Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2018

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

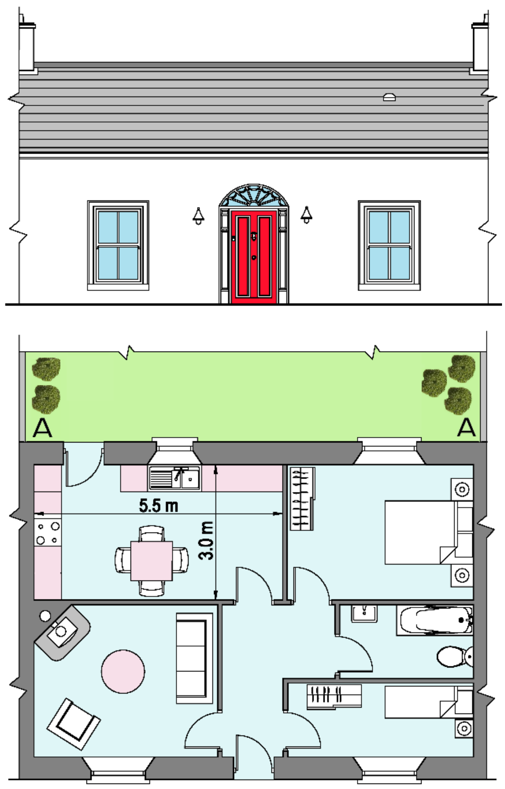
Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in 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

Scrúdú na hArdteistiméireachta 2018

Staidéar Foirgníochta

Teoiric – Ardleibhéal

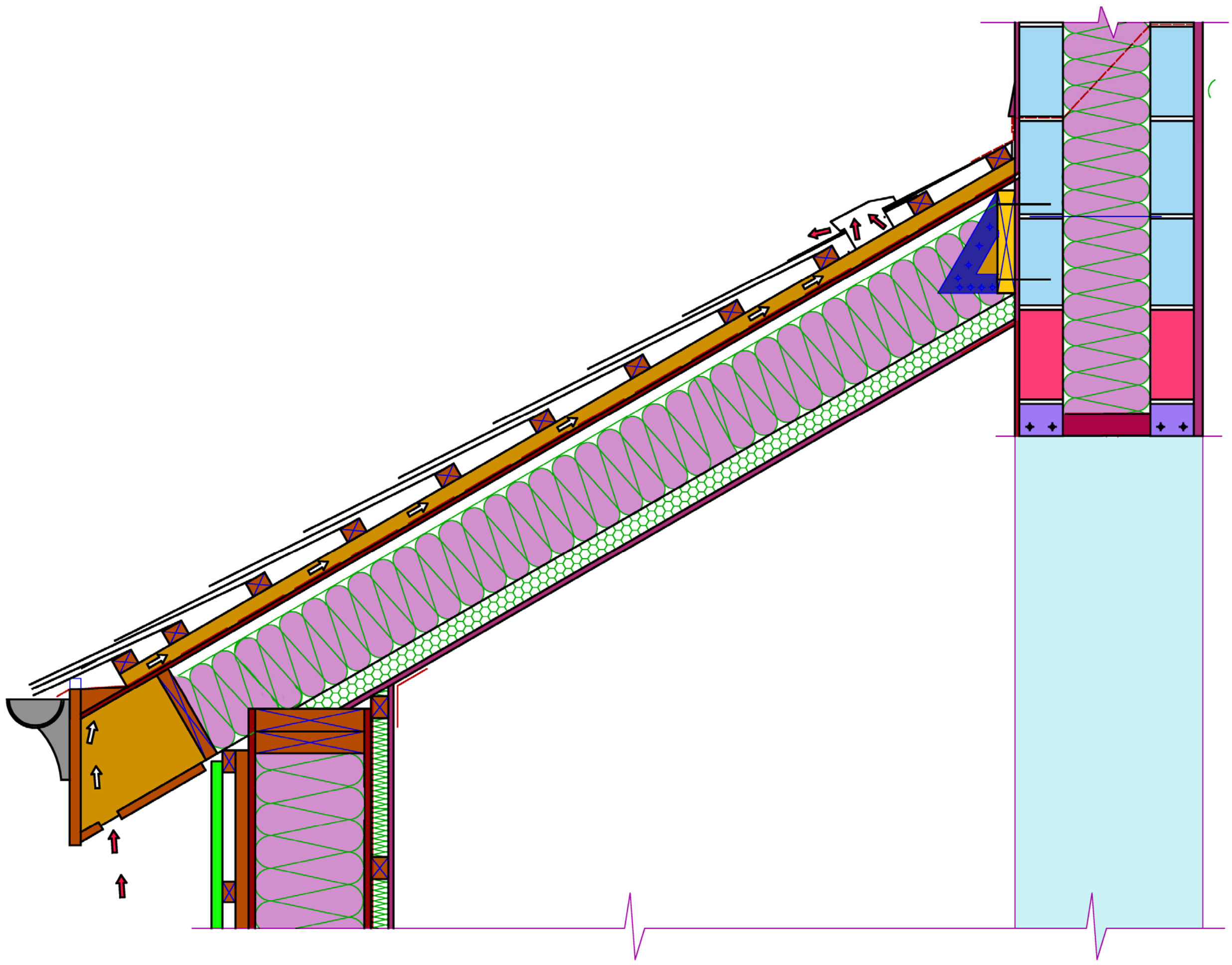


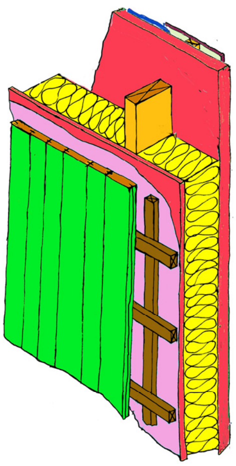
Construction Studies

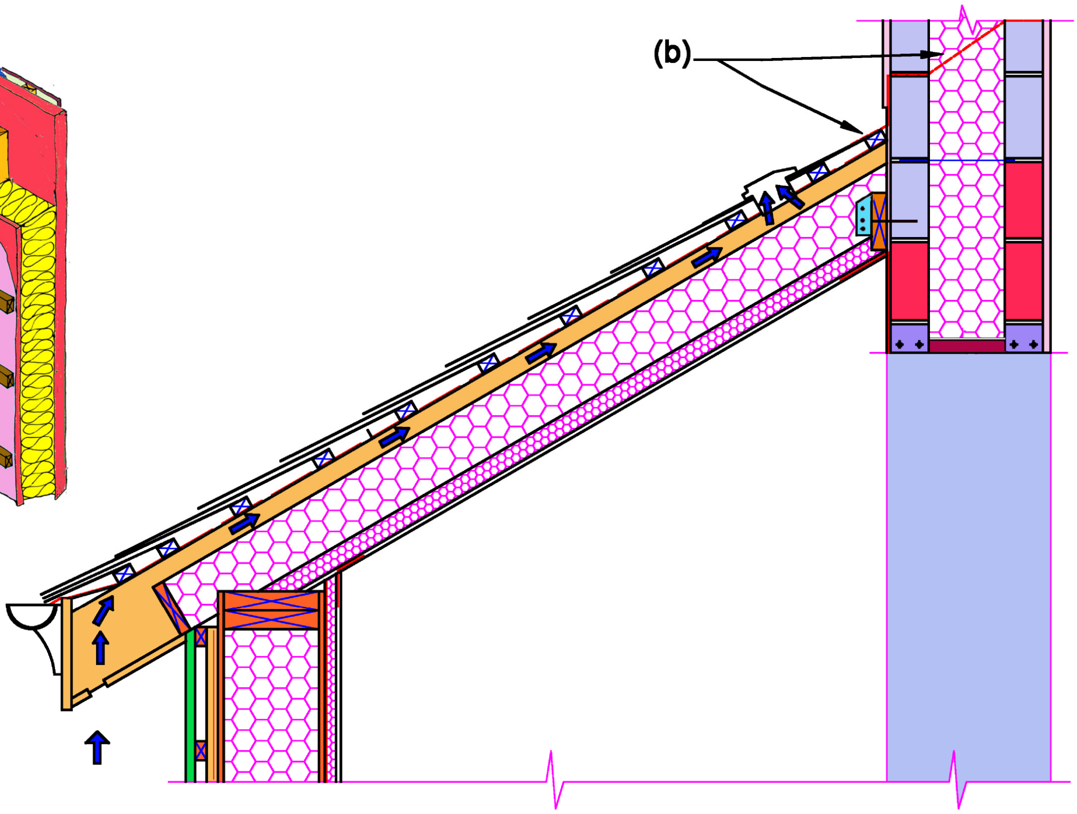
Theory – Higher Level

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.*

Ceist 1. Typical best practice details of cavity wall, sloping roof and timber clad wall – such as:







Typical best practice details of flat roof to front porch – through and through ventilation
cavity wall – typical details

- external plaster finish, scud coat, undercoat, floated sand /cement finish coat
- 100 mm concrete block outer leaf
- 200 mm full-fill insulated cavity
- basalt coated low conductivity wall ties
- 100 mm concrete block inner leaf
- 15 mm internal skim coat or cement /sand render– 2 coats or lime plaster internal render.

external wall, timber clad - typical details

- vertical cedar cladding on
- 50 × 35 mm battens and counter battens on
- thermal breather membrane on
- 10mm OSB on
- frame consisting of 250 × 50 mm studs, packed with 250 mm sheep/mineral wool/cellulose insulation
- 10mm OSB to inside face with vapour control layer taped and sealed,
- service cavity formed of 38 mm battens
- 12.5mm plasterboard taped and filled or with a skim coat.

typical details - roof

- galvanised steel wall brackets secured with resin anchored bolts to wall or
- 150 /200 × 50 mm wallplate secured to wall with resin anchored bolts
- galvanised steel wall brackets secured to wallplate
- 200 × 50 mm sloping rafters @ 400 mm centres
- OSB 10 mm secured to rafters for windtightness
- vapour diffuse barrier laid over OSB
- slate, battens and counter battens 35 × 50 mm fixed on top of OSB for ventilation to roof
- flashings and counter flashings at abutment to wall, lead, zinc, pressed aluminium, copper etc.
- insulation 200 mm min between roof joists
- vapour control layer on warm side of insulation, taped at wall junctions or
- insulated plasterboard with integral vapour control layer fitted to underside of pitched roof joists
- scrim/tape at wall and ceiling junction to ensure airtightness
- internal skim coat to wall to ensure airtightness
- fascia, soffit and gutter with proprietary vents on soffit and vent slate for roof ventilation

Any other relevant points.

Ceist 2 (a) one possible safety risk associated with **each** of the following tasks on a construction site:

excavating where there are underground electrical cables

- risk of exposing live electrical cables
- safety risk of damaging cables
- safety risk of electric shock or electrocution
- safety risk of coming into contact with live cables of any voltage - including low voltage
- contact with cables of any voltage, even low voltage, can cause fatal injuries and heart damage
- risk of explosion, fire or flames if a cable is pierced or crushed causing the outer cable sheath and the inner conductors of the cable to connect
- risk of severe, potentially fatal burns to hands, face and body
- safety risk of electrical fires due to oil-filled high-voltage cables igniting
- safety risk of spread of fire to other nearby services such as gas pipes
- damage to cables can cause loss of power supply - risking serious consequences for emergency services such as hospitals

working in a deep trench

- sides of trench collapsing leading to risk of workers being crushed or buried or fatally injured due to instability of trench
- risk of neighbouring structures being undermined leading to collapse of structures
- risk of injury or death resulting from workers or others falling into unguarded trench
- risks from materials falling into trench and injuring or killing workers
- plant or machinery falling into unguarded deep trench
- materials stored too near trench, leading to collapse of walls of trench and injury or death of workers

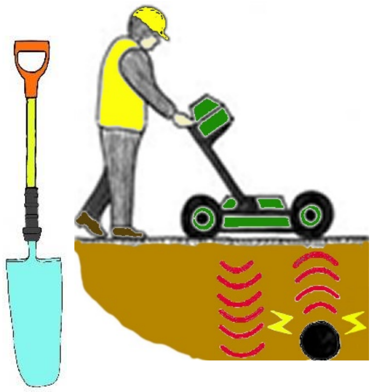
working at height when slating a roof

- risk of workers falling from roof
- risk of workers falling from scaffold/ladders
- risk of workers slipping when working on the slated surface
- risk of workers falling when working near the verge of the roof
- risk to workers below due to falling materials or tools from above

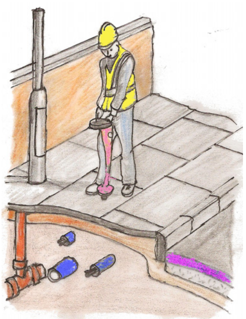
(b) two best practice guidelines that should be observed to reduce the possibility of injury to a worker

excavating where there are underground electrical cables

- dial before you dig – contact supplier for information regarding cable location
- access plans of cable layout from supplier of electrical services, use correctly to help locate power cables
- plans may not show cable depths, never assume you know how deep the cables are, always be cautious as cables may be found at shallow depths



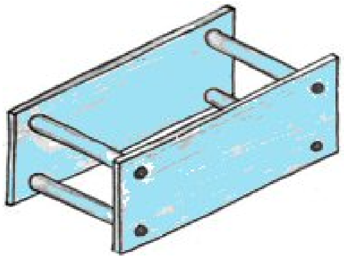
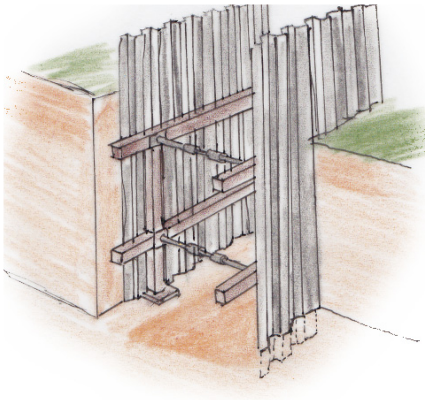
- always check the area for signs that might suggest the presence of service cables
- locate buried cables using cable location devices, such as hum detectors, radio frequency detectors
- mark position of all cables on the ground using waterproof paint
- treat all cables found anywhere as 'live' cables
- hand dig carefully near cables, cable position marked with sand, timber and colour tape over a cable as an indicator of depth and position
- always use insulated hand tools - with wooden or fibreglass handles
- take special care when digging by hand or machine
- do not use hand held power tools within 0.5 m of marked position of electrical cables
- do not use handheld power tools directly over a marked line of a cable unless:
  - you have already found the cable by careful hand digging beneath the surface and
  - it is a safe depth (at least 300mm) below the bottom of the surface to be broken or
  - you have used a physical barrier to prevent the tool striking the cable

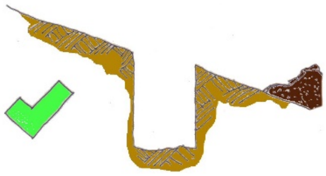
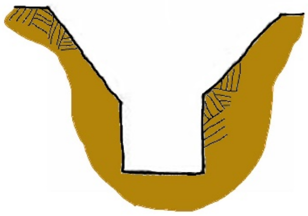


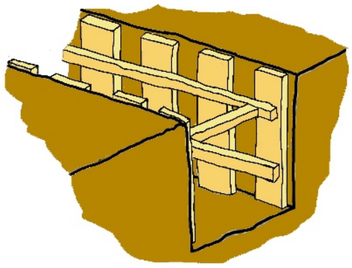
- use the cable locator frequently and repeatedly during the work
- excavate trial holes before using a mechanical excavator near electricity cables
- do not operate the excavator within 300mm of the cable
- keep everyone clear of the bucket - bucket without teeth - and the excavator while digging near cables
- where cables become exposed for any reason, take suitable precautions to prevent damage while other works are going ahead, e.g. using timber boarding or sand bags
- never handle or move exposed cables
- take extreme care where joints in the cables have been exposed
- have an emergency contact number for ESB and other relevant utilities readily available for immediate contact – dial before you dig
- follow the legal requirements to ensure a safe place of work as set out in the:
  - safety health and welfare at work act
  - safety health and welfare at work construction regulations
  - safety, health and welfare at work (general application) regulations; and
  - health and safety authority (HSA) code of practice for avoiding danger from underground services

working in a deep trench - guidelines

- use a trench box, as shown, or shuttering to support trench sides and protect workers
- do not dig deep trench in poor weather conditions – risk of side wall slippage
- batter (slope back) the trench walls
- survey neighbouring structures, walls, scaffolding etc. and provide extra support where needed
- provide guard and toe boards
- do not heap spoil, blocks etc. close to the edge of the trench
- do not park or position plant or machinery close to the edge of trench
- use personal protection equipment(hard hat and eye protection, insulated footwear)
- arrange a clearly marked exclusion zone – barrier and tape - around open trench
- use appropriate safety signage – in multilingual form and with easily understood graphics
- provide temporary cover for vacant trench.

