Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2019

Marking Scheme

Construction Studies

Higher Level

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

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

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

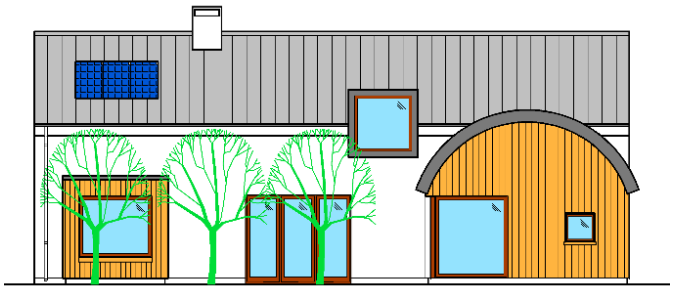
In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when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

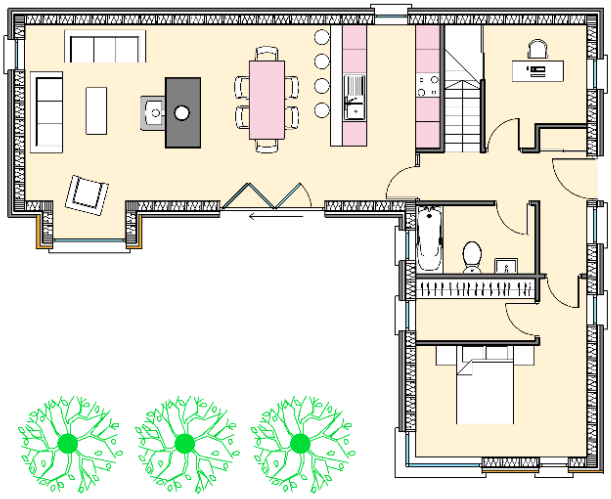
Future Marking Schemes

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

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2019





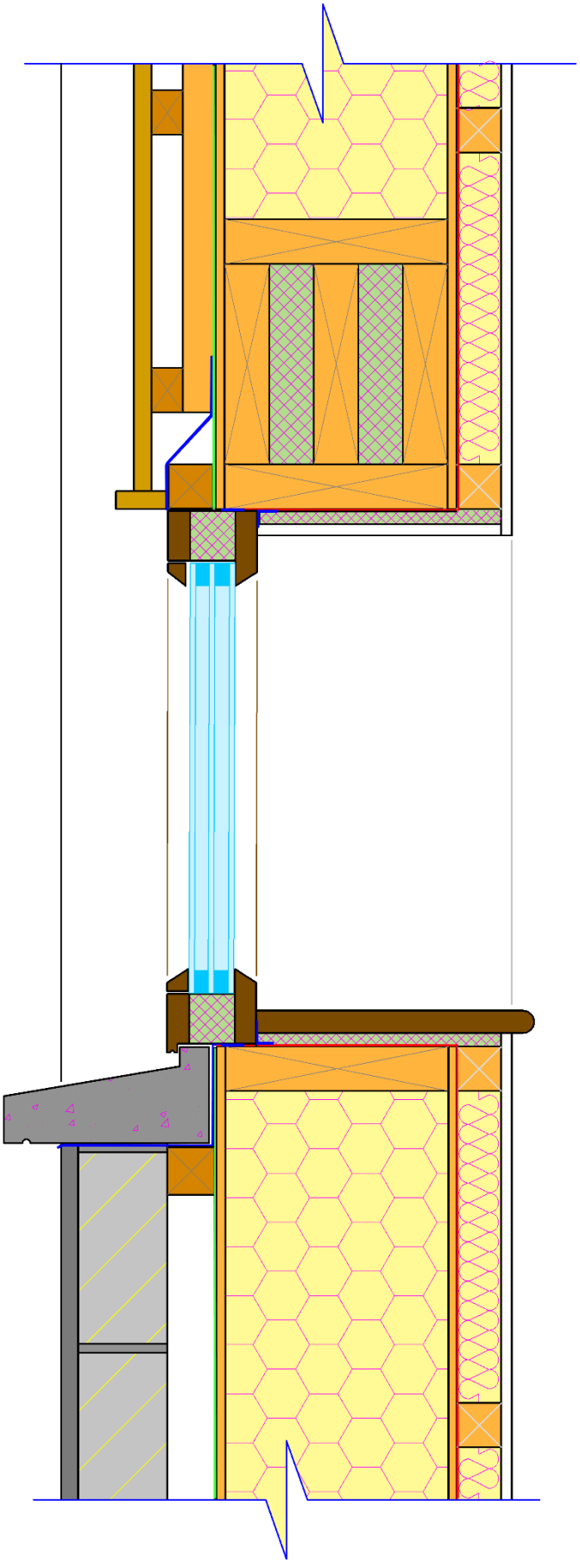
Construction Studies

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.

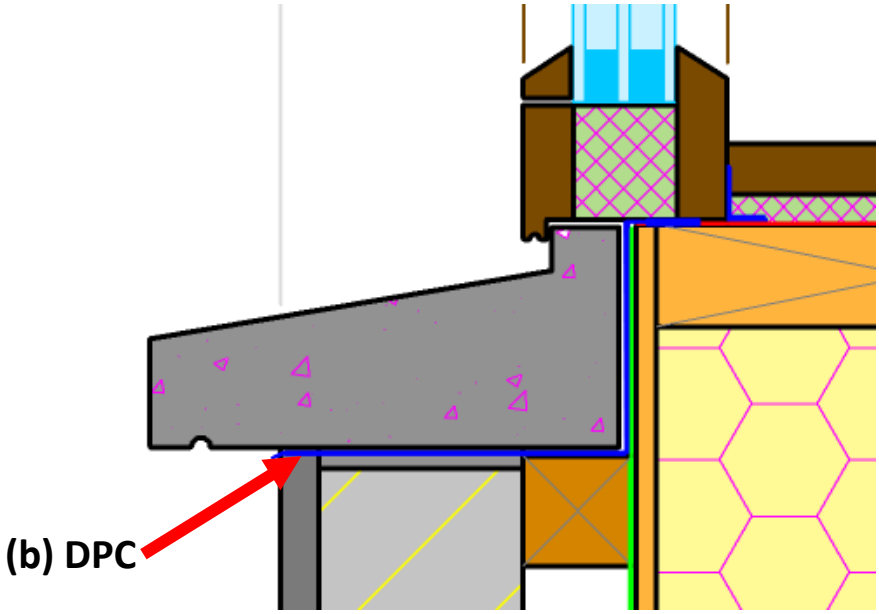
(a) Vertical section through the fixed frame of a window and the external wall of the house.



Typical best practice detailing of a fixed frame window and the external timber frame wall of the house

Any other relevant points.

(b) Typical design detailing to prevent the ingress of rainwater at the window cill.



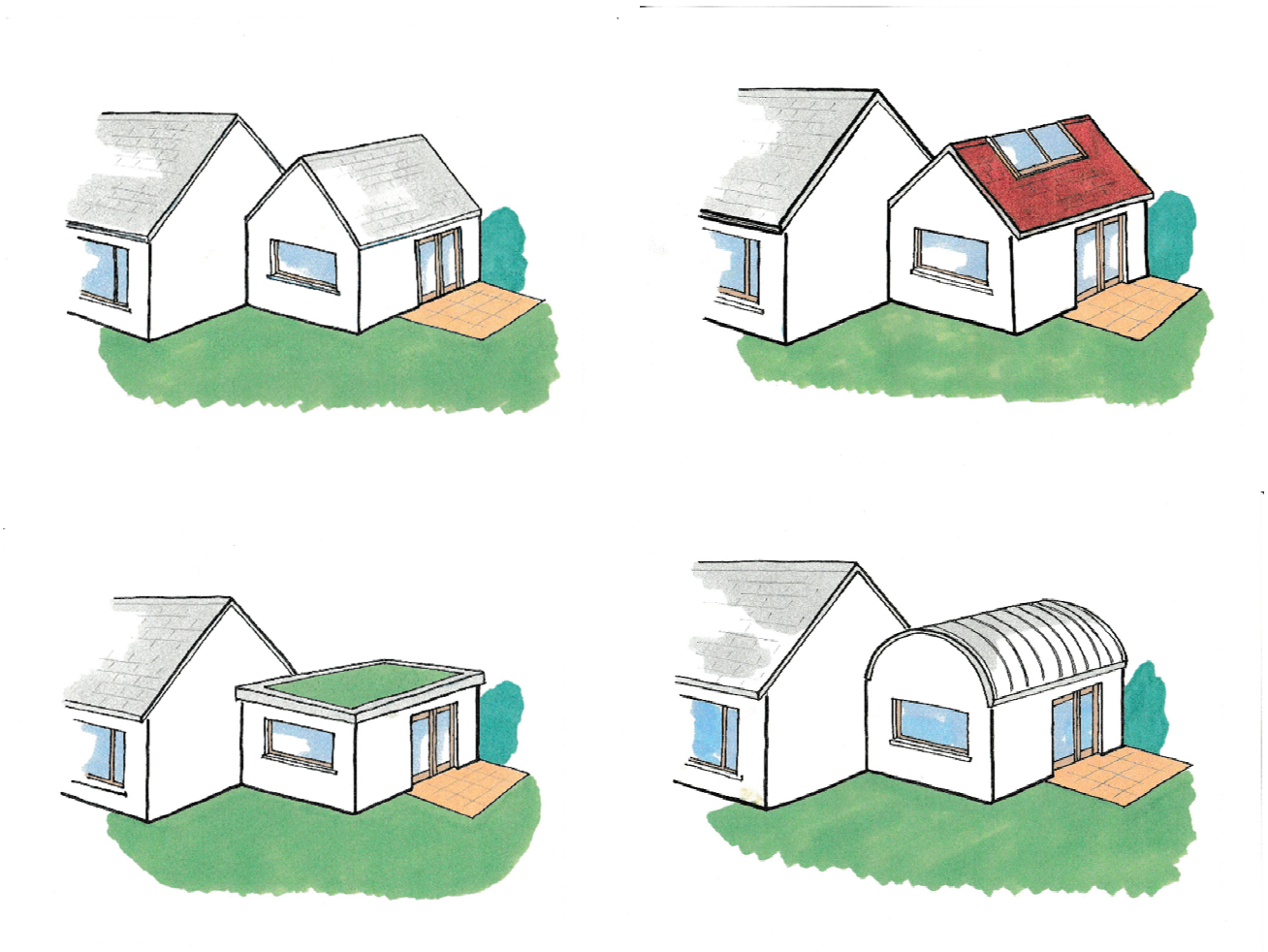
Question 2

(a) Functional requirements of a roof suitable for a domestic house.

- Weather resistant: The roof should be able to protect the building from all external elements (rain, snow, wind and sun).
- Structural stability: The roof structure must be capable of supporting all imposed loads (dead and live) and resist lateral movement of the roof.
- Thermal insulation: It should provide a high of thermal comfort for the occupants, keep heat in during the winter and resist excessive heat gain during the summer.
- Durability: The roofing members should be long lasting and require little maintenance. Selection of appropriate material for roof members and application of preservatives.
- Ventilation: The roof profile must be adequately ventilated in order to prevent condensation build up and possible fungal attack.
- Airtightness: The roof structure detailing should contain and maintain the airtightness layer in the building.

Any other relevant points

(b) Possible roof profiles design for the new house extension



Any other appropriate roof profile

Recommend one preferred roof profile for the house extension.
Justify your roof profile selection

(c) Select a different roofing material for each roof profile presented.

Possible roofing materials for the roof profiles presented:

- Natural Slates
- Fibre cement slates
- Concrete tiles
- Clay tiles
- Zinc sheeting
- Wood shingle
- Thatch
- Corrugated steel
- Roofing felt
- Asphalt
- Single-Ply Membrane (EPDM Rubber)
- *Any other appropriate material*

Appropriate advantage and disadvantage for each material chosen.

Other relevant information

Question 3

Detached house – second-storey extension.

(a) Three design considerations for the proposed bedroom and en-suite bathroom

Primary functional needs of a bedroom with en-suite:

Furniture Layout

- The location for the bed and other possible furniture such as bedside lockers, wardrobe, dressing table should be taken into consideration in order to achieve the most efficient use of the space.
- The layout of all white goods (toilet, sink, shower) in the en-suite should be considered to optimise the space and be arranged close to existing draining systems.

Access & Escape

- A bedroom must have one other method of egress beyond the entrance point in the event of a fire.
- A door to the exterior works as an exit point or a window which meets the required regulations.
- Provides adequate circulation areas between spaces to meet access and egress requirements.

Storage

- Storage can be achieved by having wardrobes/drawer units or a separate walk-in wardrobe area.
- The integration of a walk-in wardrobe into a bedroom design may not be the most efficient use of space in small rooms. This space could be better used as multi-purpose circulation space if shared between a bed and wardrobe.

Future Flexibility

- Allow for future flexibility and multi-functionality of the space. This is particularly important when deciding on the location of sockets, light fittings, TV outlets etc.
- Depending on the user of the bedroom, the bed could be risen to bunk level to include a desk or study area underneath. This would give more flexibility and enable the room to be multi-functional space.

Ergonomics

- Is the distance between wardrobe doors or drawers and other fixed furniture ample – to enable access
- Pull-down rods in the wardrobe can be accessed using a wand so people with physical disability can still access all storage areas.

Human Sensory Experience:

Visual

- Connecting a room with the outdoors is a great way to make the space feel larger and admit more natural light.
- Natural light enhances the wellbeing of the user.
- Windows located on the south façade will allow for greater natural light to both light and heat the internal space.

Auditory

- Sound controls are critical in urban locations in bedroom spaces. One opening on a window offers better controls from noise pollution.
- The direction of the noise pollution may be a key consideration when deciding on the location of a larger opening.
- All windows should be triple glazed with flexible seals to prevent sound transfer.

Tactile

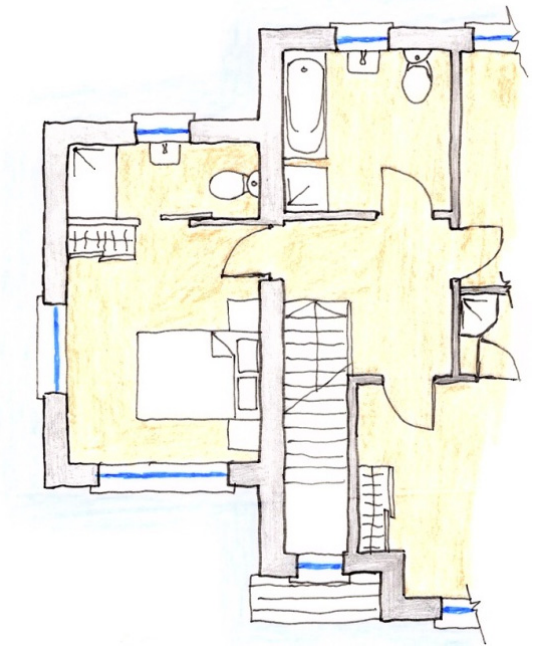
- This sense not only responds to touch but to heat and cold also. Walls, floor and ceilings of bedrooms need to be adequately insulated to prevent temperature fluctuations which can disturb sleep.
- Thermostats should be considered when designing a new space so that the room temperature is kept at a constant throughout the night.

Olfactory

- As people spend large portions of their life asleep in the bedroom, adequate ventilation is necessary to maintain healthy air qualities.
- Appropriate ventilation is also required in the en-suite to remove odours and stale air.

Any other relevant points

(b) Proposed internal layout for additional bedroom and en-suite bathroom.



Furniture Layout:

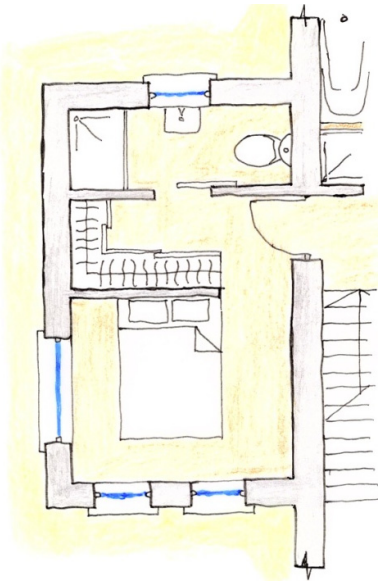
- Key items of furniture identified and positioned to ensure ample circulation space for access, egress and cleaning.
- White goods in the bathroom are located to optimise space and be in close proximity to existing waste water systems or on the exterior wall so new waste pipes can be easily added.

