Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2013

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 Ardteistiméireachta 2013

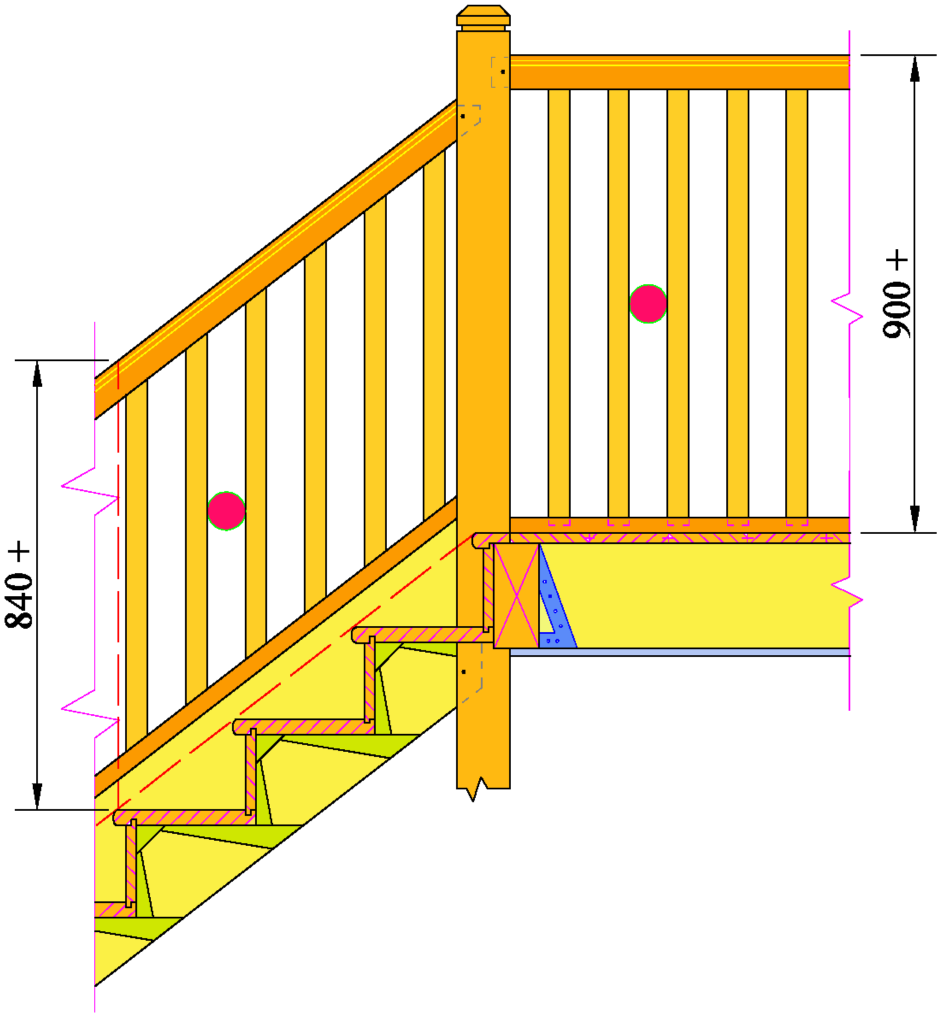
Staidéar Foirgníochta

Teoiric – Ardleibhéal

Construction Studies

Theory – Higher Level

Ceist 1



Closed string stairs and landing – other similar detailing accepted

- String: 250 mm × 50 mm – or similar
- Thread: 225 mm (plus nosing) - 30 mm + – or similar
- Riser 175 mm plus tongue – or similar - 20 mm
- Newel post 100 mm × 100 mm
- Balusters: 40 mm × 40 mm – or similar
- Handrail to stairs: 60 mm × 60 mm to 120 mm × 70 mm
- Handrail to landing – same
- Nosing to thread 30 mm – or similar
- Saddle piece with groove to string – at base of balusters
- Trimmer to landing 200 mm × 75 mm or similar
- Floor joist 200 mm × 50 mm
- Hangers to joists – metal or alternative detail - notched
- Hardwood floor to landing 100 mm × 20 mm or similar
- Glue blocks 60 mm × 60 mm or similar
- Wedges to threads and risers
- Handrail and string fixed to newel using tenons
- Pitch line – less than 42°
- Sphere 100 mm Ø not to pass between balusters
- Minimum handrail heights to stairs and landing - on drawing.

Ceist 2 (a)
Development of a safety culture amongst workers

Training
- Essential in order to develop awareness amongst workers of possible risks on site
- Minimise accidents through planning and constant risk assessment
- Construction workers are legally required to do a safe pass course
- Safe pass course - to be renewed every 4 years
- Regular monitoring of work practices
- Specialist equipment training
- Ensure mandatory use of personal protective equipment – safety clothing, goggles, ear protection etc.