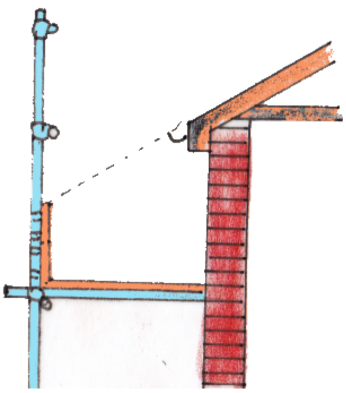
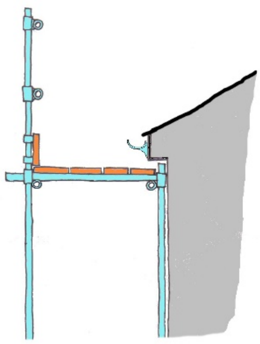


working at height when slating a roof

- ensure a safe work platform at eaves level
- ensure the required safety rails and toe boards are fitted to the scaffold
- use slating jacks and boards if needed on slope of roof (traditional roof on heritage building)
- use safety harness or other fall protection as necessary, not necessary if fall prevention measures are effective
- properly secured ladders
- use safety netting as a protection for workers and for others below

Note: duty on all workers to observe best practice safety regulations

Any other relevant points

2(c) – promoting a culture of safety among workers - t*hree strategies*

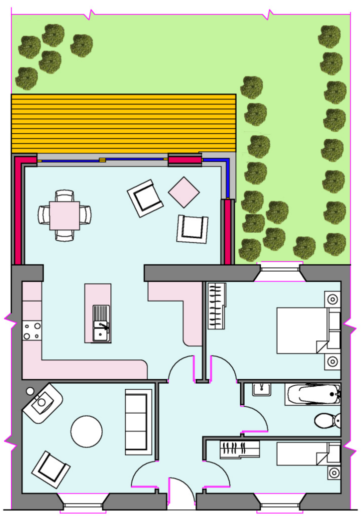
- buddy system, a new employee be paired with a more experienced worker
- ensure all workers are fully trained to carry out required tasks
- regular appraisal by management to ensure safe practice by all workers
- safe pass course mandatory for all workers
- all workers look out for one another and alert to possible risks
- manual handling course mandatory for all workers
- operators' licences for machinery e.g. forklift, telly porter etc.
- hazardous goods training course
- frequent site safety meetings
- a safety statement must have an emergency plan outlined in the case of an accident. In the event of an emergency immediate action can be taken to ensure the treatment of the injured party
- ensure that all workers and visitors to the site are familiar with the safety statement
- provide visitors to the site with appropriate PPE
- ensure all signage and directional signs are clearly visible
- provide a safer working environment
- identify hazards and to reduce the associated risk of injury
- employers are obliged to provide appropriate information, training and supervision
- scaffolders are required to be qualified and certified as are crane drivers, banksmen, advanced scaffolders and operators of certain mechanical plant
- regarding safety consultation, all sites with more than 20 workers are required to actively facilitate the appointment of a safety representative to facilitate effective consultation
- employers are also obliged to appoint a designated safety officer who has responsibility for reviewing and updating the safety plan on a regular basis. This is to identify new hazards and develop safe working practices to remove or reduce the associated risk
- sites of today are very multi-cultural and it is imperative that all understand each other, and that an interpreter be available - especially in the event of confusion or an accident.

Other relevant information

Ceist 3 (a) - Terraced Cottage – addition of extension not greater than 18 m^2:

Three design considerations that enhance the health and well-being of the occupants – such as

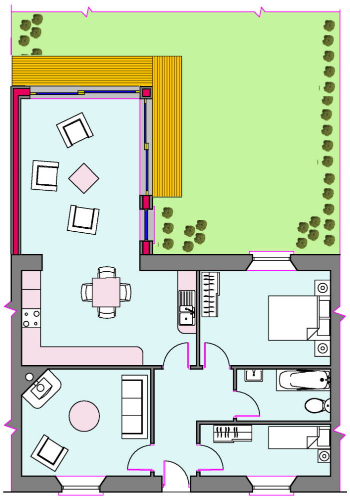
- putting the health and well-being of the occupants at the centre of the design process - biophilic design
- people have phototropic tendencies, move to the light, sit in light-filled spaces, enjoy sitting and working in a naturally lighted space – enhances health and well-being, so consideration of daylight central to design



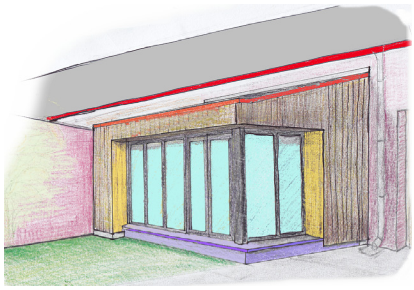
- purposeful design – to connect with nature - being able to see plants, hear birds, observe change of seasons etc. reduces stress, improves mental health - a positive impact on health and well-being
- increased glazing to the south increases natural solar gains, reduces heating costs and improves health and well-being
- natural light and shade evoke feelings of drama and intrigue as well as a sense of calm
- using materials that have a strong connection with the local ecology creates a distinct sense of place - genius loci - and peace and gives a feeling of connectedness and well-being
- decking to extend the inside to outside with seating to enjoy nature and the surroundings, enhances health and wellbeing
- a space with good thermal and airflow variabilities is both invigorating and comforting – provide openable windows, skylight windows to provide airflow and purge overheating in hot weather
- providing a sense of safety reduces stress and anxiety levels, solid walls give security
- providing a multi-sensory experience of nature is both stimulating and calming, flowers, trees and plants

  Any other relevant points

(b) Proposed modifications to the design - such as



- glazed openings that allow a visual connection to nature – biophilic design
- access to the garden through opening / sliding doors, bi-fold doors, floor to ceiling glazing and provide external decking
- glazing to the floor so that the nature can be seen from seated level
- creating an internal planted courtyard in buildings with limited views to nature
- open-plan layouts so the daylight and sunlight can penetrate into the house
- high performance - triple and quadruple low-e glazing - maintains thermal comfort internally and reduces glare
- opening windows allowing natural airflow and fresh air inside that mimic the outside environments - occupants in control of temperature and ventilation and can open to purge overheating
- construction of high thermal mass so that its regulatory properties can increase the internal comfort levels and reduce overheating
- overhangs/brise soleil to the south to reduce glare and overheating during summer
- lower cill levels to allow daylight and sunlight to penetrate deeper into the house
- glass panels to the side of or in the door itself to brighten hallways or main living areas
- bright colours to internal walls and window frames to increase natural light and thus well-being
- strategically placed mirrors can reflect light further into the house
- high ceiling levels or double height spaces can vary the intensity of light and shade and instil fascination
- do not over glaze a façade – light can only be appreciated if there is also shade
- varying intensities of light and shadow change over time to create conditions that occur in nature and increase well-being of occupants, roof lights to increase natural light and provide natural ventilation
- create a place to relax where the individual is not overlooked by neighbours
- construction should be secure to protect against the elements and the risk of intruders
- provide adjustable screens or shades/blinds
- deep overhangs create privacy to single storey extensions that are overlooked by two storey houses
- use natural materials where possible which have fewer toxins than highly processes products
- use local materials to reduce carbon emissions and the embodied energy of that material – embodied energy is the energy required to get a product from its natural state to its final delivery
- natural materials provide a rich sensory environment for the occupants
- take inspiration from local vernacular and use natural stone and timber in the extension
- a water-pond close to the building can collect storm water for reuse and add a relaxing feature to the garden
- a water feature, water fountain, stimulates the senses through its auditory and tactile nature textured and colourful planting to visually enhance the surroundings. ***any other relevant points***



(c) How the design meets the considerations identified in A – such as

- large south facing windows to maximise light, solar gains and create a visual connection with nature
- sliding, folding or swing doors to garden to bring outside in and to link garden to extension brings visual delight and fosters the health and wellbeing of the occupants

- open plan layout, windows with low cill levels and roof lights all allow sunlight to enter further into the dwelling
- bringing the outside in through sliding/swing doors and low level glazing fosters visual delight
- flexible open-plan layout allows penetration of light and spaces can be reconfigured to meet changing needs
- open-plan layout facilitates ease of movement for all and especially for persons with reduced mobility
- high ceilings, cathedral ceilings, increase volume and give a sense of spaciousness in a small extension

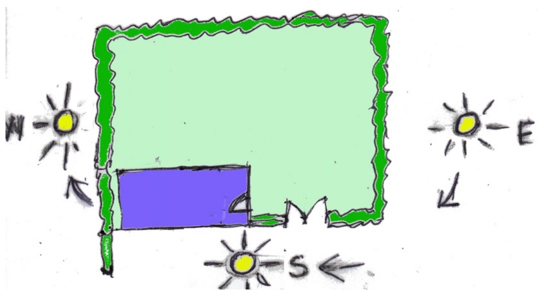
- opening windows or similar approach to allow natural ventilation
- construction of wall and windows to have high thermal performance to maintain thermal comfort
- shading added to prevent overheating, increase privacy and facilitate close contact with nature
- external materials used that are tactile and connected to the ecology of the country
- water feature and planting added to stimulate the senses

any other relevant points

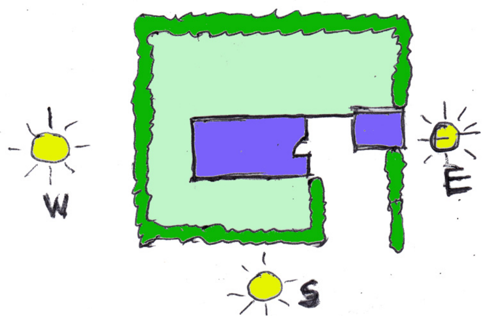
See: 14 Patterns of Biophilic Design – Improving Health and Well-Being in the Built Environment:
Terrapin Bright Green LLC - https://www.terrapinbrightgreen.com
The Eco-Home Design Guide: Christopher Day - ISBN: 978 0 85784 304 3 /ISBN: 978 0 85784 306 7 (ePub)

Ceist 4 (a) Discuss the importance of each of the following when choosing a site

Characteristic of existing dwellings - *such as*



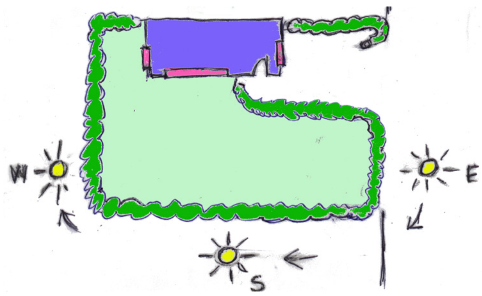
- care should be taken so that scaling and volume is relative to existing dwellings
- the shape of the proposal should be informed and reflective of the local built vernacular
- the materials to be used on the new proposal should reflect those of buildings in the local area
- natural materials are preferred over synthetic products
- existing forms simple and geometrically regular, the new design should follow similar patterns
- how existing dwellings relate to surrounding building should inspire a new development
- the direction and position of vernacular dwellings in the landscape should inform new builds so that they too can maximise sunlight and shelter
- proposals should be sensitive to existing dwellings so as not to invade privacy or overshadow them in size and scale



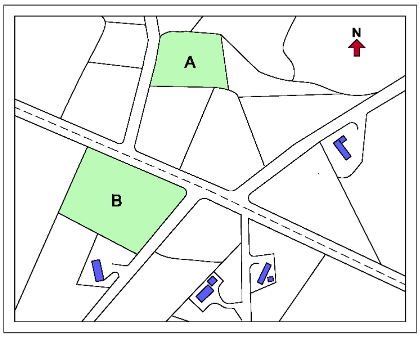
Characteristics of proposed site – *such as*

- the layout of the road along the site should inform the positioning of the entrance so that sufficient sightlines can be achieved – safe for vehicular access to main road from site
- if an existing road is not in contact with the site, the construction of a long driveway will greatly increase costs
- new proposals should be sensitive to prevent the destruction of existing features, such as stone walls, mature planting, field boundaries
- existing trees can provide a shelter belt as these have taken up to 100 years to mature

- the topography of the site should be used as inspiration for the form of a new house
- existing mounds, slopes, contours on a site should not be removed to facilitate a new proposal but should be used to their potential as a natural shelter or privacy barrier
- sites on top of hills may not get planning permission as a new proposal may break the skyline
- the name of an area – often in Irish, may hint towards the previous use of the land and its soil conditions e.g. bog road and may inspire the new house design
- the orientation and shape of the site will indicate if the new build will maximise solar gain by having a glazed elevation facing south
- the presence of plants which only grow in wet land may be an indication of poor soil percolation
- proximity to services such as water, broadband and electricity to the site - the further the distance the greater the costs
- the presence of rivers, lakes or streams nearby may cause flooding and will inform the siting of the wastewater treatment plant and percolation area

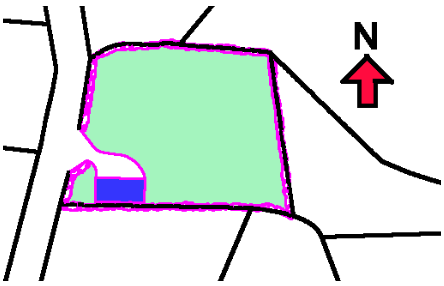


(b) Choose a site A or B and discuss why you selected it



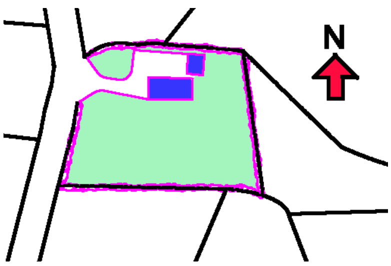
Why site A may be considered suitable for a new house - *such as*

