Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2024

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 2024

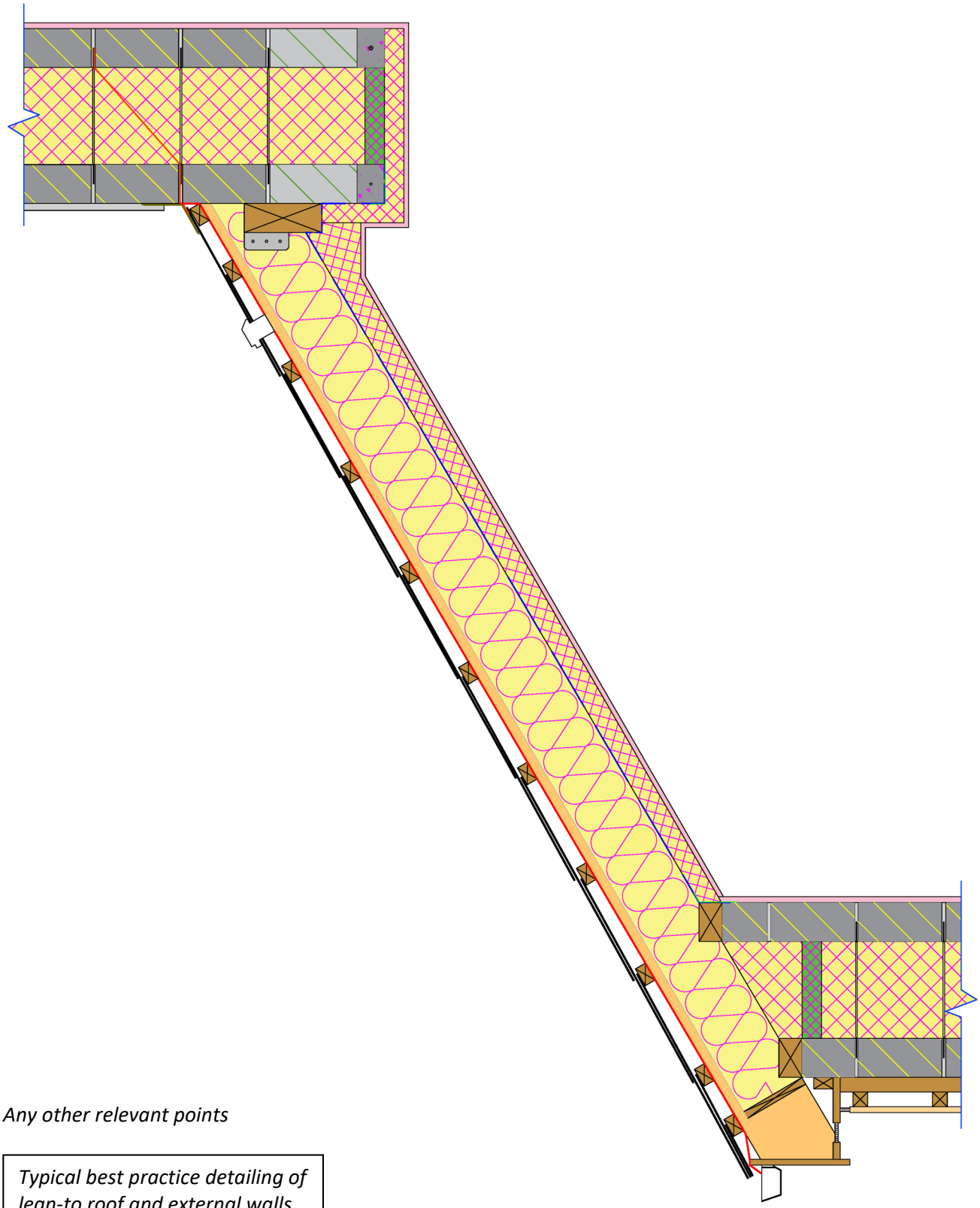
Construction Studies

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 lean-to roof and external walls of a house.



Any other relevant points

Typical best practice detailing of lean-to roof and external walls of a house.

External wall and eaves - typical detailing

- Larch cladding rain screen
- Battens / counter battens
- Cavity wall blockwork & wall ties
- Full-fill insulation
- Cavity closer
- Wallplates
- Skim

Lean - To roof - typical detailing

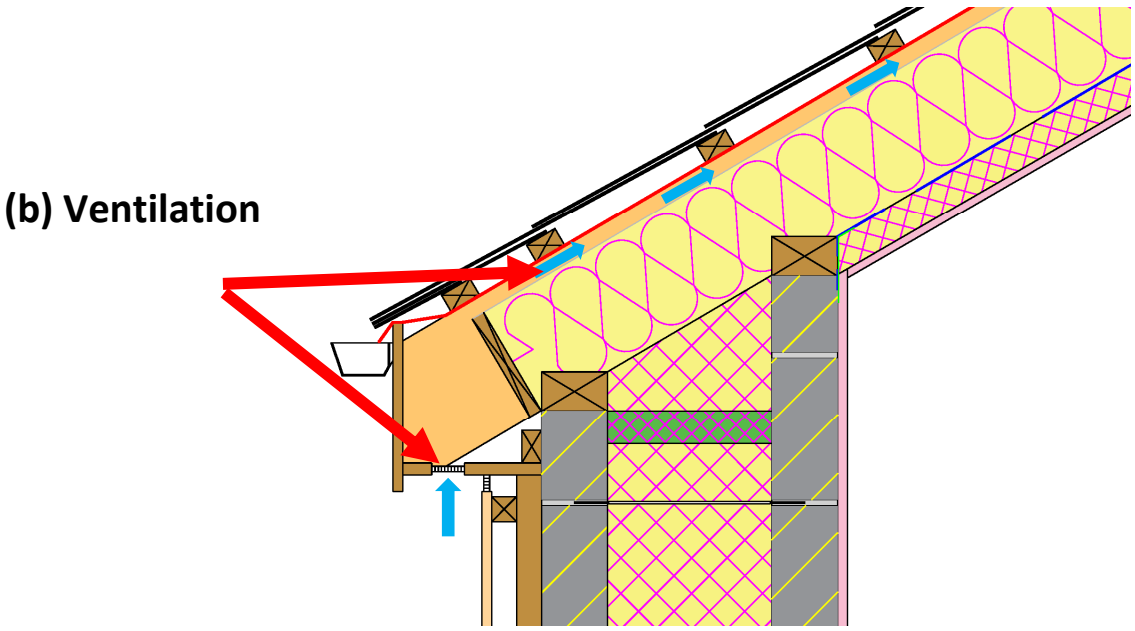
- Fascia / soffit / gutter (Any two)
- Three courses of slate
- Slating battens 50 × 30 mm @ 400 mm centres
- Roof breather membrane
- Ventilation
- Roof rafter & insulation
- Air barrier membrane & airtightness taping
- Insulated plasterboard (50 mm insulation + 12.5 mm plasterboard)

Front wall of house and abutment - typical detailing

- External & internal render
- Full-fill cavity wall blockwork & low conductivity wall ties
- Concrete lintels
- Cavity closer
- Rafter support
- Stepped DPC
- Lead flashing (under and apron)

Any other relevant points

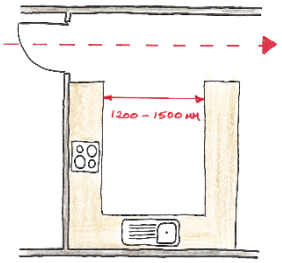
(b) Typical design detailing that will ensure ventilation of the roof structure.

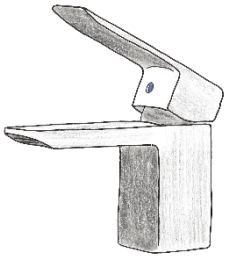


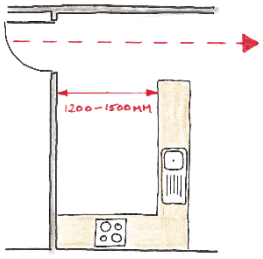
Question 2

(a) Two best practice guidelines for each of the following areas when designing a house for lifetime use.

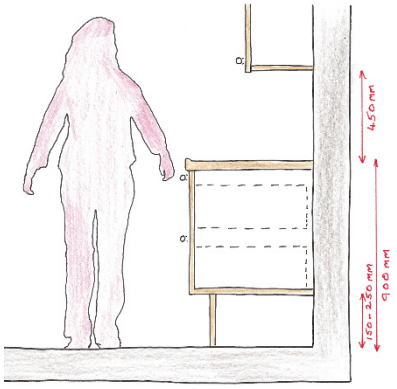
Kitchen





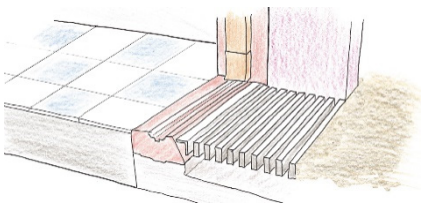


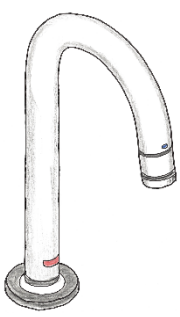
- 1200 – 1500 mm between opposing work surfaces will allow ease of movement for everyone to use the kitchen safely
- Angled sockets / pop-up sockets within a worktop or to the side of a cupboard- easily seen and accessed
- Shallow sinks
- D-handles to drawers and cupboards, which are easy to grip, minimum of 100 mm long
- Fit hinged cupboard doors which can be opened to minimum 135 degrees
- Ensure that hot water supply to sink does not exceed 40 °C, taps controlled by sensor or elongated control handles
- Doors to the kitchen outside the main workspace
- Narrow base units, 300 – 400 mm deep are easier for everyone to use, less stooping and bending to get items out of the cupboards. However, most worktops need to be 500 – 600 mm wide to provide enough space for preparing and cooking meals. Therefore, pull out drawers are preferable to shelving in 500 – 600 mm deep base units
- Providing clear knee-space beneath sink, hob, and other areas of the kitchen worktop will allow the full use of the kitchen by someone seated. In addition, a setback for the plinth should be deep enough for toe space for someone standing or foot space for a wheelchair footrest

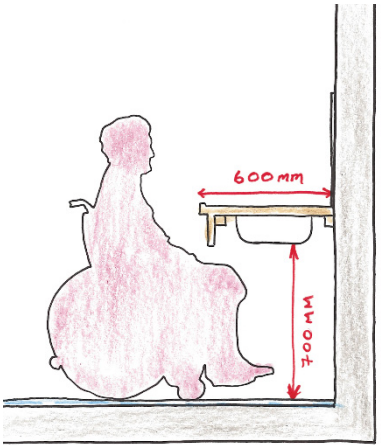


- Wheelchair-users will benefit from the oven and fridge being located in a housing to bring them up to accessible height. Locating the fridge and oven within a housing unit next to a worktop will avoid problems when moving
- The edge of the worktop should be detailed to reduce risk of run-off if there is a spillage. Use a slightly raised trim or “waterfall lip”
- Provide space of at least 300 mm on either side of the hob, and to one side of the oven
- Provide the option of having height adjustable or fixed height worktops between the heights of 760 mm and 900 mm high

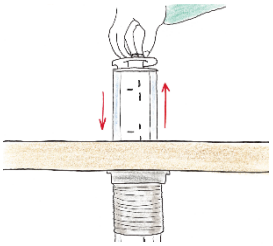
- Install a pull-down mechanism for bringing shelf contents within reach
- A level threshold should be provided to the back garden, and at every entrance door
- The table is best located in the kitchen to minimise the distance for carrying food and drinks. There should be 1200 mm minimum clear space on at least two sides of the table





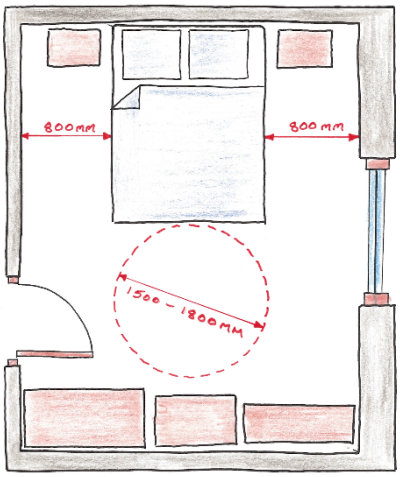


- Plinth, 250 mm high to suit wheelchair users
- Flooring material continued under base unit
- Shallow wall mounted cupboard 450 mm above work surface

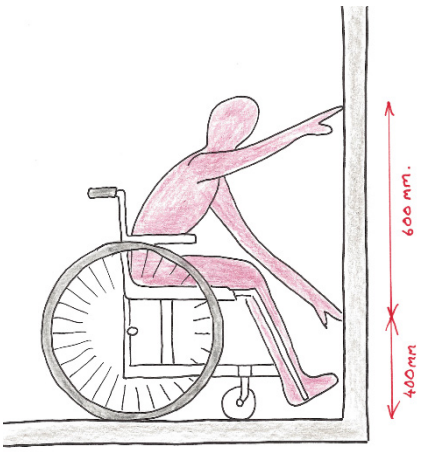


Any other relevant points

Bedroom



- At least 800 mm clear space either side of bed and more at the end of the bed. Sockets and switches installed at between 400 mm and 1000 mm above floor level
- Provide a clear space for a turning circle of 1500 mm in the double bedroom. Provide a clear space for a turning circle of between 1500 and 1800 mm within the room
- Where possible an additional room at ground floor should be provided for various uses such as ground floor bedroom or study
- Windows should be operable with one hand, with lever fixings between 800 mm and 1200 mm
- Bedrooms have multiple functions such as a place for sleeping, for children at play, and sometimes the room is a study space
- The room needs to be large enough for the furniture usually required in bedrooms (for one or two people)
- It should be comfortable to move around with easy access to the bed as well as unobstructed access for opening doors and windows
- A ‘soft spot’ in the wall between the bedroom and bathroom can allow easy installation of a door to convert to an en suite. This requires careful planning at the design stage of wall studs, bathroom fittings and bedroom furniture configurations to suit adaption



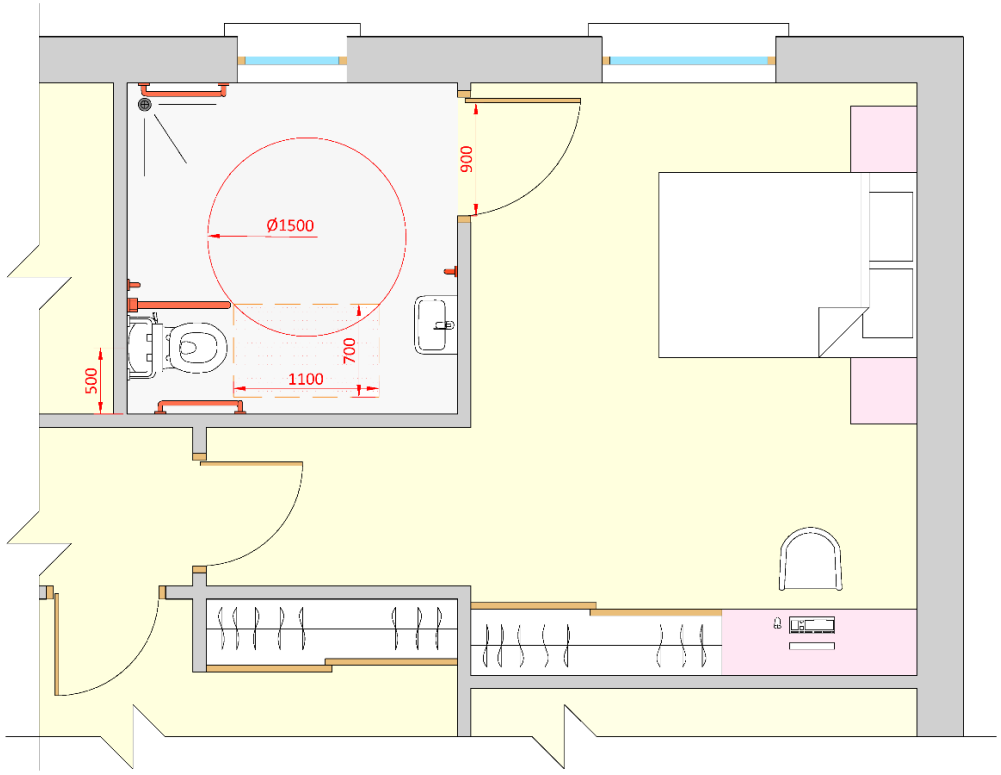
- Provide “hard-spots” for future installation of a short hoist for use to transfer someone from the bed to a wheelchair, and from a wheelchair to a WC or bath, or vice versa
- Provide light switches at the entry door and on both sides of the double bed

Any other relevant points

(b) Using notes and a freehand sketch, show a preferred layout for the en suite to ensure ease of use by a person with limited mobility.

