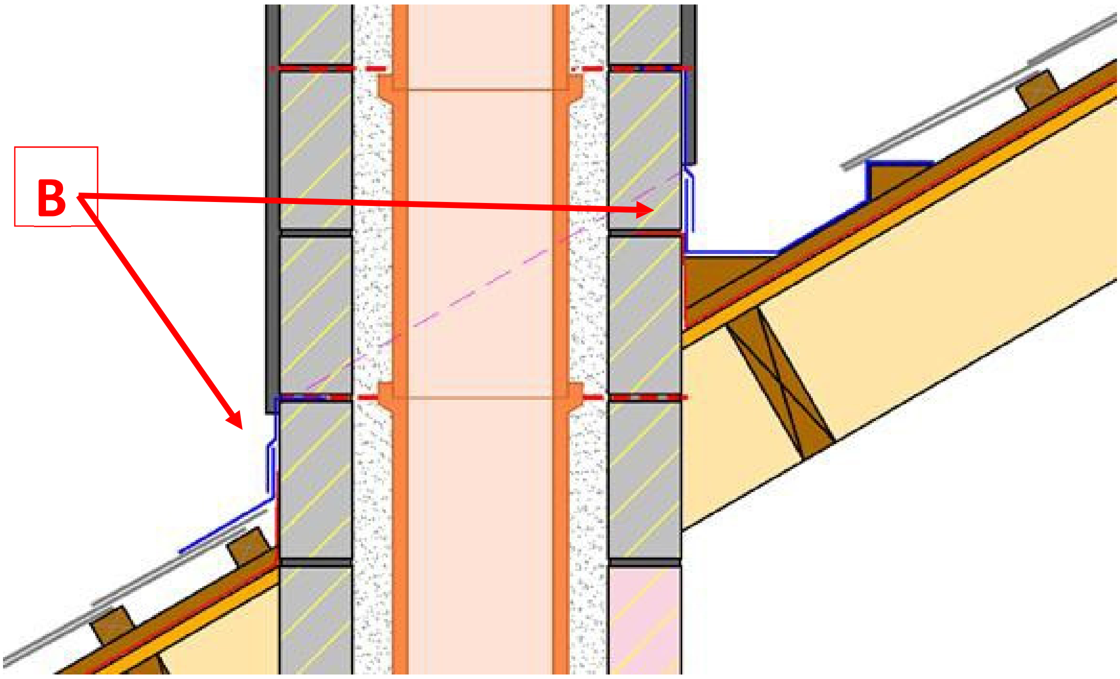
(a) Vertical section through centre of chimney stack and roof structure.



- External render
- Chimney Blockwork
- Plaster
- Flue Liners
- Lime sand fill / Vermiculite
- Concrete chimney capping
- DPC beneath chimney capping
- Lead cover flashing × 2
- Under flashing (apron)
- Flashing to rear gutter
- Horizontal Tray
- Rafter
- Windtight OSB layer
- Fillet piece
- Breather membrane / felt
- Battens / counter battens
- Chimney trimmer
- Slates

Any other relevant detail

(b) Typical design detailing to prevent the penetration of rainwater between the chimney stack and the adjoining roof surface.



Any other relevant detail

Back of chimney

- Lead back gutter welted over tilting fillet and under breather membrane
- Breather membrane carried under tilting fillet and overlaps into lead back gutter
- Lead cover flashing to overhang lead gutter.

Front of chimney

- Breather membrane carried under battens
- Front lead apron flashing is dressed on top of slates and is covered by the DPC tray
- Lead DPC tray (150mm above lowest point where stack exits the roof).

Question 8

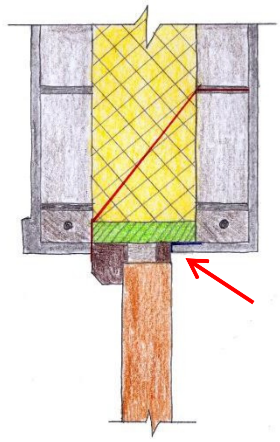
(a) Discuss two benefits of preventing air leakage in a dwelling house:

Reduces energy bills

- Reduces energy bills as heat loss through air leakage is minimised
- Mechanical Ventilation systems will work more efficiently and there will be better indoor air quality (less allergens from outside)
- Reduces carbon emissions as fewer fossil fuels are used in heating the house
- Thermal comfort is reduced as there are no draughts coming into the house
- Reduce heat loss through gaps in the building fabric
- Reduction in moisture entering the building fabric – preventing rot etc.
- Reduces noise pollution
- Improves the performance of the thermal insulation.

Any other relevant points

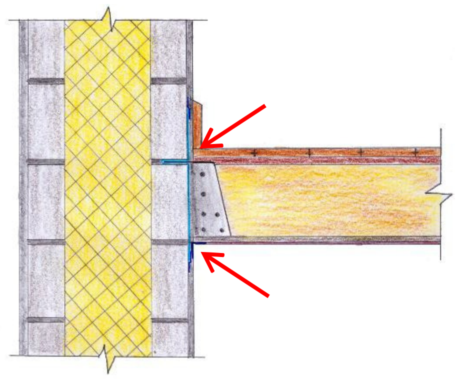
(b) Best practice design detailing that will prevent air leakage at any three of the locations circled on the drawing:



Head of external door

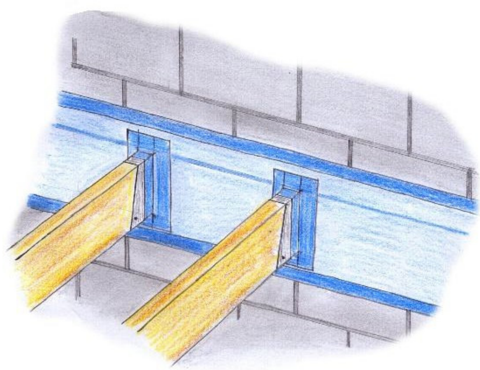
- The thermally broken frame of the door is sealed to the reveal of the internal block wall using a plasterable airtightness tape. This needs to be done very carefully
- The reveal can then be plastered over the plasterable airtightness tape
- Airtightness paint could also be used to make the reveal airtight before plastering or alternatively, it could then be slabbed and skimmed.

Any other relevant points



First floor junction with external wall

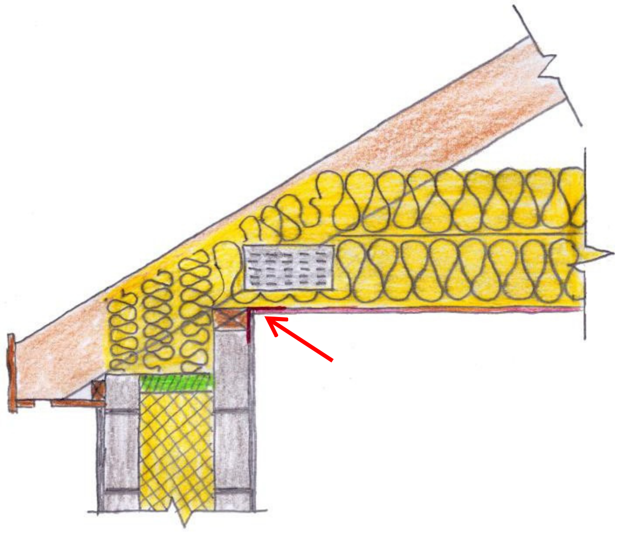
- The section of wall where the joists will be placed should first be made airtight with an airtightness membrane. This would then need to be sealed with an airtight silicone or a plasterable airtightness tape
- Alternatively, the wall could be plastered with sand cement render or painted / sprayed with an airtightness paint
- Where the joists break the airtightness barrier, airtightness tape will need to be used
- With regards to the floor / wall junction and roof/wall junction this will also need to be made airtight. This can be done with airtightness tape or airtightness paint.



Any other relevant points

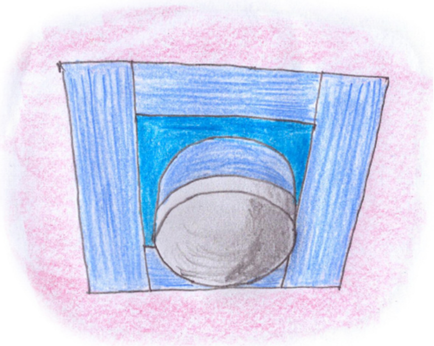
Wallplate level

- An airtightness membrane should be fixed to the underside of the joists, this should wrap around onto the wallplate and down on to first block under the wallplate
- The airtightness membrane will need to be fixed to the block wall with a plasterable airtightness tape or with a bead of airtight silicone
- Scrim or mesh will then be applied before plastering in the usual way with sand cement plaster.