- the site is located away from the main road so there is less noise pollution
- the site is not overlooked by existing houses
- there is greater privacy as it is not adjacent to the main road
- minimum traffic on the side road would also reduce the risks when accessing and exiting the site
- access can be achieved onto the preferred minor road
- it is a smaller site so the existing site boundary can be maintained
- the smaller site would result in minimum area for manicured lawns in the countryside
- smaller site means that less arable land is used
- minimal visual impact on the environment
- there are no existing dwellings to the south of the site so larger windows could be facilitated without compromising privacy
- the building should be designed so that the glazed elevation faces South
- house is positioned close to the perimeter fence, so maximum garden space is available to supply house with garden produce – fruit and vegetables grown on site

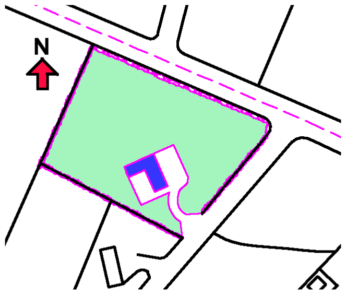


Why site B may be considered suitable for a new house - *such as*

- access can be gained from the main or minor road, so little roadworks are required – environmentally sustainable
- greater proximity to dwellings with existing connections to services such as waste management facilities, water, electricity and broadband, bin collection - resulting in cost-effective provision of public services
- long sightlines can be achieved on the straight road, which increase safety when entering or exiting the site – usually for a 60 km/hour speed limit, 90 metre sightlines are required for safe access

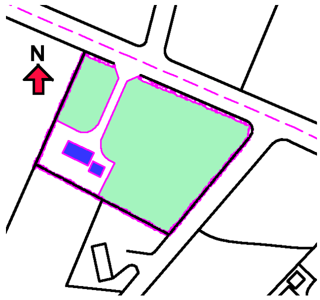


- houses adjacent to site B are in clusters, thus cluster developments are a favourable development and reflect the existing development patterns
- reduced distance from leisure facilities, schools and employment
- sufficient space exists to facilitate waste-water treatment and percolation area on the site
- the long southerly aspect of the site increases design possibilities to optimise solar gain.



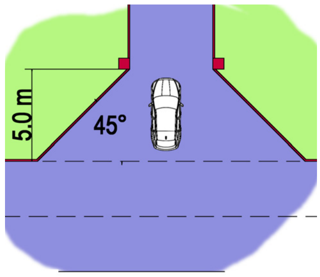
(c) Location and orientation on site A and B entrance and driveway.
The house is to be positioned so that:

- the side of the house with the greatest surface area is south facing to maximise solar gains which will increase its sustainability and reduce energy costs
- it is close to the road where services are located
- it is set back from the road to reduce the environmental impact on the landscape
- house placed so that greater privacy can be achieved
- the form and layout of the proposal is similar to the characteristics of existing vernacular structures.

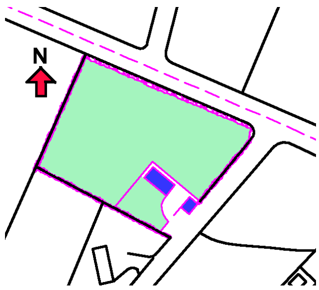


The layout of the entrance and driveway:

- is short to reduce the need for hard paving and surface water disposal facilities which will save money
- allows shrubs to be planted to help integrate the house into the landscape and increase privacy
- enables the driver to clearly see oncoming traffic from both sides
- follows the contours of the site instead of cutting into the landscape
- is set back – 5 metres - so that a car waiting to enter closed gates is not obstructing traffic, sidewalls splayed at 45° for clear vision
- meets the criteria set out by the local authority – in design and measurements
- house is positioned close to the perimeter fence, minimum driveway, reducing hard surfaces and cost and allows maximum garden space to supply house with garden produce – fruit and vegetables



Any other relevant points



Ceist 5 (a): U-value of wall A

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
Internal Top Surface				0.1040
Screed	0.720	0.71	0.05	0.0355
Concrete Floor Slab	1.280	0.78125	0.1	0.0781
Radon Barrier	0.250	0	0.00025	0.0010
Sand Blinding	0.160		0.040	0.2500
Hardcore	1.350		0.2000	0.1481
Subsoil	1.600		0.300	0.1875
			Total R	R^t = 0.8042
		Floor	**U-value 1/R**	**1.2434**
		New floor	**Given U-value**	**0.15**

5(b) Cost of heat lost annually through the wall **Formulae: R=T/k R=T × r U= 1/R^t**

U-value: U = 1 / 0.8042 = **1.2434** W/m^2 ˚ C.

Heat lost through uninsulated floor

- Heat loss formula: = U -Value × area × temp. diff
- Floor area = 72m^2

1.2434 × 72 × 16 = 1432.3968 Watts (Joules / sec)

- Heating period p/a:

60 × 60 × 10 × 7 × 38 = 9,576,000 seconds (2,660 hours)

Kilo joules p/a:

$$\frac{9,576,000 \times 1432.3968}{1000} = 13,71663.\ 17568 \text{ kJ/sec}$$

$$\frac{13716631.17568}{37350} = 367.24 \text{ litres}$$

- Litres p/a: (Note: Calorific value of 1 litre oil = 37350 kJ) Cost p/a: (Note: 1 litre of oil costs 96c)

Cost p/a: 367.2 **× 0.96 = €352.5**

Cost of heat loss annually through floor = €352.5

Alternative method:

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

$$= \frac{\mathbf{1.2434} \times 72 \times 16 \times 9,576,000 \times 0.96}{37,350 \times 1000}$$

$$= \frac{13167966486.528}{37,350,000}$$

= **€352.5**

Q.5 (c) thickness of expanded polystyrene insulation required to give a floor U-value of 0.15 W/m^2 $^\circ$C.

Determine the Resistance for a U-value of 1.2434 W/m^2 K

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

R = 1/ U-value   R = **1/ 1.2434** = 0.8042 m^2 K / W

Resistance for required U-value of 0.15 = 1/0.15 = 6.6666 m^2 K / W

Difference in Resistance = 6.6666 - 0.8042 = 5.8624 m^2 K / W

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

5.8624 = T/0.037

T = 5.8624 × 0.037 **= 0.2169088 metres** to achieve U value of **0.15 W/m^2 $^\circ$C.**

Thickness of required Expanded Polystyrene insulation = **216.9 mm -** accept **216/217 mm.**

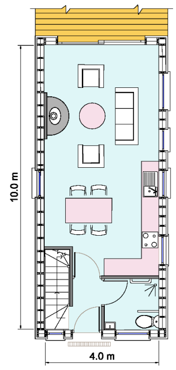
Alternative calculation methods acceptable.

Ceist 6.

Two advantages and **two** disadvantages of self-build as a method of building a house.

Advantages – such as:

- reduced costs – help from family, friends and neighbours
- avoids need to acquire a large mortgage
- enhanced control over build quality and finish
- personal satisfaction, enhanced wellbeing from physical and creative involvement in the project
- can be built over longer period as budget allows
- building skills capacity with self and friends
- built in conjunction with friends as gift or on an exchange of labour basis

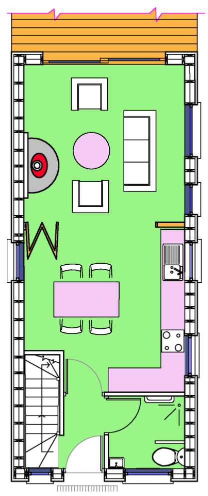


Disadvantages – such as:

- possible skills deficit through inexperience
- building control management required, compliance may be challenging
- longer construction period
- demanding on personal time
- lack of building guarantee scheme
- no contractual agreements with friends
- all responsibility for maintaining quality standards falls on self-builders
- extra statutory responsibilities on self-builders, e.g. health and safety provision, public liability, adherence to building regulations
- materials bought in small quantities, extra expense

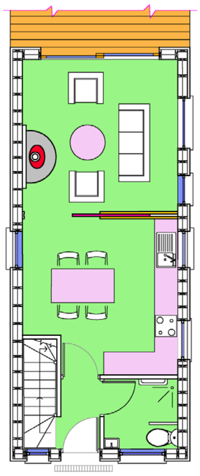
Any other relevant points

(b) Three features of the design shown that make the house suitable as a self-build project – such as



- ecologically friendly design - can be built mainly from locally sourced materials
- the house, except for foundations, chimney stack and internal plasterboard for fire-proofing is entirely constructed from wood
- wood is renewable, carbon neutral, is easy to cut and shape using hand tools and has low embodied energy
- the use of native wood, locally sourced such as native larch finish on the exterior, is carbon neutral and reduces the embodied energy of the house, giving a low-carbon construction
- simple building form - easy to set out foundations, obtain levels

- the house is small and compact, facilitating ease of construction by self-builders
- no need for specially designed beams or supports
- one and-a-half storey build maximises living space with minimum of materials
- narrow width – can be spanned with standard wooden joists without need for structural steel
- lighter building simplifies foundation design and earthworks – environmentally friendly
- straightforward roof design for ease of marking-out and erection
- light timber frame and external rainscreen cladding obviates need for mechanical lifting equipment
- framework can be constructed on site, can be easily cut by hand or with chop saw
- early closing-in of frame provides a dry workspace at an early stage of construction
- indoor trades can commence early in build process – electrical and plumbing
- low moisture, short drying out time, house can be lived in more quickly due to design of construction.



(c) two modifications to the existing design that would further reduce the environmental impact of the house and help meet the nearly Zero Energy Building (nZEB) requirements.

The Energy Performance of Buildings Directive (EPBD) defines a nearly zero energy building as follows:

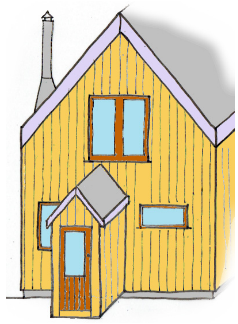
A nearly zero energy building is a "building that has a very high energy performance … the nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby."

The EPBD does not prescribe a uniform approach for implementing nearly Zero-Energy Buildings and neither does it describe a calculation methodology for the energy balance. nZEB standards are to be introduced from 2019 for all publicly-owned buildings and from 2021 for all buildings.

Modifications – such as

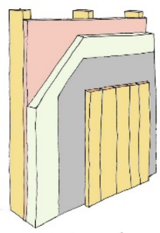
provide a storm porch or inner entrance hall with doors -

- reduce heat loss when front door is opened
- extra insulation at door



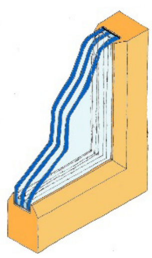
Increase the thickness of insulation in the external walls –

- the insulation can be fixed to the inside of external leaf
- the rainscreen can also be fixed outside the insulation
- modifications may be needed at the eaves to accommodate the increased wall thickness



increase window area in south-facing wall to boost solar gain

- a glazed south-facing area attached to the outer wall
- increased solar gain and greater thermal comfort
- sheltered seating area for all-year use
- add on a purpose designed sunroom

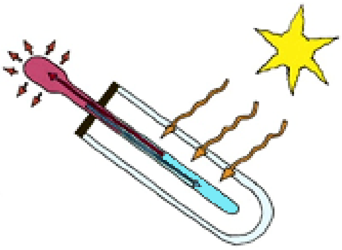


erect a partition with glazed doors to separate kitchen and dining areas

- allows both the living and kitchen areas to be zoned for space heating
- reduces demand for heating and improved thermal comfort
- increases acoustic comfort and increases privacy
- sliding doors or bi-fold doors for ease of access
- install air-to-water heat pump and integrate space and hot water heating in conjunction with under-floor space heating
- replaces the fuel-burning stove shown and reduces environmental impact reduces CO_2 emissions – no burning of fossil fuels

install evacuated tube / solar panels on the roof surface

- place closest to south-facing for domestic water heating
- to reduce dependency on mains electricity and carbon footprint
- roof pitch of 45° most advantageous



install photovoltaic (PV) panels to supplement electricity from the grid

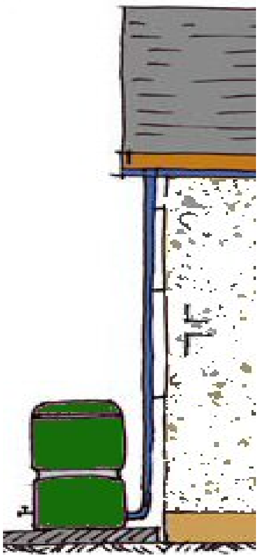
- photovoltaic panels reduce the use of mains electricity generated from fossil sources by replacing some of the energy with electricity from a renewable source, the sun

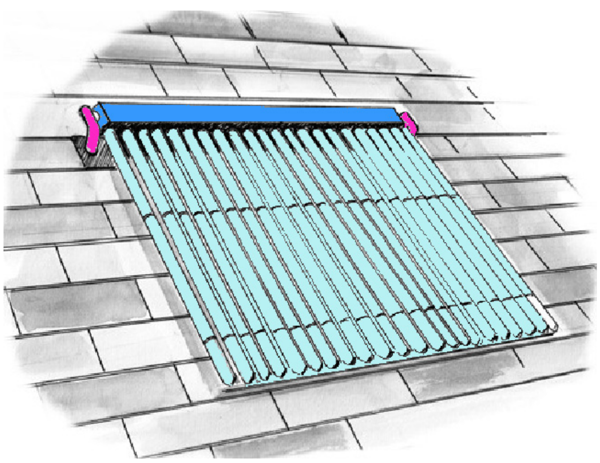
install rainwater harvesting system

- collect rainwater from roof
- simply store in rainwater butts or containers or
- use larger capacity underground tank
- water from large capacity tank filtered and pumped into house
- water for flushing, watering plants, etc. replaces chlorinated treated mains water for these uses
- separate distribution system for drinking water and recovered rainwater