Vigilance
- Firm commitment from management to monitor and improve health and safety on site
- Clear health and safety statement which is regularly reviewed and updated
- Safety officer – responsibility on site for the regular assessment of possible risks and the development of strategies to minimise danger to employees
- Awareness and reporting of any potential hazards
- Ongoing review of workers work practices on site
- Clear channel for identifying and reporting risks to management
- Mandatory reporting of accidents and near accidents – in order to better inform policy making
- Enforcement is essential. Health and Safety Authority is responsible for compliance. Fines and penalties for companies who break the rules.

Teamwork
- Peer to peer training. Inexperienced workers paired with experienced and properly trained personnel
- Trust between management and employees and employees – good communication
- Development of a shared responsibility for health and safety in the workplace
- Develop a climate of openness and trust. Workers encouraged to make suggestions
- Each worker is part of a team and given work suitable to their skills
- Foster a positive atmosphere towards health and safety in the workplace – buddy system – esprit de corps.

Any other relevant details

(b) Using a ladder on a construction site

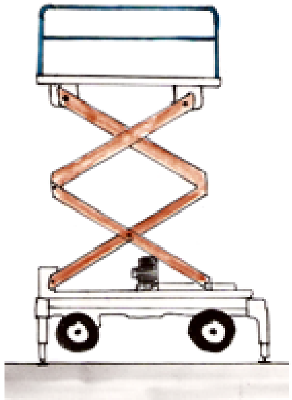
- Inspection of ladder to ensure that the ladder is not damaged and is capable of carrying the required loads
- The ladder should be securely fixed at both ends
- Place the ladder on a firm and level base
- The operator should maintain 3 points of contact with the ladder at all times
- The ladder should extend at least 1.0 metres above any platform
- Ideal angle 74°. The distance of the foot of the ladder from the wall should be ¼ the height of the wall.
- Wooden ladders near power lines
- Avoid metal on metal contact – increased risk of the ladder sliding.

Any other relevant information

Fitting a window in a second storey window

- Ensure a safe platform such as scaffolding to work from
- Max lifting load of 25Kg per person
- Prevent back injury - use correct lifting procedure
- Have enough people available to lift the window safely into place
- Teamwork for lifting in unison
- Use of lifting system such as a cherry picker/ teleporter to raise the window to the second storey
- Use suction pads to lift – mechanical lifting where possible.

Any other relevant information

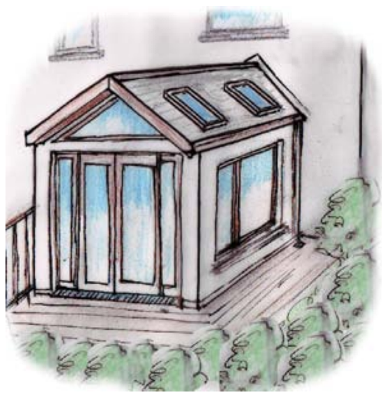


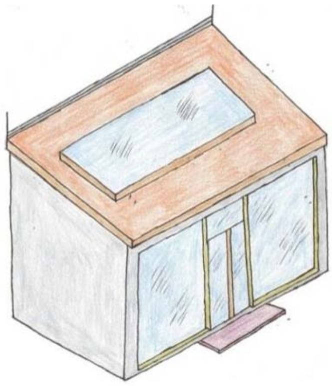
(c) Best practice guidelines when using electrical power tools on site

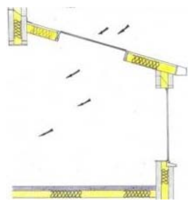
- All tools should be regularly serviced and properly earthed
- All power tools on site must use a 110 volt supply
- Double insulated for external use
- Using a 110 volt supply greatly reduces the risk of electrocution
- Cabling is correctly sized and free from damage
- Ensure cabling does not constitute a trip hazard
- Wear correct *PPE* equipment – insulated footwear and gloves
- Use waterproof cabling suitable for outdoor use and ensure all connections are sealed
- Personal safety equipment such as earmuffs and safety glasses must be used
- Keep electrical equipment covered and dry in between uses
- Don't use electrical tools outside when wet
- Ensure all damaged electrical equipment is removed from service and sent for repair.
  Any other relevant information

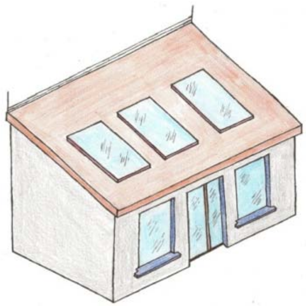
Ceist 3 (a) ***Proposed design for the extension***