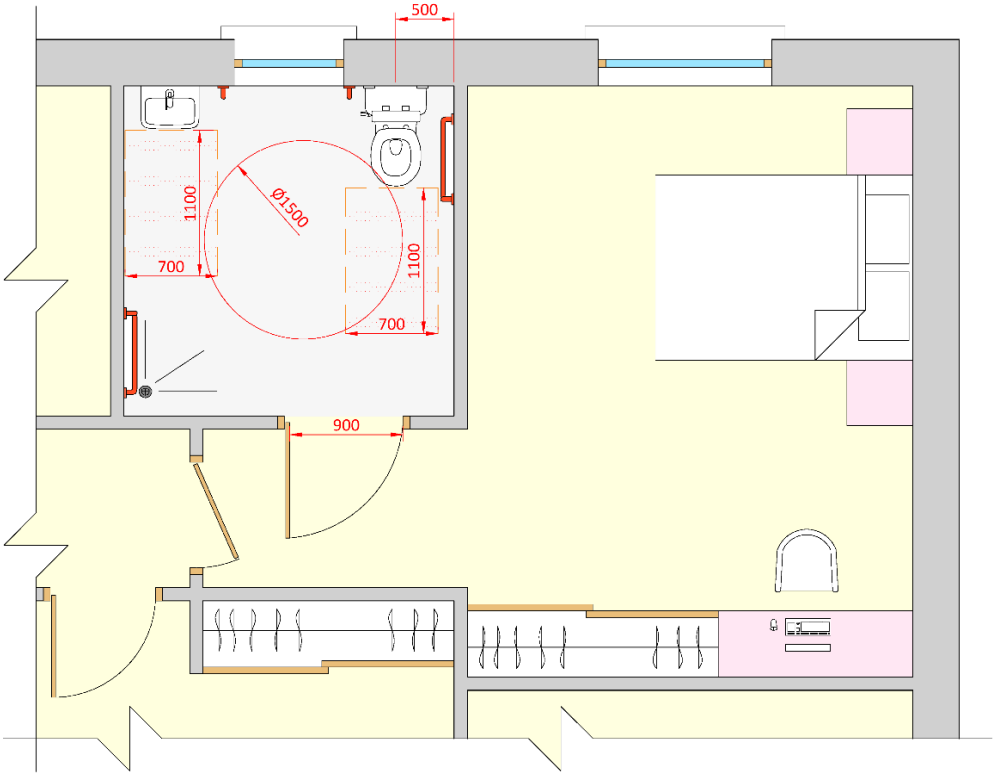
On your design sketch, show the location of the following:
- **access to the en suite from the bedroom**
- **shower area**
- **water closet (W.C.)**
- **wash basin**
- **grab rails.**

Layout 1



Any other relevant layout

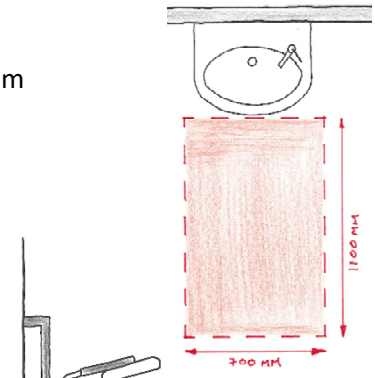
Layout 2



Any other relevant layout

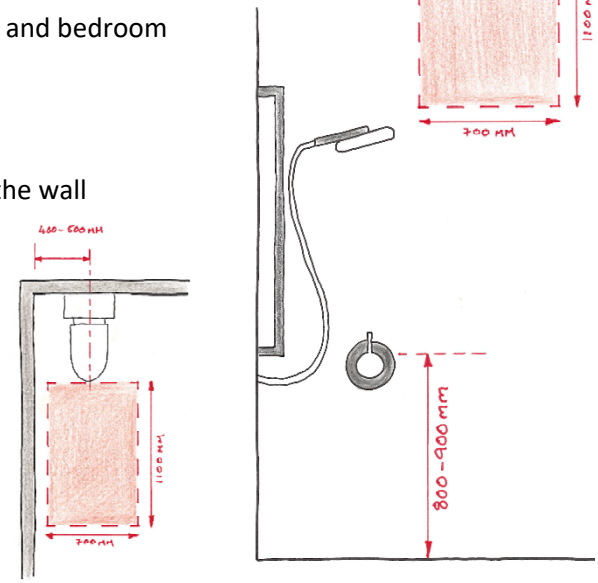
(c) Justify your preferred location for each of the bathroom items listed at 2(b) above.

Access to the en suite from the bedroom



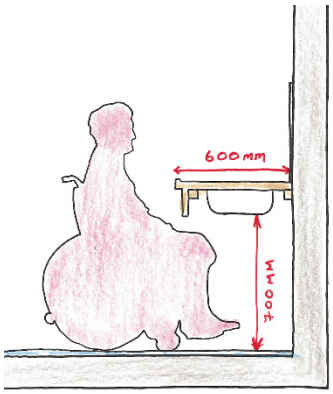
Door opening to allow wheelchair to comfortably access the en suite - 900 mm width clear entrance
Opening out of the en suite to allow more space for moving and turning
Adequate space for the door to open in or out of the bedroom
Door in layout 1 is opening against wall to avoid swinging
Door in layout 2 provides move privacy between en suite and bedroom

Shower area



Wet shower area with/without flush finish shower tray
Positioned in a corner to provide grabrails to be fixed to the wall
Easier to provide a fall for water in a shower area with no tray
Positioned close to wall will allow folding seat to be fixed to the wall if required in the future
Layout 1 will allow access to an external wall for drainage
Appropriate non-slip floor finish applied
Minimum shower area 1 m x 1 m

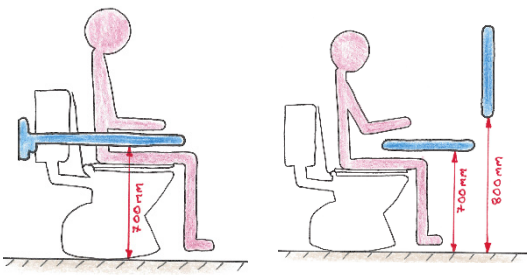
Water closet (W.C.)



Centre of the toilet located 450-500 mm from the wall to allow installation of hand rails
Layout 2 will allow easier access to vent pipe
Clear access zone of 1100 mm x 700 mm in front of the fixture for ease of movement for the user
At corner, allow fixture to be positioned on wall and space for drop rail or grab rail
Toilet not opposite the access door for privacy
Provide a lever handle to the cistern, rather than a push-button mechanism

Wash basin

Provide a basin at a height 750-800 mm above floor level, with flexible water supply pipes and easily adjustable waste connections
Provide a clear access zone of 1100 mm × 700 mm minimum from the front of the basin, free from any obstruction
Provide a large basin that is not a pedestal or semi-pedestal basin and provides knee space of at least 600 mm below the sink bowl
Provide adequate structural support in the stud should a height adjustable basin be required
Lever taps or sensor taps installed for ease of use
Sufficient 1500 mm turning circle provided



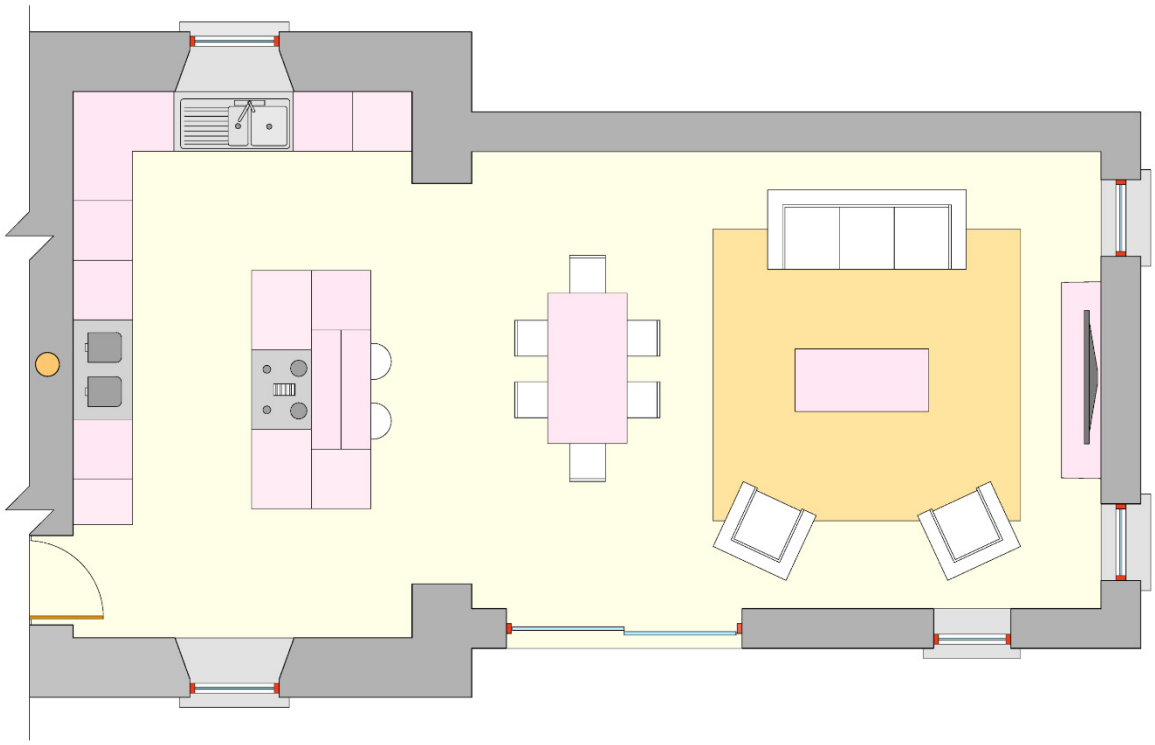
Grab rails.

Horizontal and vertical handrail installed at fixtures
Drop rails provided to side of W.C.
Fold up grab rail 400 mm long on open side of toilet
Ø 35 mm horizontal grab and vertical grab rails installed in the shower area

Any other relevant points

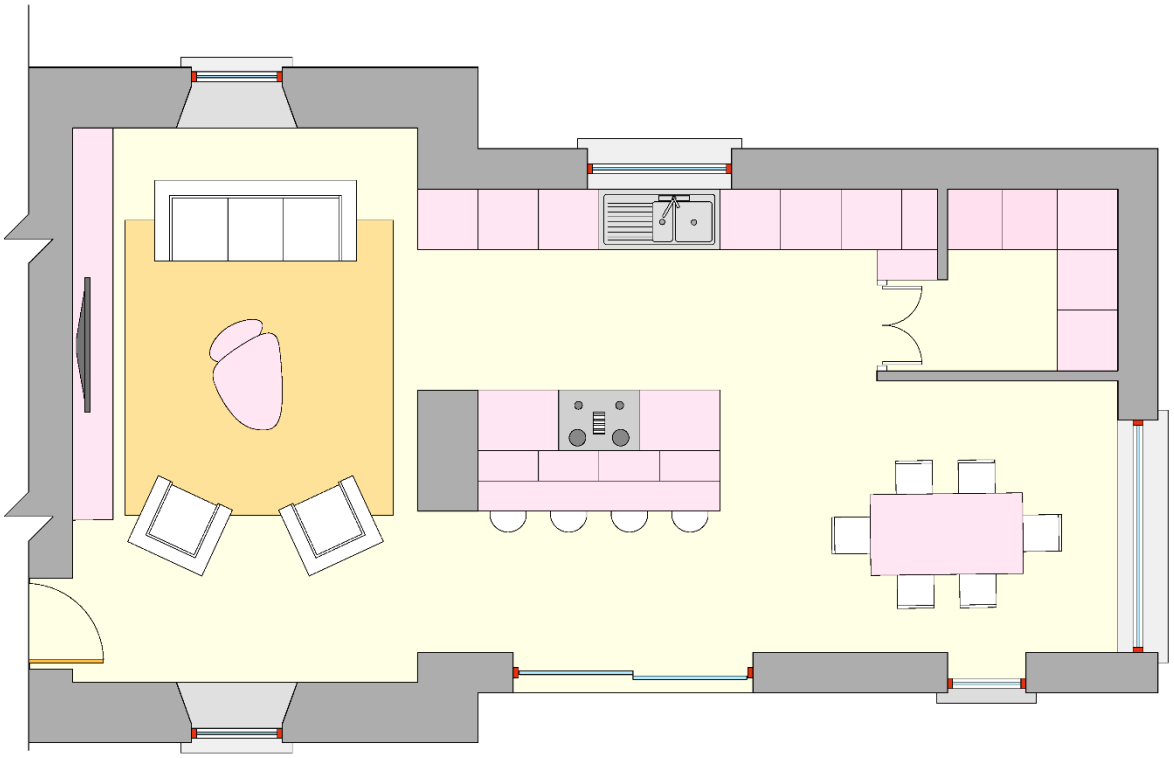
Question 3

(a) Revised internal layout for proposed renovation of the forge that incorporates each design considerations.



- Erect structural steel into gable at the junction of the house and the forge, making the forge and existing kitchen one space allowing for an open plan kitchen/dining and living space
- Large open plan space will allow for heat and light to flow between spaces
- Replace doors on wall A-A of the forge with glass doors to allow southern light to enter
- Glass doors allow access onto patio area for outdoor dining area
- Install high performance windows, of similar size to existing glazing, to the gable of the forge to optimise light and maximise views to the mountains
- Retain the kitchen in the existing location to reduce the cost and labour of moving services
- Retain existing windows location and size to retain the vernacular character of the building
- Install ridge or roof glazing units to optimise unobstructed natural light throughout the day

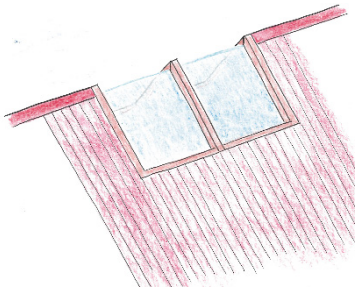
Any other relevant points



- Maintain a section of the forge gable wall between the two spaces. This will help to define the internal spaces and will require less structural work and steel support
- Maintaining existing wall will create privacy between spaces while still allowing heat circulation and light flow
- Dining table adjacent to large glazed areas to appreciate the natural light and views to the mountain while dining
- Relocating kitchen island to centre of new open plan space, will encourage social interactions between occupants
- Install large glazing toward mountain view (east facing) to allow morning light to enter the space. Ensure high performance glazing units are used, triple or quadruple low-e glazing, to maintain thermal comfort internally while reducing glare for occupants
- Add floor to ceiling glazing to the south façade to replace existing forge window. Allows thermal gains and light penetration into dining space

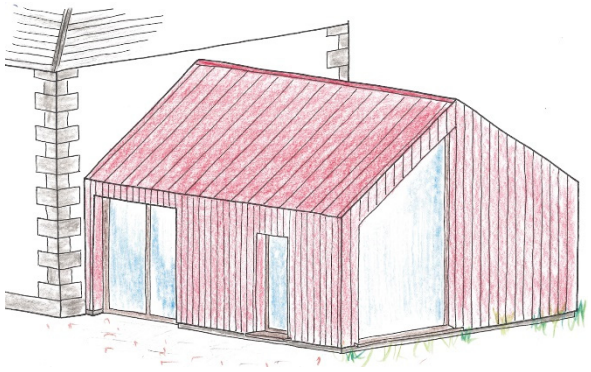
Any other relevant points

(b) External design for forge renovation that will respect and enhance the overall visual appearance of the house.