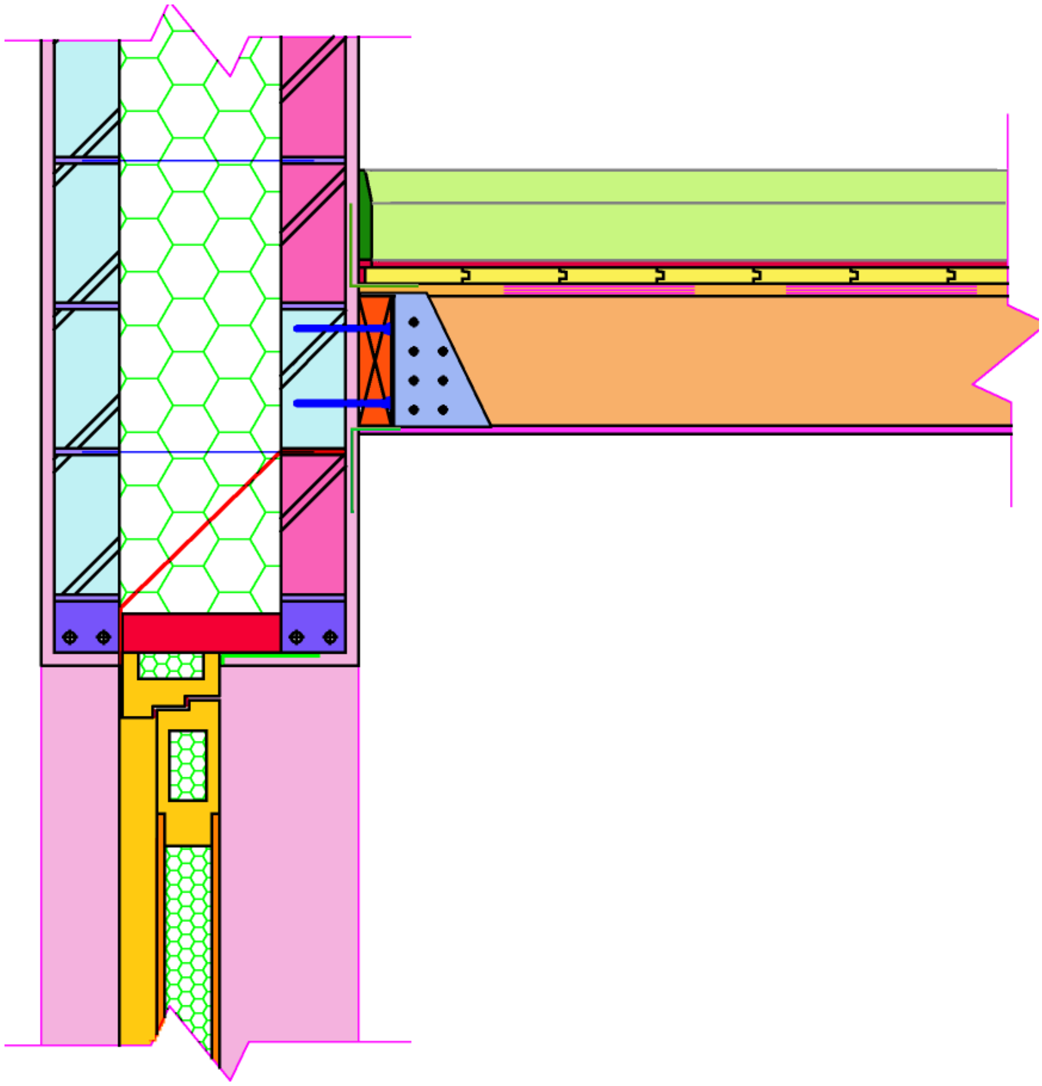
install wind generator to provide off-grid electricity

- wind speed and height of turbine are critical for electricity generation
- should be a minimum of 10.0 m above the roof /obstruction within 100.0 m - such as buildings or trees to avoid air turbulence which reduces efficiency and causes wear.





Ceist 7.



Ceist 7

Floor, wall and door detail - typical details – floor details

- 20 mm floating floor on 20 mm plywood decking
- breather membrane sealed and taped
- ceiling joists 200 × 40 mm min at 400 mm centres
- hangers with resin anchored bolts and
- plasterboard to ceiling – fireproofing and heat retention
- airtightness tape at junction of wall and ceiling

walls

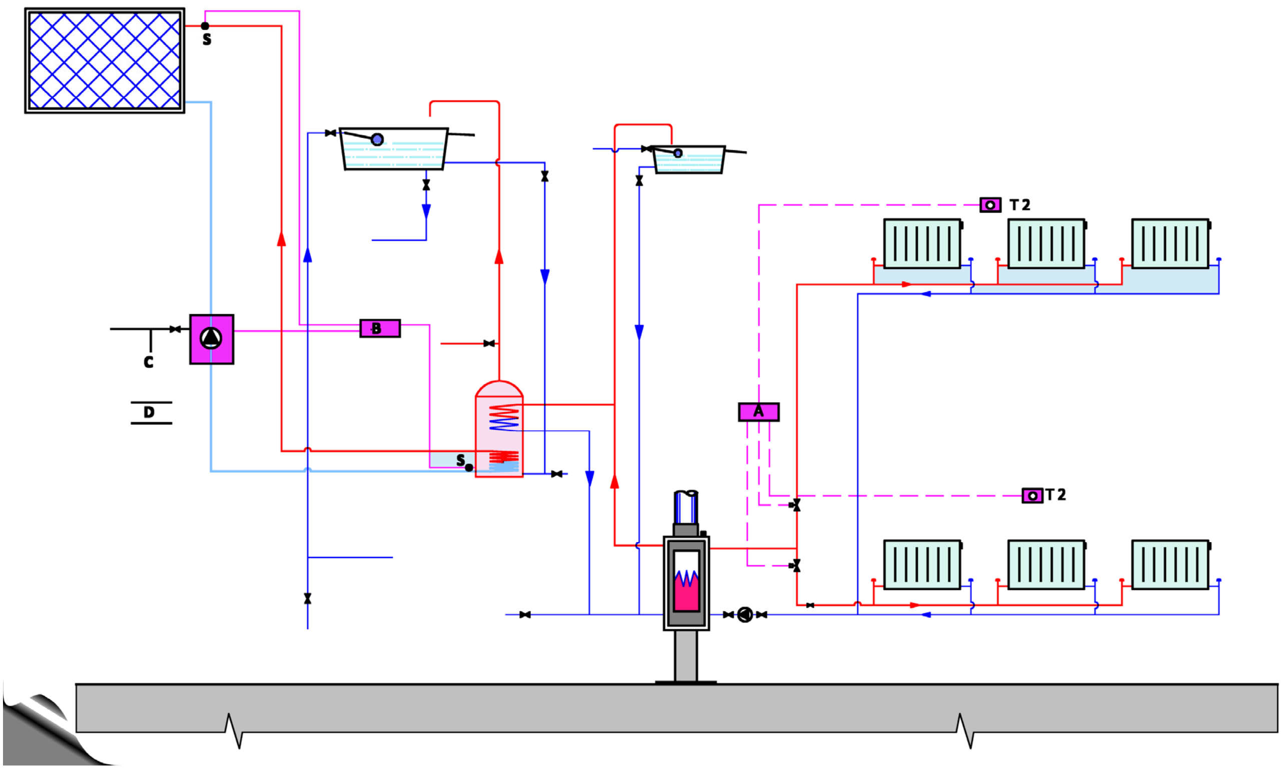
- 18 mm external render and 100 mm solid concrete block
- Reinforced concrete lintels to head
- PIR or similar high-density insulation as cavity closer
- cavity ties, stainless steel wall brackets set in blockwork
- external render and external plaster
- stepped dpc

door

- Thermally broken frame and door
- Double rebated door for draught proof
- Continuous draught strip - double
- Vertical sheeting and insulation

Other appropriate detailing accepted

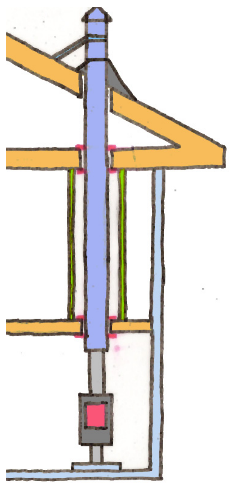
Ceist 8



Ceist 8 (b) - **Safety features of system**

thermostatic control of the burning rate

- thermostatic control of the burning rate based on temperature of water in the boiler where the appliance uses a boiler
- thermostatic radiator valves (TRVs) should be wired electronically to provide boiler interlock



hot water cylinder - thermostatic control

- fitted about one third of the way up the cylinder
- should have clean contact with the metal on the cylinder
- avoids overheating thus ensuring safe temperature of water in taps
- thermostat should be as accessible as possible
- the cylinder thermostat should be wired to provide a boiler interlock

vent valve to boiler

- a safety feature that stops too much pressure from damaging the plumbing system and causing injury to a person
- helps to prevent the risk of an explosion due to build-up of pressure

ease of cleaning/maintenance

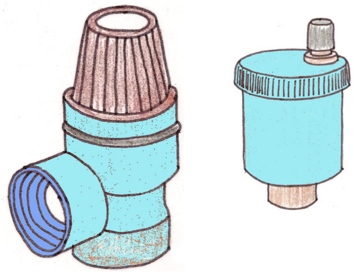
- the opening for this purpose should have a rigid, non-combustible and gastight cover, or a removable section in condensing type appliances

carbon monoxide

- the heating appliance must be correctly installed and serviced at regular intervals to ensure efficient combustion and removal of products of combustion
- a carbon monoxide alarm be fitted in vicinity of burning appliance
- detector should have both a visible and audible alarm to alert occupants of the presence of carbon monoxide

expansion of hot water

- expansion pipe provided to allow safe expansion of water (vented system)
- closed system incorporates expansion vessel to allow for expansion

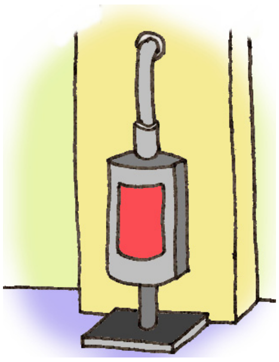


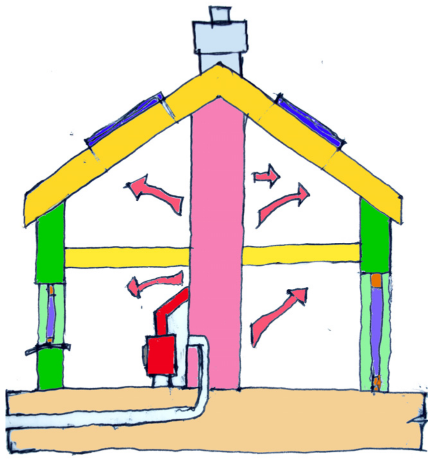
pressure release valve

- often fixed on the boiler or as near as possible to the boiler
- spring loaded valve releases water if there is a build-up of pressure
- pressure gauge indicates pressure in bars

(c) location of chimney

- stove to be located on internal wall to maximise thermal mass of chimney stack and heat retention and to maximise dispersal of heat
- chimney centrally located and near to bathroom to avoid wasting water
- stove may use system-built chimney or connect to new build or existing chimney
- prefabricated chimney system should be insulated and double-walled
- metal chimney system passing through any part of the building should be encased in non- combustible material





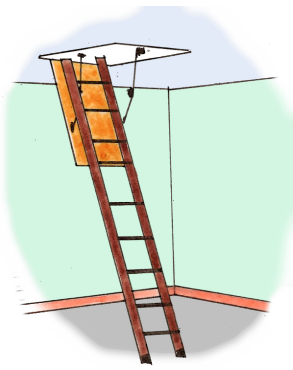
Ceist 9

(a) Functional Requirements of attic space

It must be feasible to achieve the following outcomes within the building envelope in line with current building regulations:

adequate floor area with suitable ceiling height

- ceiling level 2400 mm minimum above floor level
- area at 1500 mm above floor level at least 50% of total floor area

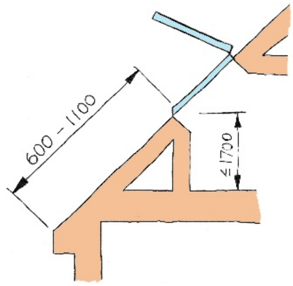


adequate natural lighting and ventilation

- roof lights flush with the roof surface may be fitted
- dormer style lighting may require planning permission if on main elevation of house
- permanent ventilation/mechanical ventilation with heat recovery in keeping with the rest of the dwelling
- use of vapour barrier on warm side of insulation/air continuity barrier
- ensure adequate ventilation of the roof structure to avoid condensation

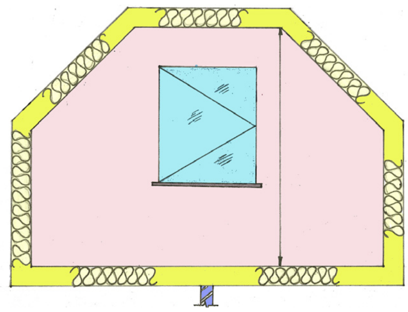
fire safety

- fire grade high density plasterboard with half hour fire resistance taped, jointed and skimmed
- smoke detection system and alarm, connected to electrical mains
- fire resistant floor construction
- high density fireproof doors with min 0.5 hours fire rating and fitted with self-closing mechanism
- structural members provided with required level of fire resistance, e.g. steel beams, columns encased
- fire retardant thermal insulation
- means of escape in case of fire, roof lights may suffice - as shown



sound insulation

- floating floor to avoid transfer of impact sound
- isolation of floor from joists
- ensure completeness of structure to avoid air borne sound penetration

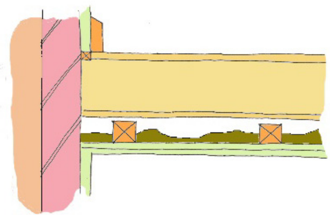


adequate access

- secure, permanent stairway access with landing and self-closing fire door at head of landing
- ladder access suitable for occasional use only

thermal insulation

- avoid thermal bridging in design
- achieve minimum U-value of 0.16 W/m2 K for the roof
- ensure ventilation space for roof members – vapour diffuse layer and counter battens
- OSB or Smartply externally for windtightness



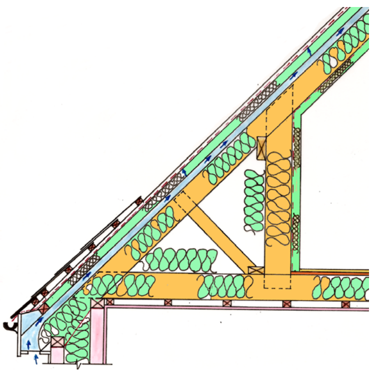
electrical installation

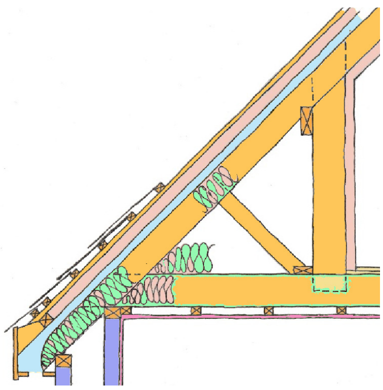
- carried out to required standards by a qualified electrician

Any other relevant points

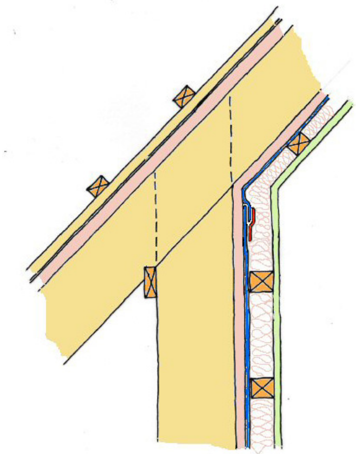
(b) Structural Stability – typical detailing

- floor joists of sufficient size for the full span
- purlins need to be strutted from a suitably mounted wall plates
- ceiling joists/collar ties to be fitted at a height of 2400 mm above the finished floor level – triangulation of roof structure
- backing to rafters to accommodate thickness of thermal insulation and ventilation
- doubling of rafters to provide sufficient support for roof lights
- slates on battens typically 50 × 35 mm
- counter battens 50 × 35 mm to provide ventilation space
- breather membrane sealed and taped
- hygroscopic layer – wood fibre board, OSB or Smartply or similar for wind tightness
- rafters 200 × 40 mm at 400 - 600 mm centres
- collar ties 200 × 40 mm to each rafter
- ceiling joists 200 × 40 mm to each rafter
- vertical struts 200 × 40 mm
- runner at foot of strut - 150 × 70 mm
- struts 150 × 50 mm perpendicular to slope of roof
- purlin 200 × 75 mm
- service cavity at ceiling





- insulation 200 mm min at slope of roof
- insulation 600 mm – two layers to ceiling
- 2 × 12.5 mm gypsum plasterboard to ceiling with vapour barrier on warm side of insulation
- airtightness tape
- fascia, soffit and gutter with continuous vent at soffit

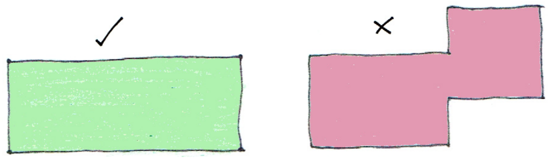


(c) air leakage at the junction of the side wall and the sloped ceiling
- the continuous airtight membrane is overlapped and then sealed by taping at the joint with proprietary adhesive tape
- the joining is kept clear of the angle formed by the studded wall and the sloping ceiling to make an airtight seal achievable.