Access & Egress:

- Door from the hallway swinging the correct way so that privacy can be maintained.
- Window openings that can be used as fire escape routes.
- Ample circulation space in the room for people with mobility impairments.

Storage:

- Storage space included in the design.



Future Flexibility:

- Stud partition wall used to separate the en-suite and walk-in-wardrobe. These can easily be removed in the future should the requirements of the room change.
- Ample sockets installed to meet changing layouts.

Ergonomics:

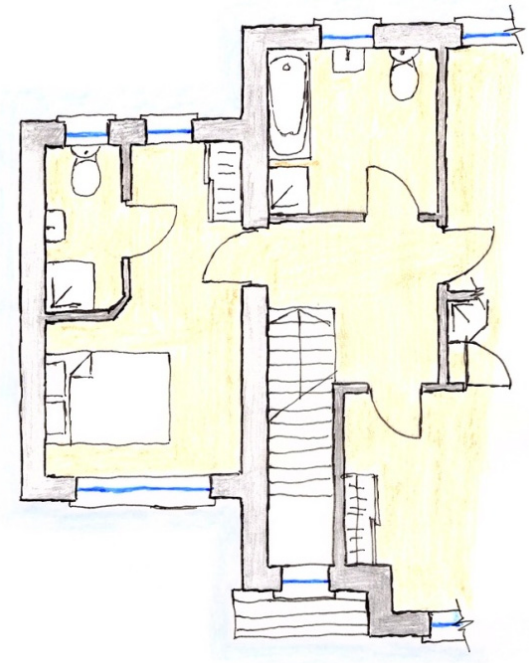
- Sufficient space for users to access all doors and storage facilities without obstructions.

Visual:

- Large south facing windows allow natural light and heat into the space.
- Window on east facing wall to get evening sunlight.
- Roof lights incorporated into the design to enhance the internal space.
- Small window to the north to reduce heat loss
- Link created with nature through the large windows.

Auditory:

- Triple glazed windows to help damped noise pollution.
- Additional insulation added to ensure noise levels from outside and within the house are reduced in the bedroom space.



Tactile:

- Additional insulation added to maintain optimum temperatures in the new extension.
- Thermostat added to ensure room temperatures remain constant.

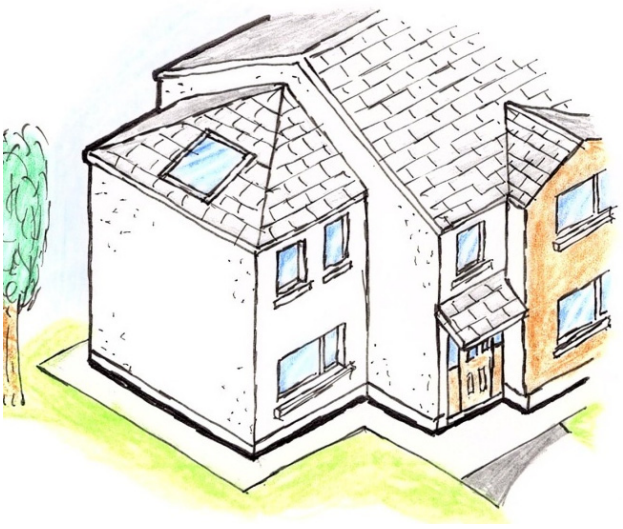
Olfactory:

- MHRV installed throughout the house to filter air, remove moisture and maintain air quality.
- Window added to the bathroom to remove excessive moisture and odours.

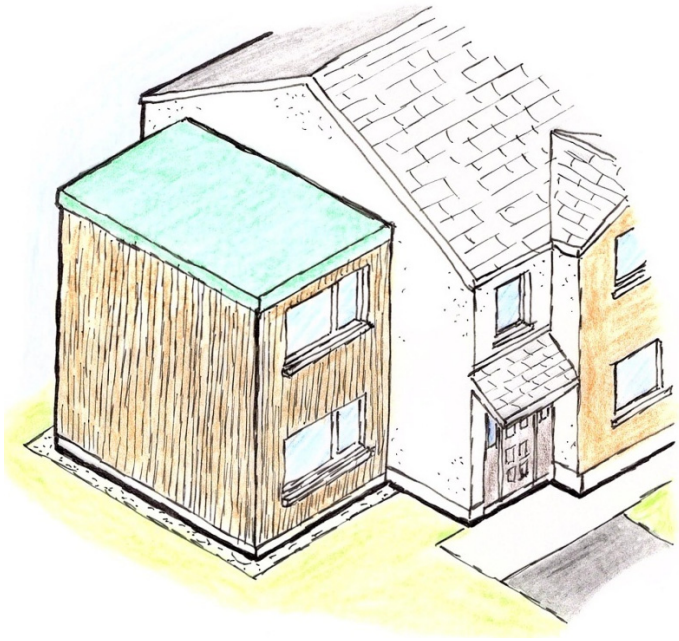
Any other relevant points

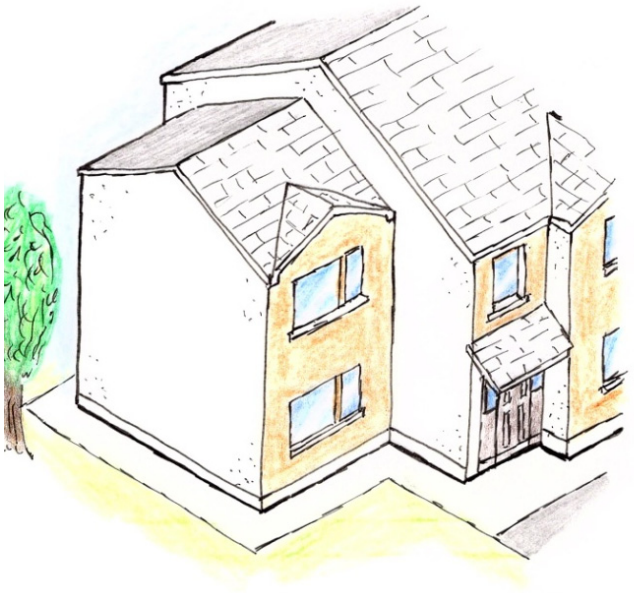
(c) Revised external design to enhance the overall visual appearance of the house.

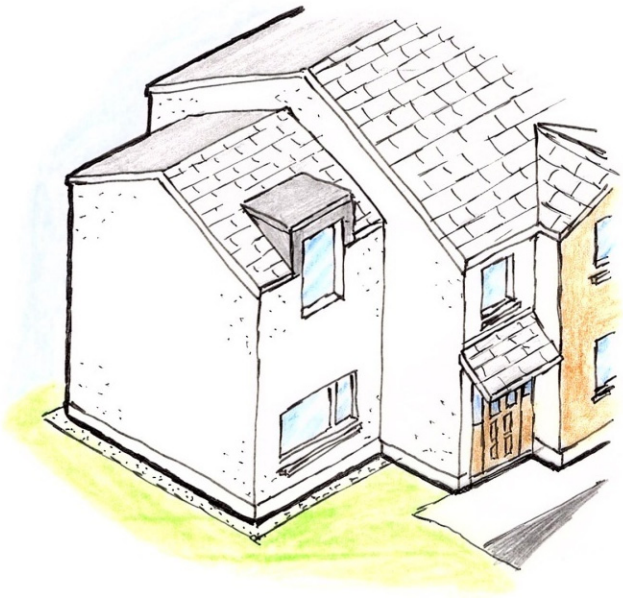
- Brick integrated into the façade in keeping with the existing material pallet of the house.
- The same pitch used on the extension as on the main house so that eaves and ridge lines are consistent.
- Roof finished with slates similar to the existing house.
- Front pitch similar to existing front facade integrated into new proposal.
- Window openings and proportions similar in size to
  the rest of the house.
- Large windows on south facing walls.
- No window(s) on gable wall so as not to overlook neighbouring buildings and gardens.
- Flat roof design on extension to distinguish between existing and new builds.
- Larch cladding external finish on extension to differentiate the new design from existing.
- Dormer extension with zinc cladding around the window.
  It is not as imposing as full two storey uses less materials. The design reflects the time that is was built in and is not trying to copy past design trends.
- Dormer window with large vertical aspect to take advantage of southern vista of the house position.
- Hip roof design so a dormer window can be installed into the roof to allow more natural light into the extension.



Any other relevant points







Question 4

(a) Benefits to the local community of refurbishing the townhouse as a family home.

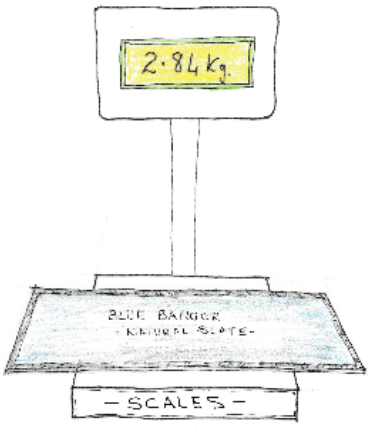
- Maintain and develop the local social community – local schools, amities, parks, playgrounds, etc.
- Improve the local economy of urban areas – shops, cafes, restaurants, etc.
- Maintain and improve the physical structure of the neighbourhood for everyone living there.
- Help alleviate the current housing shortage in urban areas.
- Engender pride in the local area and encourage neighbouring premises to upgrade.
- Maintaining the existing, residential, architectural heritage of the urban area.
- Encourage regeneration of the area.

Any other relevant points

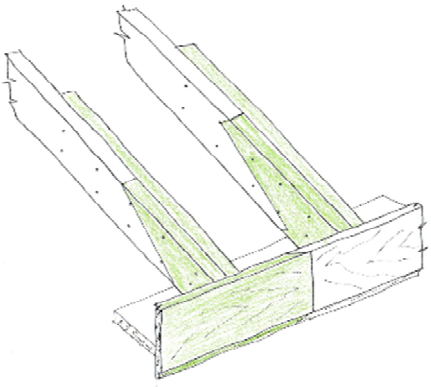
(b) Steps involved in upgrading each area in a manner that respects the appearance and character of the original townhouse.

Roof Upgrading traditional cut roof roof of natural slate

- Remove existing slate carefully
- Clean all slates on the underside only of lime parging. (No felt used at time of construction – 100 years ago)
- Weigh each slate – following removal of lime parging
- Record weight on underside of slate and stack in bundles eg 1.0kg -1.99kg: 2.0kg -2.99kg: 3.0kg -3.99kg:
- Do not power wash or clean the top surfaces of the natural slate as this will eliminate the “patina” that these 100 year old natural slates have acquirel and helps to maintain the character of this period dwelling
- When refitting slates place heaviest slates at eves and working up the roof lay each slate according to its decreasing weight. The lightest slates will be located at ridge level

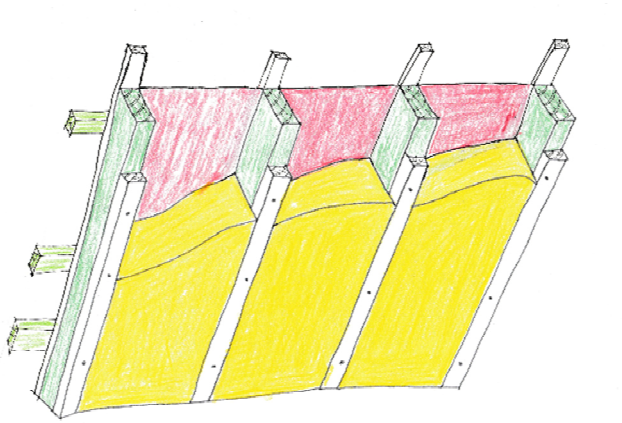


- Remove existing battens
- Examine roof joists for signs of decay and remove decayed end of rafters, wall plate, fascia and replace if necessary with the same species of wood and same profiles/ mouldings so as to maintain the historical integrity of the original roof.
- Trades persons such as carpenters should use the same carpentry jointing details during repairs where possible as this helps retain older traditional skills and tecniques (sketch)



- Treat all new replacement timbers with preservative – boron.
- Install vapour diffuse breathable membrane – to allow any vapour escape
- Counter battens for ventilation -should be used -provided the single roof plane for the terrace is maintained.
- Replace slate on the principal elevation - keeping same lap.

- Broken slates should be replaced – firstly with slates taken from the rear and secondly using re claimed or salvaged natural slate on the lesser visible roof surface
- Rain water goods – gutters and downpipes – should be of the period -cast iron. The principle elevation should utilise salvaged or "new" cast iron rain water goods again to help maintain the character of the dwelling
- Insulate roof – all insulation materials to be hygroscopic – allow water vapour pass though
- Insulation such as sheeps wool laid between rafters: woodfibre board above and /or beneath rafters, lime plaster to fibreboard beneath rafters allow moisture through
- All roof structures must be thoroughly vented, otherwise condensation will cause the decay of the roof members
- Full fill insulation can be achieved if insulation is permeable and breathable membrane with counterbattens are installed. (Sketch)



Other Option:

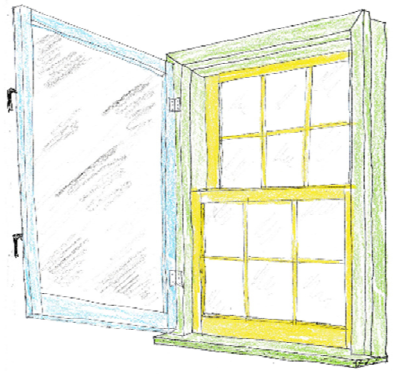
- insulation to roof with ventilation path, or full - fill blown cellulose
- continuous vapour barrier on warm side of insulation, taped and joined to plaster layer
- insulated service cavity of hemp or wool - electrical services not to puncture vapour barrier
- vapour permeable ceiling board to form permanent shuttering to inside face such as Heraklith, Sasmox, Fermacell or similar
- vertical insulation to prevent cold bridge at wall plate.

Any other relevant points

Original sliding sash windows-softwood and single glazed

- Retaining the original sliding sash, softwood, single glazed windows maintains the character and increases the value of this - 100year old dwelling
- The repair of such historic sash windows is therefore the recommended option rather than replacement
- Repair of these sash windows is expensive - however, grants are sometimes available from local authorities and the Heritage Council should the dwelling be included on the list of protected structures.
- The sliding sash windows should be carefully removed taking care not to break the original "float" glass or the timber sashes and frames.
- Retain the sash - counter balancing weights.
- A specialist conservation joiner should be tasked with the repair work
- Carefully remove glazing and note/record its original position in the sash window
- Caution required with this task as in removing the hardened linseed oil putty the original historic glass may get broken
- When framed up 100 years ago "animal glue" would have been used. This glue is thermoplastic and on re heating the joints it will be possible to dis-assemble (if necessary) all the components of both the sashes and the frame.

- Remove all rotten timbers and replace with the same species (Red Deal)
- Identical profiles for all components must be replicated where required
- Traditional jointing details should also be utilised as this also helps to retain historic craft skills and develop an appreciation for such historic carpentry/joinery work
- When gluing up the repaired sashes and frames "animal glue" should again be used as this enables maximum retention of the original fabric and allows for repair and conservation work into the future.
- Pulleys should be removed and cleaned/freed up
- Sash cords will need to be replaced and the original sash counter- balance weights reused
- In the re assembly of the sashes and glazing- linseed oil putty should be used
- Original "float" glass is no longer manufactured in Ireland – however it is available and should be sourced elsewhere
- Non - toxic paints are a better or preferred option in the repainting of the windows
- A record of the date of conservation/repair work including the name of the individuals who carried out the work to the sash windows - should be made and placed – perhaps on the inside of the sash frames in the voids that house the counter – balance weights. Pencil is best for this purpose.