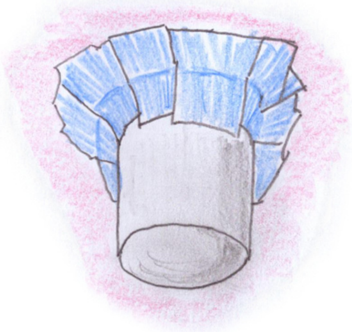


MVHR duct protruding through the ceiling

- An airtightness membrane should be fixed to the underside of the joists
- There are two approaches for making this break in the airtight membrane airtight:



(i) A grommet could be used which would seal any gap between the airtightness membrane and the protruding MVHR ducting. These are usually self-adhesive and are fixed to the airtightness membrane



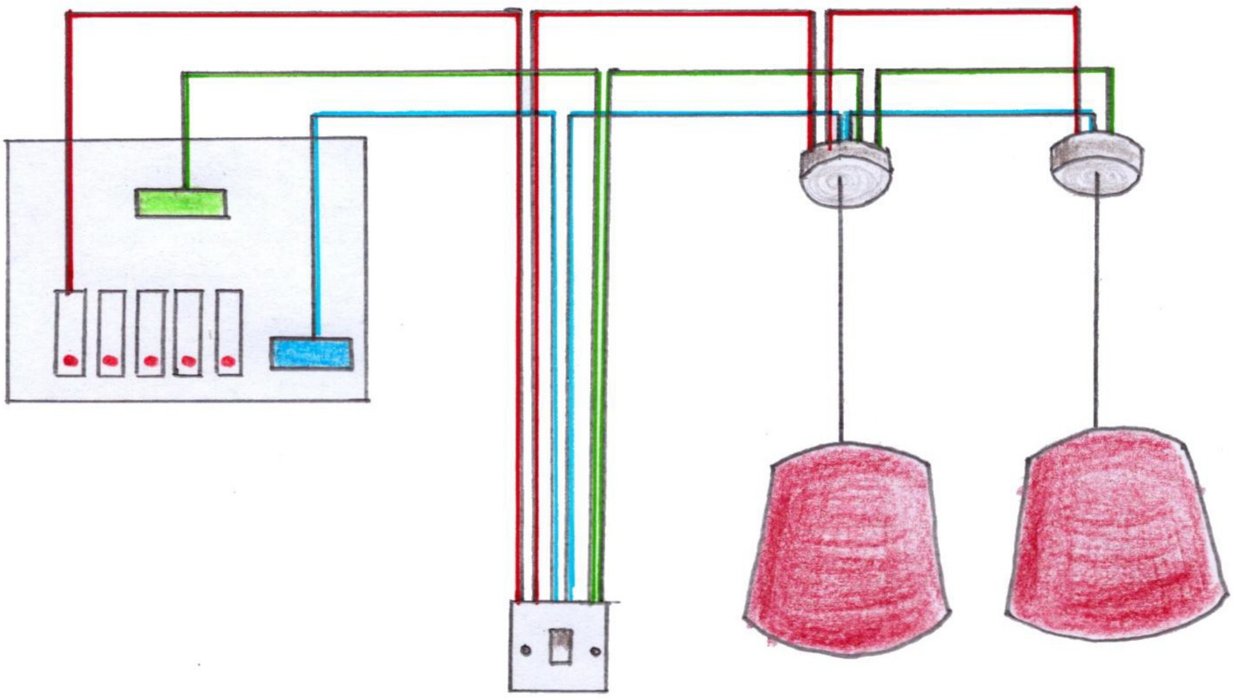
(ii) Alternatively, the MVHR ducting could be carefully taped at the airtightness membrane using airtightness tape. Great care would need to be taken with this approach to ensure its success.

Any other relevant points/sketches

Question 9

(a) Typical wiring layout for two electrical points which are controlled by a single switch:

- A 1.5mm^2 twin and earth LSF (low-smoke and fume) cable is fed from the distribution board to the single switch
- This will provide power to the switch
- The 1.5mm cable is then fed from the switch to the first light where it is looped and then onto the remaining lighting point.



Typical circuit detailing

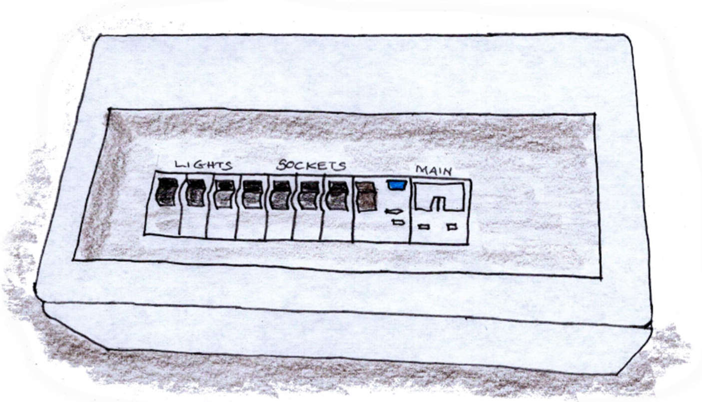
- 1.5 mm^2 twin and earth LSF cable
- Live – Brown
- Neutral – Blue
- Earth – Green & Yellow

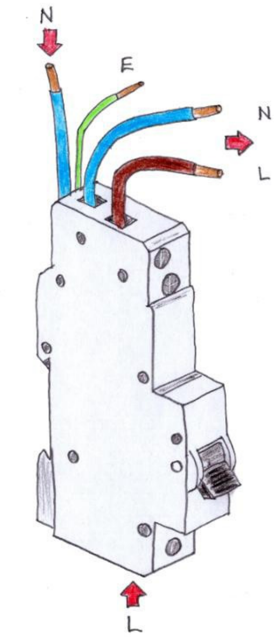
Any other relevant points

(b) Using notes and freehand sketches, show two safety features that are incorporated in the design of the lighting circuit to ensure the safety of all users.

- An earth is provided to both lighting points and to the switch
- The correct size cables of 1.5mm^2 are used so there will be no issue with the load placed on them
- LSF cable is used. This low-smoke and fume cable enhances safety in the event of a fire
- The circuit is protected by a 6amp RCBO so that it can be isolated and turned off, if any work needs to be carried out on the circuit e.g. changing light fixture
- The switch breaks the phase conductor (live wire) so a bulb can be safely changed
- The distribution board should be labelled so that the circuit can be quickly isolated.

Any other relevant points





(c) Two approaches to reduce electrical consumption in a domestic dwelling

- Low wattage LED bulbs to minimise electricity used
- Using sensor lights outside the dwelling so lights only turn on when they are being used
- Motion sensor lights in unoccupied rooms
- Smart lightbulbs which can be controlled from an app on a smartphone or other device
- Using A rated appliances or higher
- Timer switches on outside lights to prevent lights being left on all night
- Separate lighting circuits in open plan rooms
- Only turning on lights as required
- Use smart metering to provide the occupants with insights on their electricity usage
- Under counter sockets on isolator switches e.g. washing machine socket is on an isolator switch so that it can be easily turned off when not in use
- Using bright paint and light-coloured surfaces to reflect natural light around the room to minimise the need for artificial lights
- Awareness of 'Vampire load' or 'phantom load' where appliances or electronic devices draw power when switched off but may be in standby mode such as TV's, appliances that incorporate a digital clock
- Where using electricity to heat the home, consider dropping thermostat to reduce power consumption
- Increased levels of insulation to reduce heat loss
- Use natural light and ventilation where appropriate.

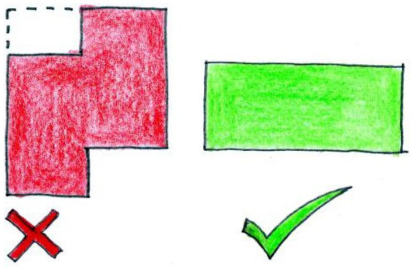
Any other relevant point

Question 10

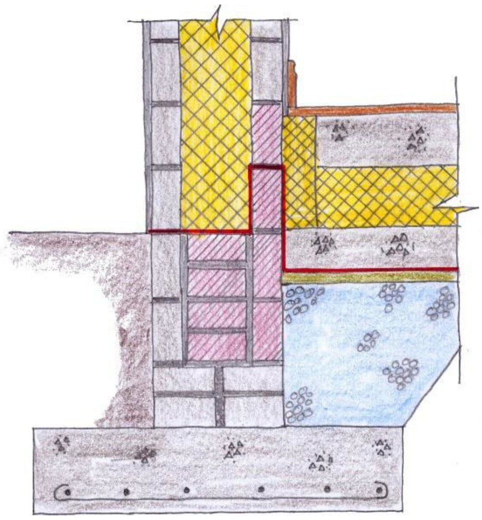
(a) Discuss the importance of any two in Passive House design: building form, foundation design and space heating energy demand.

Building form

- Building form should have a narrow plan, one room deep to maximise solar gain
- A compact dwelling which fits in with its landscape and surrounding buildings
- Complicated designs with lots of corners or abutments need more materials to construct and are at a greater risk of heat loss when compared with rectangular form buildings
- The compactness ratio of surface area to the volume contained (A/V) should be 0.7 or less
- Simple rectangular shape to minimise corners and hence the perimeter of the wall to minimise opportunities for heat loss
- To minimise heat loss and cost of construction, it should have the smallest surface area possible
- A compact form will reduce the amount of materials needed in construction which reduces its effect on the environment
- If a deeper plan is utilised it will reduce the benefits of solar gains as it increases the volume of air to be heated
- Clean lines in walls and roof to facilitate easy achievement of airtightness.