- Use materials similar to those used on the existing forge to retain the character of the buildings previous use, corrugated metal and stone. By undertaking this, the forge will still read as a separate building without being pastiche, trying to imitate the rendered house style from a previous era
- Material of similar age and style, can be sourced and reused from salvage yards or sourced from disused buildings
- Retain and repair existing stonework to respect existing visual appearance. Engage a specialist to examine and re-point brickwork with lime mortar

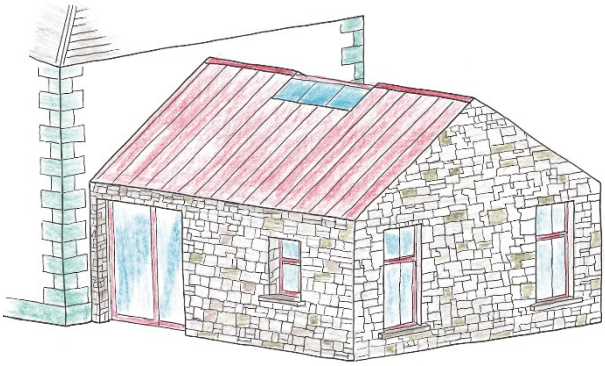
- Maintain the opening size and proportions on the front façade similar to those which previously existed

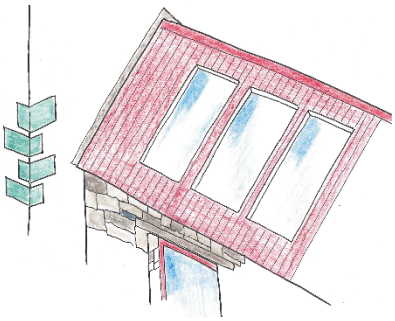


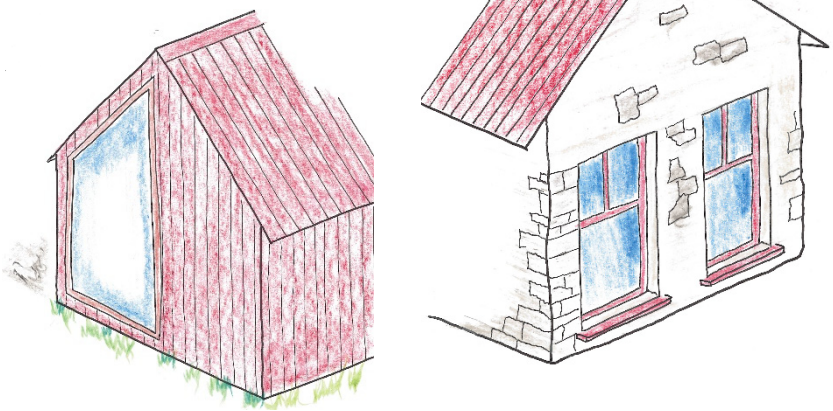
- Clad the entire forge building in corrugated metal – modernise the building while being respectful of previous material choices

- Add glazed areas to the gable of the forge. This façade is not on the same plane as the front of the existing house and is therefore not competing or disrespecting the visual appearance of the building

- Addition of a ridge glazing system. This allows light in without overtly altering the character of existing vernacular building form







Any other relevant sketch or points

(c) Two advantages of respecting Irish vernacular architecture when renovating an old building.

Advantages

- The character of old buildings enhances and contributes to the local and National Irish landscape. It gives an insight into what the building and surrounding areas were used for in the past
- Renovating old buildings affiliated with traditional architecture, ensures historical continuity and preserves a connection to the past. By respecting the original design intent and craftmanship, the building maintains a sense of authenticity and historical integrity
- The design, craft, and material used to build vernacular heritage was strongly related to the region in which they were located. Their loss in a particular place would be detrimental to that locality's sense of place
- Irish vernacular architecture carries unique design aesthetics that can enhance the beauty and character of a building. Respecting and incorporating these elements during renovation can result in a visually appealing and harmonious blend of old and new

- Materials used in constructing vernacular buildings — clay, cereal straw, stone from the adjacent field or small quarries, timber from local woodland, etc are distinctly local. Vernacular building crafts that used these materials were also rooted in local tradition and landscape. The materials are substantially green, environment-friendly, and sustainable. The greenest building is the one that is already built
- Ireland as a tourist attraction is known throughout the world for its own unique natural and built environment. By altering our vernacular buildings, in a strive for modernity, we are altering them beyond the constraints of the tradition that had created them. This would be detrimental for our tourism industry and our Irish heritage

Any other relevant points

Question 4

(a) Three reasons why local planning authorities regulate the design and location of all proposed new dwellings.

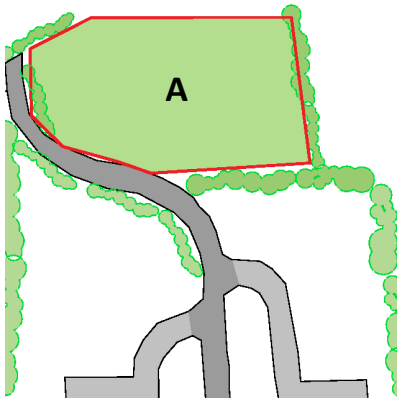
- Planning authorities ensure that buildings comply with safety standards to protect occupants and the public from hazards such as structural instability, fire risks, inadequate emergency access, etc. By regulating design and location, planning authorities can impose regulations and prioritise safety
- Planning authorities consider the overall impact of new dwellings on urban infrastructure such as transportation and access to public services. By regulating designs and locations, they can prevent overdevelopment and congestion on resources. This allows sustainable growth and efficient use of existing infrastructure
- Planning authorities safeguard the visual character and historical significance of areas by regulating buildings design and location. Authorities impose guidelines to preserve heritage buildings and maintain architectural consistency to ensure new dwellings complement the existing surrounding
- Planning authorities regulate building design and locations to minimise environmental impact and promote sustainability. They may impose sustainable building standards, energy efficient designs or zoning restrictions to protect natural habitats. These conserve limited resources and reduces the carbon footprint on the landscape
- Planning authorities prioritise enhancing the quality of life for residents by controlling the design and locations of new dwellings. The authorities impose regulations that promote access to green spaces, natural light, privacy, and amenities. This ensures a liveable and inclusive communal environment for all
- Planning authorities address traffic congestion and parking issues by regulating building design and locations. Authorities require sufficient parking spaces, access roads and alternative transportation options to mitigate the impact new developments have on traffic flow and parking availability
- Planning authorities consider the long-term vision for an area when controlling building designs and locations. By aligning with local and urban development plans, planning authorities ensure that new dwellings contribute to the overall development objectives of the area and benefit the residents now and in the future

Any other relevant points

(b) Select your preferred site and discuss three considerations you took into account when selecting your site.

Site A – Considerations

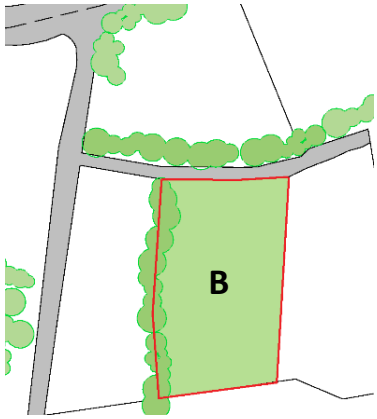
- Less visual impact on the landscape and environment as there are existing neighbouring buildings
- Site is located in a cluster development. Planning authorities favour new dwelling construction close to existing developments
- Proximity to neighbouring dwellings will result in cost effective provision of public services
- Site is located close to neighbouring building which may increase security
- Long southern axis of site increases design possibility of maximising solar gains
- Sustainable development, need for excessive utilities work will be reduced as neighbouring dwelling will previously have utilities. Reduces water mains pipes, reduced need for ESB and fibre broadband poles and cables, etc.



Any other relevant points

Site B – Considerations

- Site is not overlooked by existing building
- Reduced risk when entering and exiting the site as it is not located on a busy main or secondary road
- Site located away from the main roads so reduced noise and air pollution
- Planning authorises may allow for more individual and creative building designs as there are no existing building in close proximity
- Greater privacy as it is not adjacent to main road
- Larger windows could be facilitated without compromising privacy
- Position of site may allow for better scenic view of the countryside compared to Site A



Any other relevant points

(c) Sketch of selected site to included house location and orientation, outdoor living space, road entrance and driveway.

House location and orientation

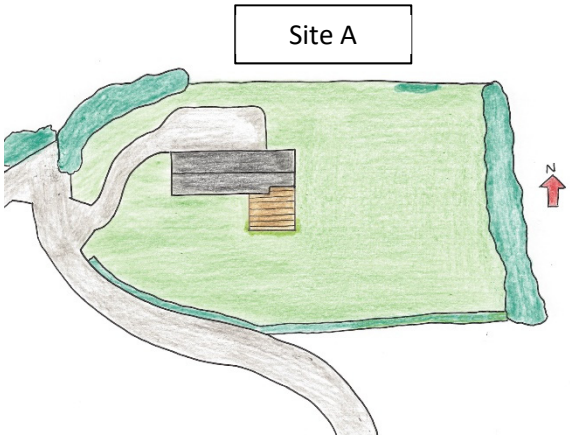
- Long axis running from east to west to maximise daylight penetration into dwelling
- Position to maintain natural hedges and trees to maintain local flora and fauna and also for shelter from weather
- The design / form of the building maximises solar gains by having the largest external perimeter facing south
- Building's proximity to the road where services are normally located
- The built form and its positioning are inspired by local existing vernacular architectural characteristics
- The building is set back from the road to reduce the environmental impact on the landscape

- Maximum daylight penetration to the living areas/spaces which ideally should be located on the southern elevation (Single room depth)
- House placed for greater privacy
- Maximum solar gain and daylight into the living spaces reduces the need for unnecessary heating and lighting

Any other relevant points

Outdoor living space

- Take advantage of scenic views and natural surroundings while also considering privacy from neighbouring properties
- Benefit of the path of the sun throughout the day. Position in location that receives ample sunlight for relaxation and outdoor dining
- Ensure space is easily accessible from the interior of the house to allow flow of movement between indoor and outdoor areas
- Position spaces to minimise exposure to weather conditions. Utilise barriers such as trees and the house itself, to create outdoor living spaces that are comfortable year-round

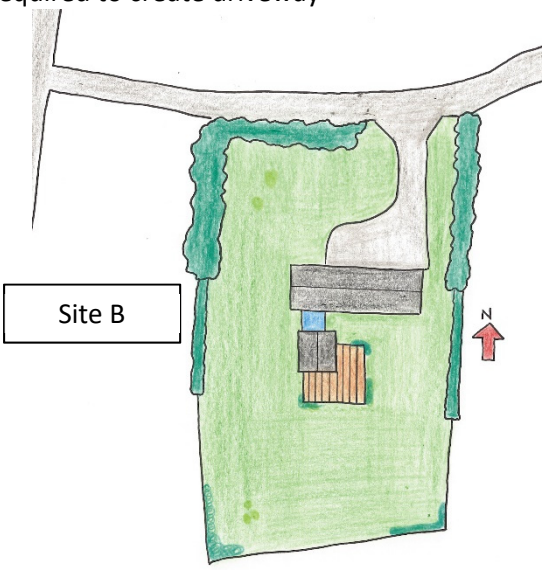


- Position area that complements the architectural style of the house and creates a harmonious blend of indoor and outdoor aesthetics

Any other relevant points

Road entrance and driveway

- Limited driveway to reduce the cost and material required to create driveway
- Position driveway and parking to the north façade of the house to limit obstruction of views and sunlight to the south
- Position entrance to limit the number of existing hedges and trees that have to be removed
- Shorter driveways result in minimal hard surfaces and less strain on surface water disposal system
- Facilitates the planting of vegetation to help integrate the house into the landscape and increase privacy
- Enables the driver to clearly see oncoming traffic from both sides
- Entrance is setback 5 metres so that a car waiting to enter closed gates is not obstructing traffic
- Sidewalls splayed at 45° for clear vision when exiting site meets the criteria set out by the local authority in design and measurements



Any other relevant points

Question 5

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

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
External resistance				0.048
Acrylic render	0.670	1.493	0.012	0.018
External insulation	0.030	33.333	0.150	5.000
Concrete	1.280	0.781	0.150	0.117
Internal insulation	0.030	33.333	0.05	1.667
Plasterboard	0.250	4.000	0.0125	0.050
Skim coat		5.550	0.004	0.022
Internal resistance				0.122
			Total R =	$R^t = 7.044$
Formulae: **R=T/k** **R=T × r** **U= 1/R^t** **U-value:** U = 1 / 7.044 = 0.142 W/m^2 °C				
			U-value =	**0.142 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
  0.142 × 110 × (20 – 6) = 218.6269 Watts (Joules / sec)
- Heating period p/a: 60 × 60 × 7 × 6 × 32 = 4,838,400 seconds (1,344 hours)
- Kilo joules p/a: $\frac{4,838,400 \times 218.627}{1000}$ = 1,057,804 KJ/ second
- Kg p/a: *(Note: Calorific value of 1 Kg of wood pellets = 17350 kJ)*

  $\frac{1,057,804}{17,350}$ = 60.96 kilograms
- Cost p/a: *(Note: 1 Kg of wood pellets cost €0.52)*

  60.98 **× .52** **= 31.71**

  Cost of heat loss annually through wall **= €31.71**

Alternative method:

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

$= \frac{\mathbf{0.142} \times 110 \times 14 \times 4,838,400 \times .52}{17,350 \times 1000}$

$\frac{467,599,528.1}{17,350,000}$ = **€31.71**

(c) Discuss two advantages and two disadvantages of designing a domestic heating system to incorporate a wood pellet boiler stove.

Advantages:

- Environmentally Friendly – Wood pellet stoves use a sustainable and renewable fuel source made from sawdust and wood shavings. When burned, the carbon dioxide released is equivalent to the amount absorbed by the tree during its growth (Carbon Neutral)
- Cost efficient fuel – Wood pellets are relatively inexpensive and are price-stable compared to other solid fuels
- High efficiency – Wood pellet stoves are highly efficient. They achieve efficiency of up to 90% due to the specific control of the air-to-fuel ratio
- Eco-design certification – Stoves are designed and manufactured to high eco-design standards. Wood pellet stoves are designed to produce lower levels of emissions when compared to a log-burning stove
- Ease of use – Pellet stoves come with programmable thermostats allowing users to control the desired temperature. Some pellet stoves feature automatic self-cleaning burners, reducing maintenance

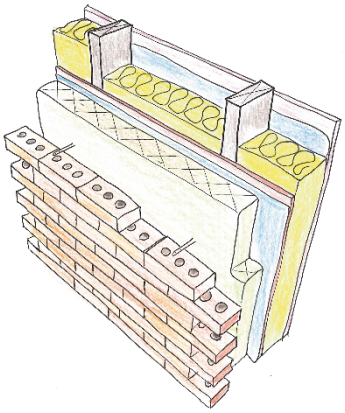
Disadvantages:

- Initial cost and installation – Wood pellet boiler stoves have a high initial purchase price compared to other heating systems. Installation can be complex and costly, requiring professional set-up with suitable ventilation
- Fuel storage – Wood pellets require dry, safe storage to prevent moisture absorption which can degrade pellets and affect combustion efficiency
- Maintenance requirements – Pellet stoves require regular maintenance to function efficiently. Maintenances include cleaning ash deposits, inspecting and servicing mechanical parts, and ensuring the hopper is regularly filled
- Fuel supply and availability – The supply and availability of wood pellets can vary, especially in some regions where wood pellet stoves are not commonly used
- Requires electricity – The wood pellet stove cannot operate without electricity. Electricity is required to operate the automatic ignition, the pellet feed, ventilation, and electronic controls

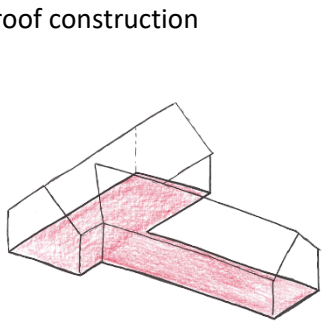
Any other relevant points

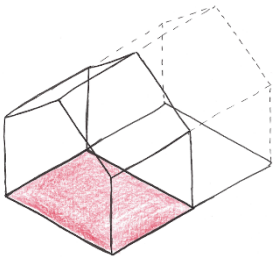
Question 6

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

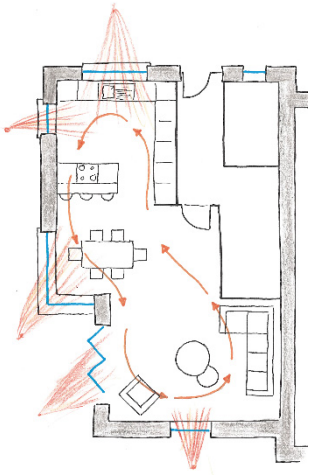


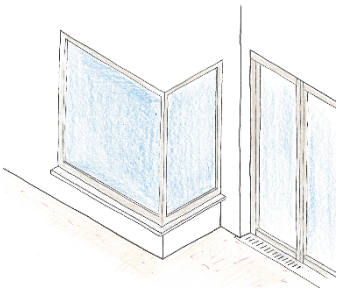
- Timber frame construction from local sources which reduces transport movements has lower carbon emissions and a reduction in localised air pollution
- Less embodied energy required to produce timber frame construction compared to a double leaf, concrete block cavity wall construction
- Locally sourced timber contributes to carbon sequestration (creates a carbon store/sink) in direct contrast to concrete production
- The house has large south facing glazed openings which fill all main living spaces with natural light – electric light bulbs only needed at night
- The heat from the sun entering through the large openings reduces the need for using non-renewable methods of heating theses spaces
- High levels of insulation in the floor, walls, and roof construction resulting in reduced demand on space heating

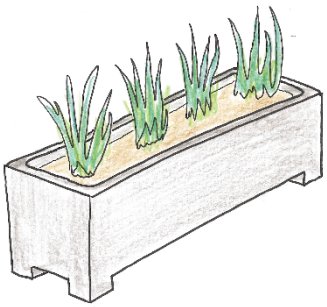


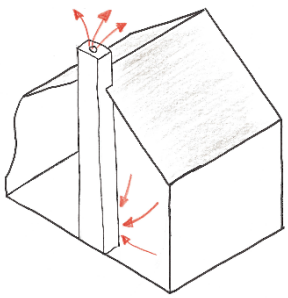


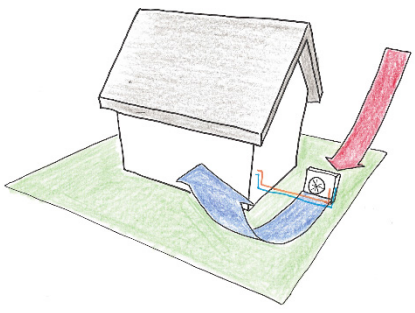
- One room deep design enables light and heat from solar gain to enter the single space building via the south, east, and west
- High-performance glazing (U-value at least 0.8 w/m^2 k) will significantly reduce heating costs
- The absence of a chimney reduces draughts and increases airtightness of the design
- One room deep living space with windows on three sides enable light to naturally light the interior
- Reduced artificial light energy consumption as a result of large windows on the south/south-east facades









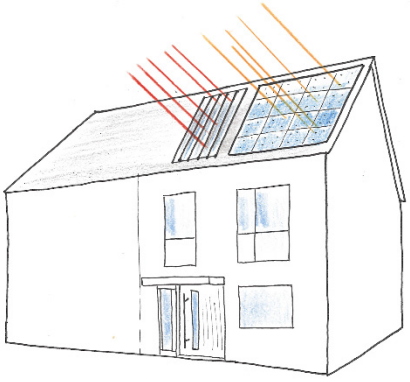


Any other relevant points/sketches

(b) Discuss two features that could be added to the house that would further increase the energy efficiency of the house.