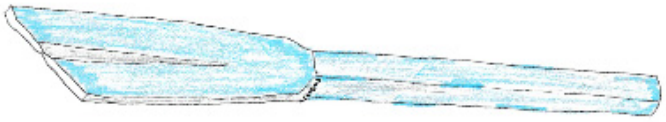


- Secondary glazing is also recommended for this dwelling as it significantly, restricts heat loss and provides excellent sound proofing – if triple glazed and having a U value of at least 0.8 Wm^2 k
- Secondary glazing should be designed to be "invisible" from the outside and therefore not detract from the period dwellings character. (Sketch)

Historic brick external wall with lime mortar on internal surface

- Should a brick external wall having lime mortar bedding require re pointing then expert advice must be sought from specialists in that field - in advance of any repair work being carried out
- Under no circumstances should cement based mortar be used as this will adversely affect the period character of the dwelling and cause "spalling" of the historic brickwork.
- Cement based mortar is not permeable and water trapped in the mortar bed will expand on freezing an over time this results in the bricks disintegrating -spalling
- Lime based mortar is permeable and allows water absorbed by the brick and lime mortar itself to pass to the external surface where it is dried by the air and wind
- The historic lime mortar should be first visually examined and photographed by a specialist
- Samples of the lime mortar should be forwarded for laboratory analysis to determine the shape and size of sand aggregate used, the strength of lime mortar used, the void space and the lime – sand mix ratio
- Lime mortar for facing brickwork historically used a fine sand with a small grit/ particle size. A coarser sand was used for exposed stone walling
- The strength of lime- Natural Hydraulic Lime (NHL) is manufactured in different strengths ranging from: NHL1, NHL2, NHL 3.5, NHL5 where the number designates the strength in N/mm^2
- Lime mortar takes a considerable time to set/harden to full strength. To accelerate this process -it is advisable to mix the lime mortar 1-2 days in advance with minimum amounts of water. When it is to be used it should be remixed – using the minimum of additional water.

- Raking out of the old deteriorated lime mortar should be undertaken with great care. Angle grinders or con saws should never be used.
- Best practice recommends the use of hand tools for raking (Plugging chisels & lump hammer)
- Raking out should commence at the top and proceed down the wall.
- Joints in general should be raked out to a depth twice the face width

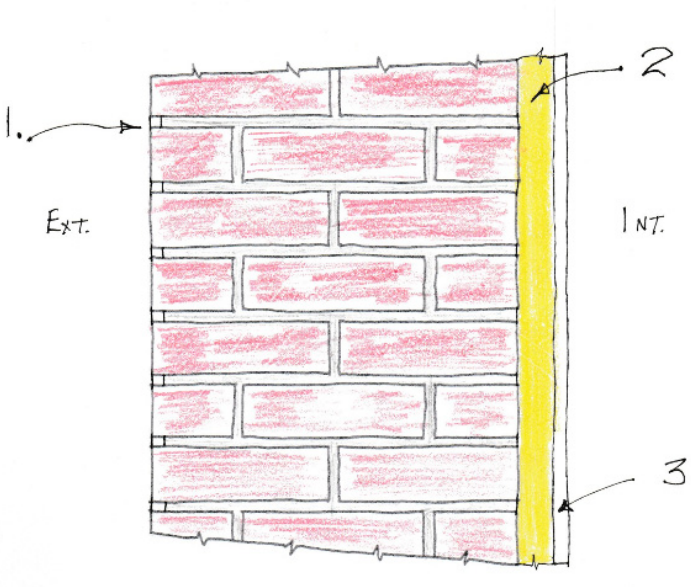


- Before re pointing starts all joints should be thoroughly brushed out to remove any loose particles - again working from the top down.
- Prior to re pointing the brick wall should be dampened using a fine spray – do not saturate wall. Work from the top down
- Deep pointing will require filling in two stages as the lime mortar needs air to harden Sketch (1)
- Freshly pointed lime mortar requires protection from the weather for a considerable time

- Hessian matting is used to protect lime from sun, wind, rain and frost.

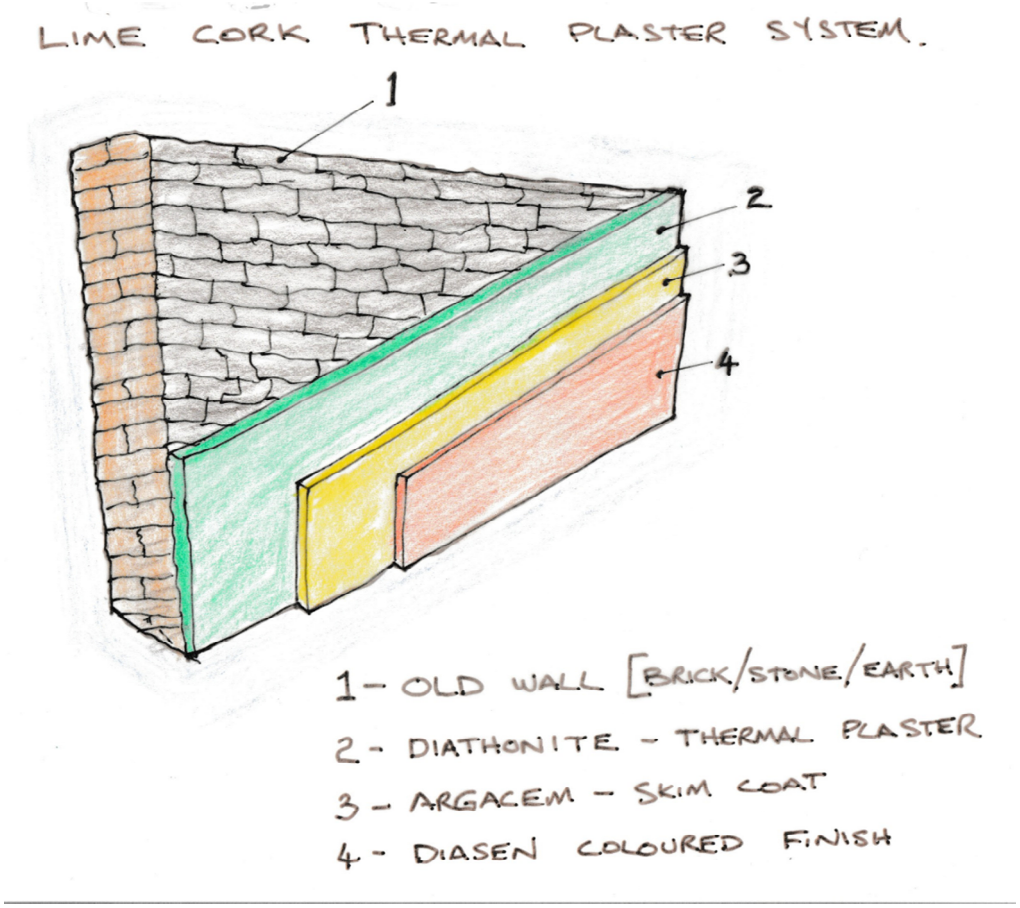
Applying hempcrete as an insulating layer over the brick -internally + two coats of lime render plaster/putty.
Applying three- coat lime plaster work to the internal surface of historic brick wall.

- Brush down the brick wall to get rid of any dust or loose particles
- All loose lime mortar beds should be raked out and re pointed prior to applying hempcrete or rendering
- Hempcrete – a mix of lime and hemp – may be sprayed directly onto internal brick surface, or it may be built up in layers with the use of temporary plumb/vertical battens or shuttering Sketch (2)
- The brick wall should be dampened down prior to applying hempcrete or lime render
- Hempcrete must be dried out completely(4-6weeks) before applying two coats of lime render/putty
- A scud coat of NHL and sand should be “dashed” onto the brick-if applying lime render only- and left for a few days to allow the grit time to bond sufficiently enough to support the following scratch coat of lime plaster. Sketch (3)
- Later (2-3days) the scratch coat made up of a weak natural hydraulic lime render (NHL) plus animal hair is applied and left rough textured for better adhesion of following coats.
- Keep from drying out too quickly – lightly spray with water (Mist only) if required
- Lay the second or float coat of lime render plus animal hair over the scratch coat and texture



- Lay the third and finish coat of lime render using a mix of lime putty and sand.
- Lime putty is manufactured by burning limestone, or chalk at a temperature of 900 degrees C to make quicklime -which is then 'slaked 'with water and left to mature for at least three months.

Any other relevant points



Question 5

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

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
External Surface				0.048
External Render		2.170	0.016	0.035
External Blockwork	1.44	0.694	0.1	0.069
Clear Cavity				0.170
Insulation	0.037	27.027	0.05	1.351
Internal Blockwork	1.44	0.694	0.1	0.069
Internal Plaster		6.25	0.012	0.075
Internal Surface				0.122
			Total R =	R^t = 1.939
Formulae: $R=T/k$ $R=T \times r$ $U=1/R^t$				
U-value: U = 1 / 1.939 = 0.516 W/m^2 ^{0}C				
			U-value =	**0.516 w/m^2 ^{0}c**

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

- Heat lost through wall
  Heat loss formula: = U -Value × area × temp. diff
  0.516 × 135 × (19 – 5) = 975.24 Watts (Joules / sec)
- Heating period p/a:
  60 × 60 × 9 × 7 × 36 = 8,164,800 seconds (2,268 hours)
- Kilo joules p/a:

$$\frac{8,164,800 \times 975.24}{1000} = 7,962,639.552 \text{ kJ/sec}$$

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

$$\frac{7,962,639.552}{37,350} = 212.34 \text{ litres}$$

- Cost p/a: (Note: 1 litre of oil costs 94c)

212.34 **× 0.94 = €199.60**

Cost of heat loss annually through floor = €199.60

Alternative method:

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

$$= \frac{\mathbf{0.516} \times 135 \times 14 \times 8,164,800 \times 0.94}{37,350 \times 1000}$$

$$\frac{7,484,881,178.88}{37,350,000} = \mathbf{€199.60}$$

(c) Thickness of external expanded polystyrene insulation required to give a wall U-value of 0.15 W/m^2 ˚ C.

Determine the Resistance for a U-value of 0.156 W/m^2 K

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

R = 1/ U-value R = **1/ 0.156** = 1.939 m^2 K / W

Resistance for required U-value of 0.15 = 1/0.15 = 6.666 m^2 K / W

Difference in Resistance = 6.666 – 1.939 = 4.727 m^2 K / W

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

4.727 = T/0.031

T = 4.727 × 0.031 **= 0.146537 metres** to achieve U value of **0.15 W/m^2 ˚C.**

Thickness of required Expanded Polystyrene insulation = **147 mm -** accept **146/147 mm.**

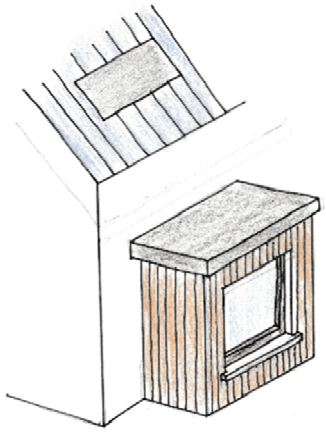
Alternative calculation methods acceptable.

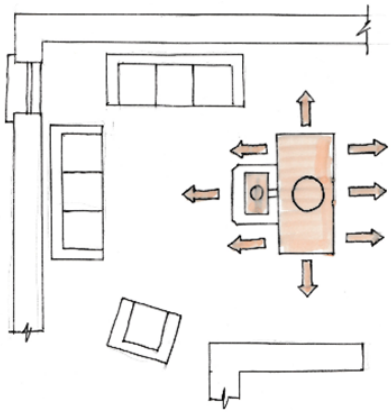
Question 6

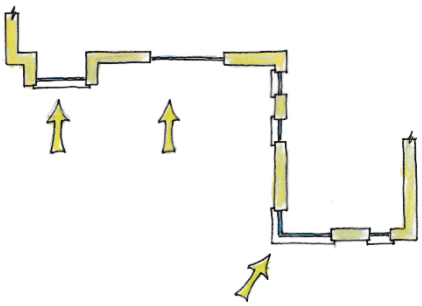
(a) Three features of the design that contribute to the house having a low environment impact:

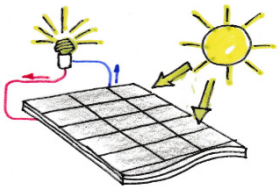
- Large south facing glazed windows and doors to allow maximum sunlight to enter the house naturally heating the internal space and therefore reducing heating costs and dependency on non-renewable fossil fuels.
- Trees on the south side to provide natural solar shading during summer months and reduce overheating internally.
- Wood burning stove contributes to the reduction of direct draughts associated with open fireplaces. They are also carbon neutral and more efficient.
- High thermal mass chimney stack is central to the design so maximum heat can be retained internally and heat is not lost to an external wall.
- High levels of insulation in the walls reducing heat loss.
- Small windows on the north elevation reducing heat loss potential and conserving energy.
- Photovoltaic cells installed on the roof to generate renewable energy.
- Timber frame construction, which has low embodied energy.
- Attic space used for additional living quarters without using additional building products and reducing the footprint of the building.

Any other relevant points



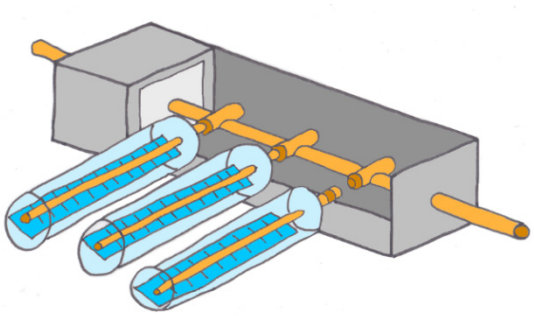






(b) Renewable energy technologies and how they contribute to making a home eco-friendly

1. Evacuated tubes

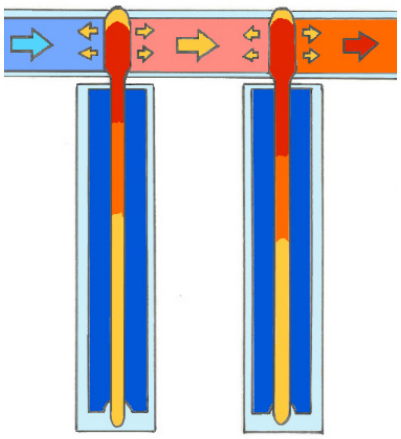


A solar evacuated tube collector is made up of two parts:

1. Heat Exchanger

This manifold is located at the top of the collector. Here, cold fluid coming from the solar storage tank is heated up as it travels through the manifold and transferred back to the solar storage tank in a cycle.

2. Individual Evacuated Tubes

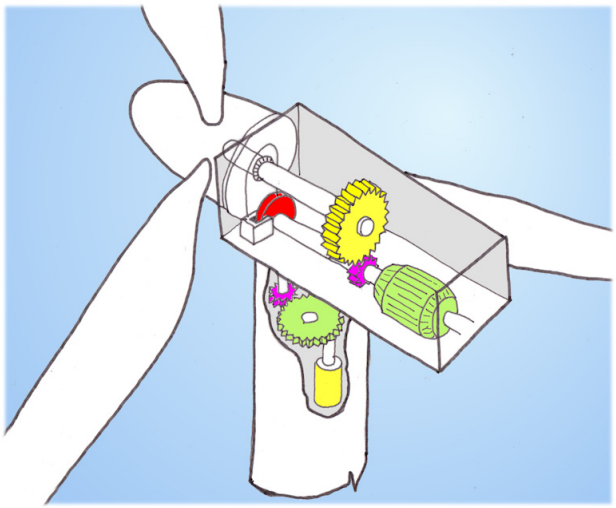


These can be attached/removed from the heat exchanger without effecting the overall functioning as fluid within the manifold and the individual tubes are on separate systems. If a vacuum tube ever broke, the system could still function. Each double walled rounded tube has a hollow copper pipe inserted through the length of the tube.

There is a vacuum between the glass and the copper pipe, which acts as an insulation against heat loss. The copper pipe contains a small amount of special liquid that acts as a heat transfer medium. This fluid vaporises at lower temperatures (30 ^{0}C or 86 ^{0}F) as a result of the low pressure. The copper pipe can have dark absorber plates/fins to improve energy absorption and the heat-transfer rate. As steam rises to the top, it heats the condenser bulb at the top of the tube, which in turn will transfer the heat to the manifold in contact with it.