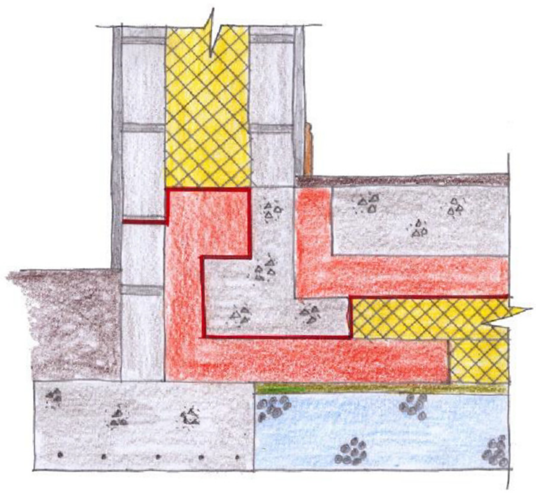


Any other relevant points/sketches



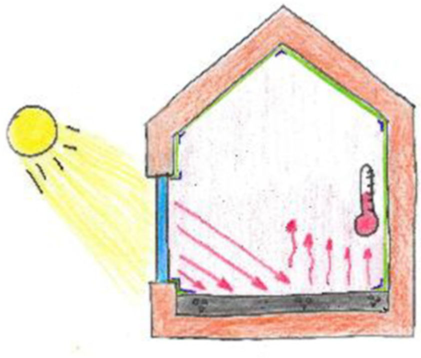
Foundation design

- Ring beam and passive raft foundations are wrapped in insulation to eliminate opportunities for thermal bridging
- In typical strip, pile and raft foundations it is critical to eliminate opportunities for thermal bridging to occur
- The internal leaf should use thermal blocks in their rising walls to prevent heat loss down the inner leaf
- The floor wall junction needs to have an insulation upstand / edge insulation of 50 mm – 100 mm to prevent a thermal bridge occurring
- If block cavity construction is chosen, thermally broken wall ties should be used instead of stainless-steel wall ties where a point thermal bridge would occur
- The wall, attic and floor should have high levels of insulation to maintain all heat gains.
- Foundation should be highly insulated to achieve a U-value of between 0.1 - 0.15 **W/m² K.**



Any other relevant points/sketches

Space heating energy demand

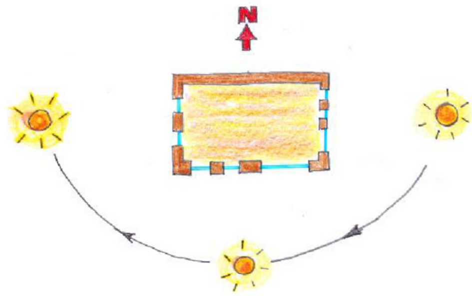


- To achieve the passive house standard, the house has to be cleverly designed to minimise space heating demand
- Space heating demand in a passive house ≤ is 15kwh/m^2/pa
- Quality workmanship especially with airtightness and installation of insulation is imperative to minimising space heating demand
- Carefully designed technical details to eliminate thermal bridging is also crucial to ensuring the passive house does not exceed its space heating demand
- Maximising solar gain by carefully designed fenestrations will maximise natural heat gains and reduce the need for artificial heat
- Solar shading, high thermal mass building components and controlled ventilation are all needed to ensure a comfortable indoor temperature of 20°C is maintained throughout the year
- In Ireland, space heating, not cooling, is the major energy demand in dwellings.

Any other relevant points/sketches

(b) Show a preferred orientation and sun path for the house shown.

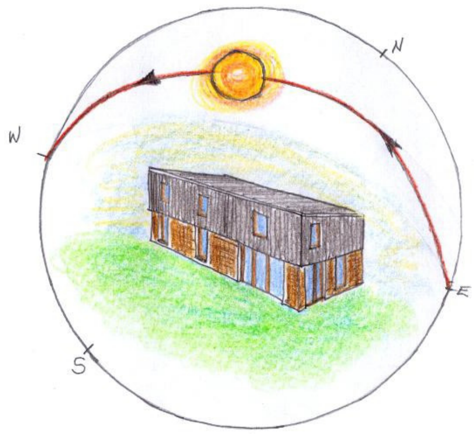
Orientation



- The long axis of the house with the largest amount of glazing should face south to maximise solar gain
- By orientating the house to maximise solar gains this will reduce the need for artificial light which will help to reduce energy bills
- It will also reduce the need for artificial heating methods which will reduce the CO^2 emissions of the dwelling
- The natural sunlight flooding into the house will have a positive effect on the mental health and wellbeing of the occupants
- Minimal glazing on the north side of the house to minimise thermal losses.

Any other relevant points

Benefits to the homeowner of your preferred orientation.



Lowers energy bills

- This orientation maximises the natural solar gains, in turn this reduces the need for artificial lights and artificial heating methods.

Reduces carbon dioxide emission

- This orientation gains heat from solar gains. This reduces the need for artificial heating methods which reduces the amount of carbon emissions of the dwelling.

Enhances wellbeing

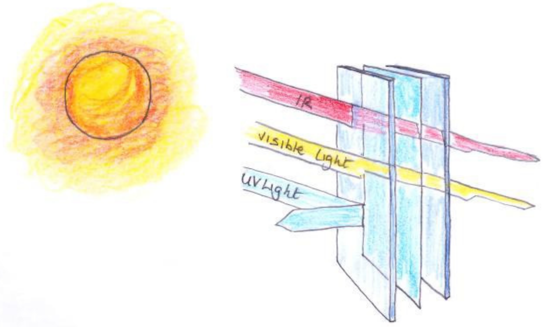
- This orientation provides a light airy space for the occupants.
- This will improve the wellbeing of the occupants.

Any other relevant points

(c) Two ways to reduce the possibility of solar overheating while respecting the character of this house design.

Dynamic Glass

- This glass has the ability to change its properties such as the level of tint response to light, heat or electrical signals
- Dynamic glass is float glass with an electrochromic coating applied on one side of the other surfaces
- Prevents ultraviolet and infrared light entering the dwelling
- Can be used in dwellings which are incorporating large high-performance glazing on the south side of the house.

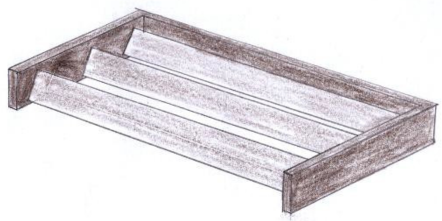


Mature Deciduous trees

- Deciduous trees have their foliage in summer when the sun is at its strongest, blocking the summer sun. In winter when the sun is at its weakest, they lose their leaves allowing the sun to shine through to heat the dwelling.

Brise Soleil

- This is attached to the south side of the house
- It protects against overheating
- The screen of the Brise Soleil can be adjusted or fixed permanently.



Shutters

- Shutters could be fitted internally or externally
- Shutters could be closed when the sun is at its strongest, to block out the midday summer sun.

Thermal Mass

- High thermal mass will absorb heat and release it slowly
- A polished concrete internal floor and exposed stone on internal walls will help the house to minimise temperature fluctuations.

Any other relevant points

Question 10

"The historic built environment is critical in addressing climate change. Protecting, adapting and reusing historic building stock reduces environmental waste and the carbon-dioxide emissions associated with demolition and reconstruction. Traditional building methods and materials have much to teach us about the skills needed to work with prevailing weather conditions and the use of available local materials".

Adapted from: Heritage Ireland 2030

Department of Housing, Local Government and Heritage
Published on: gov.ie/housing

(a) Discuss the above statement in detail.

Discussion of the above statement– such as

- Demolition of a dwelling causes significant environmental waste and carbon-dioxide emissions
- Demolition generates a considerable amount of construction waste, much of which ends up in landfills. By reusing and adapting historic buildings, valuable materials such as timber, stone, and brick are conserved, reducing the need for raw material extraction and lowering waste
- Preserving historic buildings will help to maintain the local character of a town and vernacular design of the area
- Reusing a historic dwelling will prevent unnecessary harm to our environment
- Historic buildings were often constructed with locally sourced materials that were well-suited to the local environment and climate. This approach encourages the use of sustainable, regionally available materials, supporting local economies and traditional craftsmanship
- Reusing historic buildings within existing urban areas reduces the need for new development on previously undeveloped land. This helps combat urban sprawl, preserves green spaces, and minimizes the environmental impact of new infrastructure
- Traditional construction methods often incorporated local knowledge of prevailing weather patterns and environmental conditions. Historic buildings can be more resilient to extreme weather events (e.g., floods, heatwaves) due to their durable construction and thoughtful design
- The greenest building is the one that is already built. It is important to recognise that the reuse or continued use of older buildings is a key component of sustainable development and energy conservation practice
- Incorporating historic building preservation into urban planning strategies supports sustainable, low-impact development. It encourages retrofitting instead of rebuilding, reducing the need for energy-intensive new infrastructure and promoting more sustainable cities
- Historic buildings often become key attractions for tourism. Preserving and adapting them can drive economic growth through heritage tourism, which generates revenue for local businesses, creates jobs, and raises awareness of the cultural and environmental importance of heritage conservation
- Protecting the historic built environment is an important aspect in preserving our history and heritage
- Adapting historic building stock can help with providing homes for those in need
- These buildings showcase the traditional skillset that was used at this time
- By protecting and reusing historic dwellings in towns it helps to maintain the vernacular heritage of the streetscape
- By reusing and adapting these buildings it will create jobs for skilled tradesmen who have the ability to reproduce the building practices and maintain the existing structures and styles of the buildings

- By reusing this historic building stock, it would afford the opportunity to increase the appeal to tourists. This could have a hugely positive effect on the local economy
- Less building materials needed to make the building habitable, this has a much better effect on the environment when compared with demolition and reconstruction
- When these historic buildings are renovated, they will aim to source materials locally which will link with the aesthetic of the structure. This will be a positive for the local economy.