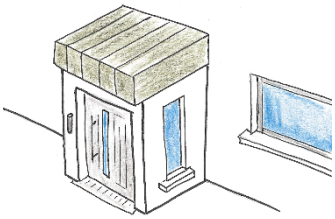
Solar Panels

- Additional photovoltaic or evacuated tubes can be installed on the dwellings pitched roof
- Panels generate electricity using renewable energy which is a clean and sustainable source of power
- Energy created by photovoltaic panels can be used or stored to facilitate the running of the house and reduce demand on non-sustainable energy sources
- Harnessing solar energy can significantly decrease reliance on fossil fuels, lower greenhouse gas emissions and help combat climate change
- Evacuated tubes can be used to heat water in the hot-water storage cylinder and reduce the energy required to bring the temperature of the water up by non-sustainable methods



Storm Lobby

- Storm lobby will reduce heat loss or gain when occupants enter and exit the entrance
- Lobby can be used to create a buffer zone between the exterior and interior temperature
- Lobby will reduce demand on heating/cooling/ventilation system when occupants enter or exit the dwelling

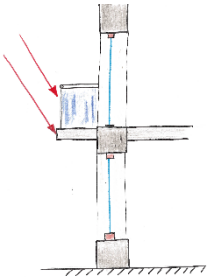


Interior sliding door to separate spaces

- Interior space separating door can be installed to further reduce the space that the occupants need to heat and light
- If the occupancy reduces, less space may be required and the reduced living space will be less energy demanding to heat if the heating system is zoned
- Interior room divisions may be used to reduce/increase living space depending on the occupants. Rooms that can be zoned off may have variable purposes depending on the lifestyle of the occupants. Multipurpose and adaptable spaces will reduce energy demand on major alterations to the interior structure

Sun shade

- Installing solar shading by means of brise soleil or balconies can be used to reduce thermal gains in summer months



Larger glazing to south façade of dwelling

- High performance glazing installed on the southern façade can be increased to improve thermal gains
- Occupants may use increased southern glazing as a means of heating the dwelling and decrease the energy demand of non-sustainable methods
- Careful planning of material selection and glazing position will allow thermal gains contribute to the overall heating of the dwelling

Any other relevant points/sketches

(c) Discuss two advantages of designing energy efficient new homes.

Reduced energy costs

Designing energy efficient new homes can significantly lower energy consumption, leading to reduced utility bills for the occupants. Well insulated homes, energy efficient appliances and smart designed features can help minimise heat loss and heat gain in the changing weather conditions over a year. Reduced reliance on energy to heat and cool the interior will result in reduced energy usage and reduced bills

Environmental sustainability

New energy efficient homes have a lower carbon footprint compared to traditionally designed houses. New energy efficient designed homes help to reduce greenhouse gas emissions and contribute to environmental conservation. Investing in energy efficient designed homes play a major and crucial role in combating climate change and preserving natural resources

Improved comfort

New energy efficient homes are designed to maintain a consistent and comfortable indoor environment throughout the year. Higher insulated, ventilated and energy efficient heating and cooling systems ensure that the occupants enjoy a comfortable living space with stable temperatures and good air quality, regardless of the external weather conditions or time of year

Increased property value

Energy efficient dwellings are in high demand due to their cost saving benefits and environmental appeal. Well designed energy efficient new homes will have a higher resale value and attract buyers looking for sustainable and efficient living spaces. Investing in energy efficient designs can enhance the long-term value of the property and may also result in a reduced mortgage rate due to a lower *loan to value* rate

Health benefits

Energy efficient dwelling design promotes improved indoor air quality by reducing pollutants and allergens. Proper ventilation systems and eco-friendly building materials contribute to a healthier living environment, minimising respiratory issues and creating a more comfortable space for occupants. Health-conscious occupants and occupants with health conditions appreciate the benefits of living in a well ventilated and clean indoor environment

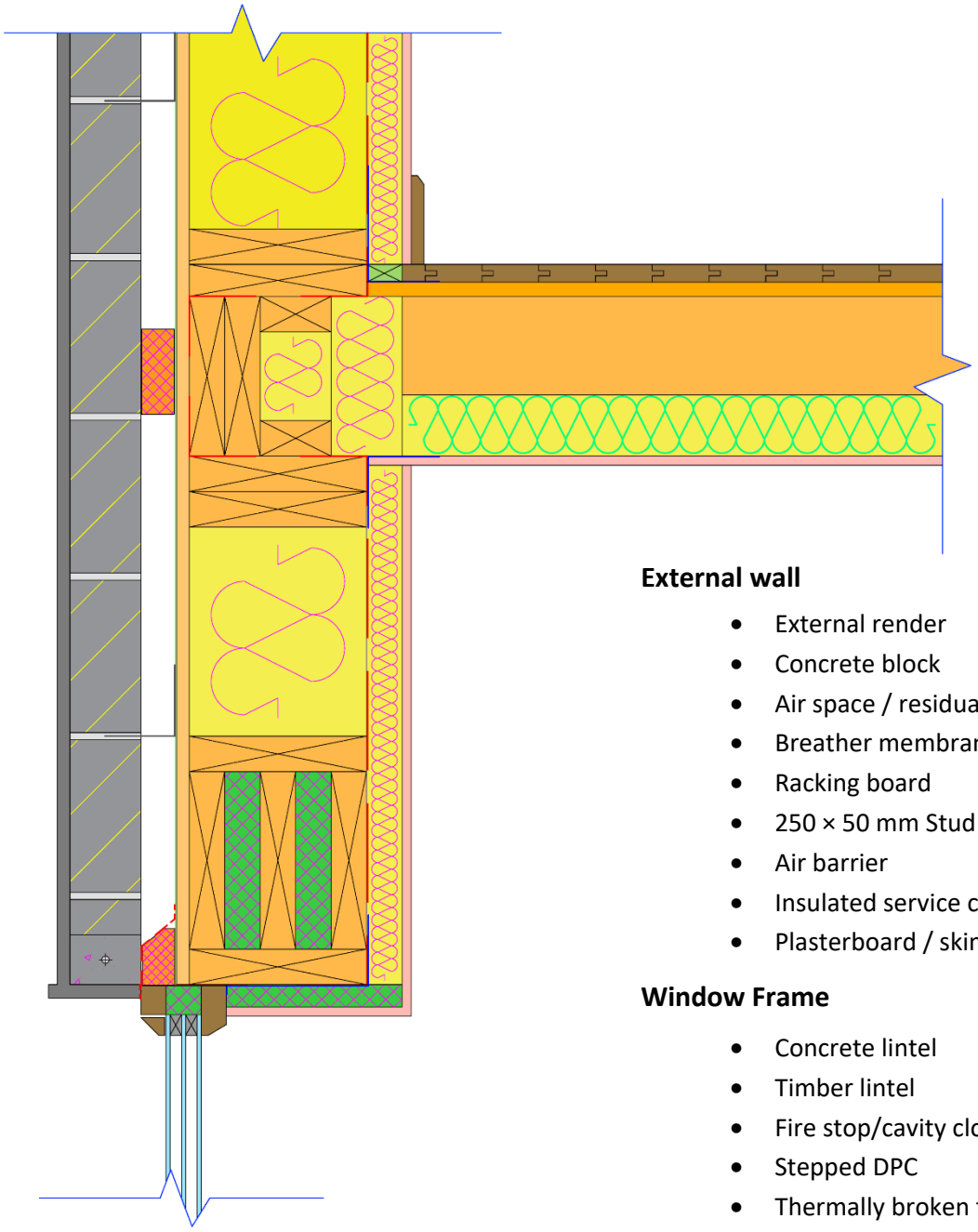
Regulation compliance and incentives

Ireland's planning Authorities have regulations and standards that require a level of energy efficiency in new dwelling construction. Designing energy efficient dwellings ensure compliance with standards and will minimise the risk of planning permission refusal for the dwelling. Compliance with energy efficiency standards can also lead to suitability to apply for a *green-mortgage* which will result in reduced mortgage repayments over the life of the dwelling

Any other relevant points

Question 7

(a) Vertical section through timber frame wall, window, and first floor joist.



External wall

- External render
- Concrete block
- Air space / residual cavity
- Breather membrane
- Racking board
- 250 × 50 mm Stud and insulation
- Air barrier
- Insulated service cavity
- Plasterboard / skim

Window Frame

- Concrete lintel
- Timber lintel
- Fire stop/cavity closer
- Stepped DPC
- Thermally broken frame
- Glazing (Triple)
- Airtightness tape – window frame head

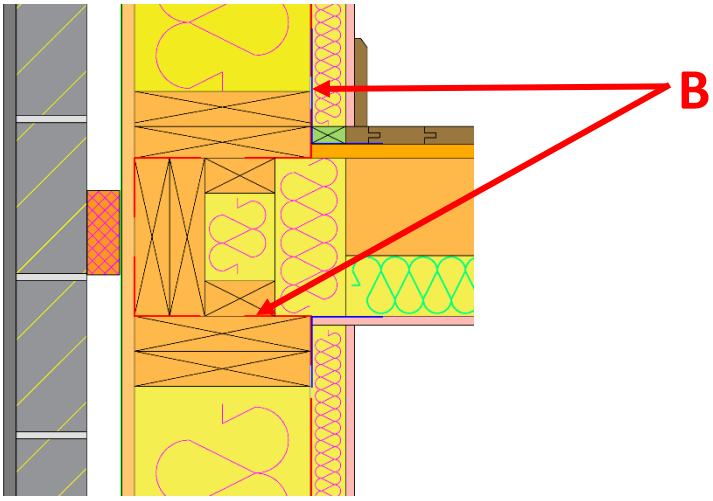
Floor

- Joist supported at wall
- Tongued and groove flooring / skirting board
- OSB decking
- 225 × 50 mm Joist
- Sound insulation
- Plasterboard ceiling

Any other relevant detail

(b) Typical design detailing to ensure air tightness at the junction of the wall and joist.

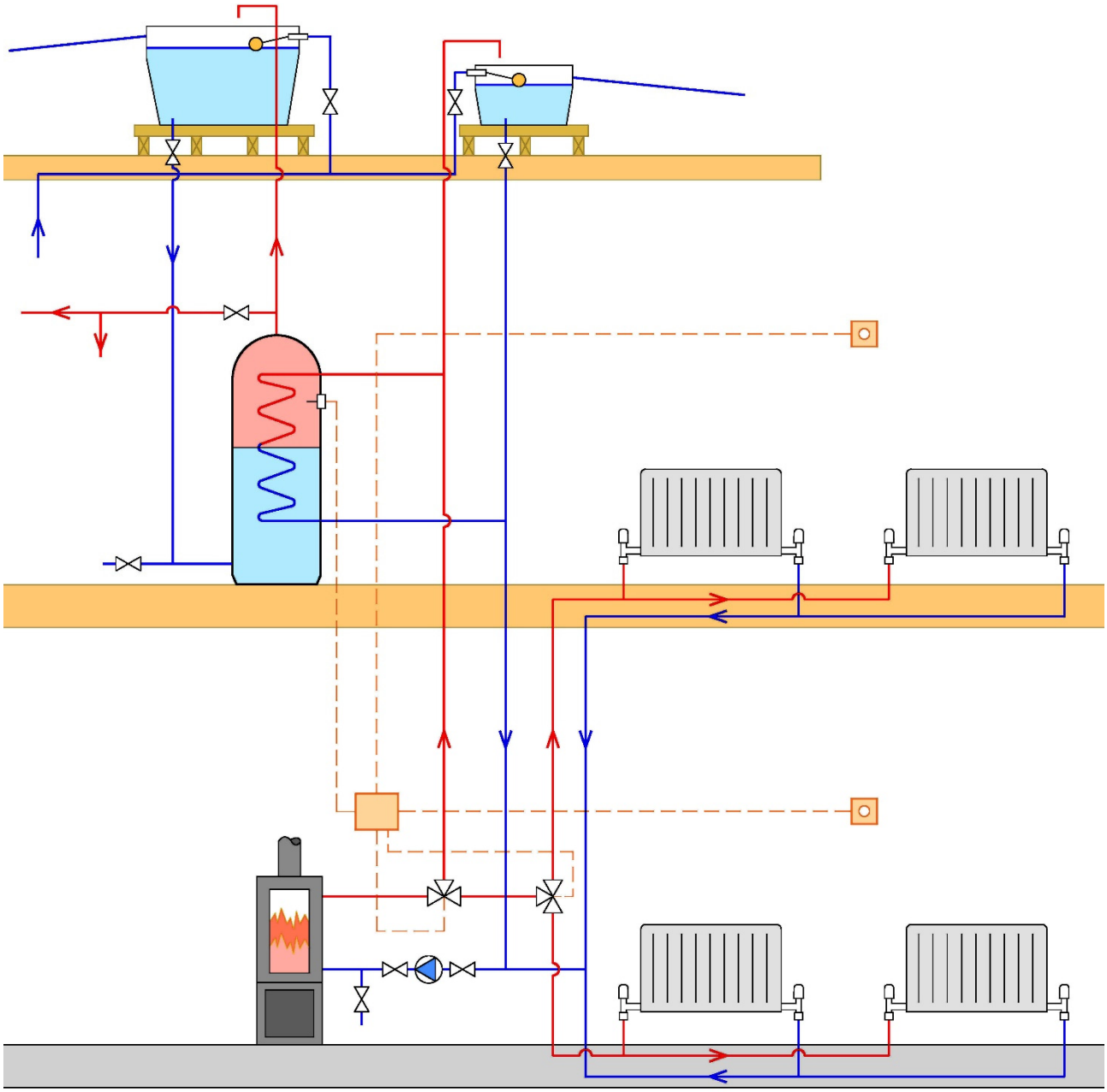
- Airtightness barrier around joists
- Junctions and corners sealed with airtightness tape



Any other relevant detail

Question 8

(a) Typical design layout to provide hot water and central heating to a two-storey house.



Typical sizes of pipework:

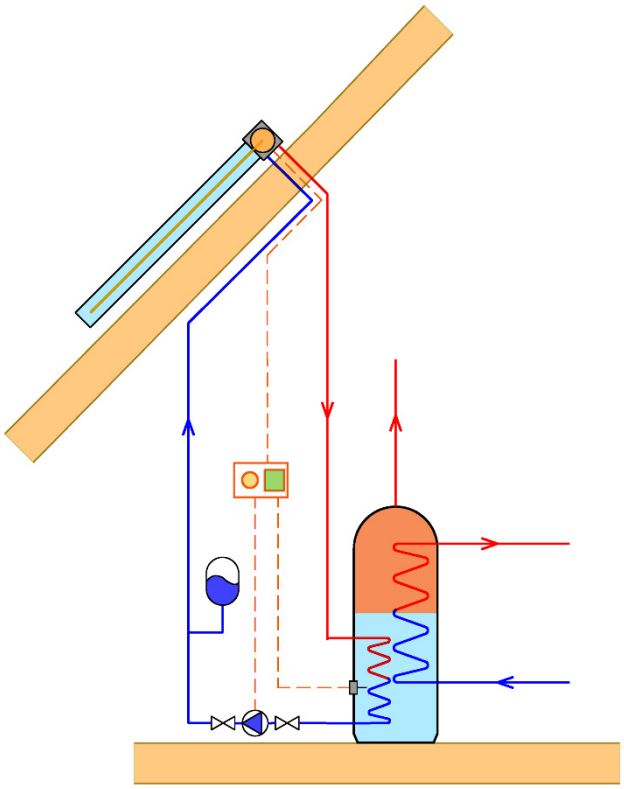
- Ø15 mm Cold water rising main
- Ø22 mm Primary flow and return to radiator
- Ø15 mm Pipes to radiators
- Ø22 mm Cold water feed to cylinder
- Ø28 mm Hot water feed
- Ø28 mm Overflow pipe

Any other relevant points

(b) Discuss one method of incorporating on-site renewable energy into a domestic hot water system.