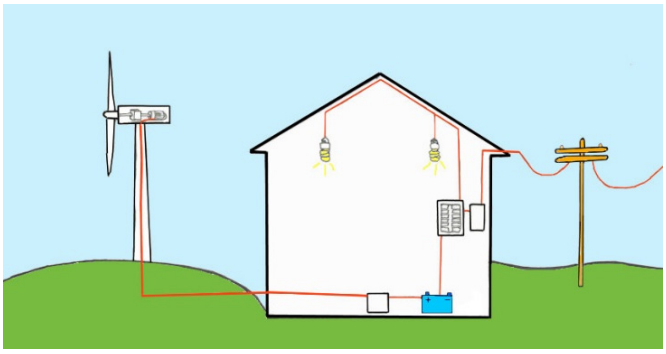
Any other relevant points

2. Wind turbine



- Wind activates the turning of the blades and rotor. They spin the main shaft and gearbox, which spins the generator resulting in electrical output.
- They can be connected to batteries or the national grid.
- When the wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin.
- An inverter is needed to convert the direct current (DC) voltage from the turbine to match the alternating current (AC) voltage required for domestic use.

- The control box is used to protect the invertor and turbine in strong winds. If the wind becomes too strong the control box will slow the turbine down.
- If the turbine sits on a tower, then a concrete foundation is generally required.
- Planning permission may however be required if it is thought that the turbine would interfere with the character of the landscape or a special amenity.

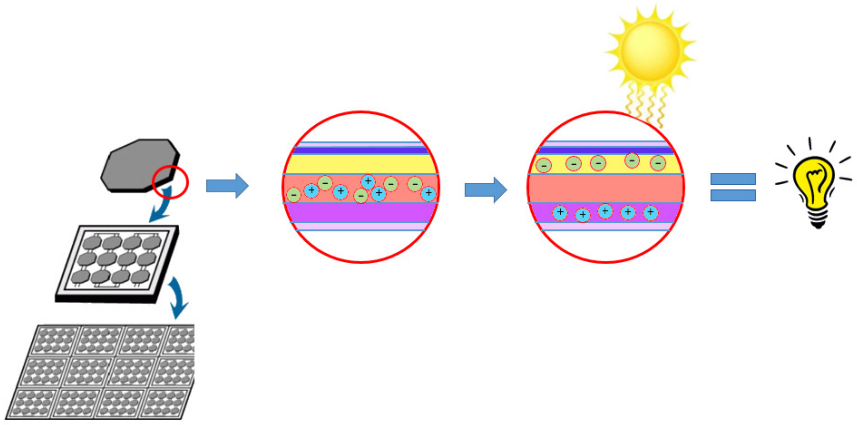


Any other relevant points

3. Photovoltaic cells

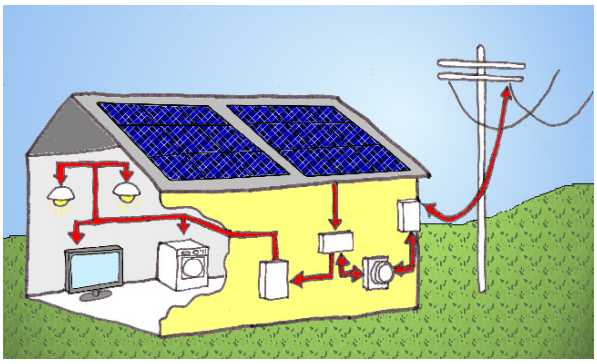
- A photovoltaic panel is a collection of photovoltaic (PV) cells. Multiple panels can be wired together to form an array. In general, the larger the area of a module or array, the more electricity that will be produced.

- The solar panel system uses particles of light from the sun (photons) to separate electrons from atoms. The process of separating electrons causes the electrons to hit off metal conductor strips on the outside of the PV cells thus generating electricity.



PV cells produce direct current (DC) electricity. Invertor's are needed to convert the DC voltage from the PV panel into alternating current (AC) voltage suitable for your home.

- Excess electricity can be stored in batteries or sent back to the grid.



Any other relevant points

How the systems contribute to making a dwelling house more eco-friendly:

Renewable energy systems contribute to making a house more eco-friendly in a number of ways:

- Reducing its dependency on non-renewable methods of energy production.
- producing free and clean energy
- Greenhouse gas emissions are reduced
- They do not require the burning of depleting fossil fuels
- No harmful gases or CO^2 is produced which has a negative impact on the ozone layer
- No waste product is generated
- No habitats are affected or destroyed

Solar Photovoltaic Panels convert solar energy into electricity. The majority of mains electricity is generated by burning fossil fuels or other combustible material that releases CO^2 into the atmosphere. The generation of electricity from a renewable source such as photovoltaic panels reduces dependency on mains supply therefore reducing carbon emissions.

Wind turbines convert natural/renewable kinetic energy from the wind into mechanical power which can be used in the home. This reduces the need for electricity from the national grid therefore reducing the demand on non-renewable methods of energy production which are harmful to the environment.

Evacuated Tube Collectors are a very efficient way of heating much of your hot water use just using the power of the sun. Less electricity is needed to boost the water to the required temperature therefore reducing energy consumption.

Any other relevant points

(c) Two advantages of using local craft skills when building the house:

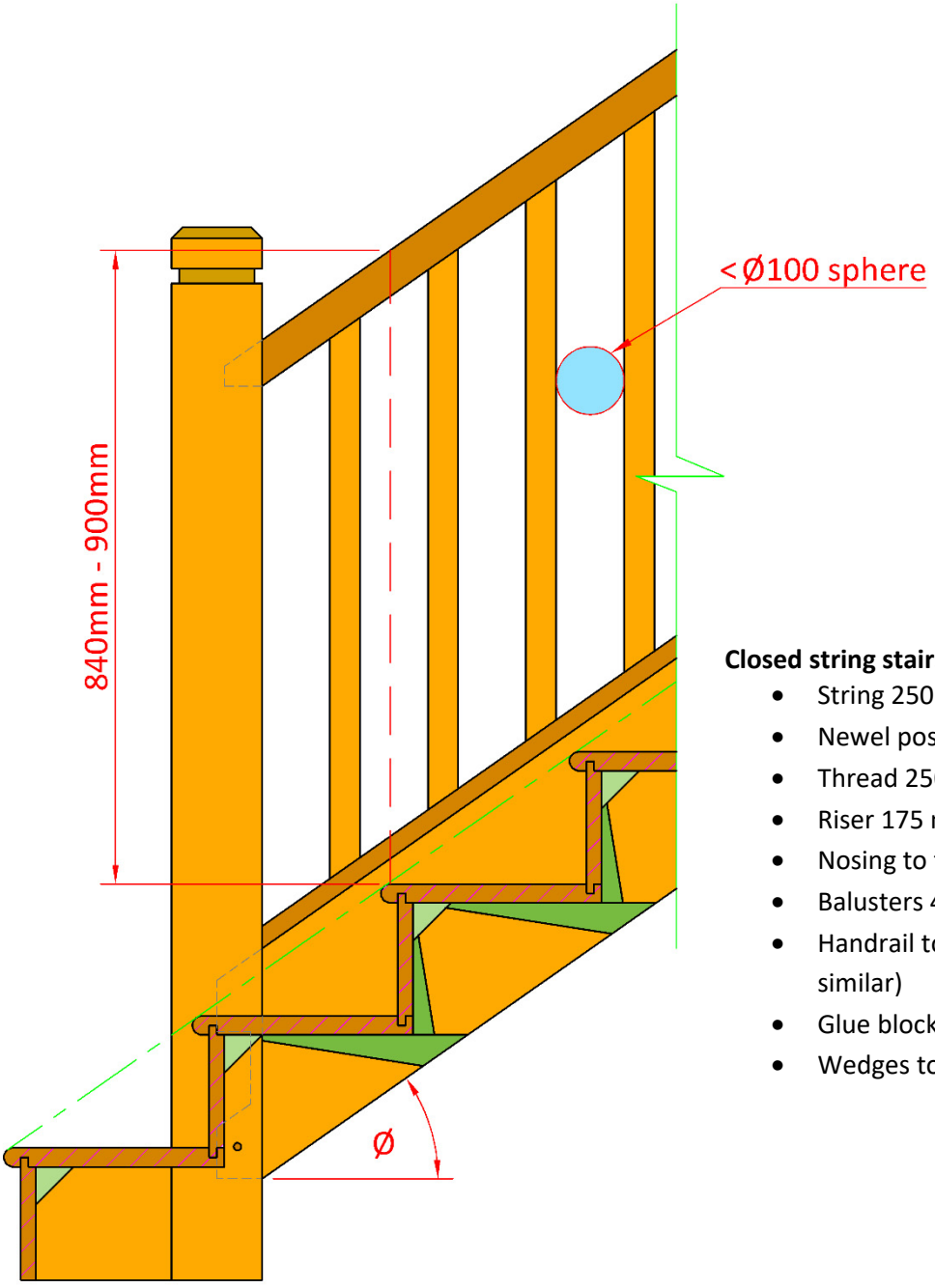
Advantages:

- It preserves traditional knowledge and skill for future generations to learn from.
- It creates a sense of place and pride by availing of skills specific to your locality.
- Employment is generated in the locality.
- Families remain in the locality and contribute to community life and events.
- Local workers will know where to source materials needed locally.
- If local workers and local materials are utilised- then it reduces the embodied energy of the house.
- It will help prevent the migration of rural labour to urban centres and give them a reason to stay and earn while preventing loss of skills.

Any other relevant points

Question 7

(a) Draw a vertical section through the centre of the wooden stairs.



Closed string stairs – typical detailing

- String 250 mm × 50 mm (or similar)
- Newel post 120 mm × 120 mm
- Thread 250 mm × 25 mm (or similar)
- Riser 175 mm × 20 mm (or similar)
- Nosing to thread 25mm (or similar)
- Balusters 40 mm × 40 mm (or similar)
- Handrail to stairs 40 mm × 40 mm (or similar)
- Glue block 60 mm × 60 mm (or similar)
- Wedges to threads and risers

(b) Three design features that ensure the stairs is safe for users.

Any three indicated on the drawing:

- Maximum pitch 42^0 (Range from 38 – 42 degrees)
- Min. Going 220 mm
- Max. Rise 200 mm
- Sphere Ø 100 mm not to pass between balusters
- Min. handrail height 840 mm
- Max. 16 risers in any one straight/ continuous flight of stairs
- Min. stairs width 800 mm
- *Any other relevant features*

Question 8

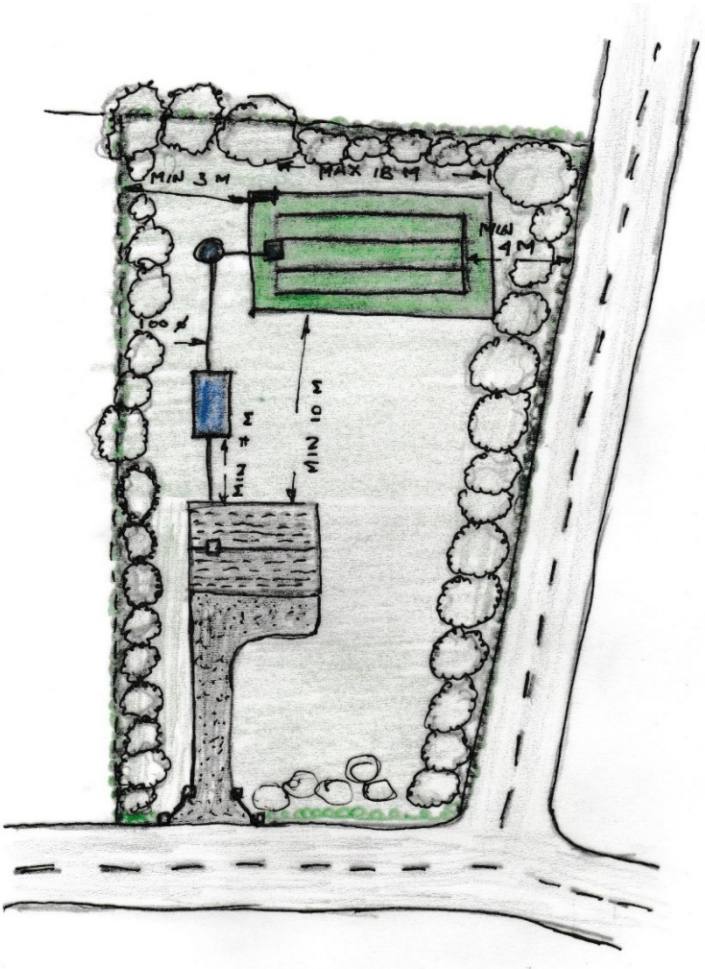
(a) Three considerations to ensure the proper treatment and disposal of sewage for a house in a rural location.

- Soil type: The soil present on the site will determine how effective the percolation will take place in breaking down and treating the waste
- Topography of the site
- Water table: At what level is the water table present on the site. If there is a high -water table there would be potential for contamination from the system
- Neighbouring buildings, roads, rivers, lakes, water sources
- Number of residences in the house
- Protection: Protect humans from contact with waste - water
- Odours: Minimise the generation of foul odours
- Correct capacity of tank (2725litres minimum)
- Gradient of pipework 1:60
- Soil Vent Pipe open at top to vent gasses
- Long radius bend to base of soil vent pipe.

Any other relevant points

(b) Design layout necessary for a typical wastewater treatment system and percolation area on the site.

- Diameter of pipes 100 – 110mm Minimum distance of septic tank to dwelling house 7m
- Minimum distance of percolation to house 10m
- Maximum length of percolation pipe 18m
- Minimum separation distance between percolation trenches 2m
- Minimum distance of systems to site boundary 3m
- Minimum distance of system to a road 4m.

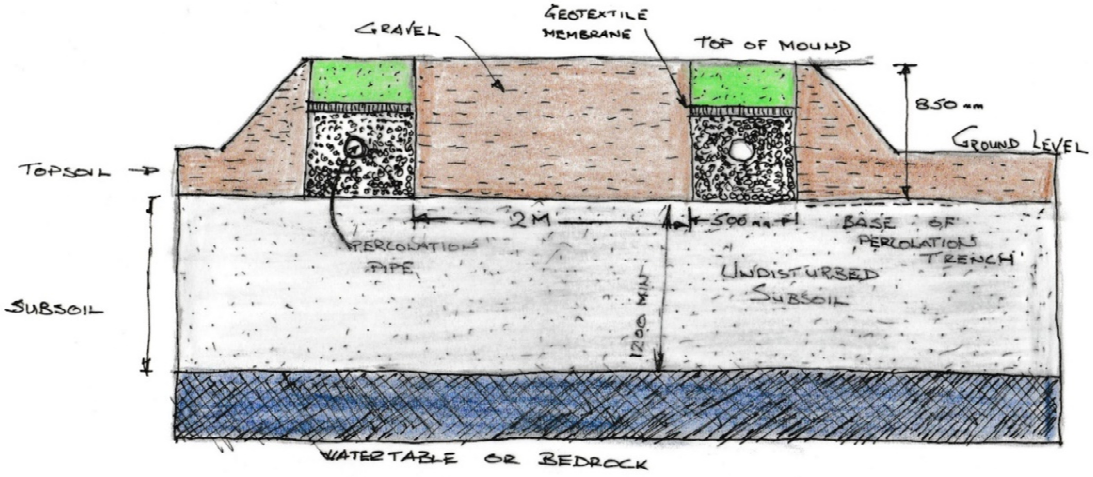


Any other relevant points

(c) Alternative method for the safe treatment of wastewater from a dwelling house.

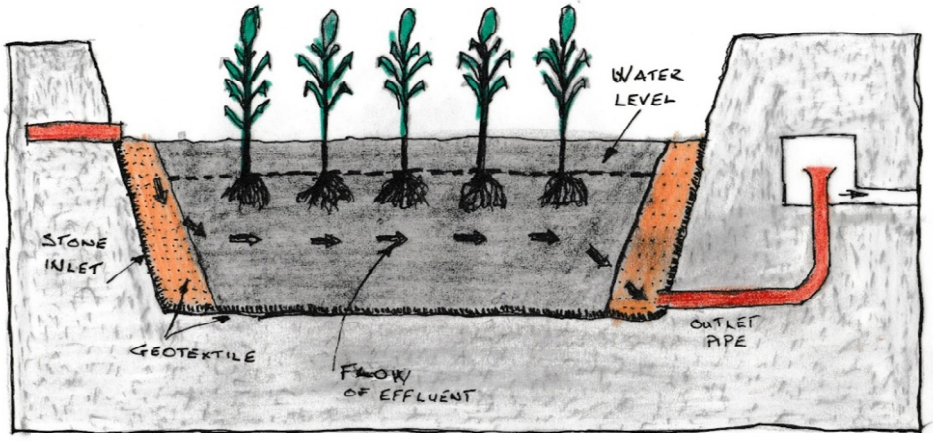
Raised percolation areas

Where site conditions are suitable, raised percolation systems may be installed. Additional topsoil is mounded above the existing ground level. The percolation pipes are laid at other depths from 800 mm below ground surface up to the ground surface and the mounded element may comprise the percolation trenches.