Any other relevant, cogent, well-argued points

(b) Propose three best practice guidelines that would promote the reuse of historic building stock.

- Financial supports and conservation grants should be made available to those undertaking a refurbishment to a historic dwelling
- Preserving our history is hugely important. Centres of excellence which provide free training courses should be provided to tradesmen, designers and craftsmen to upskill them in conservation methods and techniques
- The government should run an advertising campaign to promote the benefits to the homeowner, of choosing a historic dwelling both in terms of environmental benefit and state supports in place
- Host consultations or workshops with local residents, heritage groups, and stakeholders to gather input and ideas for adaptive reuse. This could include using the building for local services, community spaces, or educational purposes, ensuring that the reuse reflects the needs of the community while preserving its historical value
- Local councils should try to purchase historic building stock and adapt them for re-use to provide housing stock for those in need in their areas
- Successful reuse of historic buildings should be promoted and advertised as examples of best practice for others to follow
- Ensure that adaptive reuse projects use high-quality traditional materials and construction methods that align with Ireland's National Heritage and Climate Action Plan. This can also support local economies by sourcing materials from regional quarries and craftspeople
- Conservation architects should form part of the design team. This could be government subsidised to encourage those individuals or organisations to involve them on their refurbishment
- Work with conservation architects to retrofit historic buildings with energy-efficient technologies that respect the structure's historical design. These interventions should balance energy performance with the preservation of features that reflect Irish heritage, such as traditional sash windows and stone fireplaces
- Collaborate with agencies like An Taisce, The Heritage Council, and local planning authorities to ensure that preservation efforts are in line with national and regional heritage conservation goals
- Fines and penalties should be put in place for owners of unoccupied, derelict historic dwellings
- The planning process could be revisited to improve the speed at which decisions are made on adaptations to historic building stock
- When restoring or adapting historic buildings, use materials that are not only historically accurate but also environmentally friendly. For example, lime mortar allows the building to breathe, which is particularly important for older stone structures, and reclaimed materials should be prioritized where possible
- Low interest rates on mortgages where historic buildings are purchased for occupation or re-use
- Education providers to develop upskilling courses for skilled craftspeople regionally, financial incentives to be provided for craftspeople to upskill.

Any other relevant, cogent, well-argued points

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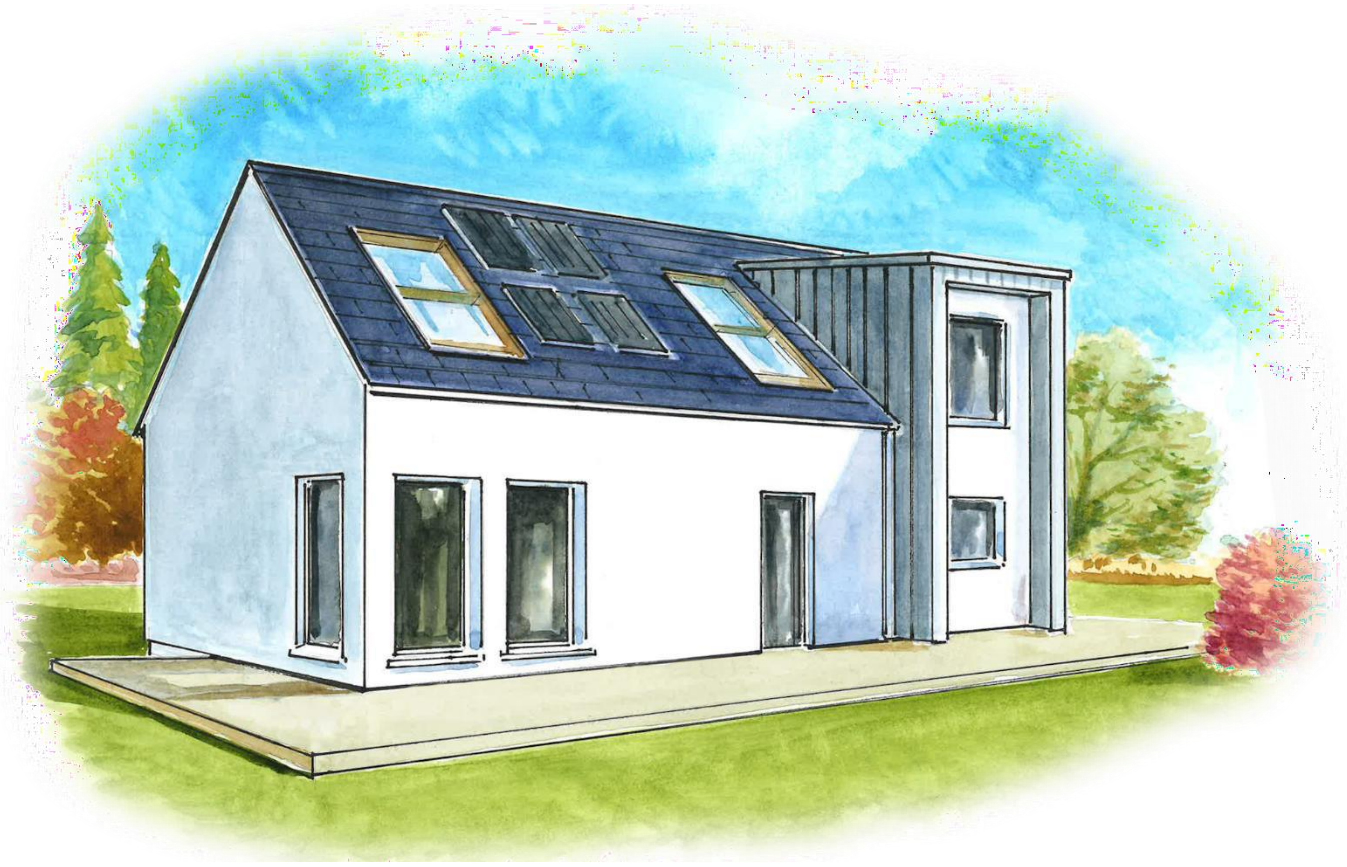

Construction Studies

Theory – Higher Level

Marking Scheme

Question 1

Performance Criteria	Maximum Mark
(a) Vertical section through foundation, solid ground floor, external wall and window ***Foundation + Solid ground floor*** ***External wall*** ***Window detail*** ***5 × 4 marks*** ***4 × 4 marks*** ***3 × 4 marks*** (3 for drawing, 1 for annotation)	
Foundation + Solid ground floor • R.C. strip foundation • Dead blockwork and cavity wall above foundation • Cavity infill • Thermal blocks on inner leaf • DPC • Hardcore/Sand blinding/Radon barrier • Subfloor • Insulation • Screed • Airtightness barrier at floor and wall junction • 20 mm quarry tile finish/Skirting board	4 4 4 4 4
External wall • External render • Concrete block outer leaf • Air space / residual cavity • Anchor strap • Breather membrane • Racking board • 250 × 50 mm stud detail and insulation • OSB sheeting • Airtightness membrane • 50 mm insulated service cavity • Plasterboard and skim	4 4 4 4
Window detail • Cavity closer • Concrete window cill • DPC at cill • Thermally broken window frame • Window board • Triple glazing • Airtight barrier at junction	4 4 4
Scale - 4 marks **Drafting** - 4 marks *Excellent* *Good* *Fair* *8* *6* *4*	8
(b) Typical design detailing that will prevent the penetration of radon gas ***(4 marks)***	
Design detailing identified to prevent the penetration of radon gas	4
TOTAL	**60**

Question 2

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) The importance of any two in maintaining a positive health and safety culture	***(12 marks)***
Safety training Health and safety officer Risk assessment audit	**6** **6**
(b) One possible safety risk	***(12 marks)***
Working in a deep trench Installing insulation in an attic space Repairing a chimney capping	**4** **4** **4**
(c) Two best practice guidelines to reduce injury	***(36 marks)***
Working in a deep trench Guideline 1 (3 for note, 3 for sketch) Guideline 2 (3 for note, 3 for sketch)	**6** **6**
Installing insulation in an attic space Guideline 1 (3 for note, 3 for sketch) Guideline 2 (3 for note, 3 for sketch)	**6** **6**
Repairing a chimney capping Guideline 1 (3 for note, 3 for sketch) Guideline 2 (3 for note, 3 for sketch)	**6** **6**
TOTAL	**60**

Question 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Revised internal layout for the ground floor and garage space	***(22 marks)***
Revised internal layout for the ground floor and garage space	**16**
Include a downstairs bathroom	**2**
Create an open-plan kitchen/dining and living area	**2**
Optimising daylight into the ground floor	**2**
(b) Three reasons for your proposed layout	***(18 marks)***
Reason 1	**6**
Reason 2	**6**
Reason 3	**6**
(c) External design of the garage to enhance the visual appearance	***(20 marks)***
Notes	**10**
Sketch	**10**
TOTAL	**60**

Question 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three functional requirements of an external wall	***(18 marks)***
Functional Requirement 1	
Notes	**3**
Sketches	**3**
Functional Requirement 2	
Notes	**3**
Sketches	**3**
Functional Requirement 3	
Notes	**3**
Sketches	**3**
(b) Two high performance external wall constructions	***(30 marks)***
External Wall Construction 1	
Notes	**5**
Sketches	**6**
Position of Insulation	**2**
Dimensions	**2**
External Wall Construction 2	
Notes	**5**
Sketches	**6**
Position of Insulation	**2**
Dimensions	**2**
(c) One advantage and one disadvantage of each wall type shown in 4(b)	***(12 marks)***
External Wall Construction 1	
Advantage 1	**3**
Disadvantage 1	**3**
External Wall Construction 2	
Advantage 1	**3**
Disadvantage 1	**3**
TOTAL	**60**