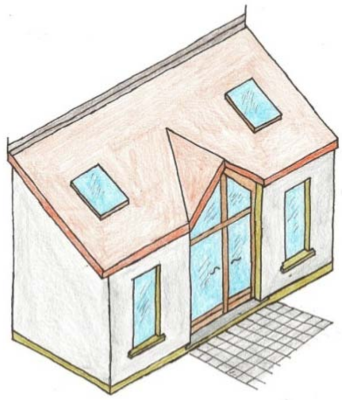
- Building footprint should be optimized (south-facing)
- Climate-responsive window-to-wall area ratio
- High performance low-e glazing system to ensure admission of natural light and provision of view to occupants to realise significant gains in energy efficiency
- Occupants can engage in activities to take advantage of natural light
- Design for thermal mass of block walls and floor
- Increased glazing for penetration of sunlight to the interior
- Maximise natural light potential through the use of rooflights
- Partial removal of external wall BB to allow increased penetration of light
- More pleasant indoor environment – better health and wellbeing.



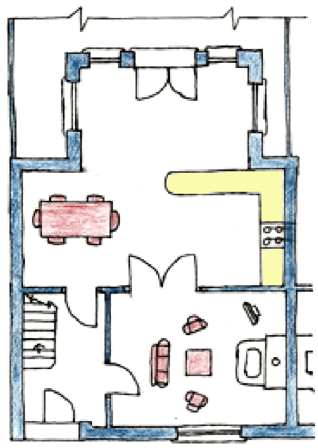








Revised layout for the ground floor

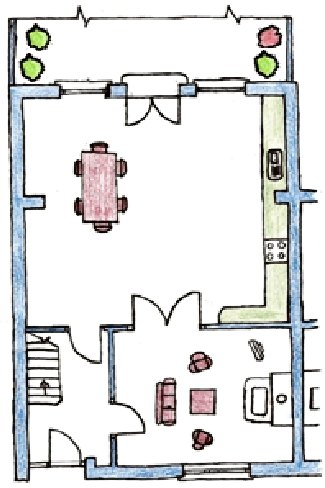


- Increased floor area for occupants
- Floor to ceiling glazing for view of garden
- Additional kitchen space
- Open plan design
- Increased provision of natural light to existing rooms
- Increased economic benefit – no cold spaces
- Access to garden – pleasant space for relaxation – health and wellbeing.

(b) Reasons for proposed design choices

Increased sunlight

- Building can realise significant gains in energy efficiency
- Room designed to collect sunlight and heat
- Health benefits associated with sunlight and natural light
- Use of shading devices to reduce glare
- Building footprint to be optimized
- Climate-responsive window-to-wall area ratio
- Careful balance between admission of sunlight and thermal issues such as winter time heat loss and summer time heat gain
- High window head height to achieve deep penetration of daylight
- Admission of natural light from skylights
- Increase brightness levels of existing rooms
- South facing facade is the optimal orientation.