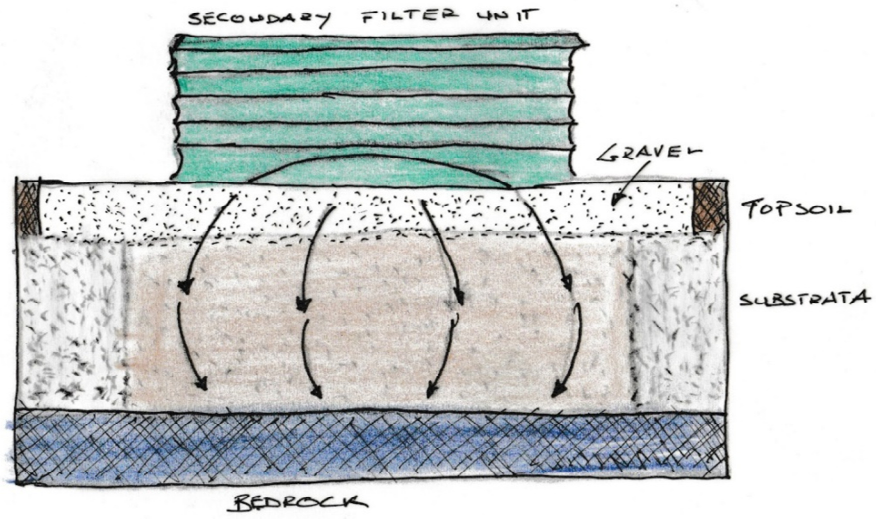
Constructed Wetlands

Constructed wetland is the generic term used to describe both (gravel- and sand-based) horizontal and vertical flow reed bed systems and soil-based constructed wetlands. A constructed wetland (a form of filter system) is another option for the treatment of wastewater from a septic tank.



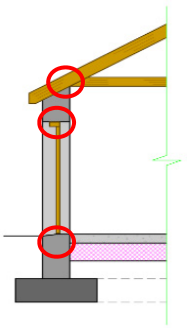
Peat filter system

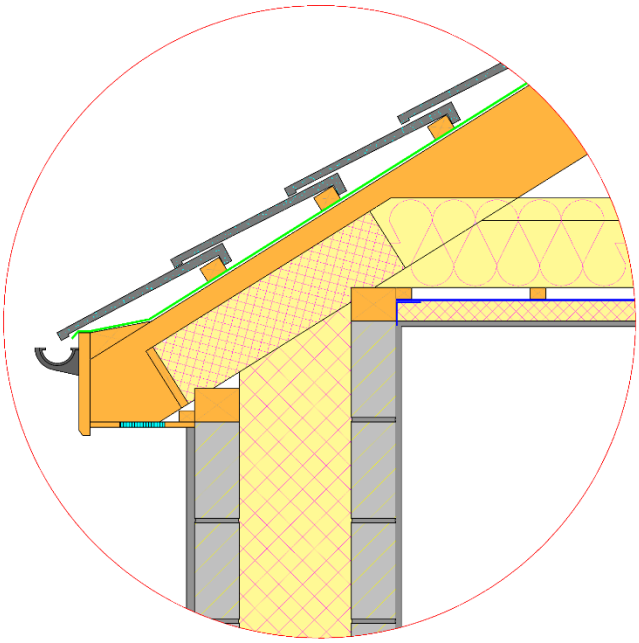
Fibrous peat filter systems consist of a set of module units which ar e filled with peat. A peat filter typically consists of a distribution system, the peat treatment media and a drain. Septic tank wastewater is intermittently dosed evenly onto the top peat media. The effluent then percolates through the peat, receiving treatment by passive biofiltration processes.

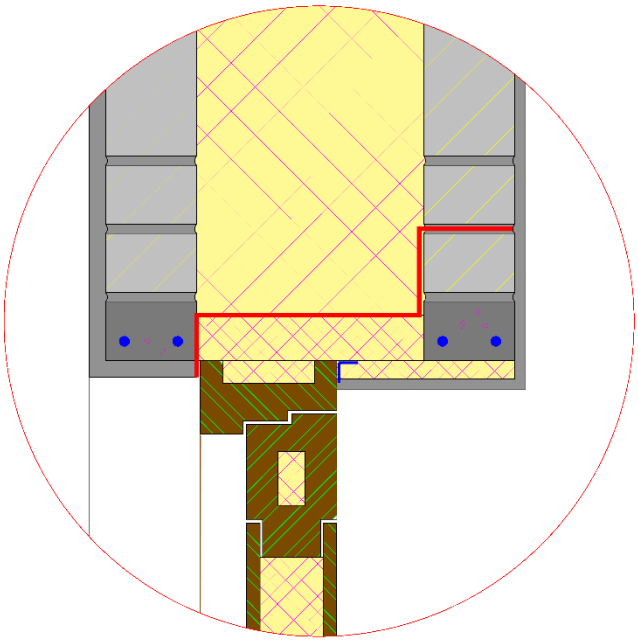


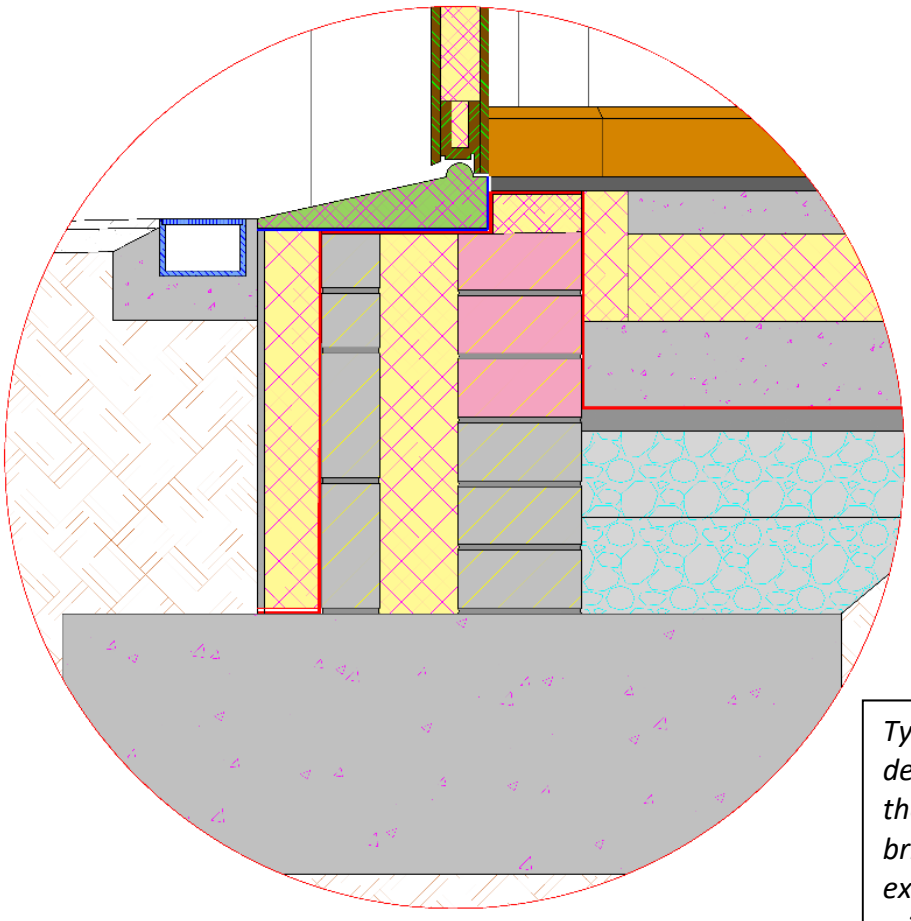
Question 9

(a) Best practice design detailing that will prevent the formation of a thermal bridge at each location.









Typical best practice detailing that will prevent the formation of a thermal bridge at each location in an external full-fill cavity wall with an external door.

(b) Discuss <u>two</u> negative impacts of thermal bridging as a result of poor design detailing.

- The negative effects of thermal bridging occur when warm air meets with a colder surface. The warm air is then cooled to its dew point leaving water as moisture on the surface
- Mould can grow on the damp internal surfaces of the dwelling
- Airborne spores from the mould can be inhaled into the respiratory system and be is harmful to human health
- Mould growth in a home is unsightly, it produces odours, causes staining and rapid deterioration of materials and finishes
- Plaster, wood, steel and other building materials can be compromised and fail as a result of thermal bridging over long periods of time
- Heat is lost when thermal bridging occurs which increases the overall energy demand and the use of resources for heating making the building less sustainable.

Any other relevant points

Question 10

(a) Outline three design considerations necessary to achieve the *EnerPHit* Passive House design standard.

EnerPHit is the standard issued by the Passivhaus Institute that focuses on retrofit projects. Significant Energy and CO^2 savings of between 75-90% can be achieved. It is not always possible to achieve Passivhaus Standard (new buildings) for the refurbishment of old buildings. For this reason the Passivhaus Institute developed the "EnerPHit – quality-approved energy retrofit with Passivhaus components" certificate. It sets a slightly different standard requirement to the full Passivhaus standard. The EnerPHit standard demands airtightness of 1.0 air changes per hour and space heating demand of 25kWh/m^2/yr (as opposed to 0.6 air changes per hour and 15 kWh/m^2/yr for the original passive house standard).

As older buildings and homes use even more energy than the average new construction, they offer even greater potential for energy savings and consequential saving in CO2 emissions. Each home and building is unique and poses its specific problems and solutions to reduce carbon emission, improve energy efficiency and ultimately achieve greater energy security.
(www.passivbuildings.com/retrofit/enerphit)

Possible design considerations for deep retrofit:

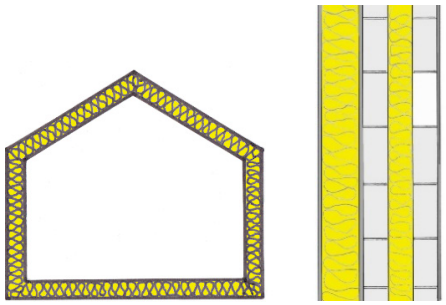
- Thermal efficiency of the external envelope of the building – insulation, windows, doors, porch
- Appropriate ventilation using a heat recovery system
- Airtightness of the building
- Maximise solar gains
- Optimum levels of thermal comfort for occupants
- Renewable energy systems to reduce energy consumption and carbon emissions

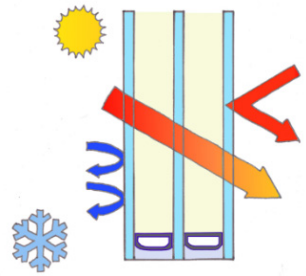
Any other relevant points

(b) How you would retrofit the given house to include each consideration

Thermal efficiency of the external envelope of the building

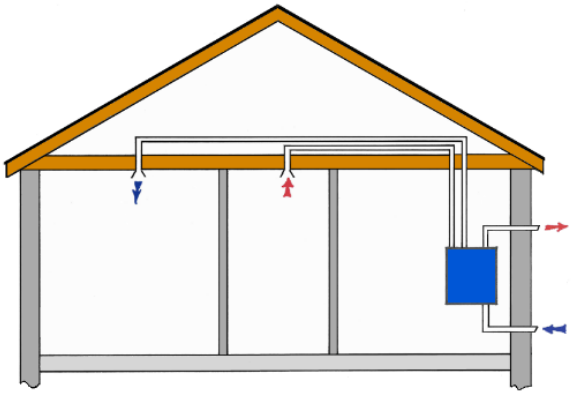
- Increase the levels of insulation in the walls, roof and floor
- EnerPHit Requirements for roof/top floor
  Ceiling U ≤ 0.120 W/m^{2}K
- Insulation can be increased in the walls using cavity wall insulation methods, external wall insulation or internally by dry lining - space permitting.
- Replace windows with Passive House triple glazed windows.
- EnerPHit Requirements for the window as a whole, UW installed ≤ 0.85 W/m^{2}K
- Replace external door with energy efficient doors.
- EnerPHit Requirements: UD, installed ≤ 0.80 W/m^{2}K
- The quality of the materials and the workmanship is vital in the above areas so that thermal bridging does not occur.





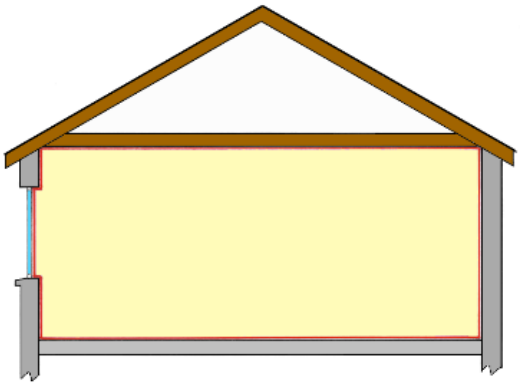
Appropriate ventilation using a heat recovery system

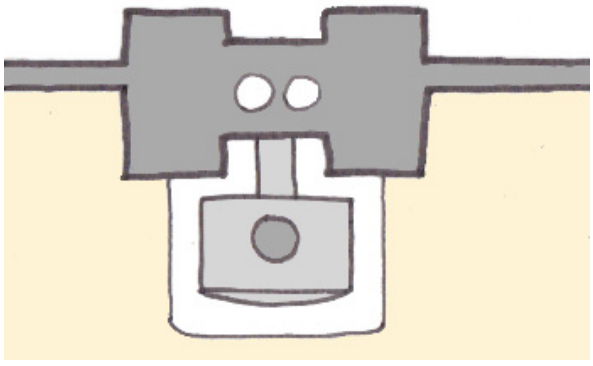
- Install a highly efficient heat recovery and ventilation system with an outlet to supply or extract air from all rooms. This will reduce heat loss, moisture content and the energy consumption of the building
- EnerPHit Requirements: Ventilation η HR,eff ≥ 75%, Electrical efficiency of ventilation system ≤ 0.45Wh/m^3.

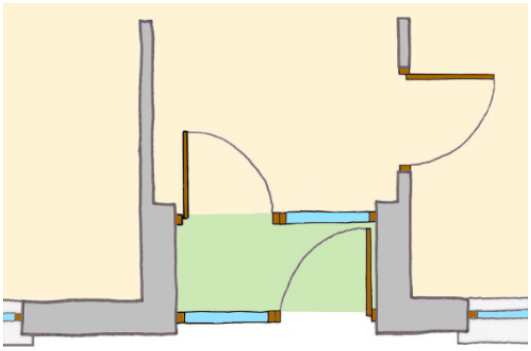


Airtightness of the building

- Seal any holes in the fabric such as pipes penetrating the external walls, joints between wall/ceiling/floor surfaces, openings around electrical services etc.
- Adjust the frames of doors and windows so they close tightly
- Install a wood burning stove to reduce heat loss through the open fireplace
- Install a storm porch to the west entrance to prevent direct access and reduce heat loss







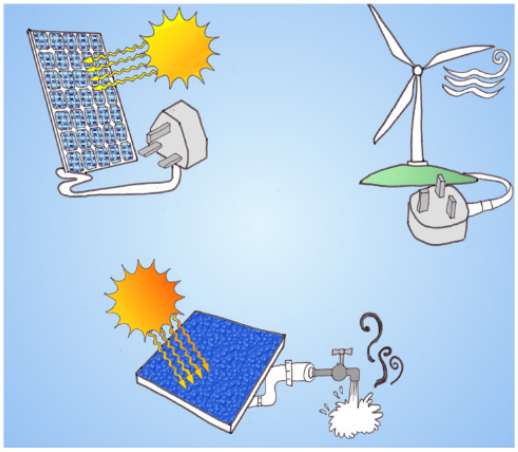
Optimum levels of thermal comfort for occupants

- The heating demand requirement should be ≤ 25 kWh/(m^2a)
- Upgrade boilers and heating controls with more efficient systems

Renewable energy systems to reduce energy consumption and carbon emissions

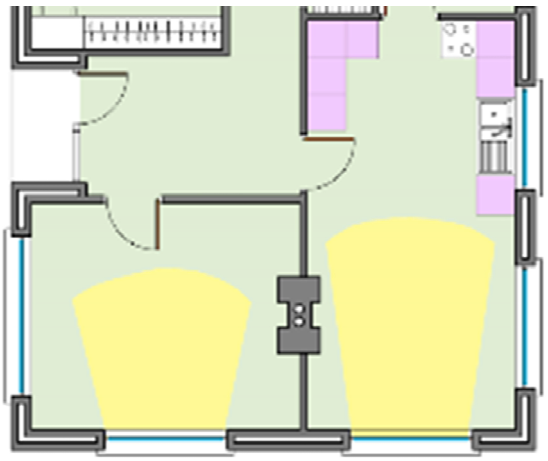
Install renewable energy systems such as:

- solar photovoltaic cells to generate electricity for domestic consumption
- wind turbine to generate electricity
- solar water heating systems such as evacuated tubes to produce hot water for domestic consumption or for space heating.