Question 5

PERFORMANCE CRITERIA	MAXIMUM MARK
***(a) U-value of* external wall**	***(33 marks)***
External surface resistance	**3**
Acrylic render	**3**
External insulation	**3**
External sand cement render	**3**
Hollow concrete block	**3**
Insulation	**3**
Plasterboard	**3**
Internal skim coat	**3**
Internal surface 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 external wall	***(15 marks)***
Heat loss formula and calculation	**3**
Heating duration for one year	**3**
k/Joules calculation for one year	**3**
Kgs of wood pellets for one year	**3**
Annual cost of heat loss	**3**
***(c) Required thickness of additional insulation for U-value of 0.11* W/m^2°C**	***(12 marks)***
Resistance for U-value for 0.11 W/m^2 °C (using R=1/U)	**3**
Difference in resistances (required resistance)	**3**
Application of formula R = T/k	**3**
Required thickness of insulation	**3**
TOTAL	**60**

Question 6

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) ***Three features of low environmental impact***		***(30 marks)***
Design Feature 1		
Notes		**5**
Sketches		**5**
Design Feature 2		
Notes		**5**
Sketches		**5**
Design Feature 3		
Notes		**5**
Sketches		**5**
(b) How each of the following contributes to the creation of a healthy indoor environment		***(18 marks)***
Indoor Air Quality	(3 for point, 3 for discussion)	**6**
Natural Light	(3 for point, 3 for discussion)	**6**
Materials and Finishes	(3 for point, 3 for discussion)	**6**
(c) Two benefits of using locally sourced materials		***(12 marks)***
Advantage **1**	(3 for point, 3 for discussion)	**6**
Advantage **2**	(3 for point, 3 for discussion)	**6**
	TOTAL	**60**

Question 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Vertical section through the centre of the chimney stack and roof structure (46 marks) ***10 × 4 marks + 6 marks*** (3 for drawing, 1 for annotation)	
• External render • Chimney Blockwork • Flue Liners • Lime sand fill / Vermiculite • Concrete chimney capping • DPC beneath chimney capping • Lead cover flashing × 2 • Under flashing (apron) • Flashing to rear gutter • Horizontal Tray • Rafter • Windtight OSB layer • Fillet piece • Breather membrane / felt • Battens / counter battens • Chimney trimmer	4 4 4 4 4 4 4 4 4 4
Two courses of slate above and below the chimney stack	6
Scale - 4 marks **Drafting** - 4 marks *Excellent* 8 *Good* 6 *Fair* 4	8
(b) Design details to prevent the penetration of rainwater between the chimney stack and the adjoining roof surface (6 marks)	
Design detail	6
TOTAL	**60**

Question 8

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Discuss two benefits of preventing air leakage in a dwelling house***	***(12 marks)***
Benefit 1 (3 for point, 3 for discussion)	**6**
Benefit 2 (3 for point, 3 for discussion)	**6**
(b) ***Best practice design detailing to prevent air leakage at any three of the locations circled*** ***(48 marks)***	
Best Practice Detailing 1	
Notes	**8**
Sketches	**8**
Best Practice Detailing 2	
Notes	**8**
Sketches	**8**
Best Practice Detailing 3	
Notes	**8**
Sketches	**8**
TOTAL	**60**

Question 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Typical wiring layout for two light points controlled by a single switch ***(34 marks)*** ***6 × 5 marks + 4 marks*** (4 for drawing, 1 for annotation)	
Distribution board	**5**
Single switch	**5**
Two electrical light points	**5**
Live cabling	**5**
Neutral cabling	**5**
Earth cabling	**5**
Cable size (1) and colour (3)	**4**
(b) Safety features incorporated in the design of the lighting circuit ***(16 marks)***	
Safety Feature 1	
Notes	**4**
Sketches	**4**
Safety Feature 2	
Notes	**4**
Sketches	**4**
(c) Two approaches to reduce electrical consumption ***(10 marks)***	
Approach **1** (2 for point, 3 for discussion)	**5**
Approach **2** (2 for point, 3 for discussion)	**5**
TOTAL	**60**

Question 10

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) Discuss the importance of any two in Passive House design		***(20 marks)***
Building form		
Notes		**5**
Sketches		**5**
Foundation Design		
Notes		**5**
Sketches		**5**
Space heating energy demand		
Notes		
Sketches		
(b) Preferred orientation for the house and how this benefits the owner		***(28 marks)***
Sketch		**8**
Orientation		**4**
Sunpath		**4**
Benefit **1**	(3 for point, 3 for discussion)	**6**
Benefit **2**	(3 for point, 3 for discussion)	**6**
(c) Two ways to reduce solar over heating while respecting the house design		***(12 marks)***
Method **1** to reduce solar overheating		
Notes		**3**
Sketches		**3**
Method **2** to reduce solar overheating		
Notes		**3**
Sketches		**3**
	TOTAL	**60**

Question 10 (Alternative)

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Discussion of Statement (Historic built environment is critical in addressing climate change)	***(30 marks)***
Discussion Point **1** *(5 for point, 5 for discussion)*	**10**
Discussion Point **2** *(5 for point, 5 for discussion)*	**10**
Discussion Point **3** *(5 for point, 5 for discussion)*	**10**
(b) Three best practice guidelines that would promote the reuse of historic building stock (30 marks)	
Guideline **1** *(5 for point, 5 for discussion)*	**10**
Guideline **2** *(5 for point, 5 for discussion)*	**10**
Guideline **3** *(5 for point, 5 for discussion)*	**10**
TOTAL	**60**

Coimisiún na Scrúduithe Stáit
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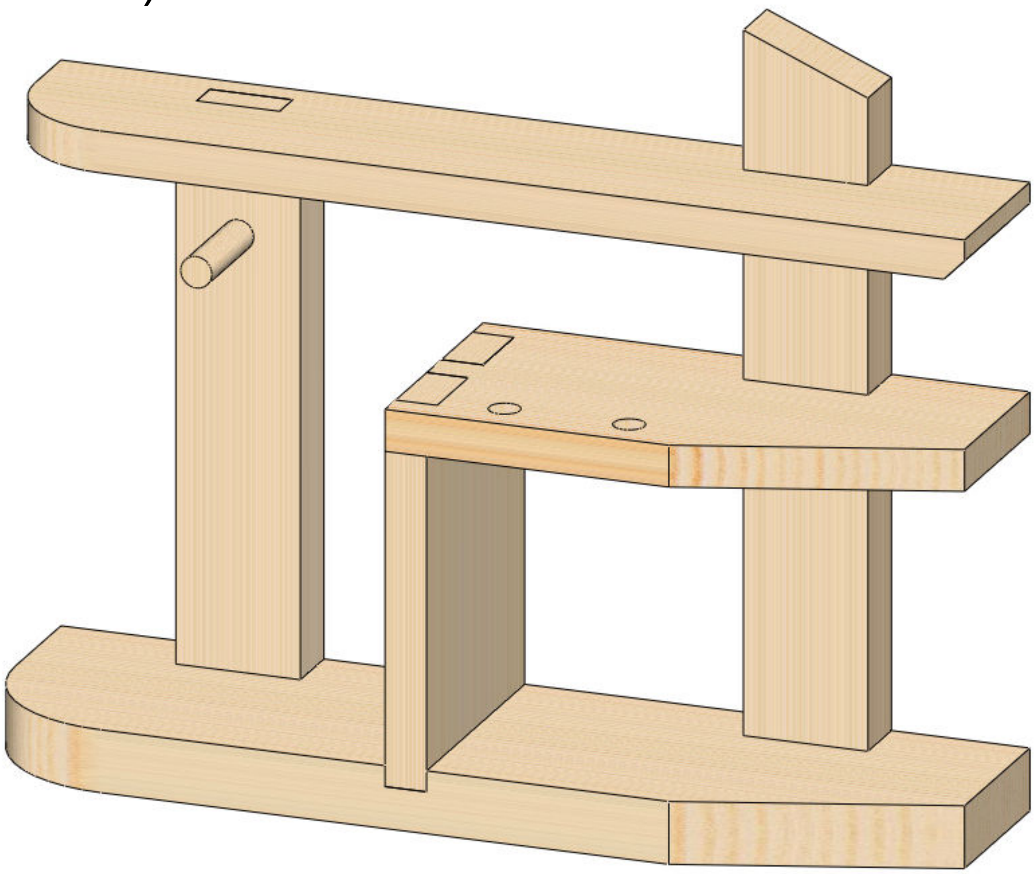
Construction Studies

Practical Test

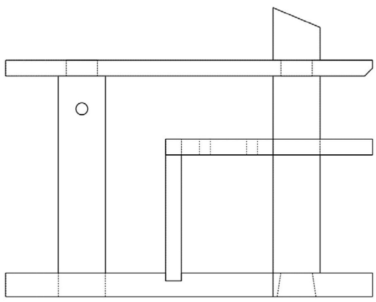
Common Level

(150 marks)