Ceist 10 (a)

(a) space heating energy demand
- minimising space heating demand central to achieving passive house standard
- space heating energy demand refers to the energy required to maintain an optimum indoor temperature of 20 °C throughout the year – for heating the space only
- space heating demand for a passive house is specified at ≤ 15 kwh/m^2 /a
- required to maintain an indoor temperature of 20° all year round
- space heating demand determined by the effectiveness of insulation and air-tightness
- in Ireland space heating, not cooling, is the major energy demand in dwellings
- approximately 60% of energy use in dwellings in Ireland is for space heating
- Passive house design principles require that “primary energy demand” must not exceed 120Kw/m^2/a
- change of energy source from fossil fuels to renewable sources needed
- space heating energy use must be reduced to meet renewable energy goals
- viable solutions include efficiency of energy conversion, heat distribution through living spaces, zoning of spaces, insulation and airtightness
- roof suitable for generating energy by installation of solar panels – orientation and pitch
- solar gain maximised by means of optimal placing of fenestration
- shading and controlled ventilation must be included to avoid overheating in summer

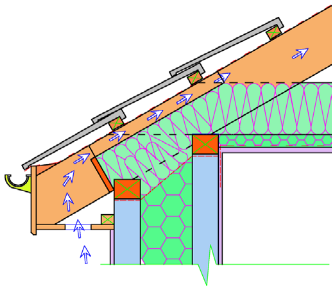
building form
- crucial in Passive House design – see sketch of complex and simple forms
- simplicity of design is best practice, without compromising quality of aesthetics
- building form should take account of local tradition/vernacular architecture
- should respect aesthetic of surroundings
- compact form is best for economical use of materials
- fewer materials and lower labour costs



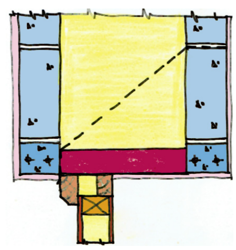
- compact form is easier to heat
- clean lines in walls and roof to facilitate easy achievement of air-tightness
- avoid complex roof layout – hips/valleys - which are difficult to insulate adequately
- wall-floor junctions minimised to avoid possible cold bridges and air-leakage points
- building envelope area minimised to reduce energy loss through external walls
- smaller surface area reduces the wind-chill factor
- reduced building envelope reduces the volume of air to be heated and the resulting space heating
- energy demand
- degree of compactness is shown by the ratio of the surface area to the volume contained (A/V)
- ideally the A/V ratio is 0.7 or less
- aim to have the required volume enclosed by the smallest possible surface area

- a building with the same U-values, air change rates and orientation as another may have a different heating demand depending on their respective A/V ratios
- should take full advantage of site aspect, potential solar energy gain, potential for energy conservation
- main windows/elevation South-facing
- windows minimised on North facade
- providing lobby and porch at entrance to conserve energy
- heating appliances kept on inside walls to reduce heat energy loss
- steeper 45° roof pitch to accommodate increased living space and roof-mounted photovoltaic and/or passive solar panels, evacuated tubes

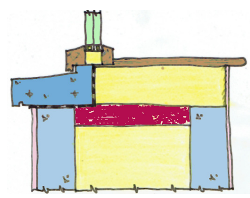
thermal bridging



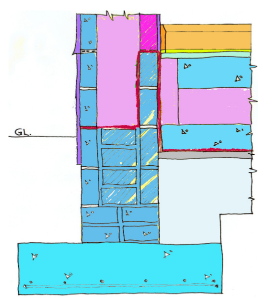
- a thermal /cold bridge is an area of a building that has a higher conductivity than surrounding materials
- and significantly detrimental rate of heat transfer than the surrounding materials, resulting in a significant reduction in the thermal insulation/performance of a building thermal energy flows from a higher to a lower temperature
- flow increases with greater temperature difference
- materials that are more efficient conductors of heat and penetrate the outer envelope lead to greater thermal energy transfer – increase heat loss overall



- local areas of greater energy flow provide cold spots on the inner surfaces and troublesome condensation, including interstitial condensation
- more of a risk where Passive House standard is achieved
- greater risk surrounding openings and where floors and ceilings abut outer walls
- continuity of thermal insulation of great importance
- passive house design attempts to eliminate all thermal/cold bridges and includes this as one of its seven principles
- thermal/cold bridging reduces the buildings energy efficiency which increased energy costs per annum
- thermal/cold bridging reduces the thermal comfort of a building for its occupants
- the presence of thermal bridging locations in a building's external envelope significantly increases the energy costs for the occupants in attempting to maintain thermal comfort



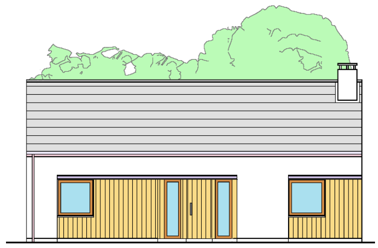
- the presence of thermal/cold bridging in residential building can adversely affect the health and wellbeing of the occupants
- the presence of thermal/cold bridging's can lead to hazardous mould growth which may also lead to the deterioration of the buildings fabric
- where thermal bridging is present in a building a significantly higher proportion of heat energy passes through the bridge in the external envelope to the outside – where the temperature is lower - this differential heat loss creates colder and warmer surfaces within the building- on the internal surface of the external wall and may lead to condensation and mould growth



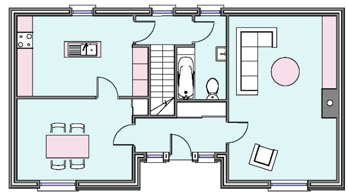
- these damp locations encourage the growth of mould – which can be harmful to the occupant's health and can also contribute to the deterioration of the building fabric
- where significant heat loss through the presence of thermal/cold bridges exists and thermal comfort needs to be maintained there will be a greater energy demand
- where the increased energy demand is maintained using fossil fuels then the building is not sustainable and increases the release of CO_2 + SO_2 which are harmful to the environment
- all openings for windows and doors, junction between the external wall and the floor, junction between the external wall and the ceiling, the eves detail, window cill, window and door head details together with projecting balcony details are typical locations where thermal/cold bridges are found in poor house design. **any other relevant details**

10 (b) Three modifications to this design to meet the Passive House standard- such as:

provide draught lobby at entrance
- minimise air movement when opening external door
- reduce heat loss and fossil fuel demand
- outside the front door in the existing recess



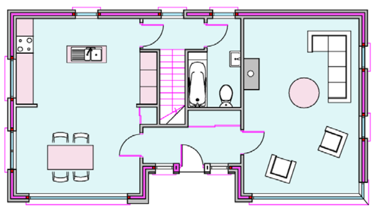
ensure suitable aspect and fenestration
- long axis in East-West direction
- south facing principal elevation maximises solar gain
- At 12 noon, angle A in sketch = 90° - latitude of site, 90° - 52° = 38° in Cork, 90° - 55° = 35° in Letterkenny)
- increase the window sizes on the front elevation
- taller, larger South-facing windows maximises solar gain to living areas
- fewer and smaller North-facing windows reduces heat loss
- passive heating reduces costs and fossil fuel demand
- large eaves overhang or brise-soleil over South-facing windows



increase the window area in kitchen and dining room
- East-facing windows enable morning solar gain to the sitting room
- increases daylighting
- reduces artificial lighting requirement
- reduces heating requirement

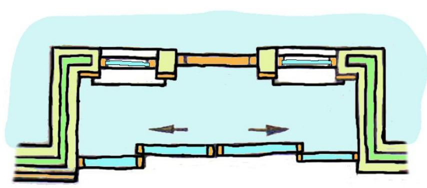
provide roof lights
- increase daylight
- give longer daylighting period
- reduce need for artificial light
- reduce lighting costs and fossil fuel use

provide wood-burning stove
- carbon neutral
- up to 70% efficiency - open fire 30% efficient at best



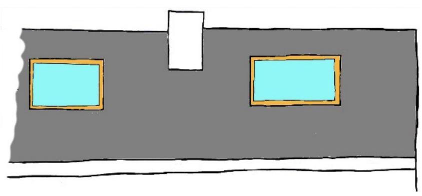
move space heating appliance and chimney stack to an inner wall
- radiates stored heat to adjoining spaces
- reduces energy loss through external surfaces
- remove chimney and stove from design and replace with MHRV
- increase thickness of wall insulation

provide heat exchange technology
- space heating by means of geothermal, air to water, ground to water systems connected to underfloor heating system



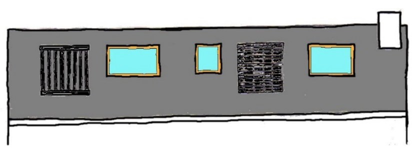
take advantage of solar heat source for water heating
- install solar photovoltaic panels on south-facing roof
- provide evacuated tube solar collector panels on South-facing roof

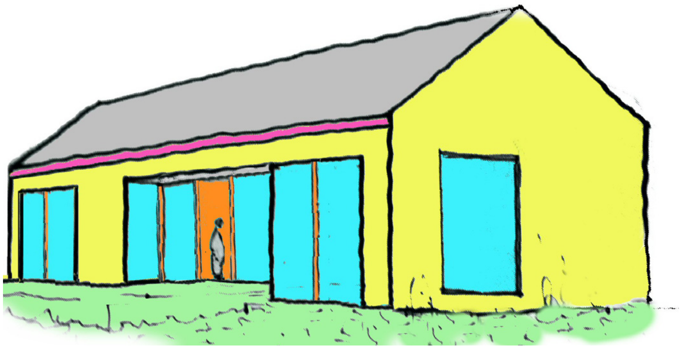
(c) a preferred orientation for the upgraded design, with the sun path included and discussion
- large glazed area to South or South-West leads to greater solar gain and decreased thermal energy demand
- ideally the long glazed facade of a Passive House should face directly South but not more than 30° off the East-West axis
- a smaller glazed area to North leads to less thermal energy loss
- south-facing roof provides suitably aligned surfaces for solar panels for domestic water heating and photovoltaic panels for energy generation

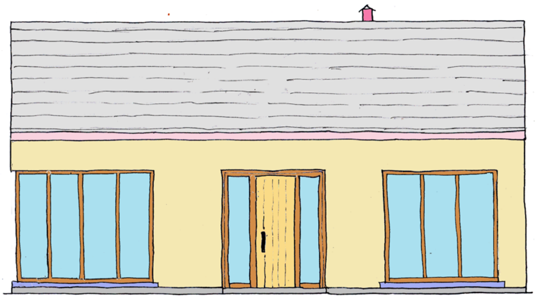


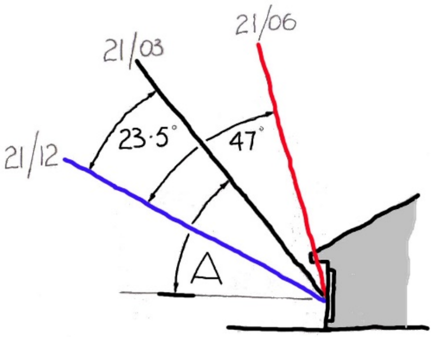
- South-West elevation provides for greater solar gain in the evenings in Ireland
- if the ideal orientation not possible, insulation has to be increased
- careful positioning of the fenestration to ensure maximum solar gain and minimum heat loss through the building fabric

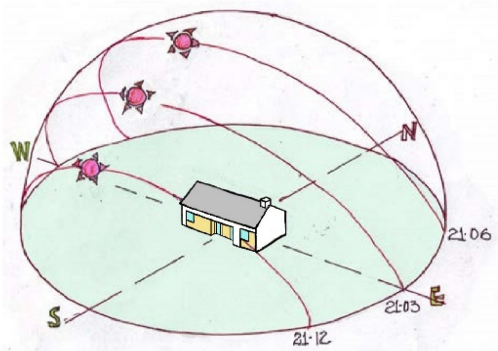
Any other relevant details











Ceist 10.

Green design is about being green, rather than simply appearing to be green. So greening your house is about more than just buying all sorts of expensive 'eco-bling' and adding it to your house. Ironically, that could be just another display of consumerism. Rather, greening your house is about making responsible environmental choices based on what you *want* to do, what you *can* do and what you can *afford*. This means that - before we get into the minutiae of sustainable building materials - we should address some fundamentals, chief among which is the need to build modestly and source locally.