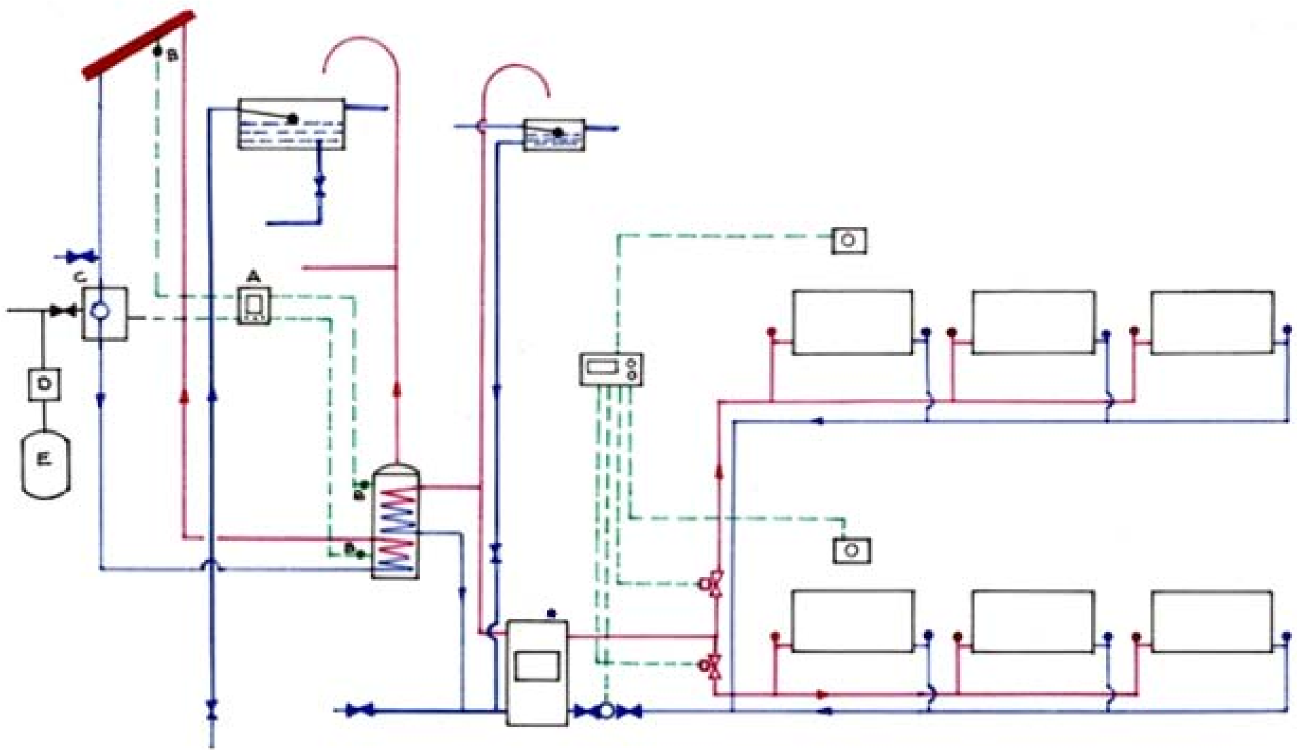


Improve the view to the rear garden

- Pleasant space for occupants to relax – bringing the outdoors indoor
- Careful selection of plants to provide colour and biodiversity
- Enjoyment of gardening as a hobby
- Planting of home grown vegetables for use
- Garden becomes part of living space
- Water feature may be included for relaxation

- Space for children to play – easy to monitor
- Fresh air
- View of wild life such as butterflies, bees
- Scent from shrubs/plants
- Benefits to health and well-being.

Ceist 4 (a)



Control Valves

- Control valves located on return
- Thermostats located in each zone
- Motorised control valves connected to electronic control panel
- Each radiator to have independent controls (thermostatic valve on flow, lockshield on return, air bleeder valve on radiators)
- Lockshield valves on return.

Solar heating system

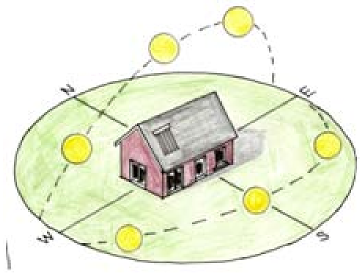
- Electronic solar control panel (A) - temperature sensors (B)
- Pump station including pump on return (C)
- Cooling vessel TRV (D)
- Expansion vessel (E)
- Pressure release valve.

Typical sizes

- 22mm flow and return
- 28mm expansion
- 15mm upstands to radiators
- 300 litre capacity hot water twin coil cylinder - 230 litre cold water storage tank.

(b) Design considerations

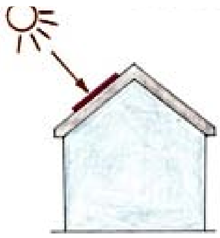
Orientation



- Sun path in northern hemisphere is East to West
- Panels to be orientated facing South
- Tolerance of 15º degrees due East or West of South.

Angle of inclination

- Angle of incidence of the sun varies throughout the year with the highest in the summer
- Water heating - Optimum angle of inclination is approximately 0.7 × latitude (e.g. Dublin 0.7 × 53.43 = 37.4º angle of solar collector)
- Space heating - Optimum angle of inclination is equal to the latitude (e.g. Dublin = 53.43º angle of solar collector)
- Rule of thumb for Ireland - inclination of panels - 45º degrees.



Location

- Avoid shading for optimum performance
- General location on roof – may be located on gable walls or ground mounted
- Located close to cylinder to minimise pipe runs
- Electronic solar control panel and pump station located in an easily accessible area
- Additional weight of panels and associated pipe work may require additional structural support works.

Sizing

- General rule of thumb 1.0 - 1.5m^2 of panel per person
- Evacuated tube collectors efficient for Irish climate
- Avoid over sizing panels as it can lead to stagnation of solar fluid.

(c) Advantages

- Solar power is a renewable and natural resource.
- Reduction in CO_2 emissions.
- Solar power is silent.
- Can provide up to 60% of hot water demand
- Reduced dependence on electricity to heat water
- As collectors are roof mounted no major change in internal layout required
- Relatively easy to install with little maintenance required
- Wood is a renewable fuel and carbon neutral
- Stoves are highly efficient (in excess of 70%)
- Grants available for installation.

Disadvantages

- Geographic limitations – further north less sunlight
- Weather dependent
- Initial capital cost significant
- Serious environmental considerations regarding disposal of solar solution - glycol
- Log burning stoves must be manually ignited
- Dry storage of wood pellets - pellets are very sensitive to increase moisture content
- Wood burning stoves need to be cleaned manually.