Marking Scheme

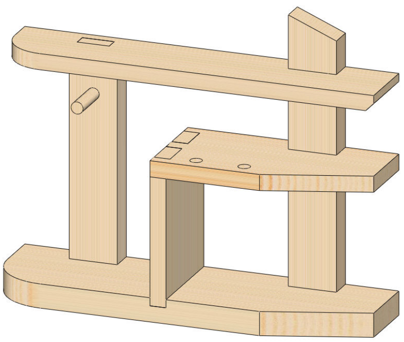
Day 1



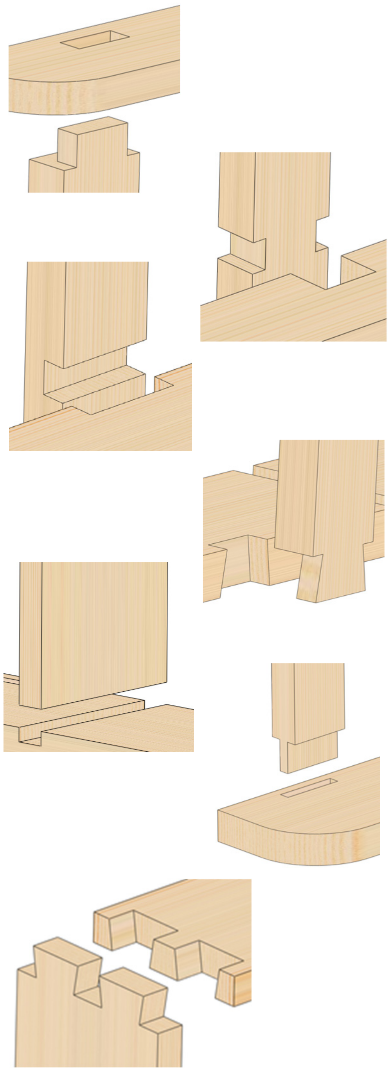
Marking Scheme – Practical Test

Note:

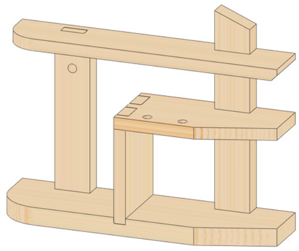
- The artefact is to be hand produced by candidates without the assistance of machinery.
- The use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that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

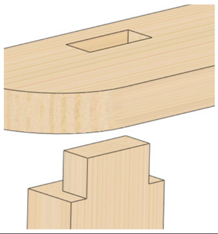


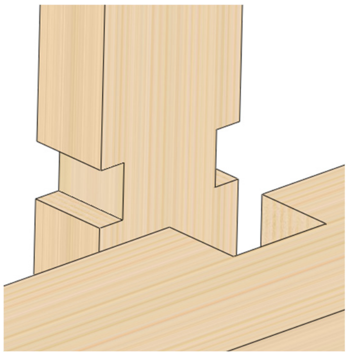
(i)	Overall Assembly	Marks
a.	Overall quality of assembled artefact	10
b.	Design and applied shaping to edges • design *2 × 1 mark* • shaping *2 × 1 mark*	4
	Total	**14**

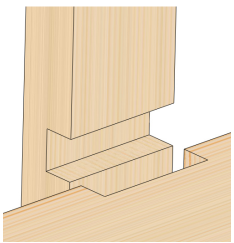


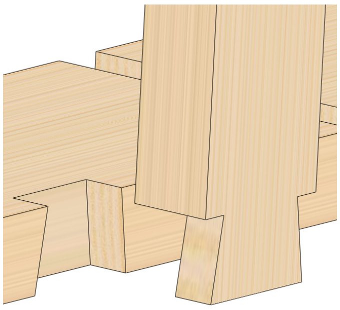
(ii)	Marking Out	Marks
a.	Barefaced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	6
b.	Notched housing joint • trenches *3 x 2 marks*	6
c.	Halving joint • trenches *2 × 2 marks*	4
d.	Dovetail joint • tail *3 marks* • trench *3 marks*	6
e.	Housing joint base • trench *2 marks*	2
f.	Mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	6
g.	Box dovetail • tails *2 × 3 marks* • pins *2 × 3 marks*	12

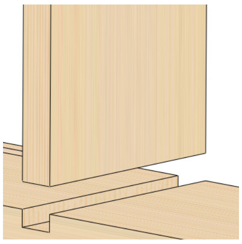
	h.	Slopes, curves, and chamfer • slopes *3 × 1 mark* • curves *2 × 2 marks* • chamfer *2 marks*	**9**
		Total	**51**

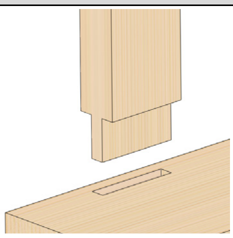
Processing of Desk Tidy			
Barefaced mortice and tenon joint	**(iii)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

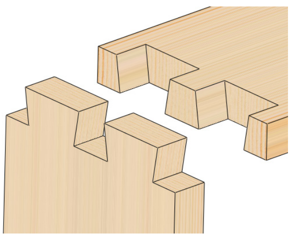
Notched housing joint	**(iv)**	**Processing**	**Marks**
	a.	Trench (horizontal) • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical) • sawing across the grain *4 × 1 mark* • paring trenches to depth *2 × 2 marks*	**8**
		Total	**12**

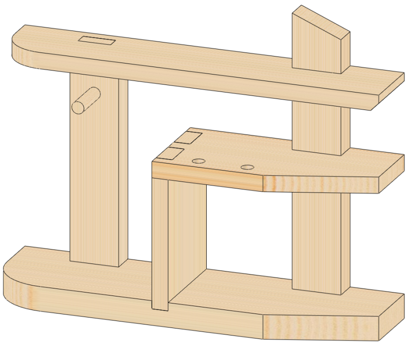
Halving joint	**(v)**	**Processing**	**Marks**
	a.	Trenches • saw across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Dovetail joint	(vi)	Processing	Marks
	a.	Tail • sawing tail *4 × 1 mark* • paring tail *2 × 2 marks*	**8**
	b.	Trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	**4**
		Total	**12**

Housing joint (base)	(vii)	Processing	Marks
	a.	Trench • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	**4**
		Total	**4**

Mortice and tenon joint	(viii)	Processing	Marks
	a.	Mortice *3 marks*	**3**
	b.	Tenon *4 × 1 mark*	**4**
		Total	**7**

Box dovetail joint	(ix)	Processing	Marks
	a.	Tails *2 × 4 marks*	**8**
	b.	Pins • sawing with the grain *4 × 1 mark* • paring across the grain *2 x 2 marks*	**8**
		Total	**16**

Shaping & drilling	(x)	Processing		Marks
	a.	Short slope	*1 mark*	**1**
	b.	Long slopes	*2 × 2 marks*	**4**
	c.	Curves	*2 × 2 marks*	**4**
	d.	Drilling holes accurately	*3 × 2 marks*	**6**
	e.	Chamfer	*2 marks*	**2**
			Total	**17**
		Overall Completion of Piece		**Marks**
			Grand Total	**150**

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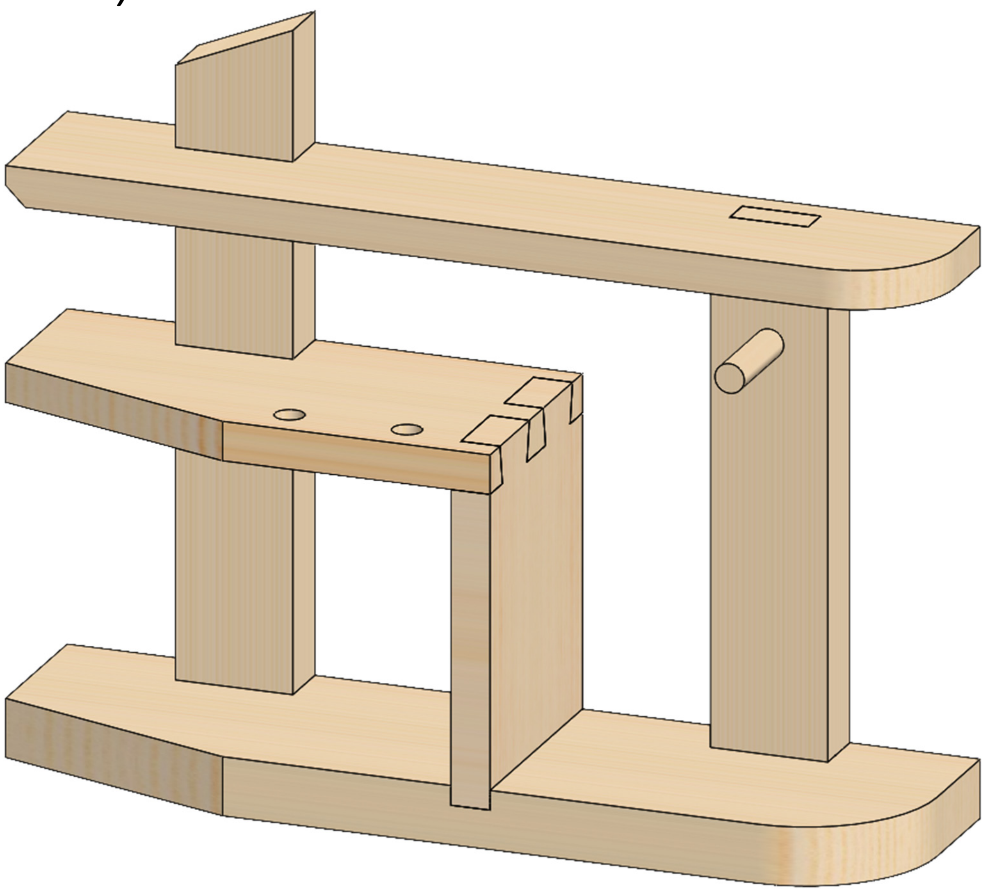
State Examinations Commission