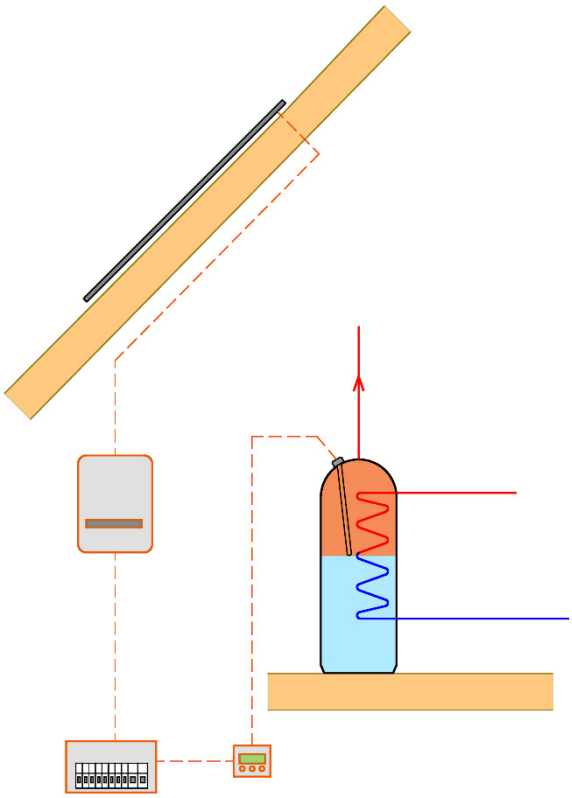
Solar Collector

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



Photovoltaic Panels

- Photovoltaic panels absorb sunlight and converts it into direct current (D.C.)
- This current is converted to alternating current (A.C.) by an inverter
- The inverter feeds A.C. into the domestic fuse board
- A solar immersion diverter switches the immersion on when the photovoltaic panels are generating more electricity than a house needs
- This uses the spare electricity to heat water in the hot water storage cylinder
- The solar immersion diverter works by constantly monitoring the electricity usage in a house. This is monitored by the CT sensor clamp
- When a house is exporting electricity to Ireland's National grid, the CT clamp tells the immersion diverter to send the surplus power to the immersion tank
- The immersion diverter device heats the water in the water cylinder for free
- When the demand in the house increases or the solar generation decreases, the immersion diverter will recognise this and reduce the amount of electricity that it is sending to the immersion



Any other relevant points/sketches

(c) Two advantages and two disadvantages of incorporating an underfloor heating system into a dwelling house.

Advantages

Even heat distribution
Underfloor heating provides an even and constant heat distribution throughout the house resulting in a more comfortable living environment
Space heating
The heating system is installed under the floor, it is space-saving and removes the need for radiators or other bulky heating units taking up wall space
Energy efficiency
Underfloor heating systems tend to be more energy efficient than traditional heating systems, leading to potential cost saving over the life span of the house
Design flexibility
The absence of visible radiators allows for more design flexibility in the room layout, furniture placement, and overall aesthetics
Low maintenance
Once underfloor heating systems are installed, they require minimal maintenance compared to other heating systems, reducing maintenance costs

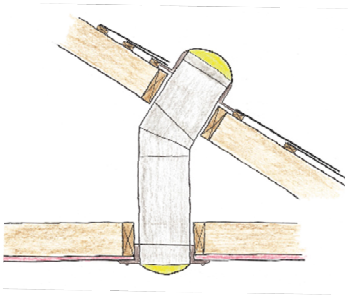
Disadvantages

Installation costs
The initial installation of underfloor heating can be more expensive than traditional heating systems, especially in existing homes where retrofitting may be required
Installation time
Installing underfloor heating can be time consuming especially if it needs to be integrated into an existing structure
Floor constraints
Some types of flooring materials are not compatible with underfloor heating, limiting the choices for homeowners
Response times
Underfloor heating systems have a slower response time compared to traditional radiators as they take longer to heat up and cool down
Difficult repairs
If there are issues with underfloor heating systems, the repairs can be more challenging and may require extensive work to access and fix the problem
Limited zoning control
Depending on the system, underfloor heating may have limited zoning control making it difficult to heat specific areas of the house independently

Any other relevant points

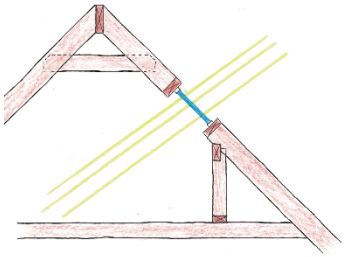
Question 9

(a) Two functional requirements of an attic space suitable for use as a home office.



Sufficient lighting

Adequate lighting is essential for a home office to prevent eye strain and promote productivity. In an attic space, skylights, dormer windows or strategically placed artificial lighting can promote ample illumination

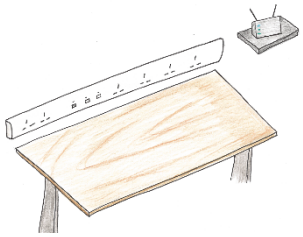


Effective insulation and ventilation

Appropriate insulation and ventilation are critical in a home attic office to maintain a comfortable working environment year-round. This helps regulate temperature, prevent heat loss in winter, and avoid overheating during the summer months

Sufficient storage

A functional home office requires sufficient storage space for files, supplies, equipment, and personal items. Utilising corners, built-in cabinets, shelving, or under-eaves storage solutions can maximise the available space in an attic office

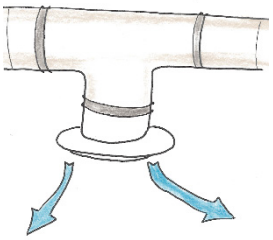


Electrical outlets and connectivity

Ensuring that the attic home office has an adequate number of electrical outlets, as well as provisions for networking, WI-FI connectivity, and cable management, is essential for powering devices, setting up technology, and staying connected during working hours

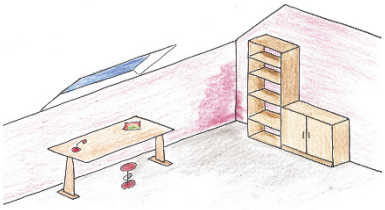
Ergonomic furniture and layout

An ergonomic workspace is key to promoting good posture, reducing the risk of musculoskeletal issues, and enhancing productivity. Choosing adjustable furniture, ergonomic chairs, standing desks, and organising the layout to support correct work habits can contribute to a healthy and efficient home office setup



Adequate heating

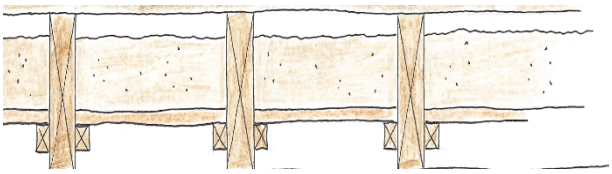
Maintaining a comfortable temperature in the attic home office is critical for productivity and well-being. Installing a heating and cooling system, such as an effectively sized radiator and ventilation system can regulate the climate and create a pleasant working environment regardless of the external weather temperature



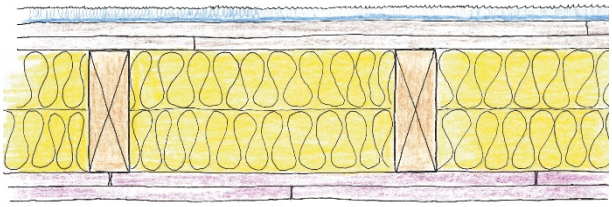
Any other relevant points

(b) Using notes and freehand sketches, show a revised design detailing that will reduce the transmission of sound through both the floor and the stud wall.

Floor

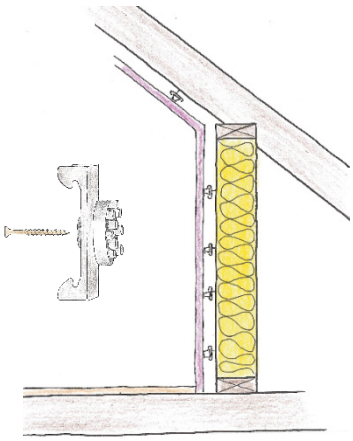


- Increase mass with the addition of dry sand plugging, 80 kg/m^2. Battens are fixed to joist with a false bottom supporting dry sand plugging
- Fill between joints with absorbent quilt insulation, tightly pack between joints for completeness and uniformity

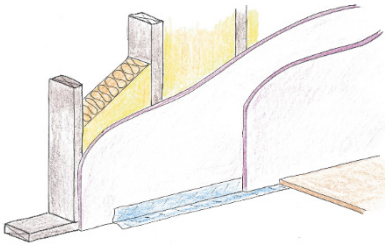


- Remove floorboards, tie joists together with 18 mm sheeting, apply 25 mm resilient acoustic matting under floating floor
- Replace floorboards with soft, absorbent floor finish; carpet, rubber flooring, cork tiles
- At ceiling level, attach second layer of plasterboard, stagger plasterboard joints
- Apply noise proofing compound, a viscoelastic damping compound dissipates sound vibrations when layered between sheets

Stud wall



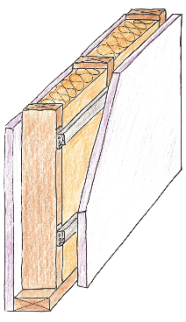
- Increase mass of wall with additional layers of plasterboard with staggered joints to reduce the transmittance of sound
- Ensure electrical sockets and switches are carefully sealed
- Apply decoupling rubber fixtures to separate plasterboard from stud. Isolating materials will dampen noise transmission
- Tightly fit quilt insulation between studs
- Use airtight tape and sealants to ensure no gaps at junctions of different materials
- Whisper Clips and channels are used in the process of decoupling walls and/or ceilings from the joists, creating what is called a floating wall or ceiling
- Decoupling the wall or ceiling helps prevent vibrations from traveling from one side of the structure to the other



Any other relevant points

(c) Two approaches used to reduce the transmission of sound in the design of a dwelling house. Identify the sound insulation principle associated with each approach.

Sound insulation principle: **Heaviness**



- Concrete upper floors: Precast floor slabs will provide mass compared to timber joist first floor construction
- Concrete blocks: Concrete block construction will reduce sound transmission due to the density of concrete. 215 mm block on flat construction of external and semi-detached partition walls
- Double/Triple/Quadruple glazing. Glass panes can range from 4 mm to 12 mm in thickness. Glass has a high density, increasing the thickness provided increase sound insulation

Heavyweight components with high mass transmit less sound than lightweight components. The high density of heavyweight materials restricts the size of the sound vibrations inside the material, so the component vibrates with less movement than a lightweight component
Sound insulation increases by 5 dB whenever the mass is doubled

Sound insulation principle: **Completeness**

- Airtight tape sealing around opening: Frames of doors and windows taped to the external wall.
- Rubber seals and weather-strips used on door and window frames. Rubber seals inspected and replaced over time due to weather damage
- Stagger junctions of plasterboard/sheeting joints. When using two layers of plasterboard to increase mass, stagger junctions to avoid gaps
- Complete coat of plaster/render on walls. Plaster to ensure block/brick joints completely filled with mortar. Care at junction of walls and ceilings, walls and floors, and at service sockets

Areas of reduced insulation or any small gap in the construction of components have an effect on overall transmission. The completeness of a structure depends upon airtightness and uniformity. Any crack or hole will have a major effect on the sound transmission through the component

Sound insulation principle: **Flexibility**

- Acoustic Panels: Reduce sound transmission by absorbing sound energy. Panels are made of flexible materials, such as fiberglass or mineral wool, and are designed to absorb sound energy and reduce its transmission
- Flexible silicone or acoustic sealants: Around doors and windows reduce sound transmission. Sealants absorb sound energy and prevent it from passing through the gaps and cracks
- Underlay on a floor: Material is flexible and can absorb sound energy, reducing the amount of sound that is transmitted through the floor

Stiffness is a physical property of a partition and depends upon factors such as the elasticity of material and the fixing of the partition. High stiffness can cause loss of insulation at certain sound frequencies where there are resonances and coincidence effects
Flexibility is not usually a desirable structural property in a wall or floor

Sound insulation principle: **Isolation**

- Cavities in wall and partition construction: Breaks the connection between the two leaves used in the construction of walls
- Airspace in multi panes glazing: Disconnection between the inner and outer layer of glazing
- Floating floors/carpets/resilient mounting/ decoupling mounting. ‘Room within room’ construction or the use of decoupling fixing to separate the surfaces of rooms

Discontinuous construction is effective in reducing the transmission of sound through a dwelling component. Sound is converted to different wave motions at the junction of different materials which result in sound energy loss, resulting in reduced sound transmission

Any other relevant points

Question 10

(a) Discuss the importance of any two of the following when carrying out a retrofit to achieve the EnerPHit Passive House design standard.

EnerPHit target values are lower than that required to achieve the Passive House Standard;

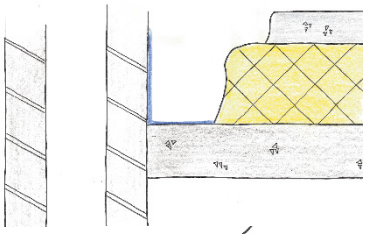
Airtightness target; Passive House Standard <0.6 air changes/hr @50 Pascals
EnerPHit Standard <1.0 air changes/hr @50 Pascals

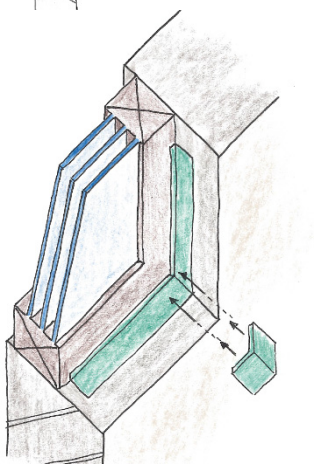
Space Heat Demand & the Space Cooling Demand;
Passive House <15 kWh/m^2/year
EnerPHit House <25 kWh/m^2/year

The way to get to the EnerPHit standard is by implementing the five passive house principles:

- high insulation levels
- limiting thermal bridging
- installing tripled glazed windows
- airtightness
- centralised mechanical ventilation with heat recovery (MVHR)

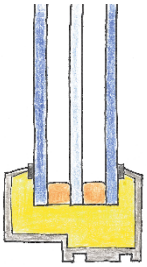
Designers, engineers and architects will use a Passive House Planning Package (PHPP) design tool to optimise the retrofitting of a building
The PHPP is a modelling tool that is used in the design phase of a Passive House and EnerPHit retrofits. It works by considering a wide range of variable characteristics which affect heat loss, energy use and internal comfort
Designers input information on the footprint, fabric, orientation, and the size of the roof, walls and floor of the house
Designers will then adjust the different elements to see the impact on the energy performance of the house





Airtightness

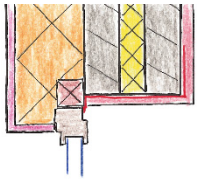
- Use a combination of airtightness membrane, Smartply airtight board, and airtight tapes at the roof and in timber frame construction buildings
- Use airtight membrane, tapes and airtightness paint in block-built construction. Block walls are made airtight with a sand and cement scratch coat and plaster. Airtightness paint used where the subfloor and wall meet and where walls are chased for services
- Check all work for air leakage at junctions of components and materials. Air leakage detection should be carried out during individual stages of construction. A full airtightness test should be carried out on completion of all work
- Retrofitting to a very high standard may not depend on a central heating system. To achieve this the house must attain a high level of airtightness. The amount of glazing fitted will require the architect to pay particular attention to the detailing to avoid thermal bridges. Walls are much more efficient at keeping the heat in than the highest performing windows
- Airtightness is essential to achieving energy efficiency and cannot be compensated by adding additional insulation. Without airtightness, insulation cannot perform its role effectively. Achieving an airtight structure requires attention to detail during all stages of the retrofit. A strategy should be in place for how the tradespersons will run their services without compromising an airtight structure

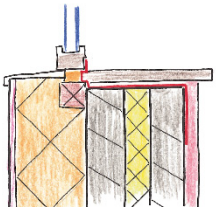


Any other relevant points/sketches

Windows

- Replace windows with Passive House standard triple glazed windows of ≤ 0.80 W/m^{2}K
- EnerPHit Requirements for the window as a whole, UW installed ≤ 0.85 W/m^{2}K
- Points to consider when carrying out a retrofit in relation to windows. U-value of glazing, G-value, material that separates glazing, U-value of frame, and connection of window into the wall measured by psi value
- When installing external insulation, window frames should be positioned in line with the external insulation to reduce a thermal bridge
- Careful planning, design and glazing positioning is required to incorporate sufficient shading and ventilation features. With a highly insulated and airtight envelope, solar gain may cause overheating of the structure in summer
- Glazing to Passive House certified standard, depending on the position and overall house redesign, glazing unit can be manufactured with up to quintuple glazing (five layers of glass) fitted in high performing frames