Any other relevant information

Ceist 5 (a)

(i) Thermally broken wooden window frame

Material Element	Conductivity k	resistivity r	Thickness T(m)	Resistance R
Wood	0.150		0.06	0.400
Insulation	0.021		0.06	2.857
Ext. Surface				0.950
Int. Surface				1.400
				5.607

Wood: Formula: R=T/k: R = 0.06 / 0.150; = 0.400

Urethane Insulation: Formula: R=T/k**:** R = 0.06 / 0.021; = 2.857

U - value: Formula: $U= 1/R^t$ U = 1 / 5.607; = 0.178 W/ m^2K

(ii) Triple glazed , low- e unit

Material Element	Conductivity k	resistivity r	Thickness T(m)	Resistance R
Glass Single Pane	1.050		0.004	0.0038095
Argon Gas	0.160		0.040	0.25
Ext. Surface				0.075
Int. Surface				0.110
Low-e glass				3.400
				3.8388

Glass: (One pane) Formula: R=T/k: R = 0.004 / 1.050 ; = 0.0038095

Argon Gas : Formula: R=T/k: R = 0.040 / 0.160 ; = 0.25

U - value: Formula: $U= 1/R^t$ U = 1 / 3.8388 ; = 0.260495 W/ m^2K

Ceist 5 (b)
Thermal Properties: Frame -

- Thermally broken wooden frame (U-value 0.178 W/m^2K):
- Traditional wooden frame (U-value 0.317 W/m^2K):
- U-values show thermally broken wooden frame to be almost twice as efficient as the traditional wooden frame
- Heat loss costs are almost halved by using a thermally broken wooden frame
- While wood is a good insulating material, introducing a layer of rigid insulation between the inner and outer surfaces of the frame significantly reduces the heat loss through the frame
- Positioning the rigid insulation directly in line with the triple glazed unit contributes to the greater efficiency of the window.

Thermal Properties: Glazing -

- Triple glazed, argon gas, low- e unit (U-value 0.261W/m^2K)
- Traditional single glazing (U-value 5.300W/m^2K)
- U-values show specified triple glazed unit up to twenty times more efficient than traditional single glazing
- It is estimated that annually 25% of heat is lost through traditional single-glazed windows
- By using the specified triple glazed unit heat loss costs are significantly reduced
- Increased thermal comfort at a reduced cost.

Environmental considerations -

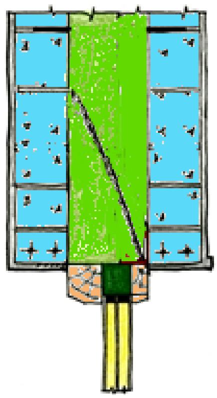
- Reduced demand for scarce and finite fossil fuels
- Reduced CO_2 emissions
- Locally sourced wood for framing has low embodied energy - less damaging on the environment – lower transport costs
- Naturally durable timbers such as European Larch, Cedar or Douglas Fir eliminate need for treatment with chemical preservatives – benefit to the environment
- Naturally durable wood framing eliminates need for alloys such as aluminium which has a high embodied energy value – benefit to the environment
- Wood to be from a sustainable source - FSC certified
- Reduced demand for tropical hardwoods - benefit to the environment
- Reduce visual impact on the landscape – less mining.

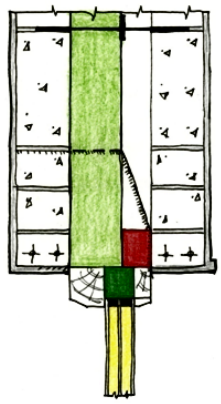
Any other relevant points

Ceist 5 (c)

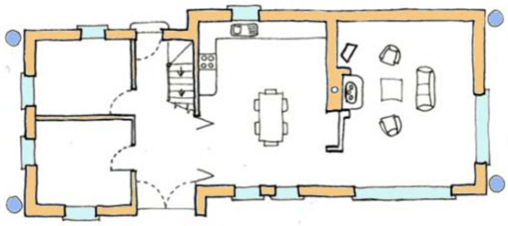
- Cavity tray
- Cavity at head and sides of window sealed with high density insulation 50mm or proprietary cavity closer
- Absence of thermal bridge
- Air tight tape
- Reinforced concrete lintels
- Wall ties
- Position of thermally broken wooden frame
- Rigid insulation 100mm – tight against inner leaf **or** full-fill cavity – see sketch
- Tape for windtightness
- Exterior and interior render.

Any other relevant points





Ceist 6 (a)



Steep pitched roof

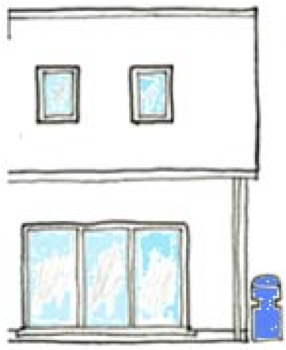
- Allows for three extra bedrooms and bathroom which is economical in terms of space and materials required – one compact foundation – two floors and roof space
- Reduced costs and energy requirements – small footprint with attic space used
- Enables maximum use of attic as a habitable space
- Less materials as form is compact – lower embodied energy, lower CO_2
- Solar panels fitted at optimum angle of 45° for solar gain - roof used to collect solar energy.