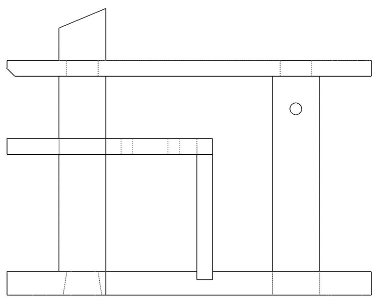
Leaving Certificate Examination 2025

Construction Studies
Practical Test

Common Level

(150 marks)





Marking Scheme

Day 2

Marking Scheme – Practical Test

Note:

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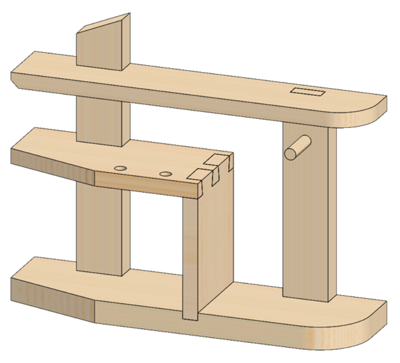
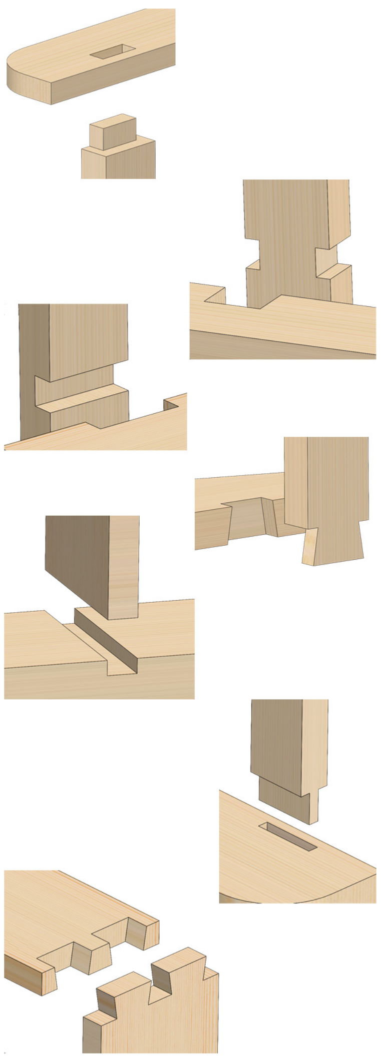
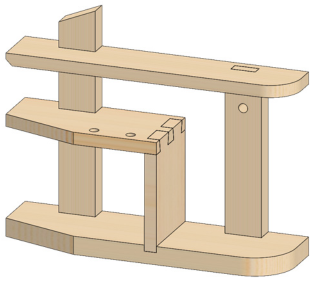
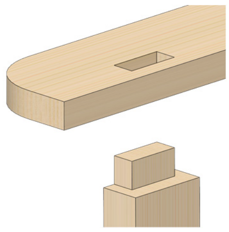


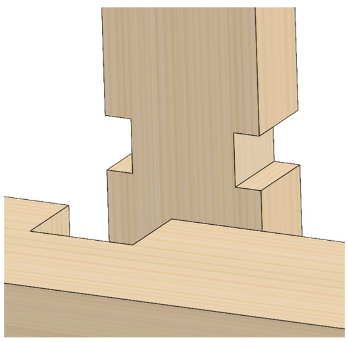
(i)	Overall Assembly	Marks
a.	Overall quality of assembled artefact	10
b.	Design and applied shaping to edges • design *2 × 1 mark* • shaping *2 × 1 mark*	4
	Total	**14**

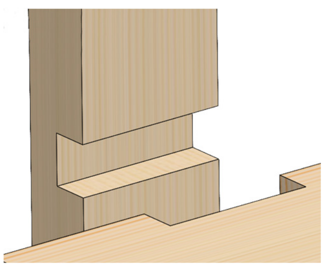


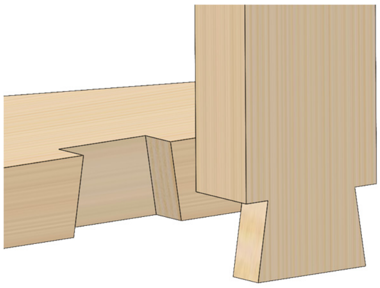
(ii)	Marking Out	Marks
a.	Barefaced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	6
b.	Notched housing joint • trenches *3 × 2 marks*	6
c.	Halving joint • trenches *2 × 2 marks*	4
d.	Dovetail joint • tail *3 marks* • trench *3 marks*	6
e.	Housing joint base • trench *2 marks*	2
f.	Mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	6
g.	Box dovetail • tails *2 × 3 marks* • pins *2 × 3 marks*	12

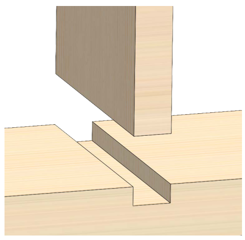
	h.	Slopes, curves, and chamfer • slopes *3 x 1 mark* • curves *2 × 2 marks* • chamfer *2 marks*	9
		Total	**51**

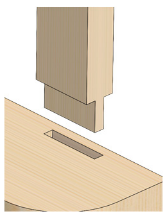
Processing of Desk Tidy			
Barefaced mortice and tenon joint	**(iii)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

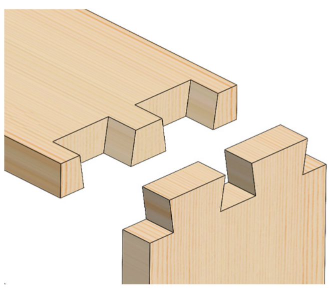
Notched housing joint	**(iv)**	**Processing**	**Marks**
	a.	Trench (horizontal) • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical) • sawing across the grain *4 × 1 mark* • paring trenches to depth *2 × 2 marks*	**8**
		Total	**12**

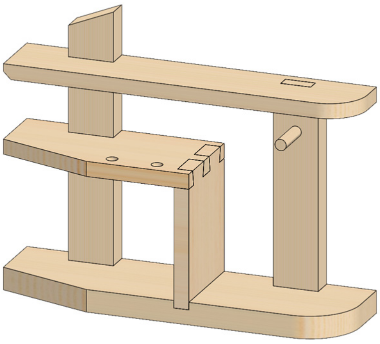
Halving joint	**(v)**	**Processing**	**Marks**
	a.	Trenches • saw across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Dovetail joint	(vi)	Processing	Marks
	a.	Tail • sawing tail *4 × 1 mark* • paring tail *2 × 2 marks*	8
	b.	Trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	4
		Total	**12**

Housing joint (base)	(vii)	Processing	Marks
	a.	Trench • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	4
		Total	**4**

Mortice and tenon joint	(viii)	Processing	Marks
	a.	Mortice *3 marks*	3
	b.	Tenon *4 × 1 mark*	4
		Total	**7**

Box dovetail joint	(ix)	Processing	Marks
	a.	Tails *2 × 4 marks*	8
	b.	Pins • sawing with the grain *4 × 1 mark* • paring across the grain *2 × 2 marks*	8
		Total	**16**

Shaping & drilling	(x)	Processing		Marks
	a.	Short slope	*1 mark*	**1**
	b.	Long slopes	*2 × 2 marks*	**4**
	c.	Curves	*2 × 2 marks*	**4**
	d.	Drilling holes accurately	*3 × 2 marks*	**6**
	e.	Chamfer	*2 marks*	**2**
			Total	**17**
	Overall Completion of Piece			**Marks**
			Grand Total	**150**