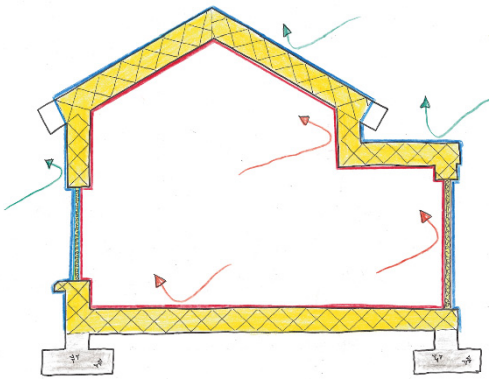




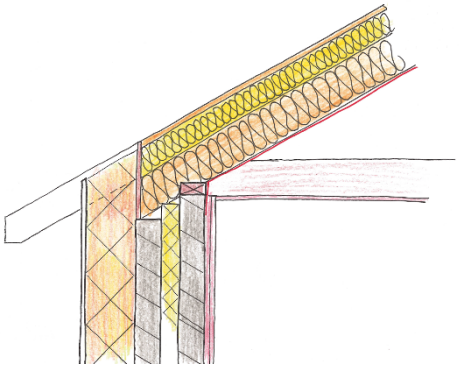
Any other relevant points/sketches

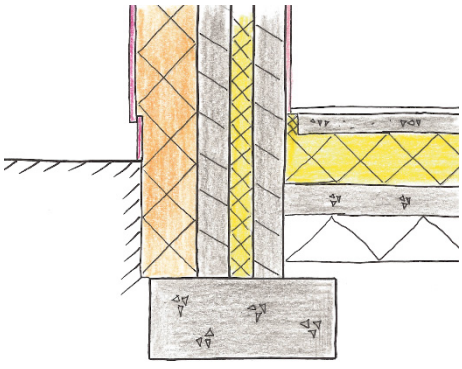
Building fabric

- Increase the levels of insulation at the external envelope. EnerPHit Requirements for roof, floor and ceiling U-value ≤ 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
- The quality of the materials and the workmanship is vital in the above areas so that thermal bridging does not occur
- The fabric needs to achieve high thermal and airtight performance while providing structural stability and weather protection



- Air tightness and insulation are both qualities and in most cases are achieved independently using a combination of materials with insulation and air tightness properties
- External insulation fixed to the external wall should be continued below the ground level to reduce thermal bridges

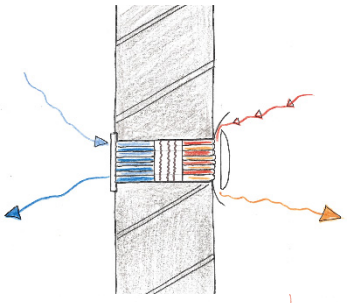




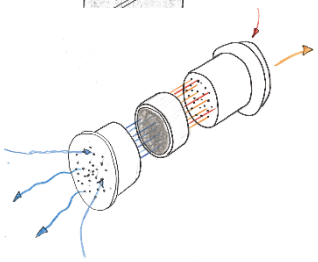
Any other relevant points/sketches

(b) Using notes and freehand sketches, discuss in detail how each of the following could be improved, when upgrading an existing building to meet the EnerPHit standard:

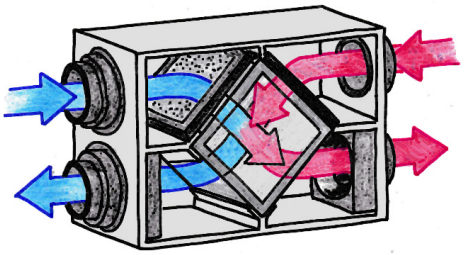
Indoor air quality



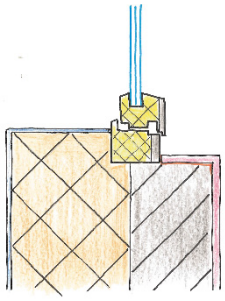
- EnerPHit buildings benefit from mechanical ventilation with heat recovery systems (MVHR). These systems ensure a constant supply of fresh air while recovering heat from exhausted air, maintaining energy efficiency. Regular maintenance and filter changes are crucial in keeping systems effective and to ensure fresh air circulation
- Selecting building materials, finishes, and furnishing that have low levels of volatile organic compounds (VOCs) and other pollutants can significantly improve indoor air quality. This includes paints, adhesives, sealants, and flooring materials designed to emit minimal toxins



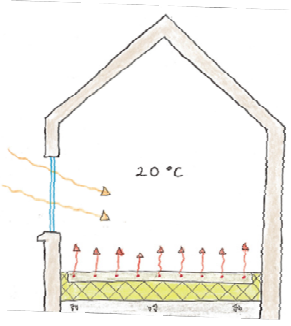
- Maintaining optimal humidity levels (between 30-50%) helps prevent mould growth which can degrade the indoor air quality. EnerPHit buildings often incorporate humidity-controlled ventilation to keep humidity within this ideal range, especially in bathrooms and kitchens
- Continuous monitoring of indoor air quality through sensors and regular maintenance of ventilation systems ensure issues are identified and addressed promptly
- Install glazed manual openings in all rooms so that air can naturally circulate bringing in fresh air from the outside and removing stale moist air from the inside



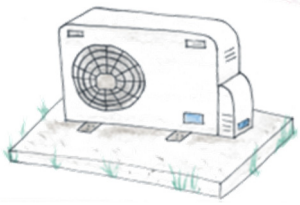
Space heating



- Upgrading the insulation in the building envelope is fundamental. High quality continuous insulation in walls, roofs, and floors reduces heat loss. Using materials with low U-values and ensuring proper installation to eliminate thermal bridges help maintain consistent indoor temperature
- Installing high performing glazing and doors with low U-values minimises heat loss. Properly sealing all openings will ensure the elimination of drafts at the junction of components. This will reduce load and demand on space heating source
- Implementing highly efficient heating systems, such as air-source or ground-source heat pumps, will significantly improve space heating efficiency. Heat pumps run at a 5:1 co-efficiency of performance. These systems transfer heat rather than generate it, offering higher efficiency compared to traditional heating methods. The combination of highly efficient systems and under-floor heating result in a balanced indoor temperature all-year round



- Using mechanical ventilation with heat recovery ensures heat from outgoing stale air is transferred to incoming fresh air. This reduces the need and demand on additional heating, maintaining a comfortable indoor environment with minimal energy use
- Maximising solar gains through passive solar design helps reduce the load on active heating. This involves strategically placing glazing to capture sunlight during winter and using thermal mass materials to store and slowly release heat. Ensuring proper shading and glazing treatments can prevent overheating during warmer months, maintaining a balanced 20 °C indoor temperature



Any other relevant points

(c) Two advantages of using qualified skilled labour when retrofitting a house to meet EnerPHit Passive House standards.

Expertise and knowledge

Skilled workers have the necessary training and expertise to understand the complexities of EnerPHit retrofits. They would be familiar with the requirements of Passive House standards and can ensure that the retrofit is conducted in accordance with the best practices and industry standards

Quality workmanship

Skilled workers bring a level of craftsmanship and attention to detail that is crucial for EnerPHit retrofits. Their experience allows them to complete the retrofit with precision, ensuring that all components are installed correctly and that the house meets the required energy performance targets

Efficiency and on-time completion

Skilled workers are efficient in their work processes and can complete EnerPHit retrofits in the scheduled time. Their expertise enables them to streamline the retrofitting process, minimise delays, and deliver the project to the client on time

Compliance with regulation

Skilled workers are experienced in building regulations and safety practices. When carrying out EnerPHit retrofits, they ensure that all work meets all necessary regulatory requirements, including airtightness and energy efficiency standards

Problem solving abilities

Skilled workers have the ability to troubleshoot and solve complex problems which may arise during EnerPHit retrofit projects. Their experience allows them to identify issues, propose effective solutions, and adapt to unexpected challenges, ensuring the successful completion of the project

Long term performance

EnerPHit retrofits require a high level of precision and attention to detail to achieve optimal energy efficiency and performance. Skilled workers can deliver a retrofit that is built to last with durable materials, proper installation techniques, and quality craftsmanship that will ensure the long-term energy performance of the house. An EnerPHit retrofit is disruptive and the occupants are going to be discommoded so they won't want to go through the building process again

Any other relevant points

Question 10

"Buildings have an impact on the environment at every stage of their lifecycle. Materials have to be quarried, mined or harvested, transported to factories and manufactured. The final products have to be transported to site, lifted into place and fixed in position. The buildings have to be operated, heated and cooled. Over a 60 year lifecycle, components fail, roof finishes fail and need replacement, finishes spoil and need repainting and replacement. Eventually the building ceases to provide its function and needs to be deconstructed and all its components disposed by landfill, incineration, recycling or direct reuse."

Adapted from: **Towards a circular economy**
Published by: Irish Green Building Council

(a) Discuss the above statement in detail.

Discussion of the above statement– such as

- Consideration of the environmental impact of operating dwellings at different stages of their lifecycle, from daily activities to long-term maintenance, occupants can adopt sustainable practices to mitigate negative effects on the environment
- The lifecycle of materials and components should be considered at the design and selection stage to limit the effect on the environment over its lifetime
- Weighing up the embodied energy against the operational energy of materials and components selection should be calculated. Materials and components with a short lifespan will have a higher carbon footprint compared to materials and components that will not require replacing over the full life of the building
- Environmental Product Declarations (EPD) are a standardised way of providing data about the environmental impacts of a product through the product lifecycle
- EPD including all life cycle stages are known as "cradle to grave" EPD. EPD can also show the potential benefits of any reuse, recovery or recycling after end of life
- EPD measures the Global Warming Potential (GWP), Eutrophication (EP), Photochemical Ozone Creation Potential (POCP), Stratospheric Ozone Depletion Potential (ODP), Acidification (AP), and Abiotic depletion of materials and components
- The Irish Green Building Council has established the Irish EPD programme to allow Irish construction product manufacturers to develop and publish Environmental Product Declarations for their products
- The term 'circular economy' describes how products and materials can continue to be used again once they have reached the end of their 'first' life; as such they are no longer viewed as a waste but as a resource
- Materials move in loops within the activities of reuse, remanufacture, and recycling. The circular economy is the opposite of the 'take-make-dispose' linear economy model. A key principle is that materials should be utilised at the highest value possible, avoiding down-cycling
- Buildings are long term investments in social infrastructure. By engaging with the circular economy, we can ensure that investment can retain its value, provide employment, reduce waste, and provide a more sustainable material resource
- Designers and homeowners should make careful ethical decisions on the selection of materials and components
- Prudently planning and design at the initial stages, will require less artificial heating and cooling over a building's lifetime. This will result in less reliance on fossil fuels to operate buildings

Any other relevant, cogent, well-argued points

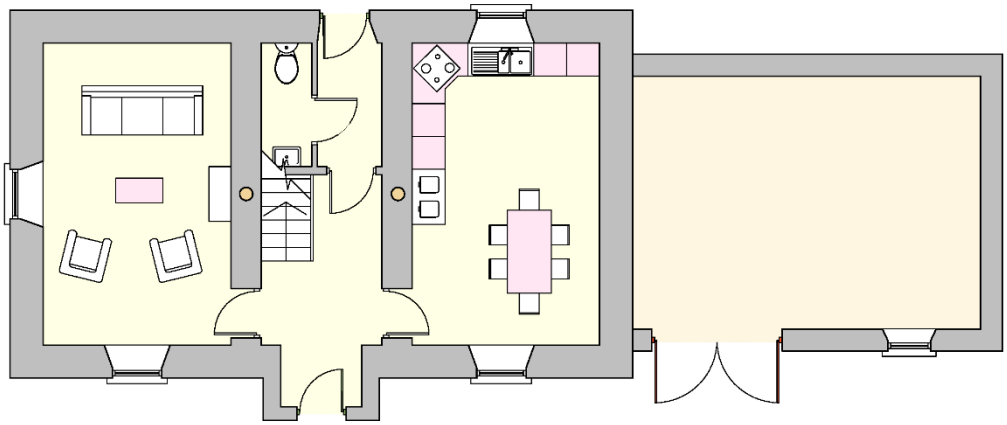
(b) Propose three best practice guidelines when selecting materials at the design and construction stages, to reduce the whole of life carbon impact of a dwelling house.

- Use PHribbon package to calculate the total cradle-to-grave carbon emitted of constructing new dwellings
- Use only products with Environmental Product Declarations (EPD)
- The hierarchy for waste management is: Reduce, Reuse, Recycle. Leaner production can reduce the amount of raw materials used
- Good architectural and structural design, including use of standard sizes can reduce the amount of material needed and resulting waste in construction
- Planning for disassembly at end of building life, allows reuse or recycling. The use of a site waste management plan encourages the contractors and designers to consider all of these issues from the earliest stages of a building project
- To enable products and buildings to become more circular, it is important to consider how they are designed. Important considerations for products include designing for disassembly, the potential for standardisation and modularity, the use of secondary materials, avoiding the use of hazardous and composite materials which may hinder reuse and recycling opportunities
- For buildings, the way the products are assembled and connected together is important. Using mechanical fixings rather than bonding is preferable, as is making sure that shorter lived products are accessible and are not enclosed by longer life material
- Designing for flexibility and adaptability (both in function and form) to enable components and buildings to be used for longer, which avoids the need for new resources
- Government and local authorities should support and actively encourage the re-use and repurposing of existing buildings
- Successful re-using and/or repurposing should be promoted as exemplars of best practice and should encourage others to follow example
- Local planning authorities to develop, publish, and promote clear planning guidelines outlining the requirements for repurposing of existing components and materials in the most sustainable way possible
- Funding and grants should be made available to builders and construction companies that can repurpose and reuse materials from end-of-life buildings

Any other relevant, cogent, well-argued points

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2024



Construction Studies

Theory – Higher Level

Marking Scheme

Question 1

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Vertical section through lean-to roof and external walls of a house. ***External wall and eaves*** ***Roof*** ***Front wall of house and abutment*** ***4 × 4 marks*** ***4 × 4 marks*** ***4 × 4 marks*** (3 for drawing, 1 for annotation)	
External wall and eaves • Larch cladding rain screen • Battens / counter battens • Cavity wall blockwork & low conductivity wall ties • Full-fill insulation • Cavity closer • Wallplates • Skim / plaster	**4** **4** **4** **4**
Lean-to roof • Fascia / soffit / gutter (Any two) • Three courses of slates • Slating battens 50 × 30 mm @ 400 mm centre / counter battens • Roof breather membrane • Ventilation • Roof rafter & insulation • Air barrier membrane & airtightness taping • Insulated plasterboard (50 mm insulation + 12.5 mm plasterboard)	**4** **4** **4** **4**
Front wall of house and abutment • External & internal render • Full-fill cavity wall blockwork & wall ties • Concrete lintels • Cavity closer • Rafter support • Stepped DPC • Lead flashing	**4** **4** **4** **4**
Scale - 4 marks **Drafting** - 4 marks *Excellent Good Fair* *8 6 4*	**8**
(b) Typical design detailing that will ensure ventilation of the roof structure ***(4 marks)***	
Design detailing identified to ensure ventilation of the roof	**4**
TOTAL	**60**

Question 2

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) Two best practice guidelines when designing a room for lifetime use		***(24 marks)***
Kitchen - (2 details)		**3**
		3
Detail 1	**Detail 2**	
Notes (3)	Notes (3)	**3**
Sketches (3)	Sketches (3)	**3**
Bedroom - (2 details)		**3**
		3
Detail 1	**Detail 2**	
Notes (3)	Notes (3)	**3**
Sketches (3)	Sketches (3)	**3**
(b) Preferred layout for en suite to ensure ease of use by a person with limited mobility.		***(21 marks)***
Line diagram of bedroom and en suite		**4**
Annotated sketch to include:		
Access to en suite		**3**
Shower area		**3**
Water Closet (W.C.)		**3**
Wash basin		**3**
Grab rails		**3**
Dimensions - Any two		**2**
(c) Justify preferred location for each item at 2(b)		***(15 marks)***
Access to en suite	(1 for point, 2 for discussion)	**3**
Shower area	(1 for point, 2 for discussion)	**3**
Water closet (W.C.)	(1 for point, 2 for discussion)	**3**
Wash basin	(1 for point, 2 for discussion)	**3**
Grab rails	(1 for point, 2 for discussion)	**3**
	TOTAL	**60**

QUESTION 3

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) Revised internal layout for proposed renovation		***(26 marks)***
Revised internal layout for the kitchen/dining and living area		**14**
Linking existing kitchen to the forge		**3**
Optimising natural daylight		**3**
Maximising the views to the mountain		**3**
Justification		**3**
(b) External design of forge that will respect and enhance visual appearance of the house		***(24 marks)***
Notes		**12**
Sketch		**12**
(c) Two advantages of respecting Irish vernacular architecture when renovating an old building		***(2 × 5 marks)***
Advantage **1**	(2 for point, 3 for discussion)	**5**
Advantage **2**	(2 for point, 3 for discussion)	**5**
	TOTAL	**60**