Any other relevant points

Roof lights

- Provide about three times more daylight over a longer period than dormers
- Reduced need for artificial light
- Reduced demand for fossil fuels and reduced lighting costs
- No shading, unobstructed light for longer.

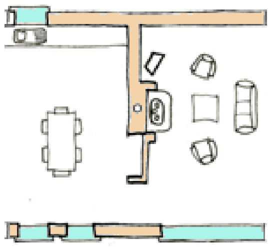
Any other relevant points



Glazing – to maximise solar gain and thermal comfort

- High thermal pe rformance uni ts e. g. frames with thermal breaks an d triple glazed, argon gas filled low-e soft coated glazing
- South facing principal elevation to maximise solar gain
- Fewer and smaller windows on the North elevation reduces heat loss
- Extended roof lights over front door for maximum sunlight to penetrate to the lobby/stairs area
- Tall / full height large south facing windows allow for maximum sunlight to the living areas
- East facing window allows morning sunlight to the sitting room – less heating required as solar gain is maximised.

Any other relevant points



Solid Fuel Heating

- Wood is carbon neutral
- Renewable
- Stoves are 70% efficient, open fires are at best 30% efficient
- Stoves may be used to heat radiators on both the ground and upper floors
- Chimney stack on internal wall radiates stored heat to adjoining spaces.

Any other relevant points

Rainwater harvesting system

- Design collects rainwater from front and rear roof surfaces and stores this water in above-ground storage tanks
- Above-ground storage system – reduced installation costs
- Lower embodied energy requirements
- Modular storage units allow for increased storage capacity at minimum cost.
- Increased use of rainwater reduces quantity of expensive treated drinking quality Alternatively this encourages the economical use of expensive high quality drinking water
- Rainwater may be used to water gardens, lawns and to flush toilets – (filter required).

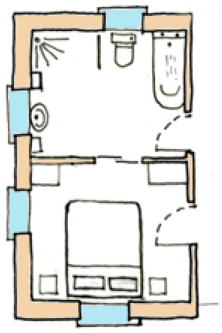
Any other relevant points

Solar Panels

- The design incorporates a passive solar collector that can provide 40% - 60% of domestic hot water requirements depending on time of year
- Reduces dependency on finite and expensive fossil fuels
- Solar collectors reduce the output of CO_2
- Solar panel positioned on south facing roof to obtain maximum solar gain
- Photovoltaic solar panels can provide up to 40% of electrical energy depending on the surface area installed
- Surplus energy may be sold or transferred to the national grid for credits
- Panels to be orientated south or 15° due east or due west of south
- Angle of inclination varies with seasons - elevation 78° summer and 30° in winter.
- Rule of thumb for Ireland - angle of inclination of solar panels is 45°.

Any other relevant points

Orientation of house

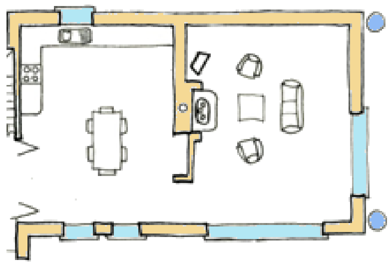


- Longer elevation on an east-west axis
- Large areas of high performance windows on the southern elevation allow for maximum solar gain
- Passive heating reduces costs and the demand for scarce and increasingly expensive fossil fuels
- Provides high level of thermal comfort from a renewable energy source.

Any other relevant points

Flexibility of design

- Universal design principles facilitate design for people of all ages, abilities and disabilities – temporary and permanent
- Study/office situated in close proximity to the wheelchair accessible bathroom
- Ground floor study/office capable of conversion to bedroom with minimum cost e.g. incorporates a door opening between bathroom and new bedroom
- Small internal spans allow for ease of redesign and lower costs – standard materials - no RSJs required
- Largely open plan living, kitchen and dining areas to facilitate ease of movement for persons of all ages and degrees of mobility - temporary or permanent.
- Doors wide enough to facilitate passage of wheelchairs – 800 mm minimum width
- Entire ground floor at one level - no ground floor steps – allowing for ease of movement – more versatility with less obstacles.