From: **contemporary design secrets: the art of building a house in the countryside.** Jane Burnside (2013)

Discussion of the above statement and ***three*** *best practice guidelines that would promote green, sustainable housing in Ireland.*

Discussion of the above statement– such as:

- building green means making responsible building choices from the start and at the heart of the building process – not as a last resort when the building choices have been made
- building green means putting a green building ethic and environmental considerations at the heart of every design decision
- building green means making eco-responsible choices about all aspect of the building - size, scale, materials, running costs, lifetime use, end of life use

- the built environment accounts for about half of all climate and ecological damage, building green is an ethical choice to help mitigate climate change
- the construction cost of a well-designed, compact, ecologically sensitive green building is cheaper than that of poorly-designed large, shapeless building
- the individual building is considered as part of the greater whole – how it fits into its surroundings giving the building a deep sense of place - genius loci
- building green is about much more than energy efficiency, it is also about beauty – it is about living on the planet as if we wish to stay
- building green puts the occupants health and wellbeing at the centre of the design process, it is about building healthy building, linking the building to nature, using non-toxic natural materials and taking the principles of biophilic design into consideration
- building green acknowledges that we cannot have a sustainable planet without sustainable buildings, one planet supplies all our needs and stores our waste – we need to tend it carefully
- diminishing natural resources, fossils fuels such as oil, coal, gas are non-renewable and diminishing, building green takes these facts into account at the design stage
- green buildings are more thermally comfortable, cheaper to keep warm and cool and are more resilient to weather extremes and energy supply disruptions than traditional buildings
- building green means doing very much more with very much less and for a lot longer
- building green means managing and conserving the earth's resources
- building green means leaving more of the earth's resources for future generations so that they too can meet their needs for shelter and food from the planet's resources
- building green implies thinking globally and acting locally
- greening your house implies avoiding eco-bling – gadgets for the sake of having them, overuse use of internal and external lighting, of energy greedy products, overuse of concrete, of impermeable paving and of hard surfaces
- greening your house involves minimum hard surfaces, the use of permeable paving, wooden fences and gates, eco-friendly natural materials, such as sheep's wool, hemp insulation, natural earth or lime plasters
- building green implies a light ecological footprint for the house – doing a life-cycle analysis to ensure that the house is eco-friendly to build, maintain and has low lifetime running costs
- a whole-of -systems team approach needs to be adopted, with all specialists considering the
- connections between the building form, building components, building envelope, building systems and
- services to maximise the overall performance of the buildings
- at the design stage it is easier and more cost effective to factor in environmental considerations than to try and upgrade the building fabric at a later stage
- making responsible environmental choices based on what you want to do, what you can do and what you can afford implies that the design leader - usually the architect – should apprise all other specialists of the ethical responsibility to design and build green
- ethically responsible green design implies the integration of passive strategies and active systems where appropriate, to maximise the building performance
- the construction process to be informed by a sustainable green ethos – considering the embodied energy of materials and specifying renewable materials of low embodied energy
- green design means reducing the use of materials of high embodied such as concrete and steel
- green design means taking care of the fundamentals at the design stage, designing a house of modest scale and proportions, so that it has a small ecological footprint
- building green implies careful specification of materials so that most can be sourced locally, thus reducing transport costs and saving on fossil fuels
- building green considers the independence, mobility, health, longevity and quality of life of occupants - green buildings are designed to connect people with neighbourhoods and with nature

Three best practice guidelines that would that would promote green, sustainable housing in Ireland – such as:

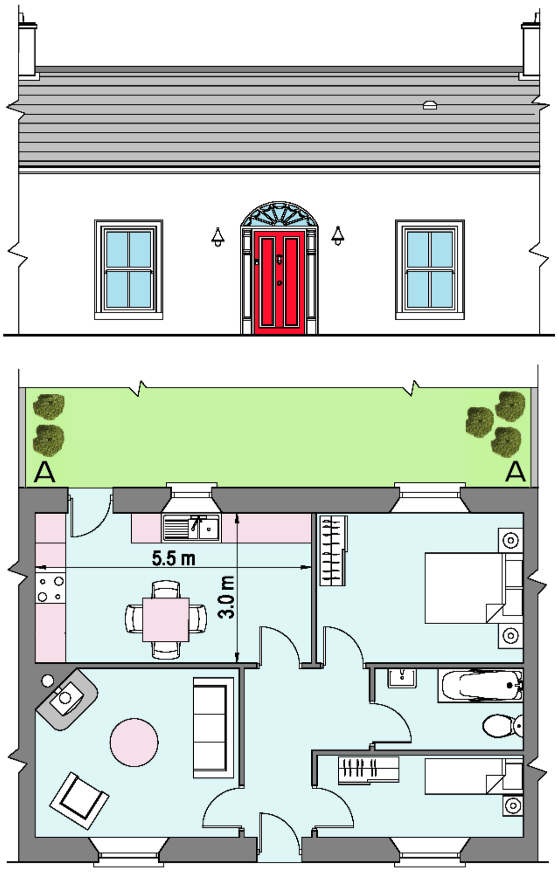
- planning authorities to publish design guides, style guides focussing on green design, with examples of best practise in green design for domestic buildings
- planning authorities to develop and publish clear planning guidelines outlining the requirements for building green, sustainable homes
- promote the use of green design and renewable energies - solar panels, on-site generation of electricity and where possible, small scale wind turbines, energy saving electrical fittings, LEDs, A-rated appliances
- incentivise through grants/incentives sustainable green design for all domestic dwellings
- through programmes of education, publish and disseminate easy-to-follow, graphic rich guidelines for the general public on the fundamentals of green, sustainable design
- planning authorities to promote and favour the development of green homes in their development plans
- adopt purposeful green design strategies not just for individual homes but for neighbourhoods, ensuring the safety of children and the elderly by providing cycle and walking paths, interconnected green car-free areas and parks and safe walk/cycle routes to promote active lifestyles and to foster a sense of belonging and local community
- provide information on green design and biophilic design which is accessible to the general public with advice on the trees and plants recommended for different locations and conditions
- provide building professionals with training and the skillset to design and build green - with alternative materials such as wood, cob, rammed earth, hemp-lime
- ensure green homes are easily adaptable for lifetime use and should be fully accessible to all following the principles of Universal Design
- promote the concept of green design and living green as desirable, purposeful and communal, having a culture of care for one another and care for our home - the planet
- develop models of good practice to encourage people to move away from the current dominant building paradigm and to embrace the alternative of building green, modest and sustainable homes e.g. eco-village at Cloughjordan, Co Tipperary - www.thevillage.ie

Any other relevant, cogent, well-argued points.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Staidéar Foirgníochta

Teoiric – Ardleibhéal



Construction Studies

Theory – Higher Level

Marking Scheme

CEIST 1

PERFORMANCE CRITERIA	MAXIMUM MARK
Timber pitched roof, cavity external wall, timber clad wall ***1. (4 × 4 marks) 2. (4 × 4 marks) 3. (4 × 4 marks)***	
(a) Wall of main house • external & internal renders • cavity wall & wall ties - 100 mm external and internal leaf • full-fill insulated cavity • lintels • thermal blocks beneath roof abutment • timber bearer to wall/ hanger to main wall/metal hanger • any 4 dimensions	**4** **4** **4** **4**
Roof: • slate on 35 × 50 mm counter battens, battens & /ventilation on • breathable roofing membrane, • on 10mm OSB for wind tightness on • 250 - 300mm rafters or I-joists • packed with 300mm sheep's /mineral wool / blown cellulose on • plasterboard with bonded insulation (polystyrene) with integral vapour control layer • tilting fillet and ventilation at eaves and roof head • fascia / Soffit / Gutter *(any 2)*	**4** **4** **4** **4**
Wall of porch – timber clad • double joists at head to support roof • external cedar cladding • SW battens/ counter battens on • thermal breather membrane on • 10mm OSB, on • 250 × 50 mm vertical studwork packed with 250 mm sheep's wool/mineral wool/cellulose breathable insulation on • 10mm OSB to inside face with vapour control layer taped • service cavity of 38 mm battens, packed with insulation • 12.5mm plasterboard taped and filled • airtightness tapes at wall and ceiling junctions	**4** **4** **4** **4**
Scale 4 marks, **Drafting** 4 marks *Excellent, Good, Fair* *4 3 2*	**8**
(b) Design detail to prevent the ingress of rainwater stepped DPC/ flashing and counter flashing	**4**
TOTAL	**60**

CEIST 2

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) One possible safety risk	***(3 × 4 marks)***
Excavating for underground electrical cables Working in a deep trench Working at height when slating a roof	**4** **4** **4**
(b) Two best practice guidelines to reduce injury	***(6 × 6 marks)***
Excavating for electrical cables Guideline 1 (3 for note, 3 for sketch) Guideline 2 (3 for note, 3 for sketch)	**6** **6**
Working in a deep trench Guideline 1 (3 for note, 3 for sketch) Guideline 2 (3 for note, 3 for sketch)	**6** **6**
Working at slating a roof Guideline 1(3 for note, 3 for sketch) Guideline 2(3 for note, 3 for sketch)	**6** **6**
(c) Discuss three strategies to promote safety culture	***(3 × 4 marks)***
Strategy 1	**4**
Strategy 2	**4**
Strategy 3	**4**
TOTAL	**60**

CEIST 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Design considerations to ensure health and well-being	***(3 × 6 marks)***
Consideration 1	**6**
Consideration 2	**6**
Consideration 3	**6**
(b) Proposed design layout of extension	***(4 × 6 marks)***
Note for extension	**6**
Sketch of extension	**6**
Note for modification	**6**
Sketch of modification	**6**
(c) Discussion of proposed design to enhance health and well-being	***(3 × 6 marks)***
Discussion 1	**6**
Discussion 2	**6**
Discussion 3	**6**
TOTAL	**60**

Ceist 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Discussion on site suitability	***(4 × 6 marks)***
Characteristics of existing dwellings (notes and sketches)	**6** **6**
Characteristics of proposed site (notes and sketches)	**6** **6**
(b) Selection of preferred site - *Site* ***A or*** *Site* ***B***	***(3 × 5 marks)***
Consideration 1	**5**
Consideration 2	**5**
Consideration 3	**5**
(c) Sketch showing location, orientation, road entrance and driveway	***(5 × 3 marks)***
• Sketch	**3**
• Location	**3**
• Orientation	**3**
• Entrance	**3**
• Driveway	**3**
Justification	**6**
TOTAL	**60**

CEIST 5

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) U-value of external wall (10 points × 3 marks)	
Tabulation	3
Internal top surface resistance	3
Fine screed	3
Concrete floor slab	3
Radon barrier	3
Sand blinding	3
Hardcore	3
Subsoil	3
Total resistance	3
Calculation of U-value of ground floor	3
(b) Annual heat loss through uninsulated concrete floor (5 × 3 marks)	
Heat loss formula and calculations	3
Heating duration for one year	3
k/Joules calculation for one year	3
Litres of oil for one year	3
Annual cost of heat loss	3
(c) Required thickness of insulation for U-value of 0.15W/m^{2}K (5 × 3 marks)	
Resistance for U- value for 0.15Wm^{2}K using **R=1/U**	3
Resistance from calculated U-value from part (a)	3
Difference in resistances (required resistance)	3
Application of formula R = T/k	3
Required thickness of insulation	3
TOTAL	**60**

CEIST 6

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) *Self-build* **(4 × 3 marks)**	
Advantage 1 of self-build	3
Advantage 2 of self-build	3
Disadvantage 1 of self-build	3
Disadvantage 2 of self-build	3
(b) Any three design features suitable for self- build ***(6 × 5 marks)***	
Design feature 1	
Note	5
Sketch	5
Design feature 2	
Note	5
Sketch	5
Design feature 3	
Note	5
Sketch	5
(c) *Modifications to existing design to meet nZEB requirements* ***(6 × 3 marks)***	
Modification 1	
Note	3
Sketch	3
Modification 2	
Note	3
Sketch	3
Justification 1	3
Justification 2	3
TOTAL	**60**

CEIST 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Vertical section - 4 points from each section (4 × 4 marks from each section)***	
External wall 450 mm concrete block wall Full-fill cavity insulation Internal and external plaster/render Cavity closer Lintels Wall tie – basalt coated low conductivity Stepped dpc	4 4 4 4
Door Thermally broken frame Top rail Airtightness tape - doorframe to wall Insulation Vertical sheeting Rebates - double & draught proofing strips	4 4 4 4
Floor Joist as bearer fixed to wall Mechanical fixing of joist to wall Joist Hanger Joist Plywood decking Floating wooden floor Plasterboard ceiling	4 4 4 4
Scale and drafting marks *(Excellent, Good, Fair)* *4 3 2*	8
(b) Best practice design detailing to ensure airtightness (4 marks)	
Design detail	4
TOTAL	**60**

CEIST 8

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Design layout of zoned plumbing system	***(8 × 3 marks)***
Wood burning stove & radiators Zone control mechanism & Zone thermostats Header / expansion / storage tank Feed to expansion tank Cold feed from expansion tank Expansion pipe or expansion vessel Flow pipes to radiators Return pipes from radiators Radiator valves Pump and valves (pump, 2 isolating valves, drain off - any 2) Solar panel Flow & Return - with arrows/colour coding/labels Solar pump Cylinder (twin coil) Control panel Expansion vessel Thermal reducing vessel	3 3 3 3 3 3 3 3
Sizes of pipework (any 2)	4
(b) Safety features of plumbing system	***(5 × 4 marks)***
Feature 1 Note Sketch **Feature 2** Note Sketch Discussion of safety features	 4 4 4 4 4
(c) Location of chimney	***(4 × 3 marks)***
Design consideration1 Note & Sketch **Design consideration 2** Note & Sketch	3 3 3 3
TOTAL	**60**

CEIST 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three functional requirements of attic space	***(6 × 6 marks)***
Functional requirement 1	
Notes	6
Sketches	6
Functional requirement 2	
Notes	6
Sketches	6
Functional requirement 3	
Notes	6
Sketches	6
(b) Typical design detailing to ensure structural stability of roof	***(3 × 6 marks)***
Structural stability - pitched roof Notes & sketches	6
Stud side wall and insulation Notes & sketches	6
Labelled components and dimensions ***(3 × 2 marks)***	6
(c) Design detail to prevent air leakage	***(6 marks)***
Air leakage design detail	6
TOTAL	**60**

CEIST 10

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) *Design of a passive house - any 2*	***(4 × 4 marks)***
Space heating energy demand Notes Sketches **Building form** Notes Sketches **Thermal bridging** Notes Sketches	**4** **4** **4** **4**
(b) Modifications to design to meet Passive standard	***(7 × 4 marks)***
Modification 1 (notes and sketches) Modification 2 (notes and sketches) Modification 3 (notes and sketches)	**4** **4** **4** **4** **4** **4**
Justification	**4**
(c) *Preferred orientation for upgraded design*	***(4 × 4 marks)***
• Sketch • Orientation • Sunpath • Optimum thermal performance	**4** **4** **4** **4**
TOTAL	**60**

CEIST 10 (ALTERNATIVE)

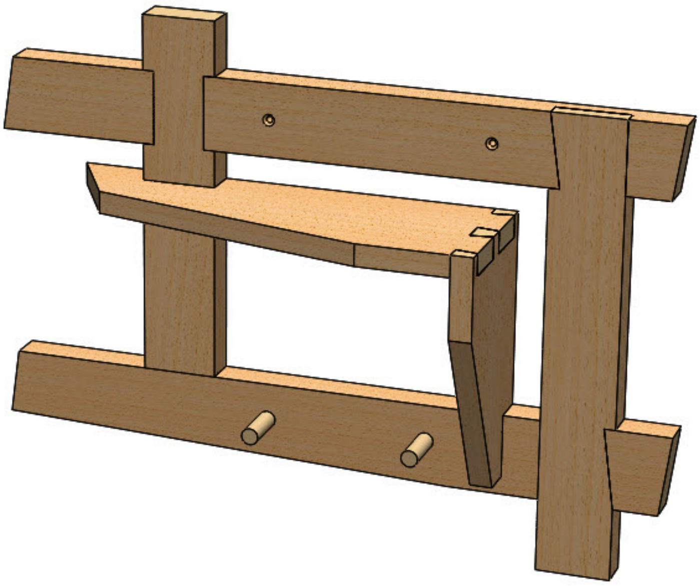
PERFORMANCE CRITERIA	MAXIMUM MARK
Discussion of Statement	***(3 × 10 marks)***
Discussion – point 1 *(4 for point, 6 for discussion)*	**10**
Discussion – point 2 *(4 for point, 6 for discussion)*	**10**
Discussion – point 3 *(4 for point, 6 for discussion)*	**10**
Three best practice guidelines to promote green design	***(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