Question 4

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) Three reasons why local authorities regulate new dwellings		***(3 × 6 marks)***
Reason **1**	(2 for point, 4 for discussion)	**6**
Reason **2**	(2 for point, 4 for discussion)	**6**
Reason **3**	(2 for point, 4 for discussion)	**6**
(b) Selection of preferred site and discuss three considerations for site selection		***(3 × 6 marks)***
Consideration **1**	(2 for point, 4 for discussion)	**6**
Consideration **2**	(2 for point, 4 for discussion)	**6**
Consideration **3**	(2 for point, 4 for discussion)	**6**
***(c)* Sketch site showing: house location and orientation, outdoor living space, road entrance and driveway**		***(24 marks)***
Sketch of selected site		**6**
House location and Orientation		**5**
Outdoor living space		**5**
Road entrance and Driveway		**5**
Justification		**3**
	TOTAL	**60**

QUESTION 5

PERFORMANCE CRITERIA		MAXIMUM MARK
***(a) U-value of* external wall**		***(11 × 3 marks)***
Tabulation		**3**
External surface resistance		**3**
External render		**3**
External insulation		**3**
Concrete		**3**
Internal insulation		**3**
Internal plasterboard		**3**
Internal skim coat		**3**
Internal resistance		**3**
Total resistance		**3**
Calculation of U-value (w/m^2 °C or w/m^2k)		**3**
(b) Cost of annual heat loss through 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) Two advantages and two disadvantages of incorporating a wood pellet boiler stove		***(4 x 3 marks)***
Advantage **1**	(1 for point, 2 for discussion)	**3**
Advantage **2**	(1 for point, 2 for discussion)	**3**
Disadvantage **1**	(1 for point, 2 for discussion)	**3**
Disadvantage **2**	(1 for point, 2 for discussion)	**3**
TOTAL		**60**

QUESTION 6

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) ***Three features of low environmental impact***		***(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) ***Two features that could be added to the house to increase energy efficiency***		***(4 × 5 marks)***
Feature 1		
Notes		**5**
Sketches		**5**
Feature 2		
Notes		**5**
Sketches		**5**
(c) Two advantages of designing energy efficient new homes		***(2 × 5 marks)***
Advantage **1**	(2 for point, 3 for discussion)	**5**
Advantage **2**	(2 for point, 3 for discussion)	**5**
	TOTAL	**60**

Question 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Vertical section through timber frame wall, window frame and first floor joist*** ***External wall 5 × 4 marks*** ***Head of the window 4 × 4 marks*** ***First floor 3 × 4 marks*** (3 for drawing, 1 for annotation)	
External wall • External render • Concrete block • Air space / residual cavity • Breather membrane • OSB Racking board • 250 × 50 mm Stud and insulation • Air barrier • Insulated service cavity • Plasterboard / skim	**4** **4** **4** **4** **4**
Window Frame • Concrete lintel • Timber lintel • Fire stop / cavity closer • Stepped DPC • Thermally broken frame • Glazing (Triple) • Airtightness tape – window frame head	**4** **4** **4** **4**
Floor • Joist support at wall • Tongued and groove flooring / skirting board • OSB decking • 225 × 50 mm Joist • Sound insulation • Plasterboard ceiling	**4** **4** **4**
Scale - 4 marks **Drafting** - 4 marks *Excellent 8 Good 6 Fair 4*	**8**
(b) Design details to ensure airtightness at junction of first floor and wall	***(4 marks)***
Design detail	**4**
TOTAL	**60**

Question 8

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) ***Typical design layout to provide hot water and central heating***		***(7 × 4 marks) + 4 marks***
Wood-burning stove Radiators ground floor and first floor		**4**
Zone control panel Zone thermostats		**4**
Cylinder and coil Header / expansion tank / storage		**4**
Rising main Feed to expansion tank		**4**
Overflow pipe Cold feed from expansion tank		**4**
Expansion pipe or vessel Flow pipe to radiators		**4**
Pump Return pipe from radiators Control valves (isolating valves, drain off valves - any 2)		
Typical sizes of pipework - any **two**		**4**
(b) ***One onsite method of incorporating renewable technology into hot water system***		***(12 marks)***
Notes		**6**
Sketches		**6**
(c) ***Two advantages and two disadvantages of underfloor heating system***		***(4 × 4 marks)***
Advantage 1	(1 for point, 3 for discussion)	**4**
Advantage 2	(1 for point, 3 for discussion)	**4**
Disadvantage 1	(1 for point, 3 for discussion)	**4**
Disadvantage 2	(1 for point, 3 for discussion)	**4**
	TOTAL	**60**

Question 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Two functional requirements of a home office space	***(4 × 4 marks)***
Functional requirement 1	**4**
Notes	
Sketches	**4**
Functional requirement 2	**4**
Notes	
Sketches	**4**
(b) Revised design detailing that will reduce the transmission of sound	***(32 marks)***
Floor detail	
Notes	**8**
Sketches	**8**
Stud wall detail	**8**
Notes	
Sketches	**8**
(c) Two approaches used to reduce transmission of sound and associated principle	***(12 marks)***
Approach **1**	**4**
Associated sound principle	**2**
Approach **2**	**4**
Associated sound principle	**2**
TOTAL	**60**

Question 10

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) ***Discuss the importance of any two in EnerPHit design standard***		***(4 × 6 marks)***
Notes		**6**
Sketches		**6**
Notes		**6**
Sketches		**6**
(b) ***Improve the following when upgrading to meet EnerPHit standard***		***(4 x 6 marks)***
Indoor air quality		
Notes		**6**
Sketches		**6**
Space heating		
Notes		**6**
Sketches		**6**
(c) Two advantages of using qualified skilled labour when retrofitting to EnerPHit standard		***(2 × 6 marks)***
Advantage **1**	(2 for point, 4 for discussion)	**6**
Advantage **2**	(2 for point, 4 for discussion)	**6**
	TOTAL	**60**

Question 10 (Alternative)

PERFORMANCE CRITERIA		MAXIMUM MARK
(a) Discussion of Statement (Impact of building material)		***(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**
(b) Three best practice guidelines when selecting materials to reduce the whole of life carbon impact of a dwelling house.		***(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

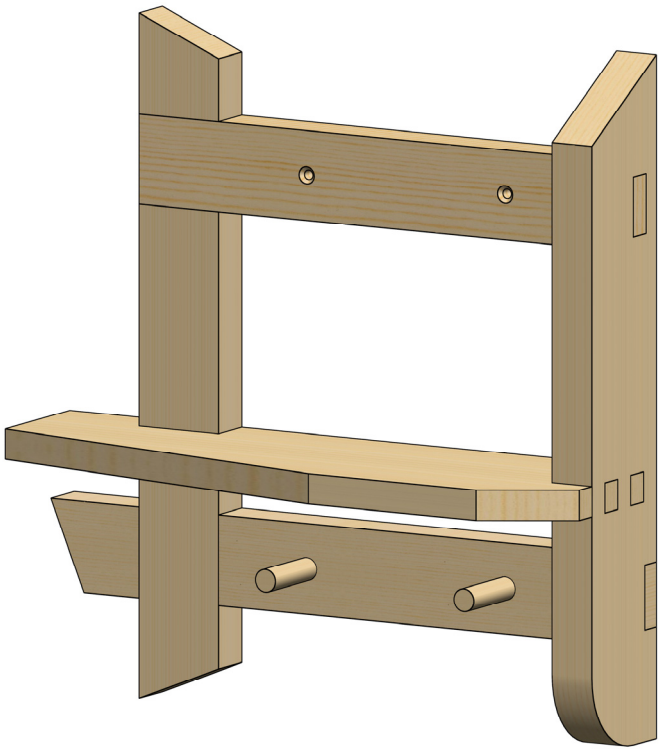
Leaving Certificate Examination 2024

Construction Studies

Practical Test

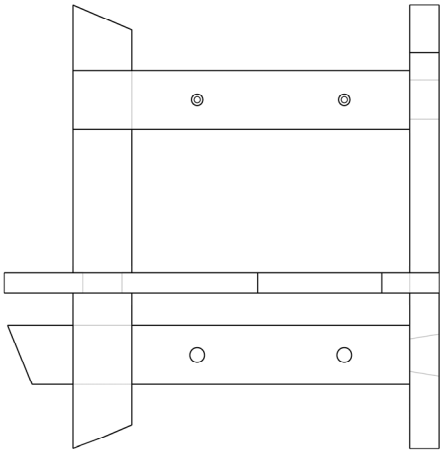
Common Level

(150 marks)



Marking Scheme

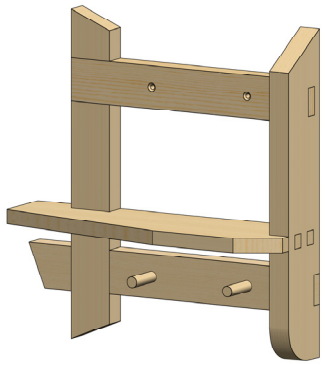
Day 1



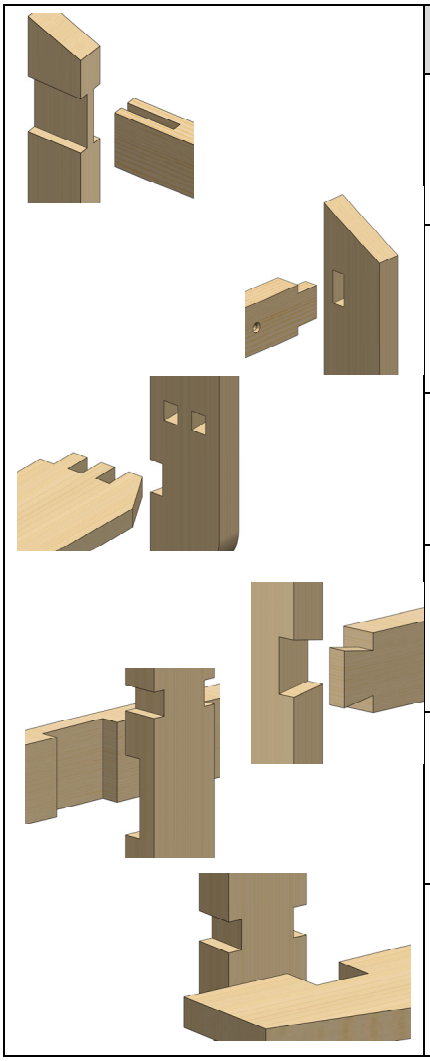
Marking Scheme – Practical Test

Note:

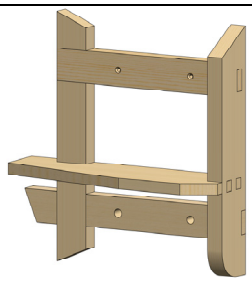
- The artefact is to be hand produced by candidates without the assistance of machinery.
- The use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that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

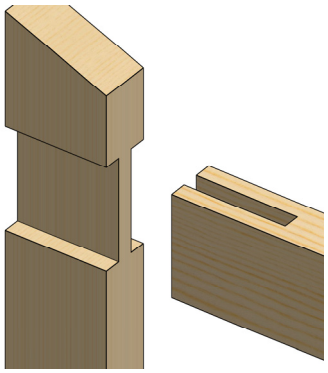
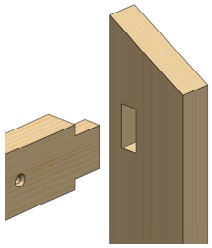


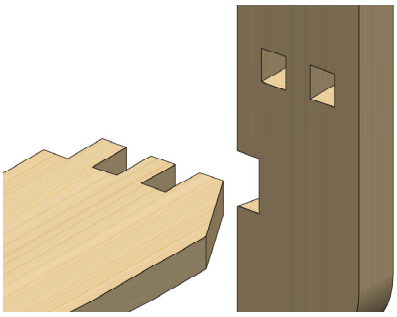
(i)	Overall Assembly	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *2 x 1 mark* • shaping *2 x 1 mark*	**4**
	Total	**14**

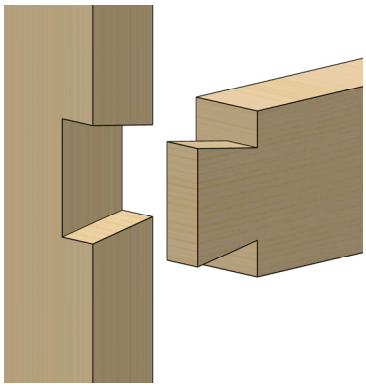


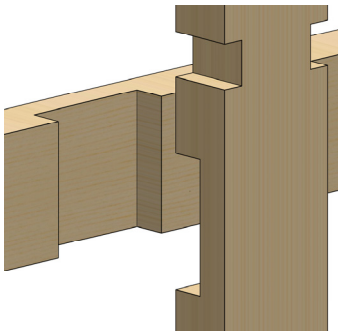
(ii)	Marking Out	Marks
a.	Bridle joint • trenches *2 x 2 marks* • bridle *3 marks*	**7**
b.	Bare faced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**
c.	Double mortice and tenon joint • mortices *2 × 3 marks* • tenons *5 marks*	**11**
d.	Dovetail joint • tail *3 marks* • trench *3 marks*	**6**
e.	Cross halving joint • trenches *2 x 2 marks*	**4**
f.	Housing joint • trenches *3 x 2 marks*	**6**

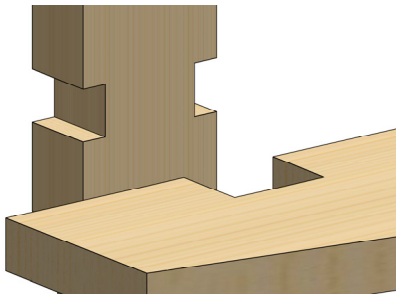
	g.	Slopes and curve • slopes *6 × 1 mark* • curve *2 marks*	**8**
		Total	**48**

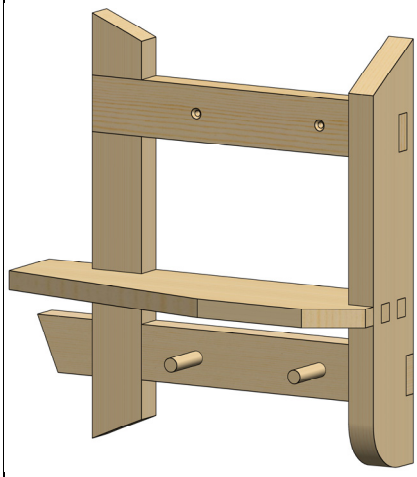
Processing of Awards Display			
Bridle joint	**(iii)**	**Processing**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(iv)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

Double mortice and tenon	(v)	Processing	Marks
	a.	Mortices • remove mortices *2 × 3 marks*	**6**
	b.	Tenons • sawing with the grain *5 × 1 mark* • sawing across the grain *1 mark* • vertical paring *2 x 2 marks*	**10**
		Total	**16**

Dovetail joint	(vi)	Processing	Marks
	a.	Dovetail • sawing of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • pairing of trench to depth *2 marks*	**4**
		Total	**12**

Cross halving joint	(vii)	Processing	Marks
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Housing joint	(viii)	Processing	Marks
	a.	Trench (shelf) • sawing across the grain *2 x 1 mark* • Paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical piece) • sawing across the grain *4 x 1 mark* • paring of trenches to depth *2 x 2 marks*	**8**
		Total	**12**

Shaping & drilling	(ix)	Processing	Marks
	a.	Short slopes *5 × 1 mark*	**5**
	b.	Long slope *2 marks*	**2**
	c.	Curve *2 marks*	**2**
	d.	Drill and countersink screw holes accurately *2 x 2 marks*	**4**
	e.	Dowels • cut dowels to length *2 × 1 mark* • drill dowel holes accurately *2 × 2 marks*	**6**
		Total	**19**

	Overall Completion of Piece	Marks
	Grand Total	**150**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