Any other relevant points

Timber – Frame buildings

- Locally grown timber has less embodied energy costs and reduced transport costs
- Timber - carbon neutral
- Timber species that are sustainable and renewable i.e. capable of being harvested between 25 - 40 years i.e. from managed forests
- Some timbers are more naturally durable i.e. European Larch, Douglas Fir, Cedar and do not require treatment with chemical preservatives
- Use of sustainable, renewable, and durable timbers reduces the volume of concrete required which has a high embodied energy - less damage to the environment e.g. mining

- Timber frame buildings reduce the volume of concrete significantly
- Concrete made from Portland cement has high embodied energy
- Portland cement produces 900 Kg of CO_2 emissions for 1000 Kg of cement
- Ground Granulated Blast Furnace Slag/Cement (GGBS) is manufactured from a waste product produced by the Steel industry
- Concrete made from GGBS cement has a low embodied energy
- Low Carbon Concrete uses 50% Normal Portland Cement and 50% GGBS cement which reduces the CO_2 emissions by about 50%
- While GGBS is imported into Ireland, the embodied energy value is still low compared to that required to extract raw material from the landscape and its subsequent manufacturing costs
- Concrete or concrete products should, ideally be manufactured using low carbon concrete
- No all round the house concrete footpaths, walls etc - concrete significantly reduced.

Any other relevant points.

Ceist 6 (b)

Modest in scale

- The footprint of the building is small. Minimal quantities of materials and reduced building costs – affordable for first time buyers
- The building is one room in depth allowing for maximum solar gain and reduced running costs for first-time buyers

  The living area consists of only two spaces

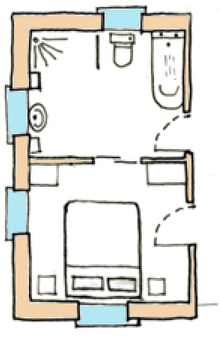
  (i) Kitchen and dining room combined - a multifunctional space

  (ii) Modest floor area to living room
- Absence of corridor space in living area – economical use of space
- Prevents heating of large corridor area – reduced running costs for first time buyers
- Area of land (site) kept to a minimum - reducing purchase cost and mortgage – suitable for first time buyers
- The attic area incorporates three bedrooms and a bathroom - minimising the building's footprint
- Small scale building reduces the heating requirements and therefore running costs to a minimum – more sustainable and suitable for first-time buyers
- The two levels enable heating to be zoned – controlling and minimising heating requirements – reduced running costs for first time buyers.

Any other relevant points

Easy to modify

- The downstairs room / study / play / storage room / bedroom is suitable for alternate use as shown in the drawing at no additional cost to the first time buyer
- A door opening may be created in the dividing wall between the downstairs room and the bathroom – ease of entry to bathroom
- Modifications to upstairs bedrooms may be carried out with minimum disruption as the ground floor space can be used as a bedroom while the work is in progress
- Should an occupant be incapacitated, the ground floor room adjoining the bathroom may be modified with minimal disruption and cost.