Scrúdú na hArdteistiméireachta 2018
Leaving Certificate Examination 2018

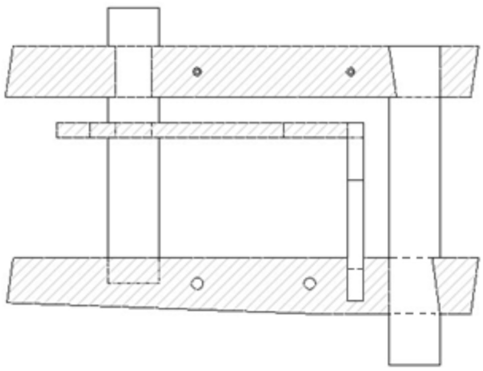
Scéim Mharcála – Lá 1
Marking Scheme – Day 1

(150 marks)



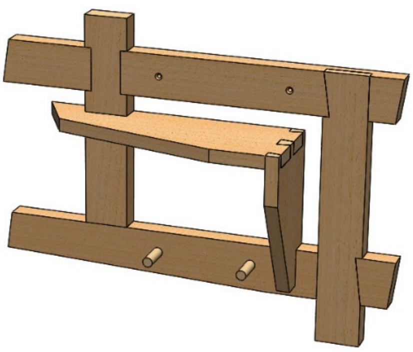
Staidéar Foirgníochta
Triail Phraticiúil

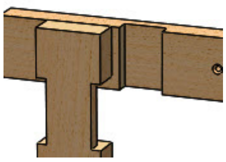
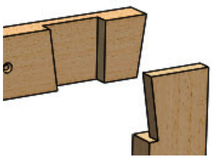
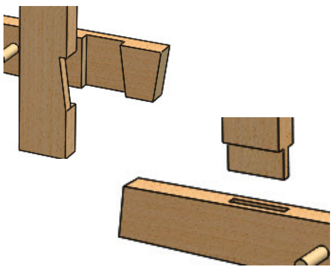
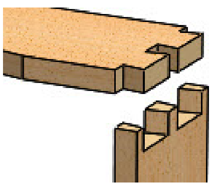
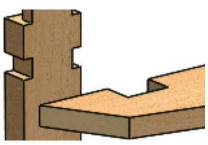
Construction Studies
Practical Test

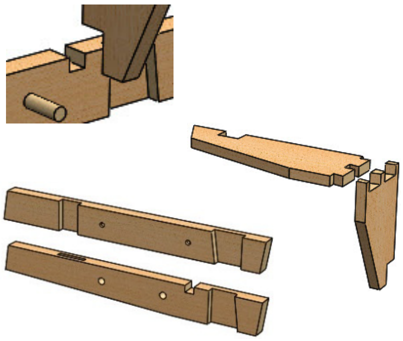


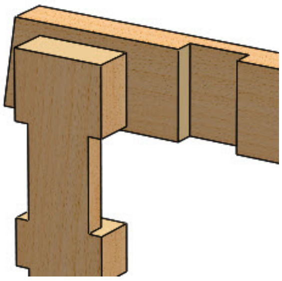
Construction Studies 2018
Marking Scheme – Practical Test

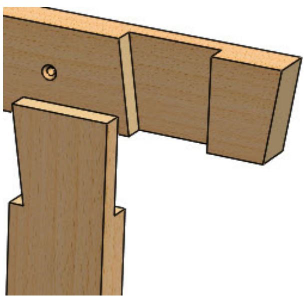
Note:
The artefact is to be hand produced by candidates without the assistance of machinery.
However the use of a battery powered screwdriver is allowed.
Where there is evidence of the use of machinery for a particular procedure a penalty applies.
Component is marked out of 50% of the marks available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

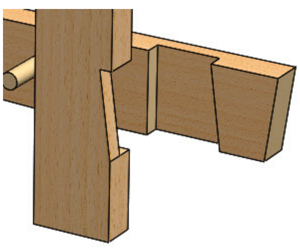
	(i)	OVERALL ASSEMBLY	MARKS
	1	Overall quality of assembled artefact	**10**
	2	Design and applied shaping to edges • design *(3 marks)* • shaping *(3 marks)*	**6**
		Total	**16**

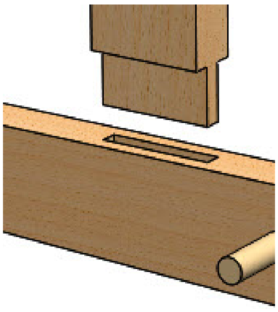
	(ii)	MARKING OUT	Marks
	1	Notched Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
	2	Dovetailed Tee Halving • Trench - horizontal piece *(2 marks)* • Dovetail *(4 marks)*	**6**
	3	Dovetailed Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
	4	Stopped Mortice • Mortice *(2 marks)* • Stub Tenon *(2 marks)*	**4**
	5	Box Dovetail • Tails *(2 × 2 marks)* • Pins *(2 × 2 marks)*	**8**
	6	Notched housing - double Notch – horizontal piece *(2 marks)* Trenches – vertical piece *(2 × 2 marks)*	**6**

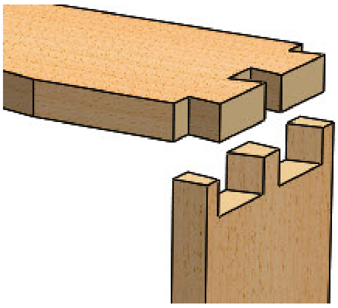
	7	Notched housing- single • Trench – horizontal piece *(2 marks)* • Notch – vertical piece *(2 marks)*	**4**
	8	Slopes *(8 × 1 mark)*	**8**
		Total	**48**

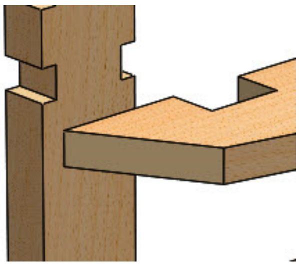
Notched Cross Halving	(iii)	PROCESSING	Marks
	1	Trench - horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trenches – vertical piece • Trenches back *(4 marks)* • Front trenches *(2 × 3 marks)*	**10**
		Total	**14**

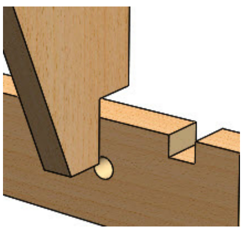
Dovetail Tee Halving	(iv)	PROCESSING	Marks
	1	Trench – horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)* •	**4**
	2	Dovetail • Sawing across the grain *(2 × 1 mark)* • Sawing with the grain *(2 marks)* • Paring Dovetail *(2 marks)*	**6**
		Total	**10**

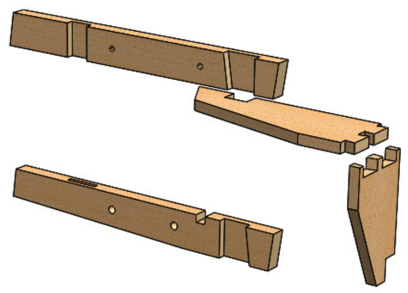
Dovetail Cross Halving	(v)	PROCESSING	Marks
	1	Trench – horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trench – vertical piece • Sawing across the grain *(3 × 1 mark)* • Paring Trench *(2 marks)* • Paring dovetail *(2 marks)*	**7**
		Total	**11**

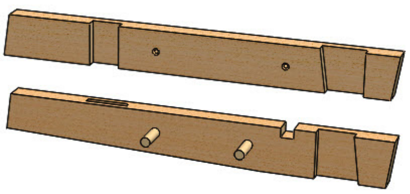
Stopped Mortice	(vi)	PROCESSING	Marks
	1	Stopped Mortice • mortice *(2 marks)*	**2**
	2	Tenon • sawing with the grain *(2 × 1 mark)* • sawing across the grain *(2 × 1 mark)*	**4**
		Total	**6**

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

Notched Housing - Double	(viii)	PROCESSING	Marks
	1	Notch - horizontal piece • sawing across the grain *(2 × 1 mark)* • paring trench *(2 marks)*	**4**
	2	Trenches - vertical piece - • trenches (*2 × 2 marks)*	**4**
		Total	**8**

Notched Housing - Single	(ix)	PROCESSING	Marks
	1	Trench • trench *(2 marks)*	**2**
	2	Notch • Sawing *(2 × 1 mark)*	**2**
		Total	**4**

Shaping	(x)	PROCESSING	Marks
	1	Short slopes *(5 × 1 mark)*	**5**
	2	Long slopes *(3 × 2 marks)*	**6**
		Total	**11**

Drilling	(xi)	PROCESSING	Marks
	1	Dowels located and fitted correctly *(2 × 2 marks)*	**4**
	2	Drilling and countersinking holes accurately *(2 × 1 mark)*	**2**
		Total	**6**

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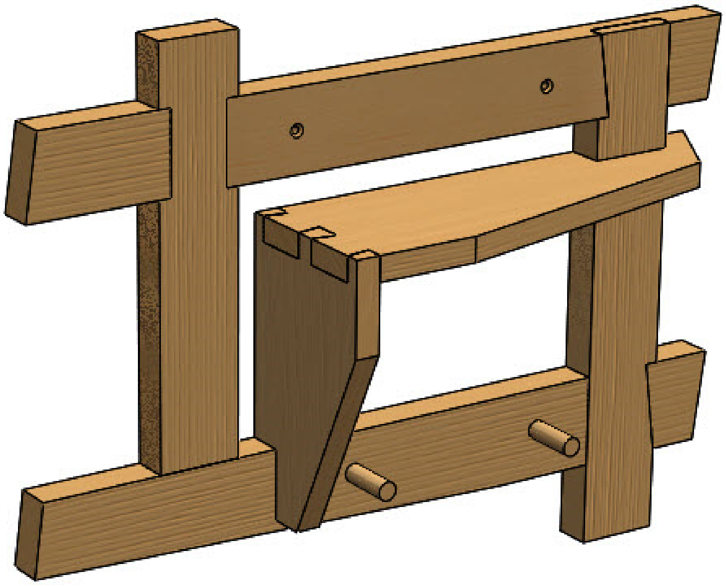
Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scrúdú na hArdteistiméireachta 2018
Leaving Certificate Examination 2018

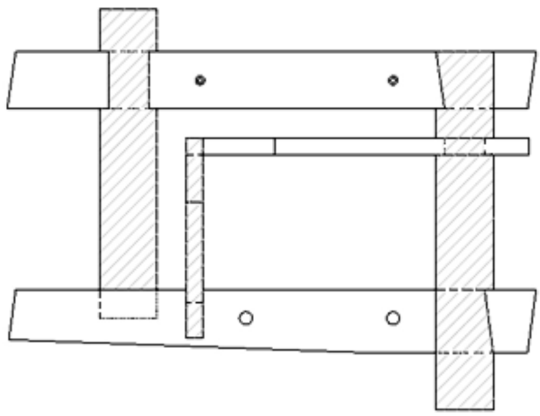
Scéim Mharcála - Lá 2
Marking Scheme - Day 2

(150 marks)



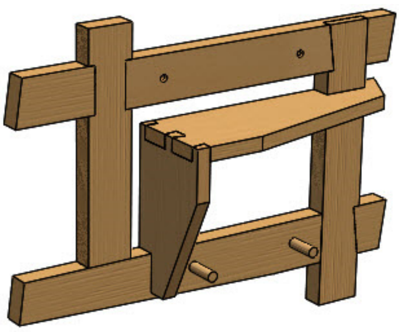
Staidéar Foirgníochta
Triail Phraiticiúil

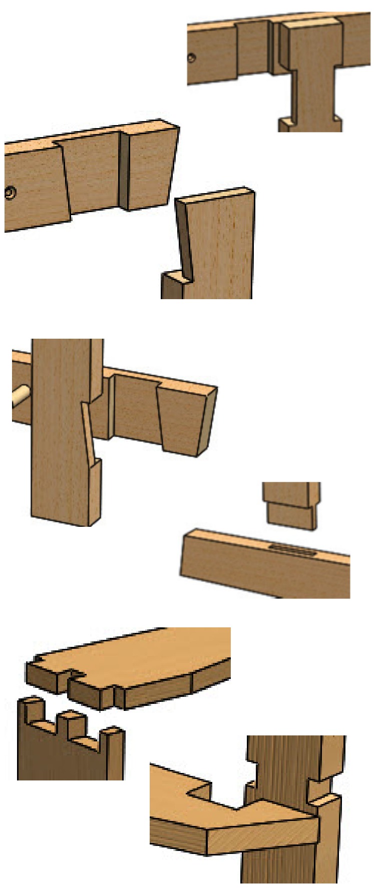
Construction Studies
Practical Test

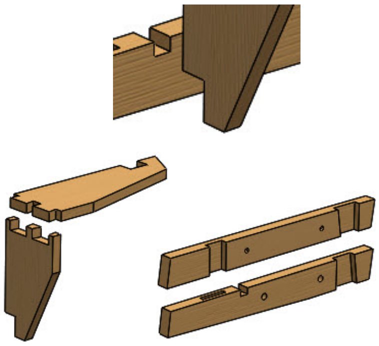


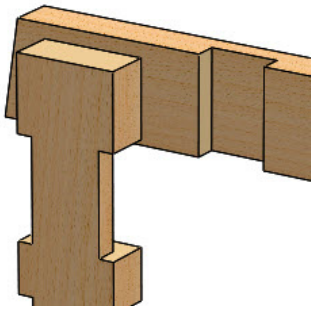
Construction Studies 2018
Marking Scheme – Practical Test

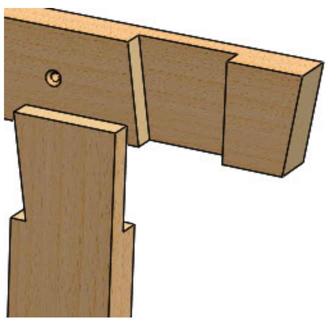
Note:
The artefact is to be hand produced by candidates without the assistance of machinery.
However the use of a battery powered screwdriver is allowed.
Where there is evidence of the use of machinery for a particular procedure a penalty applies.
Component is marked out of 50% of the marks available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

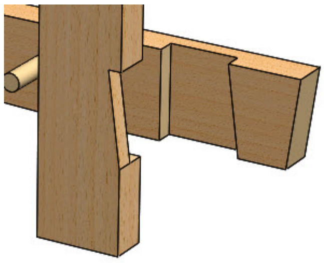
	(i)	OVERALL ASSEMBLY	MARKS
	1	Overall quality of assembled artefact	**10**
	2	Design and applied shaping to edges • design *(3 marks)* • shaping *(3 marks)*	**6**
		Total	**16**