Maximise solar gains

- Install new windows on the south facing wall of the house.
  Energy demand will be reduced by using the sun to heat the house
- Remove the wall between the dining room and kitchen so both light and heat from the sun can enter further into the house.



Any other relevant points

(c) Two advantages of retrofitting an existing house to meet the *EnerPHit* standard.

- Reduced heating costs
- Improve energy efficiency of the building
- Reduced carbon emissions
- Increased savings on the overall cost of running the home
- Improved wellbeing and quality of life for the inhabitants
- Reusing existing buildings in the community
- Contributing to your moral responsibility to the natural environment and future generations.

Any other relevant points

Question 10.

"Global warming is now a generally recognised phenomenon and sustainability is recognised as being a necessity, not an option. One of the main culprits blamed for global warming is carbon dioxide (CO_2), so it is worth taking a look at what can be done about it. CO_2 is produced by each of us every day, and our personal carbon footprint is a measure of how many tonnes of CO_2 are emitted directly or indirectly, as a result of the consumption of goods and services. When building your own home you should take every opportunity to build in the most sustainable way so as to minimise your own carbon footprint."

Adapted from: **Building Your Own Sustainable and Energy Efficient House.** by Henry Skates

Discuss the above statement in detail and propose three best practice guidelines that would ensure that buildings are built in the most sustainable way possible and thus minimise their carbon footprint.

Discussion of the above statement– such as

- Global warming is a result of human activity, with an increase in the levels of CO_2 in the atmosphere - resulting in the melting of the polar ice caps and a consequent rise in sea levels
- Global warming results in unpredictable weather patterns, with a general raising of global temperatures, resulting in severe droughts in some countries, which impacts on human health, food security, employment and poverty
- Global warming is also responsible for an increased in forest fires, with large areas of precious woodland being destroyed
- Many human activities contribute directly to global warming, through emitting CO_2 directly into the atmosphere
- We cannot have a sustainable planet without sustainable buildings, one planet supplies all our needs and stores our waste – we need to tend it carefully
- Rachel Carson published a ground-breaking book - Silent Spring - in 1962, and she drew attention to the relationship between economic development and environmental degradation, with a reduction in plant, animal and bird species as a result of an excess of CO2 in the atmosphere
- In 1987 the United Nations published a report Our Common Future, commonly called the Brundtland Report, which defined sustainable development as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*."
- This definition has been further refined and sustainability is now also seen as the ability to do much more with very much less for very much longer
- Under the Paris Agreement of 2016, adopted by 196 countries, each country must determine a plan, and regularly report on the contribution that it undertakes to reduce global warming and each target set by a country should go beyond previously set targets
- The Paris Agreement outlines that much greater efforts will be required to reduce greenhouse gas emissions and to hold the increase in the global average temperature to below 2°C
- A global average temperature increase of more than 2°C will make normal activities like growing food impossible in many regions where people currently live
- Climate change is becoming a human rights issue, with human rights at the core of climate change governance
- Our carbon footprint is the amount of carbon, CO_2, our activities release into the atmosphere
- The built environment accounts for about half of all climate and ecological damage, building in a sustainable way is an ethical choice to help mitigate climate change
- Reducing our personal carbon footprint is about changing our lifestyle - such as reducing dependency on the private car and getting on our bikes when we can
- Change from fossil fuels to green energy derived from the sun, wind and water
- Consume less, as every gadget, toy, magazine or piece of clothing that you buy has had an impact on the environment just by being made, as the energy to make these products almost certainly comes from the burning of the fossil fuels that cause greenhouse gas emissions

- The products are often transported over long distances, often half- way across the world to get to us, so think globally and act locally
- Change our attitudes and be happy with the important things in life, most of them aren't made in factories, buy what you need rather than everything you want
- Plant a tree because trees absorb CO_2 from the atmosphere and store it as wood in their trunks, branches and roots.
- Pledge to fly less, eat less meat and grow you own vegetables
- When building or extending your own home, put building green and lean at the centre of every design decision – sustainability at the heart and from the start and of the building process build a small, energy efficient, compact, airtight dwelling to the highest building and aesthetic standards
- Put the occupants' health and wellbeing at the centre of the design process, linking the building to nature, using non-toxic natural materials and incorporating the principles of biophilic design
- Building in a sustainable way means leaving more of the earth's resources for future generations
- Use energy saving products, use permeable paving to absorb water
- Use eco-friendly natural materials such as wood, sheep's wool insulation, hempcrete, earth and lime, don't overuse concrete and use permeable paving, wooden fences and gates
- Building in a sustainable and ethical way implies a light ecological footprint for the house – doing a life-cycle analysis to ensure that the house is eco-friendly to build, easy to maintain and has low lifetime running costs
- Building in a sustainable way means careful specification of materials so that most have low embodied energy, can be sourced locally and built using local design and craft skills

Three best practice guidelines that would ensure that buildings are built in the most sustainable way possible and thus minimise their carbon footprint – such as

To ensure that all buildings are built in the most sustainable way possible and thus reduce their carbon footprint such as:

- Promote, through grant-aid where possible, the use of renewable energies - solar panels, on-site electricity generation where possible and small- scale wind turbines
- Specify energy saving electrical fittings, LEDs, A-rated appliances
- Under discussion is the possible banning of the use of oil or gas operated home heating boilers.
- Air to water heat pumps are highly efficient and operate off renewable energy
- Provide on-site water harvesting facilities and use water saving appliances
- Planning regulations to promote best practise in sustainable design and construction for domestic buildings
- Planning authorities to develop and publish clear planning guidelines outlining the requirements for the construction of sustainable homes
- Through programmes of education, publish and disseminate easy-to-follow guidelines on the fundamentals of sustainable design and construction
- Provide information on biophilic design with advice on native trees and plants - that support wildlife - and that are suitable for different locations and conditions
- Designers to design buildings to reduce use of materials with high embodied energy, such as concrete and steel
- Provide building professionals with training in sustainable design and low energy, airtight construction methods and promote the use of materials with low embodied energy, such as wood cob, rammed earth, hemp-lime.

Any other relevant, cogent, well-argued points.

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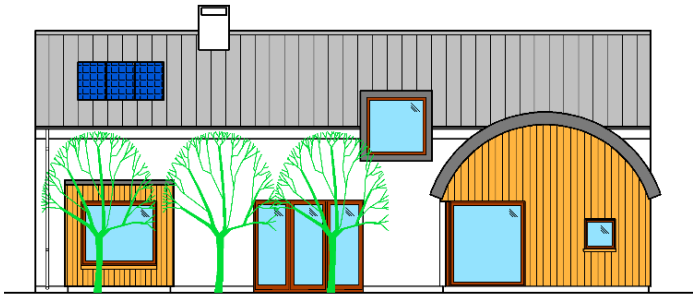
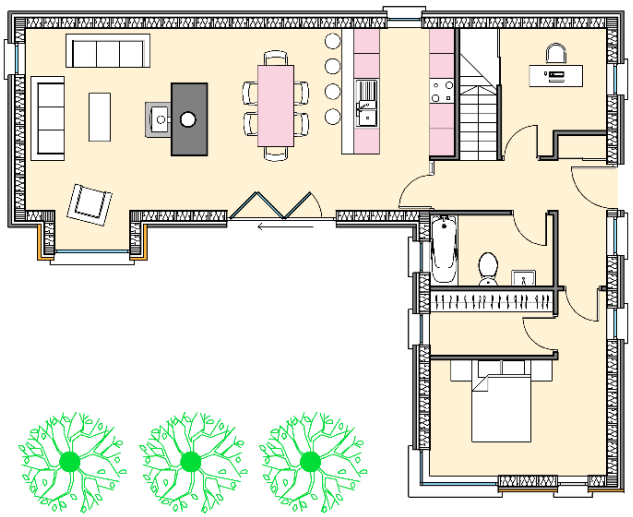
Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2019





Construction Studies

Theory – Higher Level

Marking Scheme

Question 1

PERFORMANCE CRITERIA	MAXIMUM MARK
Lintel + Sheeting ***Ext TFWall:*** ***T-Glazing:***	***Any 12 × 4marks***
External Timber Frame Wall • External render • Concrete block • Air space/Residual cavity • Cavity closer • Breather membrane (BM) • Racking board • 250 Stud/insulation • Sheeting • Air barrier membrane (ABM) • Insulated service cavity • Plasterboard/skim	**4** **4** **4** **4** **4** **4**
Triple Glazing • Concrete Window cill • Wrap around DPC • Frame cill – thermally broken • Window board • Glazing (Triple) • Frame head -thermally broken • Air -tight tapes @ head and cill	**4** **4** **4** **4**
Sheeting /Panel / Lintel • Larch Cladding • Soffit • Battens • Counter battens • DPC • Batten for DPC • Timber lintels	**4** **4**
Scale 4 marks: **Drafting** 4 marks: *Excellent: 8 Good: 6 Fair 4*	**8**
(b) Design detail to prevent the ingress of rainwater at window cill wrap around DPC	**4**
TOTAL	**60**

Question 2

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three functional requirements of a roof	***(3 × 6 marks)***
Design Feature 1 Notes (3 marks) Sketches (3 marks)	**6**
Design Feature 2 Notes (3 marks) Sketches (3 marks)	**6**
Design Feature 3 Notes (3 marks) Sketches (3 marks)	**6**
(b) Three roof profiles suitable for the proposed extension	***(3 × 8 marks) + (2 × 3 marks)***
Roof profile 1 Notes (2 marks) Sketches (6 marks)	**8**
Roof profile 2 Notes (2 marks) Sketches (6 marks)	**8**
Roof profile 3 Notes (2 marks) Sketches (6 marks)	**8**
Recommendation for a roof profile	**3**
Justification for recommendation	**3**
(c) Roofing material for each profile: adv/disadv for each	***(3 × 4 marks)***
Material 1 - identify (2 marks), adv (1 mark), disadv (1 mark)	**4**
Material 2 - identify (2 marks), adv (1 mark), disadv (1 mark)	**4**
Material 3 - identify (2 marks), adv (1 mark), disadv (1 mark)	**4**
TOTAL	**60**

QUESTION 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three design considerations for the proposed bedroom and en-suite	***(3 × 6 marks)***
Design consideration **1** - *(3 for point, 3 for discussion)*	**6**
Design consideration **2** - *(3 for point, 3 for discussion)*	**6**
Design consideration **3 -** *(3 for point, 3 for discussion)*	**6**
(b) Proposed internal layout for the bedroom and en-suite	***(26 marks)***
Internal layout design (Bedroom + *en-suite*)	**14**
Design Consideration **1**	**3**
Design Consideration **2**	**3**
Design Consideration **3**	**3**
Justification	**3**
(c) External design for the extension	***(16 marks)***
Notes	**4**
Sketches	**12**
TOTAL	**60**

QUESTION 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three benefits to the local community	***(3 × 8 marks)***
Benefit **1** (4 for point, 4 for discussion)	**8**
Benefit **2** (4 for point, 4 for discussion)	**8**
Benefit **3** (4 for point, 4 for discussion)	**8**
(b) Two areas for upgrading	***(2 × 10 marks) + (2 × 8 marks)***
Areas to upgrade: • Traditional cut roof with natural slates • Softwood sliding sash windows with single - glazing • Solid external walls of brick construction, uninsulated and with internal lime render	
Area 1	
Notes	**10**
Sketches	**8**
Area 2	
Notes	**10**
Sketches	**8**
TOTAL	**60**

QUESTION 5

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) U-value of external wall	***(10 points × 3 marks)***
External surface resistance	**3**
External render	**3**
External blockwork	**3**
Clear cavity	**3**
Polystyrene insulation	**3**
Internal blockwork	**3**
Internal plaster	**3**
Internal surface resistance	**3**
Total resistance	**3**
Calculation of U- value	**3**
(b) Annual heat loss through uninsulated concrete floor	***(5 × 3 marks)***
Heat loss formula and calculations	**3**
Heating duration for one year	**3**
k/Joules calculation for one year	**3**
Litres of oil for one year	**3**
Annual cost of heat loss	**3**
(c) Required thickness of insulation for U-value of 0.15W/m^{2}K	***(5 × 3 marks)***
Resistance for U- value for 0.15Wm^{2}K (using R=1/U)	**3**
Resistance from calculated U-value from part **(a)**	**3**
Difference in resistances (required resistance)	**3**
Application of formula R = T/k	**3**
Required thickness of insulation	**3**
TOTAL	**60**

QUESTION 6

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Three features of low environmental impact design***	***(6 × 5 marks)***
Design Feature 1	
Notes	**5**
Sketches	**5**
Design Feature 2	
Notes	**5**
Sketches	**5**
Design Feature 3	
Notes	**5**
Sketches	**5**
(b) Renewable energy technologies and contributes to eco-friendly home	***(6 × 3 marks)***
Evacuated Tubes	
Notes - discussion	**3**
Sketch	**3**
Wind Turbines	
Notes - discussion	**3**
Sketch	**3**
Photovoltaic Panels	
Notes - discussion	**3**
Sketch	**3**
(c) Two advantages of local craft skills	***(2 × 6 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 stairs***	***(8 x 5 marks)***
Any 8: • Bullnose step • Newel post • String • String capping • Riser • Tread • Wedges • Glue blocks • Hand- rail • Balusters • Nosing line/pitch line • Jointing -hand rail to newel post • Jointing – string to newel post	**5** **5** **5** **5** **5** **5** **5** **5** **5**
Three dimensions of the stairs	**6**
Scale and drafting marks *(Excellent, Good, Fair)* *8 6 4*	**8**
(b) Indicate on drawing 3 safety design features:	
Design details *(3 x 2 marks)*	**6**
TOTAL	**60**

Question 8

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Proper treatment and disposal in rural location	***(3 × 6 marks)***
Consideration **1** - *(3 for point, 3 for discussion)*	**6**
Consideration **2** - *(3 for point, 3 for discussion)*	**6**
Consideration **3** - *(3 for point, 3 for discussion)*	**6**
(b) Typical wastewater treatment system and percolation layout	***(2 × 10 marks) + (6 marks)***
Typical layout: (Dwelling, Chamber, PA)	**10**
Notes	
Sketch	**10**
Dimensions - Any three	**6**
(c) Alternative method of treating wastewater	***(2 × 8 marks)***
Alternative system	
Notes	**8**
Sketch	**8**
TOTAL	**60**

QUESTION 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Best practice design detailing to prevent thermal bridging	***(6 × 8 marks)***
Wallplate position detail	
Notes	**8**
Sketches	**8**
Head of door detail	
Notes	**8**
Sketches	**8**
Threshold of door detail	
Notes	**8**
Sketches	**8**
(b) Two negative impacts of thermal bridging	***(2 × 6 marks)***
Impact 1 - *(3 for point, 3 for discussion)*	**6**
Impact 2 - *(3 for point, 3 for discussion)*	**6**
TOTAL	**60**

QUESTION 10

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Three design considerations to achieve Enerphit standard***	***(6 × 4 marks)***
Design consideration 1	
Notes	**4**
Sketches	**4**
Design consideration 2	
Notes	**4**
Sketches	**4**
Design consideration 3	
Notes	**4**
Sketches	**4**
(b) Retrofit upgrades for each consideration to the house	***(6 × 4 marks)***
Retrofit upgrade 1	
Notes	**4**
Sketches	**4**
Retrofit upgrade 2	
Notes	**4**
Sketches	**4**
Retrofit upgrade 3	
Notes	**4**
Sketches	**4**
(c) ***Two advantages of retrofitting to Enerphit standard***	***(2 × 6 marks)***
Impact 1 – (3 for name, 3 for discussion)	**6**
Impact 2 - (3 for name, 3 for discussion)	**6**
TOTAL	**60**