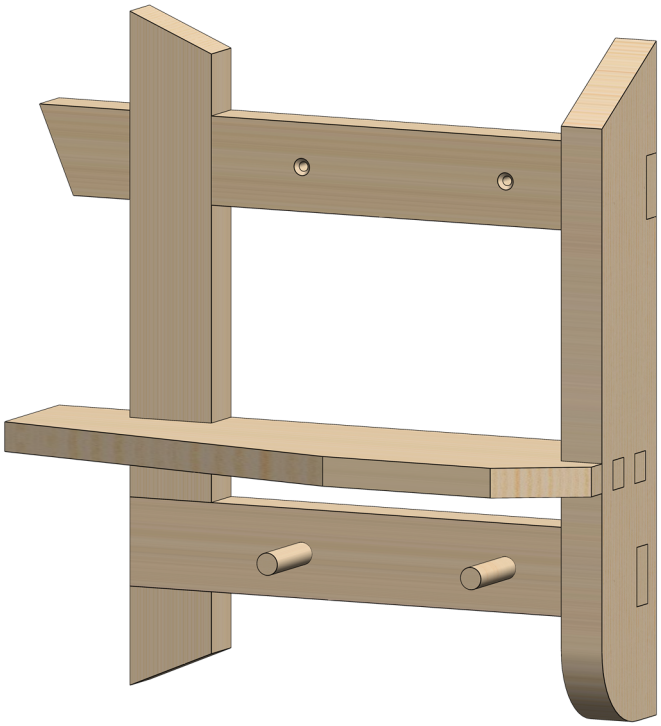
Leaving Certificate Examination 2024

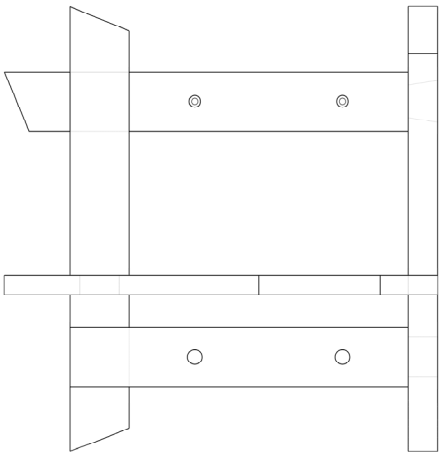
Construction Studies

Practical Test

Common Level

(150 marks)





Marking Scheme

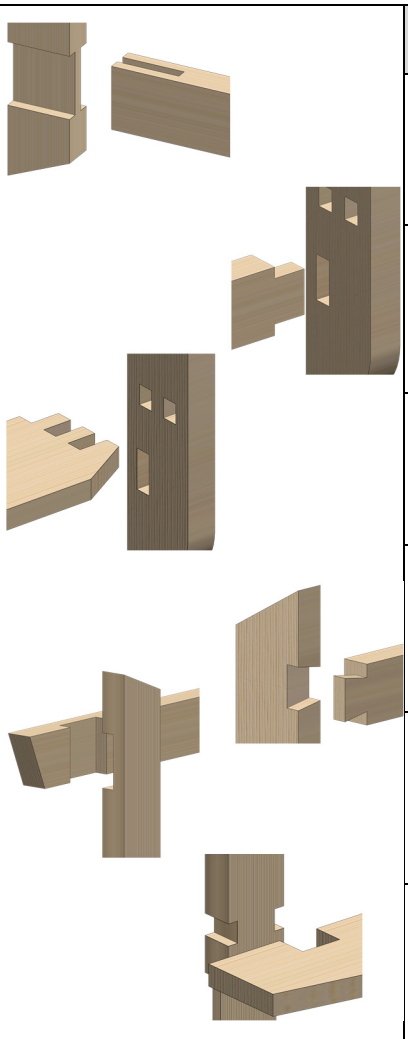
Day 2

Marking Scheme – Practical Test

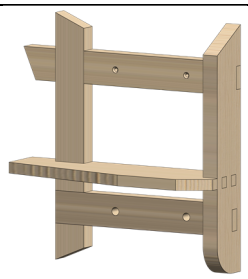
Note:

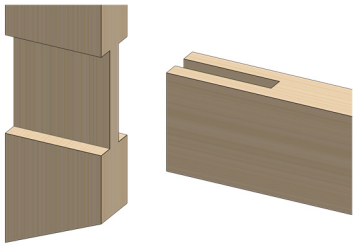
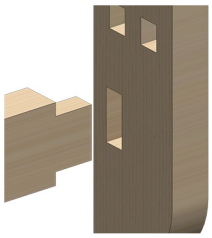
- The artefact is to be hand produced by candidates without the assistance of machinery.
- The use of a battery powered screwdriver is allowed.
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that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

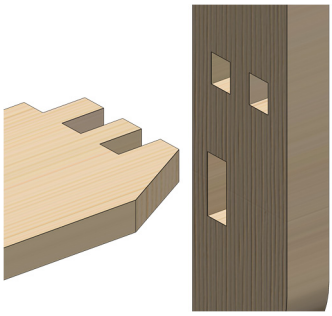
(i)	Overall Assembly	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *2 x 1 mark* • shaping *2 x 1 mark*	**4**
	Total	**14**

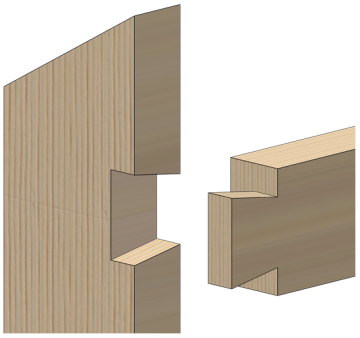


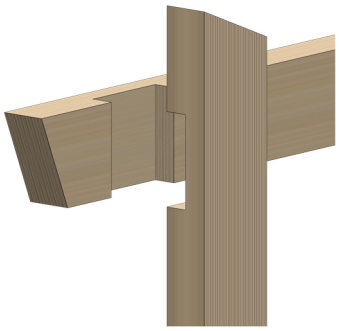
(ii)	Marking Out	Marks
a.	Bridle joint • trenches *2 x 2 marks* • bridle *3 marks*	**7**
b.	Bare faced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**
c.	Double mortice and tenon joint • mortices *2 × 3 marks* • tenons *5 marks*	**11**
d.	Dovetail joint • tail *3 marks* • trench *3 marks*	**6**
e.	Cross halving joint • trenches *2 x 2 marks*	**4**
f.	Housing joint • trenches *3 x 2 marks*	**6**

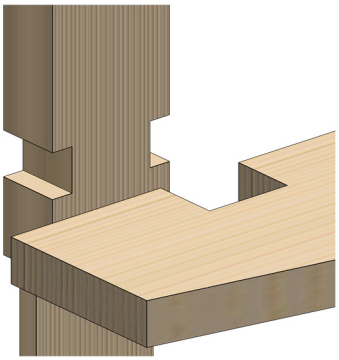
	g.	Slopes and curve • slopes *6 × 1 mark* • curve *2 marks*	**8**
		Total	**48**

Processing of Awards Display			
Bridle joint	**(iii)**	**Processing**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(iv)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

Double mortice and tenon	(v)	Processing	Marks
	a.	Mortices • remove mortices *2 × 3 marks*	**6**
	b.	Tenons • sawing with the grain *5 × 1 mark* • sawing across the grain *1 mark* • vertical paring *2 x 2 marks*	**10**
		Total	**16**

Dovetail joint	(vi)	Processing	Marks
	a.	Dovetail • sawing of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • pairing of trench to depth *2 marks*	**4**
		Total	**12**

Cross halving joint	(vii)	Processing	Marks
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Housing joint	(viii)	Processing	Marks
	a.	Trench (shelf) • sawing across the grain *2 x 1 mark* • Paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical piece) • sawing across the grain *4 x 1 mark* • paring of trenches to depth *2 x 2 marks*	**8**
		Total	**12**

Shaping & drilling	(ix)	Processing	Marks
	a.	Short slopes *5 × 1 mark*	**5**
	b.	Long slope *2 marks*	**2**
	c.	Curve *2 marks*	**2**
	d.	Drill and countersink screw holes accurately *2 x 2 marks*	**4**
	e.	Dowels • cut dowels to length *2 × 1 mark* • drill dowel holes accurately *2 × 2 marks*	**6**
		Total	**19**

	Overall Completion of Piece	Marks
	Grand Total	**150**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

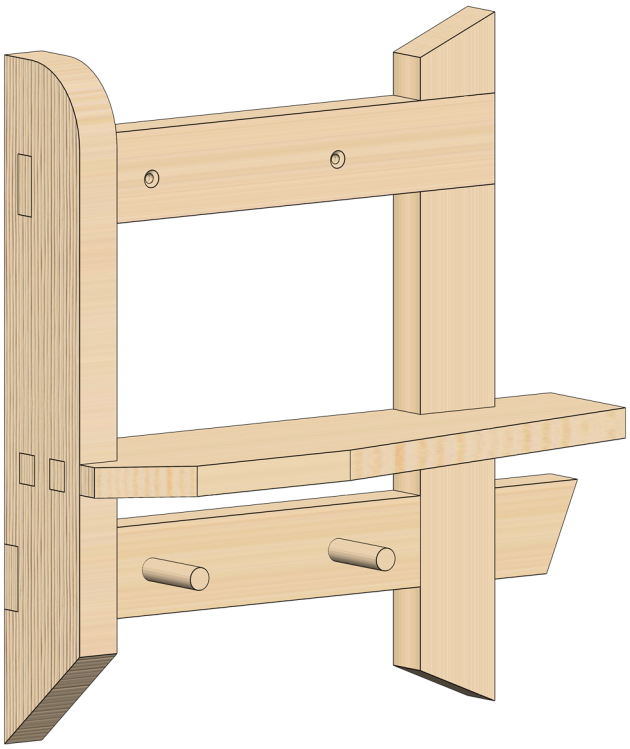
Leaving Certificate Examination 2024

Construction Studies

Practical Test

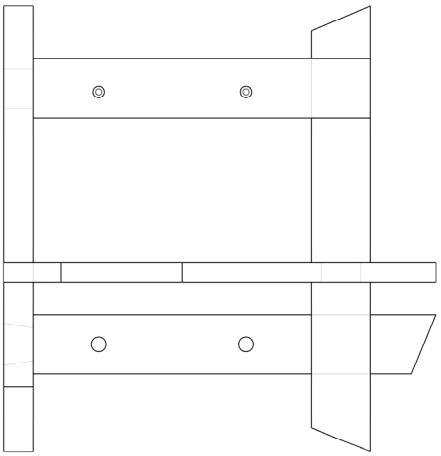
Common Level

(150 marks)



Marking Scheme

Day 3



Marking Scheme – Practical Test

Note:

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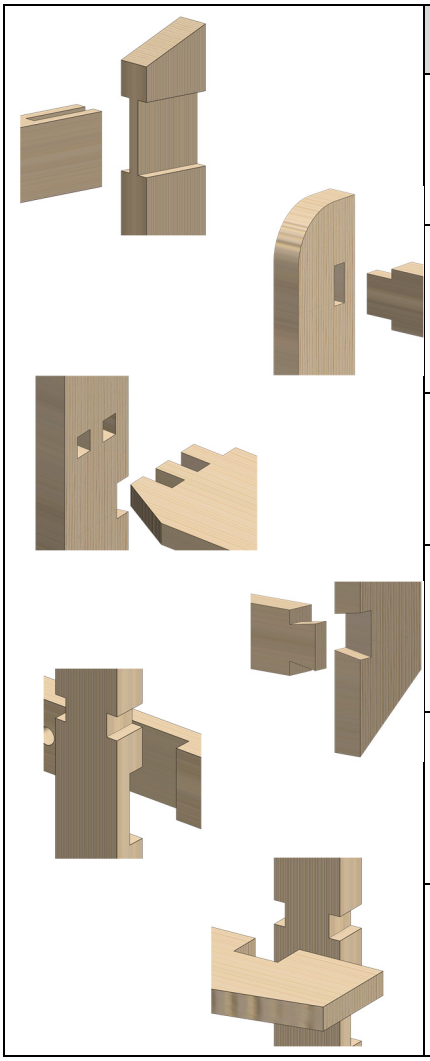
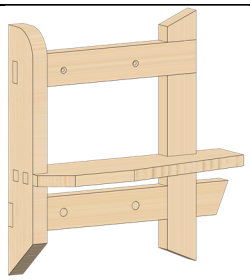
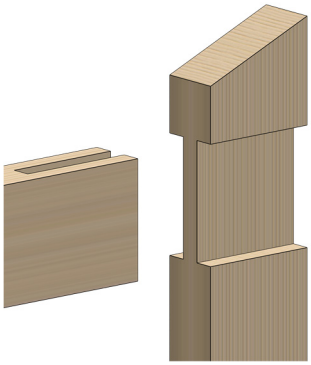
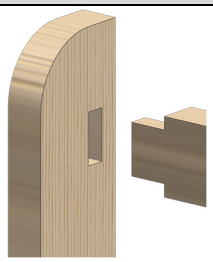
- Where there is evidence of the use of machinery for a particular procedure a penalty applies.
- Component is marked out of 50% of the marks available for that procedure.

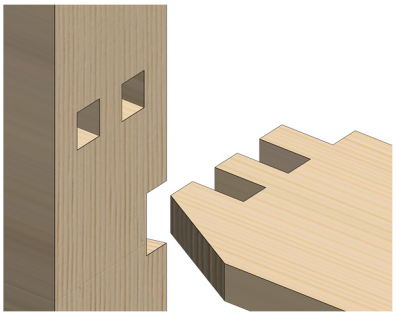
(i)	Overall Assembly	Marks
a.	Overall quality of assembled artefact	**10**
b.	Design and applied shaping to edges • design *2 x 1 mark* • shaping *2 x 1 mark*	**4**
	Total	**14**



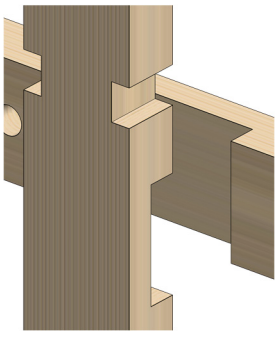
(ii)	Marking Out	Marks
a.	Bridle joint • trenches *2 x 2 marks* • bridle *3 marks*	**7**
b.	Bare faced mortice and tenon joint • mortice *3 marks* • tenon *3 marks*	**6**
c.	Double mortice and tenon joint • mortices *2 × 3 marks* • tenons *5 marks*	**11**
d.	Dovetail joint • tail *3 marks* • trench *3 marks*	**6**
e.	Cross halving joint • trenches *2 x 2 marks*	**4**
f.	Housing joint • trenches *3 x 2 marks*	**6**

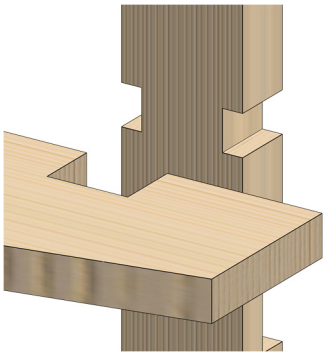
	g.	Slopes and curve • slopes *6 × 1 mark* • curve *2 marks*	**8**
		Total	**48**

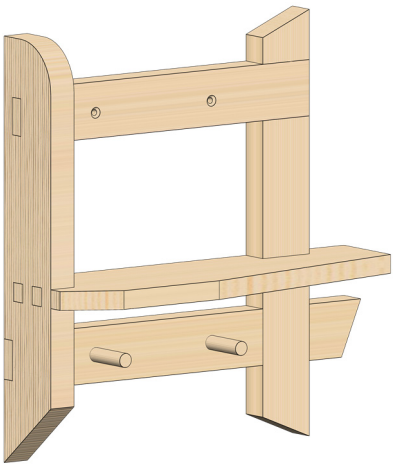
Processing of Awards Display			
Bridle joint	**(iii)**	**Processing**	**Marks**
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
	b.	Bridle • sawing with the grain *2 × 1 mark* • paring bridle *2 marks*	**4**
		Total	**12**
Bare face mortice & tenon	**(iv)**	**Processing**	**Marks**
	a.	Mortice *3 marks*	**3**
	b.	Tenon *6 marks*	**6**
		Total	**9**

Double mortice and tenon	(v)	Processing	Marks
	a.	Mortices • remove mortices *2 × 3 marks*	**6**
	b.	Tenons • sawing with the grain *5 × 1 mark* • sawing across the grain *1 mark* • vertical paring *2 x 2 marks*	**10**
		Total	**16**

Dovetail joint	(vi)	Processing	Marks
	a.	Dovetail • sawing of dovetail *4 × 1 mark* • paring dovetail *2 × 2 marks*	**8**
	b.	Dovetail trench • sawing across the grain *2 × 1 mark* • pairing of trench to depth *2 marks*	**4**
		Total	**12**

Cross halving joint	(vii)	Processing	Marks
	a.	Trenches • sawing across the grain *4 × 1 mark* • paring of trenches to depth *2 × 2 marks*	**8**
		Total	**8**

Housing joint	(viii)	Processing	Marks
	a.	Trench (shelf) • sawing across the grain *2 x 1 mark* • Paring of trench to depth *2 marks*	**4**
	b.	Trenches (vertical piece) • sawing across the grain *4 x 1 mark* • paring of trenches to depth *2 x 2 marks*	**8**
		Total	**12**

Shaping & drilling	(ix)	Processing	Marks
	a.	Short slopes *5 × 1 mark*	**5**
	b.	Long slope *2 marks*	**2**
	c.	Curve *2 marks*	**2**
	d.	Drill and countersink screw holes accurately *2 x 2 marks*	**4**
	e.	Dowels • cut dowels to length *2 × 1 mark* • drill dowel holes accurately *2 × 2 marks*	**6**
		Total	**19**

	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.*