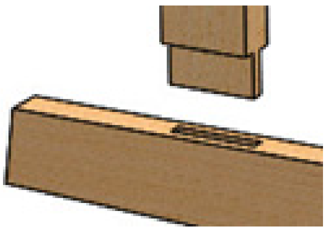
	(ii)	MARKING OUT	Marks
	1	Notched Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
	2	Dovetailed Tee Halving • Trench - horizontal piece *(2 marks)* • Dovetail *(4 marks)*	**6**
	3	Dovetailed Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
	4	Stopped Mortice • Mortice *(2 marks)* • Stub Tenon *(2 marks)*	**4**
	5	Box Dovetail • Tails *(2 × 2 marks)* • Pins *(2 × 2 marks)*	**8**
	6	Notched housing - double Notch – horizontal piece *(2 marks)* Trenches – vertical piece *(2 × 2 marks)*	**6**

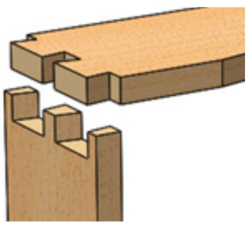
	7	Notched housing- single • Trench – horizontal piece *(2 marks)* • Notch – vertical piece *(2 marks)*	**4**
	8	Slopes *(8 ×1 mark)*	**8**
		Total	**48**

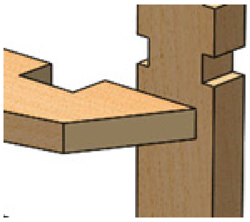
Notched Cross Halving	**(iii)**	**PROCESSING**	**Marks**
	1	Trench - horizontal piece • Sawing across the grain *(2 x 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trenches – vertical piece • Trenches back *(4 marks)* • Front trenches *(2 x 3 marks)*	**10**
		Total	**14**

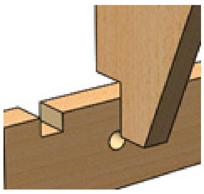
Dovetail Tee Halving	**(iv)**	**PROCESSING**	**Marks**
	1	Trench – horizontal piece • Sawing across the grain *(2 x 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Dovetail • Sawing across the grain *(2 x 1 mark)* • Sawing with the grain *(2 marks)* • Paring Dovetail *(2 marks)*	**6**
		Total	**10**

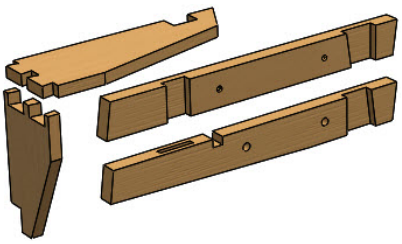
Dovetail Cross Halving	(v)	PROCESSING	Marks
	1	Trench – horizontal piece • Sawing across the grain *(2 x 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trench – vertical piece • Sawing across the grain *(3 x 1 mark)* • Paring Trench *(2 marks)* • Paring dovetail *(2 marks)*	**7**
		Total	**11**

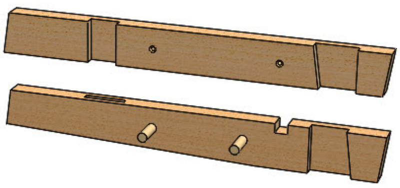
Stopped Mortice	(vi)	PROCESSING	Marks
	1	Stopped Mortice • mortice *(2 marks)*	**2**
	2	Tenon • sawing with the grain *(2 × 1 mark)* • sawing across the grain *(2 × 1 mark)*	**4**
		Total	**6**

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

Notched Housing - Double	(viii)	PROCESSING	Marks
	1	Notch - horizontal piece • sawing across the grain *(2 × 1 mark)* • paring trench *(2 marks)*	4
	2	Trenches - vertical piece - • trenches *(2 × 2 marks)*	4
		Total	**8**

Notched Housing - Single	(ix)	PROCESSING	Marks
	1	Trench • trench *(2 marks)*	2
	2	Notch • Sawing *(2 × 1 mark)*	2
		Total	**4**

Shaping	(x)	PROCESSING	Marks
	1	Short slopes *(5 × 1 mark)*	5
	2	Long slopes *(3 × 2 marks)*	6
		Total	**11**

Drilling	(xi)	PROCESSING	Marks
	1	Dowels located and fitted correctly *(2 × 2 marks)*	4
	2	Drilling and countersinking holes accurately *(2 × 1 mark)*	2
		Total	**6**

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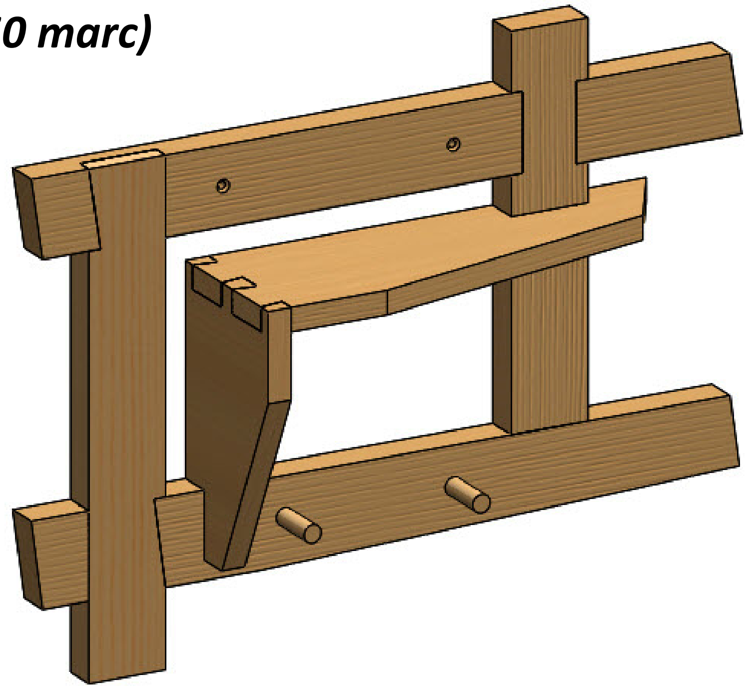
Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scrúdú na hArdteistiméireachta 2018
Leaving Certificate Examination 2018

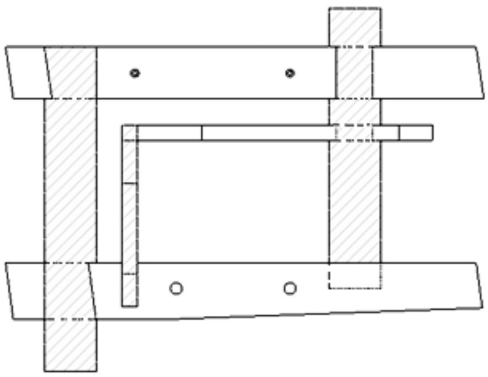
Scéim Mharcála - Lá 3
Marking Scheme - Day 3

(150 marc)



Staidéar Foirgníochta
Triail Phraiticiúil

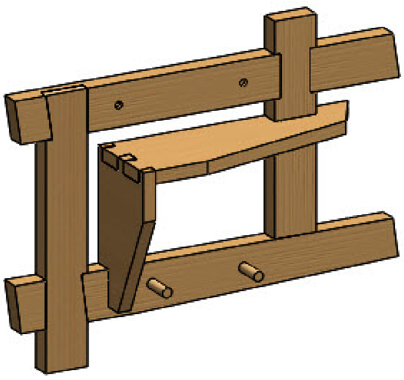
Construction Studies
Practical Test



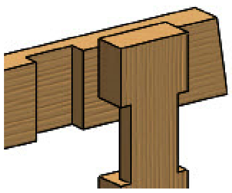
Construction Studies 2018
Marking Scheme – Practical Test

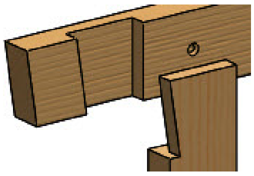
Note:

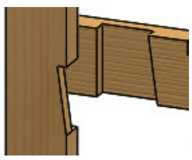
The artefact is to be hand produced by candidates without the assistance of machinery.
However the use of a battery powered screwdriver is allowed.
Where there is evidence of the use of machinery for a particular procedure a penalty applies.
Component is marked out of 50% of the marks available for that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

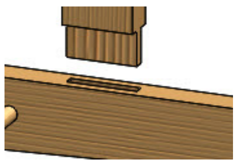


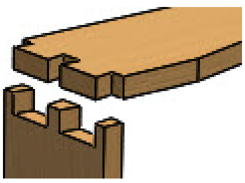
(i)	OVERALL ASSEMBLY	MARKS
1	Overall quality of assembled artefact	**10**
2	Design and applied shaping to edges • design *(3 marks)* • shaping *(3 marks)*	**6**
	Total	**16**

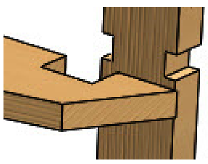




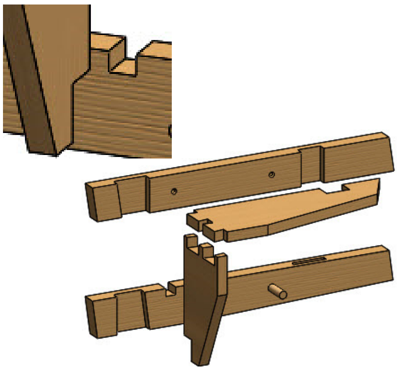


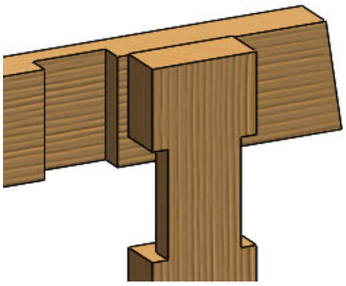


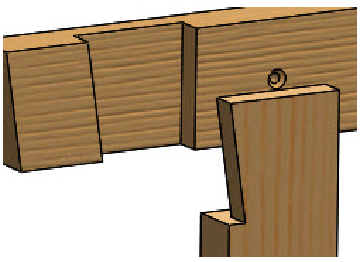


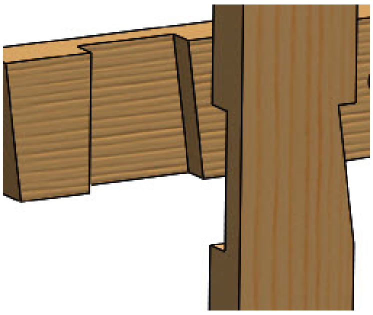


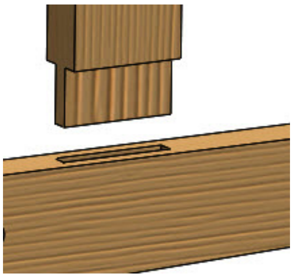
(ii)	MARKING OUT	Marks
1	Notched Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
2	Dovetailed Tee Halving • Trench - horizontal piece *(2 marks)* • Dovetail *(4 marks)*	**6**
3	Dovetailed Cross Halving • Trench - horizontal piece *(2 marks)* • Trenches - vertical piece *(4 marks)*	**6**
4	Stopped Mortice • Mortice *(2 marks)* • Stub Tenon *(2 marks)*	**4**
5	Box Dovetail • Tails *(2 × 2 marks)* • Pins *(2 × 2 marks)*	**8**
6	Notched housing - double Notch – horizontal piece *(2 marks)* Trenches – vertical piece *(2 × 2 marks)*	**6**

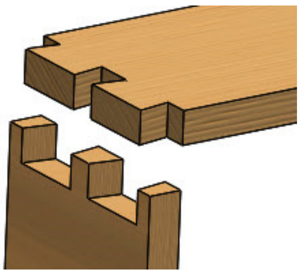
	7	Notched housing- single • Trench – horizontal piece *(2 marks)* • Notch – vertical piece *(2 marks)*	**4**
	8	Slopes *(8 × 1 mark)*	**8**
		Total	**48**

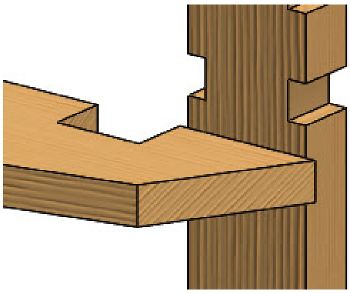
Notched Cross Halving	(iii)	PROCESSING	Marks
	1	Trench - horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trenches – vertical piece • Trenches back *(4 marks)* • Front trenches *(2 × 3 marks)*	**10**
		Total	**14**

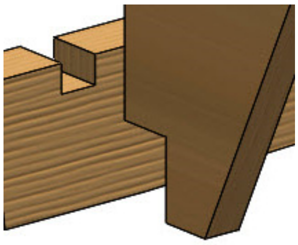
Dovetail Tee Halving	(iv)	PROCESSING	Marks
	1	Trench – horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Dovetail • Sawing across the grain *(2 × 1 mark)* • Sawing with the grain *(2 marks)* • Paring Dovetail *(2 marks)*	**6**
		Total	**10**

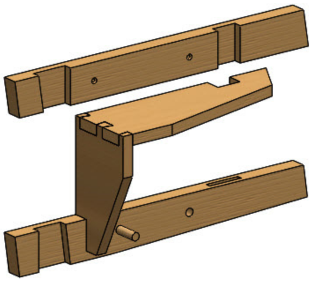
Dovetail Cross Halving	(v)	PROCESSING	Marks
	1	Trench – horizontal piece • Sawing across the grain *(2 × 1 mark)* • Paring Trench *(2 marks)*	**4**
	2	Trench – vertical piece • Sawing across the grain *(3 × 1 mark)* • Paring Trench *(2 marks)* • Paring dovetail *(2 marks)*	**7**
		Total	**11**

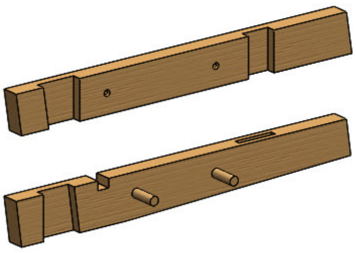
Stopped Mortice	(vi)	PROCESSING	Marks
	1	Stopped Mortice • mortice *(2 marks)*	**2**
	2	Tenon • sawing with the grain *(2 × 1 mark)* • sawing across the grain *(2 × 1 mark)*	**4**
		Total	**6**

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

Notched Housing - Double	(viii)	PROCESSING	Marks
	1	Notch - horizontal piece • sawing across the grain *(2 × 1 mark)* • paring trench *(2 marks)*	**4**
	2	Trenches - vertical piece - • trenches *(2 × 2 marks)*	**4**
		Total	**8**

Notched Housing - Single	(ix)	PROCESSING	Marks
	1	Trench • trench *(2 marks)*	**2**
	2	Notch • Sawing *(2 × 1 mark)*	**2**
		Total	**4**

Shaping	(x)	PROCESSING	Marks
	1	Short slopes *(5 × 1 mark)*	**5**
	2	Long slopes *(3 × 2 marks)*	**6**
		Total	**11**

Drilling	(xi)	PROCESSING	Marks
	1	Dowels located and fitted correctly *(2 × 2 marks)*	**4**
	2	Drilling and countersinking holes accurately *(2 × 1 mark)*	**2**
		Total	**6**

Coimisiún na Scrúduithe Stáit

State Examinations Commission

Form A

Leaving Certificate Examination 2018

Construction Studies

Assessment of Candidates' Practical Coursework

Examination Number:

Type of Project:

- ☐ Practical Craft
- ☐ Building Science
- ☐ Written/Drawn with Scale model
- ☐ Composite

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

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