Question 10 (Alternative)

PERFORMANCE CRITERIA	MAXIMUM MARK
Discussion of Statement	***(3 × 10 marks)***
Discussion: Point 1 *(4 for point, 6 for discussion)*	**10**
Discussion: Point 2 *(4 for point, 6 for discussion)*	**10**
Discussion: Point 3 *(4 for point, 6 for discussion)*	**10**
Three best practice guidelines to sustainable building	***(3 × 10 marks)***
Guideline **1**: *(4 for point, 6 for discussion)*	**10**
Guideline **2**: *(4 for point, 6 for discussion)*	**10**
Guideline **3**: *(4 for point, 6 for discussion)*	**10**
TOTAL	**60**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

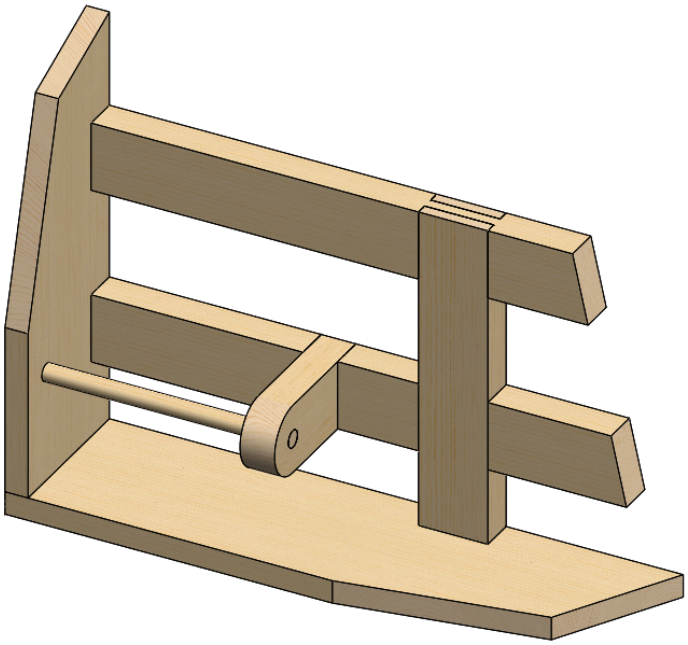
Leaving Certificate Examination, 2019

Construction Studies

Practical Test

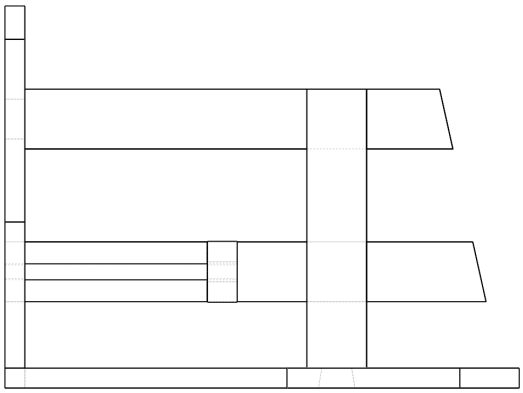
Common Level

(150 marks)



Marking Scheme

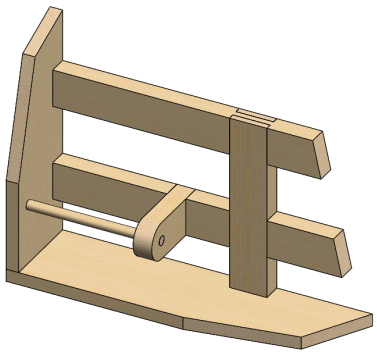
Day 1



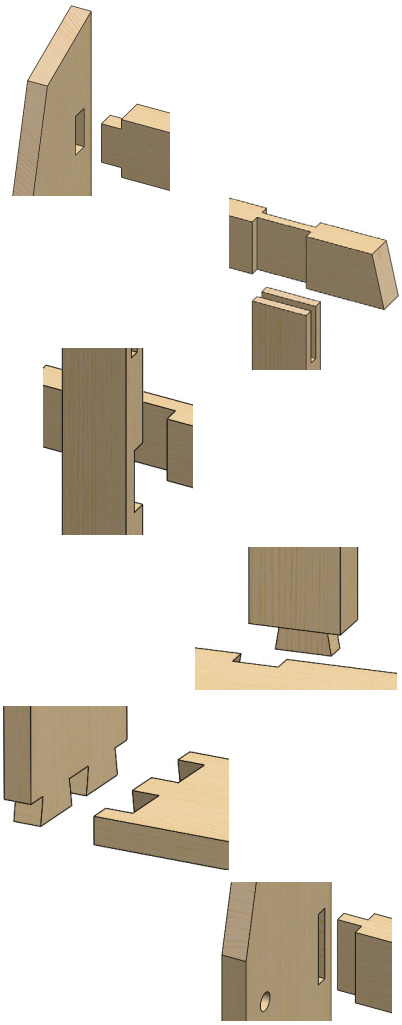
Marking Scheme – Practical Test

Note:

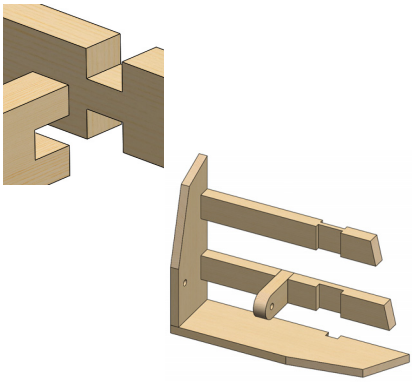
- The artefact is to be hand produced by candidates without the assistance of machinery.
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available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

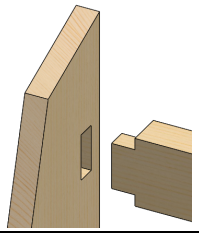


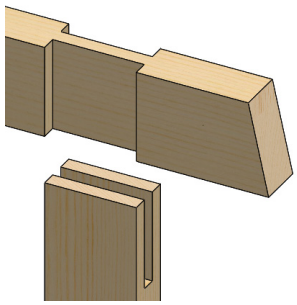
(i)	OVERALL ASSEMBLY	MARK
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *3 marks* • shaping *3 marks*	**6**
	Total	**16**

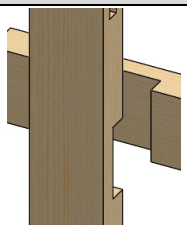


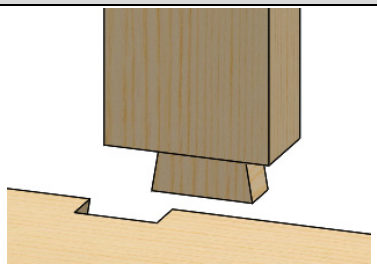
(ii)	MARKING OUT	Marks
a.	Bare Faced Mortice and Tenon • mortice *3 marks* • tenon *3 marks*	**6**
b.	Top Bridle Joint • trench *2 × 2 marks* • bridle - vertical piece *2 marks*	**6**
c.	Cross Halving Joint • trench - horizontal piece *2 marks* • trench - vertical piece *2 marks*	**4**
d.	Dovetail • tail *3 marks* • trench *3 marks*	**6**
e.	Box Dovetail • tails *2 × 2 marks* • pins *2 × 2 marks*	**8**
f.	Mortice and Tenon • mortice *2 marks* • tenon *2 marks*	**4**

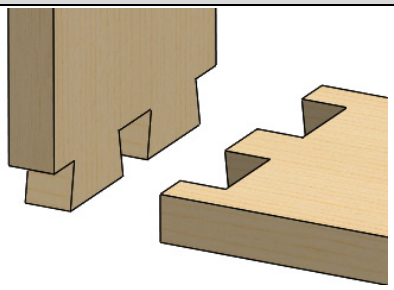
	g.	Bridle Joint • trenches *2 × 2 marks* • bridle *2 marks*	**6**
	h.	Slopes and Curve • slopes *6 × 1 mark* • curve *2 marks*	**8**
		Total	**48**

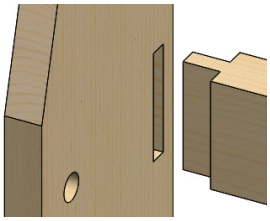
Bare Faced Mortice and Tenon	**(iii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

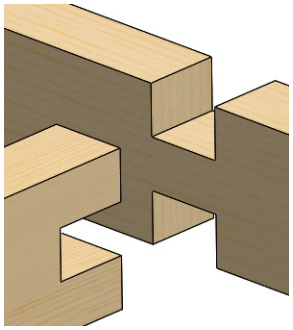
Top Bridle Joint	**(iv)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 x1 mark* • paring to trenches to depth *2 x 2 mark*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**

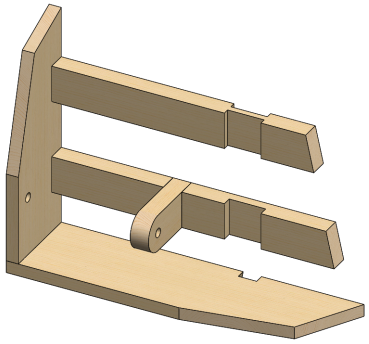
Cross Halving Joint	**(v)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring trenches *2 x 2 marks*	**8**
		Total	**8**

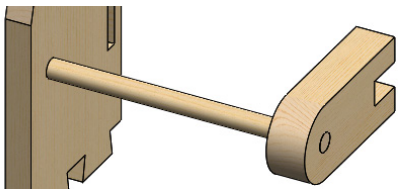
Dovetail Halving	(vi)	PROCESSING	Marks
	a.	Tail – vertical piece • saw of dovetail *4 x 1 mark* • paring dovetail *2 x 1 mark*	**6**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	**4**
		Total	**10**

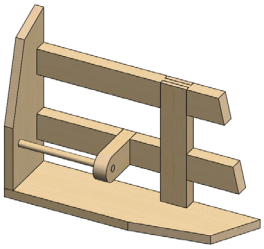
Box Dovetail	(vii)	PROCESSING	Marks
	a.	Tails *2 × 4 marks*	**8**
	b.	Pins • sawing with the grain *4 × 1 mark* • sawing/paring across the grain *2 × 2 marks*	**8**
		Total	**16**

Mortise and Tenon Joint	(viii)	PROCESSING	Marks
	a.	Mortise *3 marks*	**3**
	b.	Tenon *4 marks*	**4**
		Total	**7**

Bridle Joint	(ix)	PROCESSING	Marks
	a.	Trenches *2 × 2 marks*	**4**
	b.	Bridle • vertical sawing *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**8**

Shaping	(x)	PROCESSING	Marks
	a.	Short slopes *2 × 1 mark*	**2**
	b.	Long slopes *4 × 2 marks*	**8**
	c.	Curve *2 marks*	**2**
		Total	**12**

Drilling	(xi)	PROCESSING	Marks
	a.	Dowel located and fitted correctly *2 × 2 marks*	**4**
		Total	**4**

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

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

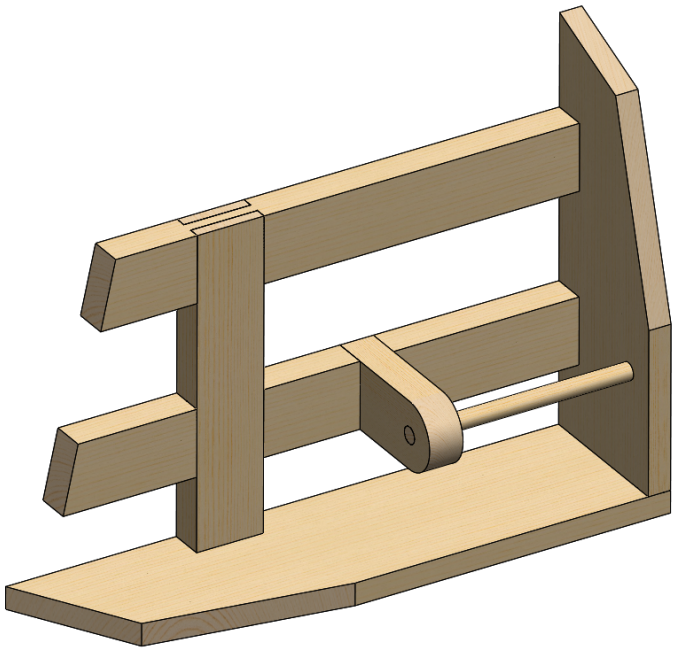
Leaving Certificate Examination, 2019

Construction Studies

Practical Test

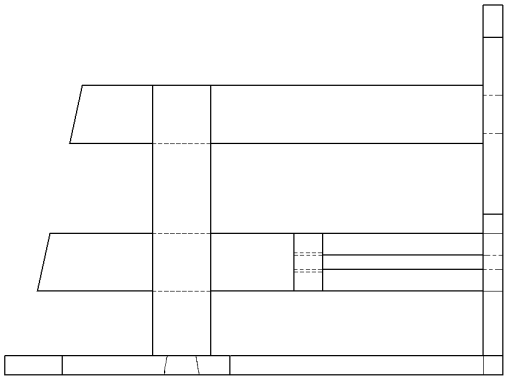
Common Level

(150 marks)



Marking Scheme

Day 2



Marking Scheme – Practical Test

Note:

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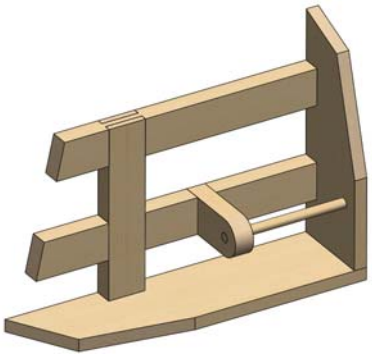
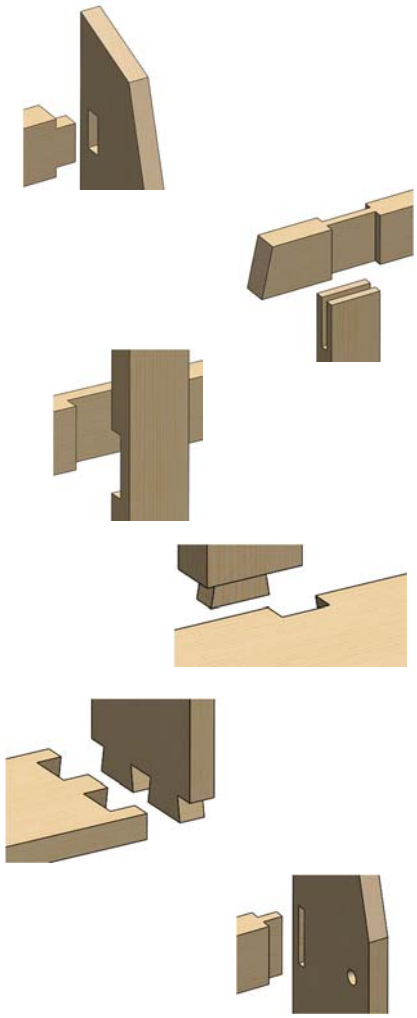
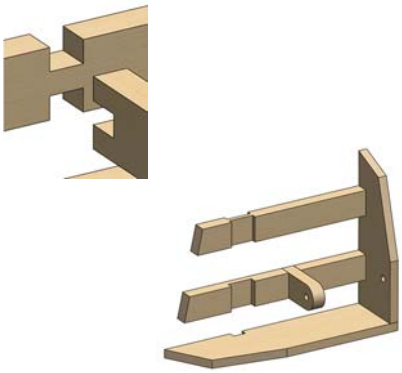
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that procedure.