Coimisiún na Scrúduithe Stáit

State Examinations Commission

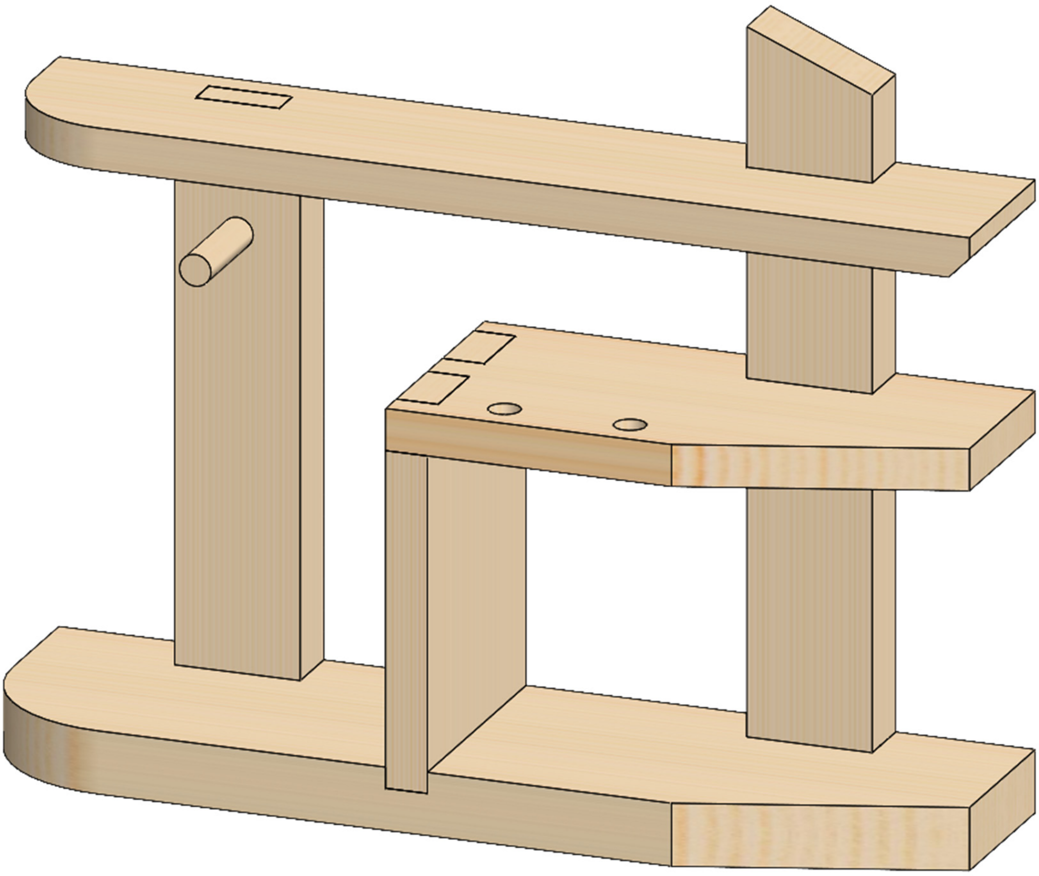
Leaving Certificate Examination 2025

Construction Studies

Practical Test

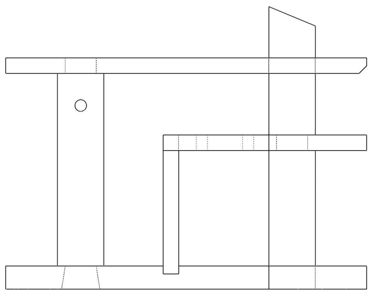
Common Level

(150 marks)



Marking Scheme

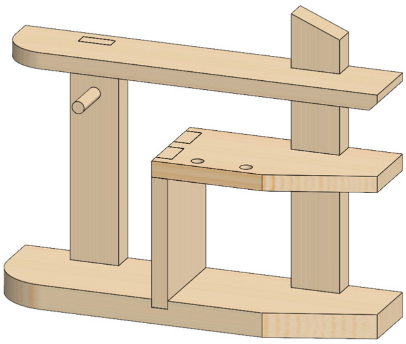
Day 3

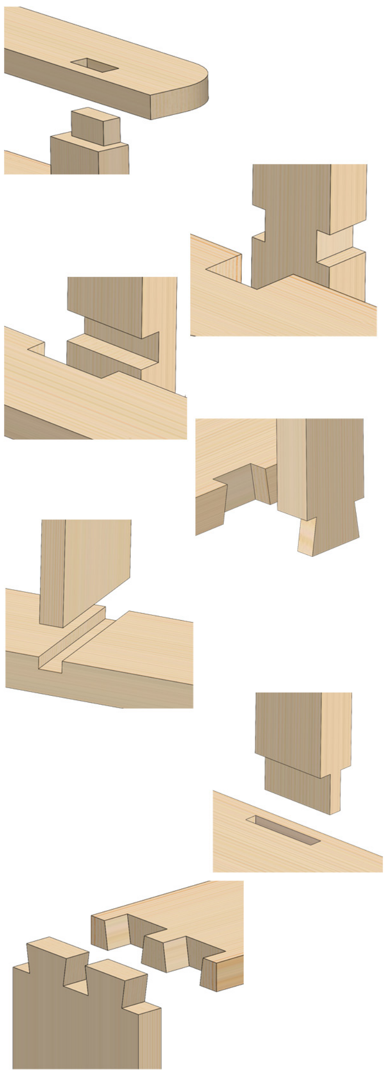


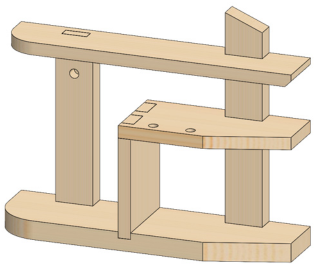
Marking Scheme – Practical Test

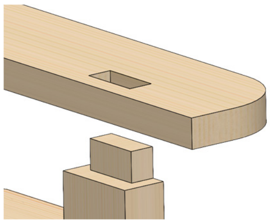
Note:

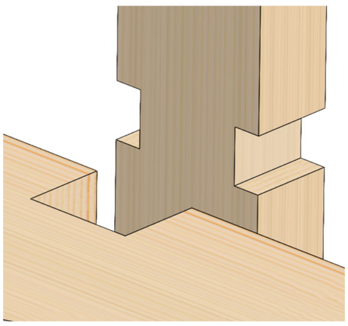
- The artefact is to be hand produced by candidates without the assistance of machinery.
- The use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that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

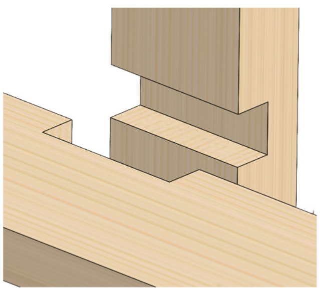
	(i)	Overall Assembly	Marks
	a.	Overall quality of assembled artefact	**10**
	b.	Design and applied shaping to edges • design *2 × 1 mark* • shaping *2 × 1 mark*	**4**
		Total	**14**

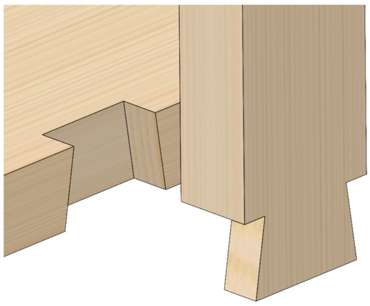
	(ii)	Marking Out	Marks
	a.	Barefaced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**
	b.	Notched housing joint • trenches *3 × 2 marks*	**6**
	c.	Halving joint • trenches *2 × 2 marks*	**4**
	d.	Dovetail joint • tail *3 marks* • trench *3 marks*	**6**
	e.	Housing joint base • trench *2 marks*	**2**
	f.	Mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**
	g.	Box dovetail • tails *2 × 3 marks* • pins *2 × 3 marks*	**12**

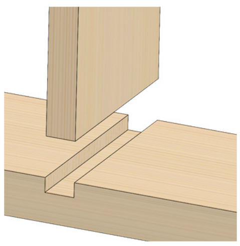
	h.	Slopes, curves, and chamfer • slopes *3 × 1 mark* • curves *2 × 2 marks* • chamfer *2 marks*	9
		Total	**51**

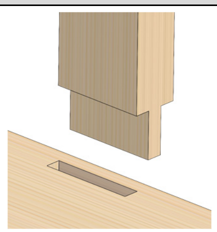
Processing of Desk Tidy			
Barefaced mortice and tenon joint	**(iii)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

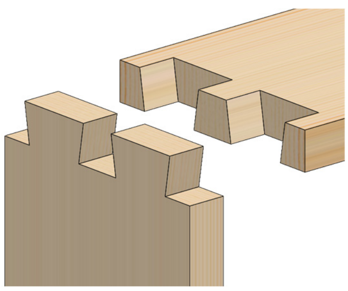
Notched housing joint	**(iv)**	**Processing**	**Marks**
	a.	Trench (horizontal) • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical) • sawing across the grain *4 × 1 mark* • paring trenches to depth *2 × 2 marks*	**8**
		Total	**12**

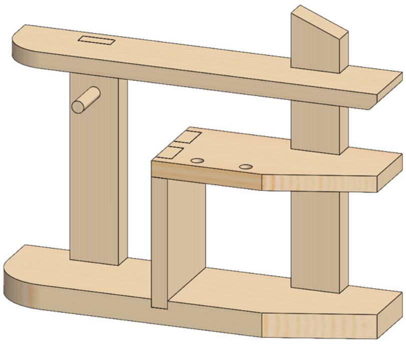
Halving joint	**(v)**	**Processing**	**Marks**
	a.	Trenches • saw across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Dovetail joint	(vi)	Processing	Marks
	a.	Tail • sawing tail *4 × 1 mark* • paring tail *2 × 2 marks*	**8**
	b.	Trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	**4**
		Total	**12**

Housing joint (base)	(vii)	Processing	Marks
	a.	Trench • sawing across the grain *2 × 1 mark* • paring of trench to depth *2 marks*	**4**
		Total	**4**

Mortice and tenon joint	(viii)	Processing	Marks
	a.	Mortice *3 marks*	**3**
	b.	Tenon *4 × 1 mark*	**4**
		Total	**7**

Box dovetail joint	(ix)	Processing	Marks
	a.	Tails *2 x 4 marks*	**8**
	b.	Pins • sawing with the grain *4 × 1 mark* • paring across the grain *2 × 2 marks*	**8**
		Total	**16**

Shaping & drilling	(x)	Processing		Marks
	a.	Short slope	*1 mark*	**1**
	b.	Long slopes	*2 × 2 marks*	**4**
	c.	Curves	*2 × 2 marks*	**4**
	d.	Drilling holes accurately	*3 × 2 marks*	**6**
	e.	Chamfer	*2 marks*	**2**
			Total	**17**
	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.***