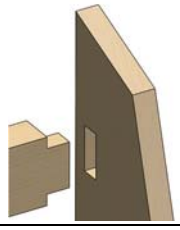


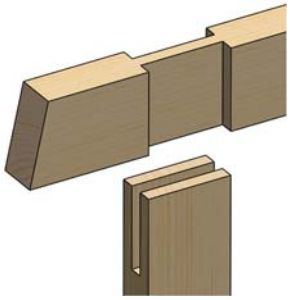
(i)	OVERALL ASSEMBLY	MARKS
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *3 marks* • shaping *3 marks*	**6**
	Total	**16**



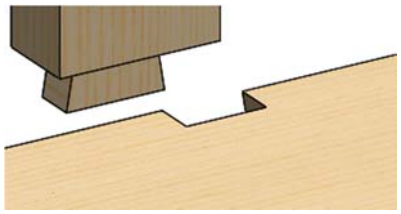
(ii)	MARKING OUT	Marks
a.	Bare Faced Mortice and Tenon • Mortice *3 marks* • Tenon *3 marks*	**6**
b.	Top Bridle Joint • Trench *2 × 2 marks* • Bridle - vertical piece *2 marks*	**6**
c.	Cross Halving Joint • Trench - horizontal piece *2 marks* • Trench - vertical piece *2 marks*	**4**
d.	Dovetail • Tail *3 marks* • Trench *3 marks*	**6**
e.	Box Dovetail • Tails *2 × 2 marks* • Pins *2 × 2 marks*	**8**
f.	Mortice and Tenon • Mortice *2 marks* • Tenon *2 marks*	**4**

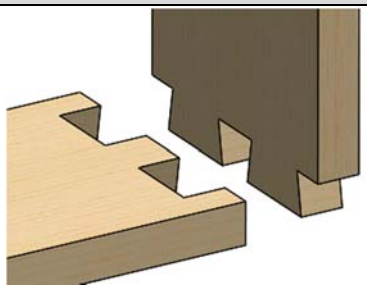
	g.	Bridle Joint • Trenches *2 × 2 marks* • Bridle *2 marks*	**6**
	h.	Slopes and Curve • Slopes *6 × 1 mark* • Curve *2 marks*	**8**
		Total	**48**

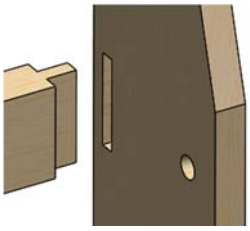
Bare Faced Mortice and Tenon	**(iii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

Top Bridle Joint	**(iv)**	**PROCESSING**	**Marks**
	a.	Trenches • Sawing across the grain *4 x1 mark* • Paring to trenches to depth *2 x 2 mark*	**8**
	b.	Bridle • Sawing with the grain *2 × 1 mark* • Paring bridle *2 marks*	**4**
		Total	**12**

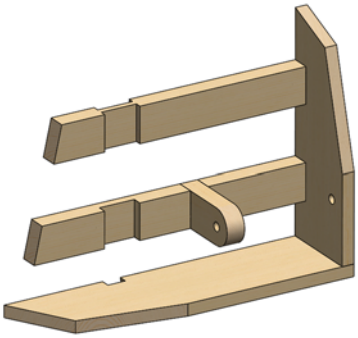
Cross Halving Joint	**(v)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring trenches *2 x 2 marks*	**8**
		Total	**8**

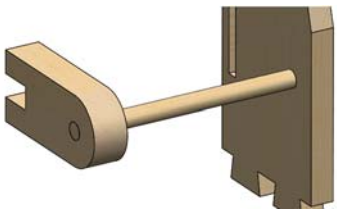
Dovetail Halving	(vi)	PROCESSING	Marks
	a.	Tail – vertical piece • saw of dovetail *4 x 1 mark* • Paring dovetail *2 x 1 mark*	**6**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	**4**
		Total	**10**

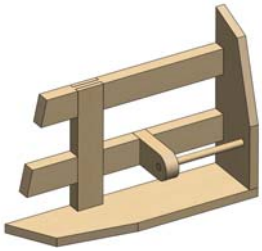
Box Dovetail	(vii)	PROCESSING	Marks
	a.	Tails *2 × 4 marks*	**8**
	b.	Pins • sawing with the grain *4 × 1 mark* • sawing/paring across the grain *2 × 2 marks*	**8**
		Total	**16**

Mortise and Tenon Joint	(viii)	PROCESSING	Marks
	a.	Mortise *3 marks*	**3**
	b.	Tenon *4 marks*	**4**
		Total	**7**

Bridle Joint	(ix)	PROCESSING	Marks
	a.	Trenches *2 × 2 marks*	**4**
	b.	Bridle • Vertical sawing *2 × 1 mark* • Paring bridle *2 marks*	**4**
		Total	**8**

Shaping	(x)	PROCESSING	Marks
	a.	Short slopes *2 × 1 mark*	**2**
	b.	Long slopes *4 × 2 marks*	**8**
	c.	Curve *2 marks*	**2**
		Total	**12**

Drilling	(xi)	PROCESSING	Marks
	a.	Dowel located and fitted correctly *2 × 2 marks*	**4**
		Total	**4**

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

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Coimisiún na Scrúduithe Stáit
State Examinations Commission

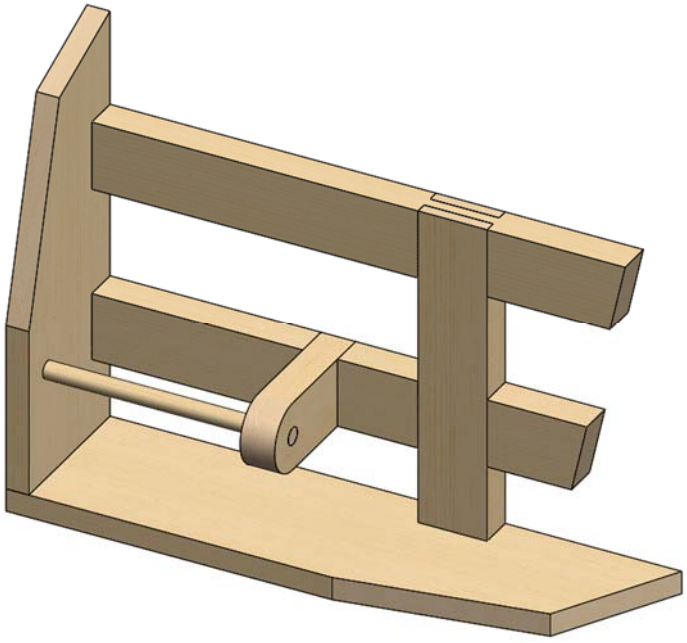
Leaving Certificate Examination, 2019

Construction Studies

Practical Test

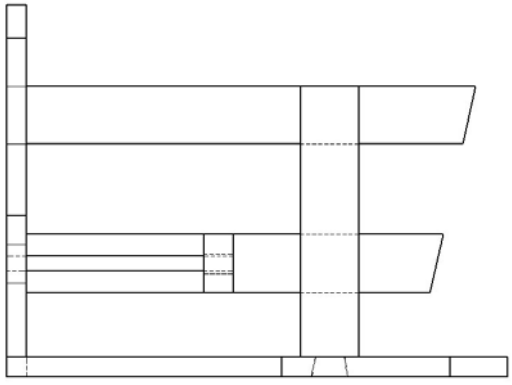
Common Level

(150 marks)



Marking Scheme

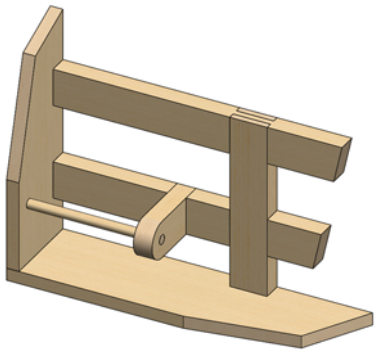
Day 3



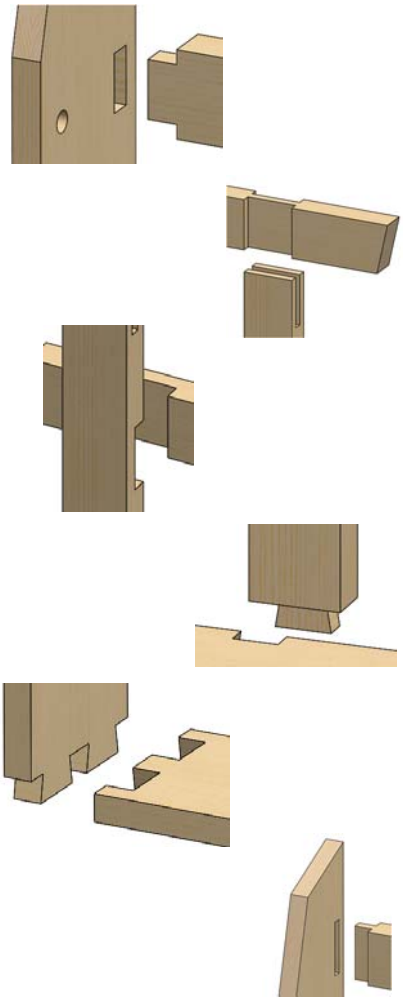
Marking Scheme – Practical Test

Note:

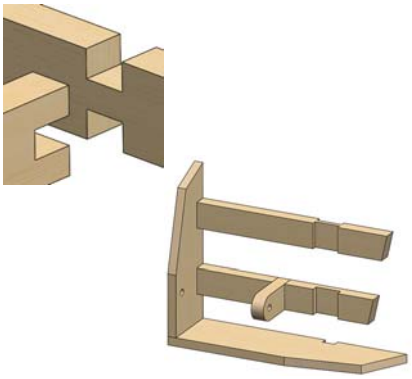
- The artefact is to be hand produced by candidates without the assistance of machinery.
- However the use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available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

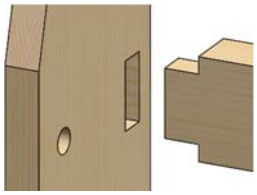


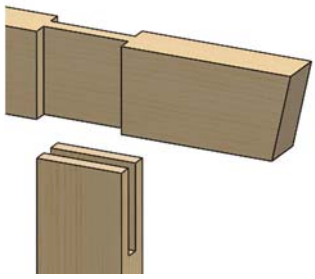
(i)	OVERALL ASSEMBLY	MARK
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *3 marks* • shaping *3 marks*	**6**
	Total	**16**

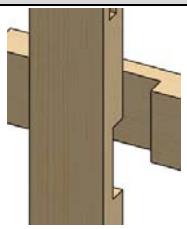


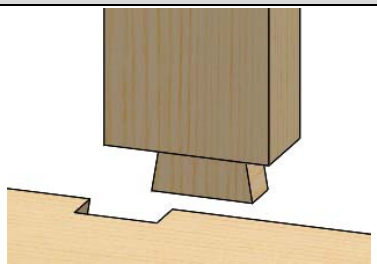
(ii)	MARKING OUT	Marks
a.	Bare Faced Mortice and Tenon • Mortice *3 marks* • Tenon *3 marks*	**6**
b.	Top Bridle Joint • Trench *2 × 2 marks* • Bridle - vertical piece *2 marks*	**6**
c.	Cross Halving Joint • Trench - horizontal piece *2 marks* • Trench - vertical piece *2 marks*	**4**
d.	Dovetail • Tail *3 marks* • Trench *3 marks*	**6**
e.	Box Dovetail • Tails *2 × 2 marks* • Pins *2 × 2 marks*	**8**
f.	Mortice and Tenon • Mortice *2 marks* • Tenon *2 marks*	**4**

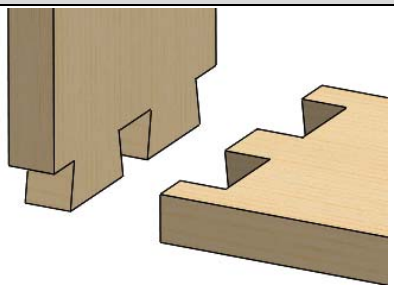
	g.	Bridle Joint • Trenches *2 × 2 marks* • Bridle *2 marks*	**6**
	h.	Slopes and Curve • Slopes *6 × 1 mark* • Curve *2 marks*	**8**
		Total	**48**

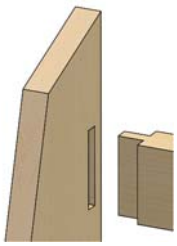
Bare Faced Mortice and Tenon	**(iii)**	**PROCESSING**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

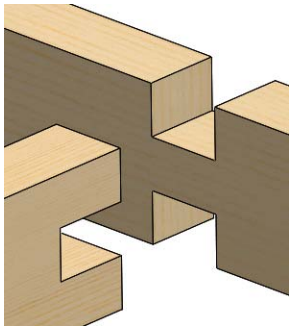
Top Bridle Joint	**(iv)**	**PROCESSING**	**Marks**
	a.	Trenches • Sawing across the grain *4 x1 mark* • Paring to trenches to depth *2 x 2 mark*	**8**
	b.	Bridle • Sawing with the grain *2 × 1 mark* • Paring bridle *2 marks*	**4**
		Total	**12**

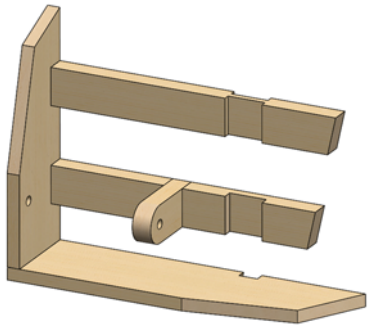
Cross Halving Joint	**(v)**	**PROCESSING**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring trenches *2 x 2 marks*	**8**
		Total	**8**

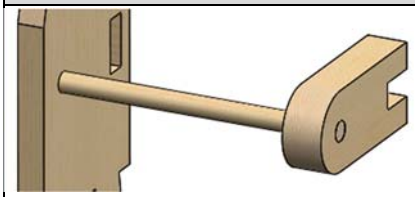
Dovetail Halving	(vi)	PROCESSING	Marks
	a.	Tail – vertical piece • saw of dovetail *4 x 1 mark* • Paring dovetail *2 x 1 mark*	**6**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • paring trench *2 marks*	**4**
		Total	**10**

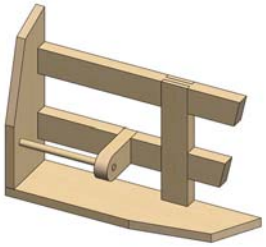
Box Dovetail	(vii)	PROCESSING	Marks
	a.	Tails *2 × 4 marks*	**8**
	b.	Pins • sawing with the grain *4 × 1 mark* • sawing/paring across the grain *2 × 2 marks*	**8**
		Total	**16**

Mortise and Tenon Joint	(viii)	PROCESSING	Marks
	a.	Mortise *3 marks*	**3**
	b.	Tenon *4 marks*	**4**
		Total	**7**

Bridle Joint	(ix)	PROCESSING	Marks
	a.	Trenches *2 × 2 marks*	**4**
	b.	Bridle • Vertical sawing *2 × 1 mark* • Paring bridle *2 marks*	**4**
		Total	**8**

Shaping	(x)	PROCESSING	Marks
	a.	Short slopes *2 × 1 mark*	**2**
	b.	Long slopes *4 × 2 marks*	**8**
	c.	Curve *2 marks*	**2**
		Total	**12**

Drilling	(xi)	PROCESSING	Marks
	a.	Dowel located and fitted correctly *2 × 2 marks*	**4**
		Total	**4**

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

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Form A

Leaving Certificate Examination

Construction Studies

School assessment of Candidates' Practical Coursework

Name of Candidate: ..... **Examination Number:**

Type of Project:

☐ Practical Craft ☐ Building Science

☐ Written/Drawn with Scale model ☐ Composite

	Marking Scheme		Maximum Marks	Marks Awarded
A	**Planning of Project** • Ability to design an appropriate plan of procedure • Evidence of research • Preparation of working drawings/use of models as graphic aids			
		Subtotal	**30**	
B	**Report Writing** • Design folio detailing planning, execution and evaluation of project • Critical appraisal of project for quality, function and finish • Conclusions from practical experience of project work			
		Subtotal	**30**	
C	**Manipulative Skills** • Skills in preparation and finishing of materials • Safe use of tools and machines - Hand/Power/CNC • Skills in assembly of materials			
		Subtotal	**30**	
D	**Presentation of Project** • Task completed to acceptable standard • Appropriate use of materials • Satisfactory knowledge of construction technology			
		Subtotal	**30**	
E	**Experiments** • Evidence of ability to plan and carry out **three** experiments *Experiments should be related to the project work or selected from the suggested experiments outlined in the syllabus for Construction Studies.*	Experiment **1** Experiment **2** Experiment **3**		
		Subtotal	**30**	
		Total:	**150**	

Signature of Teacher:..... ***Date:*** .....

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