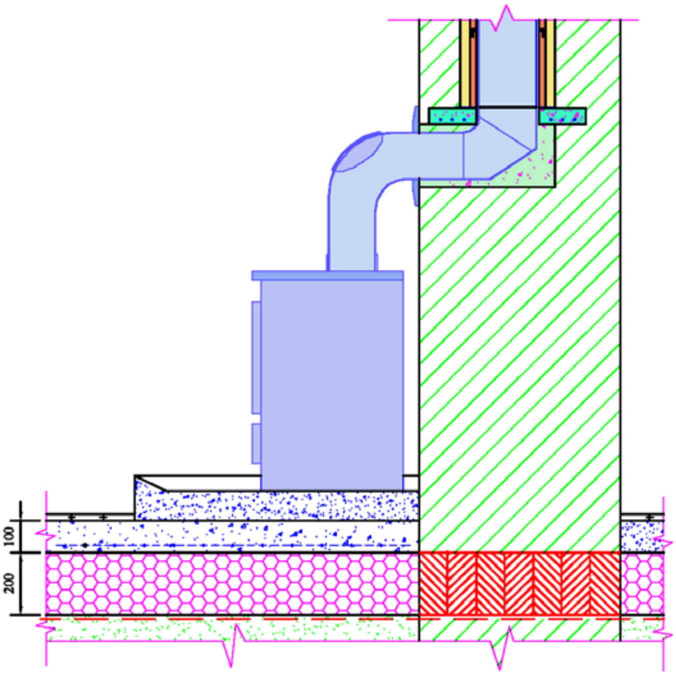
Any other relevant points

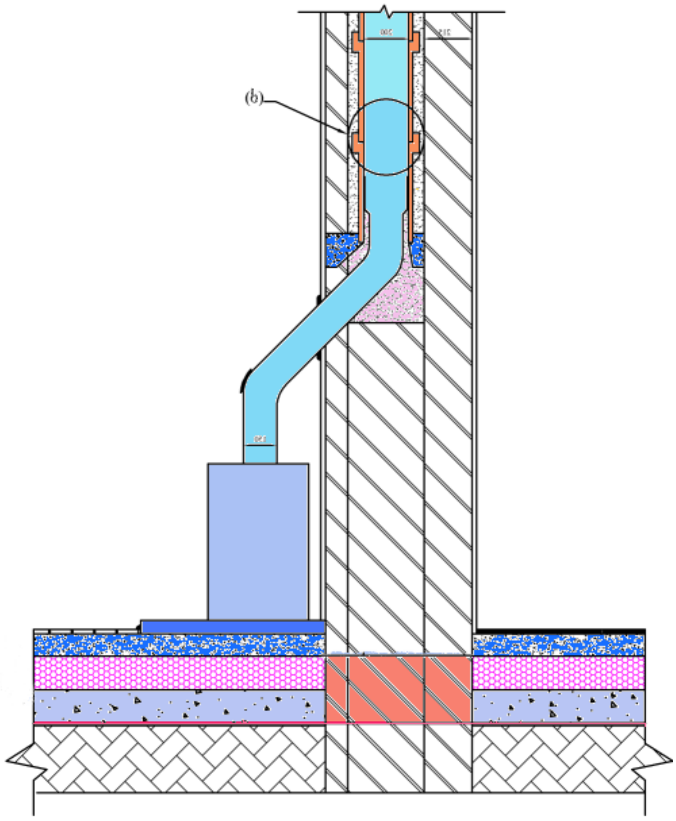
Proximity to services

- Facilities e.g. schools within short commuting distances are ideal for first time buyers
- Eliminates the need for a second car - reducing transport costs, CO_2 emissions and long periods of time spent in traffic
- Public transport enables first-time buyers to commute to work without a need for a car - reducing living costs and increasing disposable income
- Local shops, doctor's surgery, post office and facilities all preferably within walking or cycling distance
- Walking and cycling have personal health benefits
- Walking or cycling allows for developing a greater sense of community than does commuting in a motor vehicle
- Water, electricity supply and waste water treatment facilities in close proximity are more environmentally sustainable.

  Any other relevant points

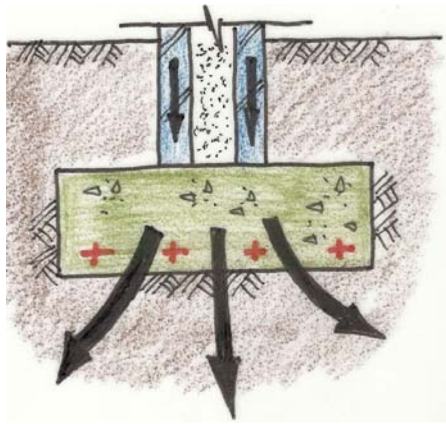
Ceist 7



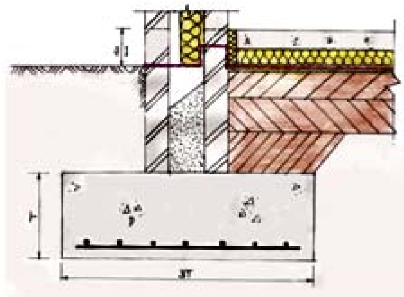


- Safety paramount to prevent carbon monoxide poisoning
- Room with appliance and bedrooms must have carbon monoxide detector
- Specialised flue adaptor to connect to clay main flue
- Continuous stainless steel flue inside in clay flue
- Vermiculite filling.

Ceist 8(a) - Two functional requirements of a foundation



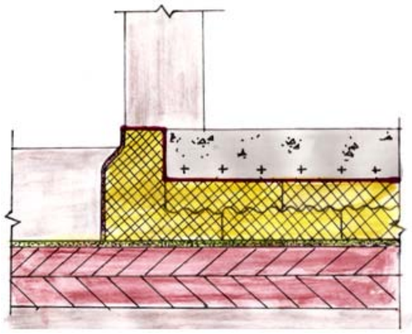
- Provide a level surface for building
- To transmit to the ground dead and live loads. Dead load - weight of the building. Live loads - weight of people, wind, snow load etc. When designing foundations a factor of safety must be taken into account
- To anchor the structure
- To prevent differential settlement
- To resist movements in the soil due to seasonal variation – swelling of the ground in winter due to freezing, contraction of the ground in summer due to the drying out of the ground – depth below frost line -
- To resist corrosive elements in the soil – sulphates.

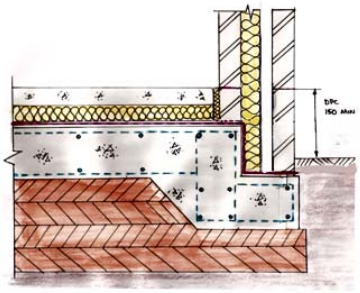


8 (b) Traditional strip foundation

- Strip foundation
- Reinforcement
- Hardcore
- Cavity fill
- Sand blinding
- Radon barrier
- 600 mm min. to the bottom of the foundation to avoid frost heave
- Insulation.

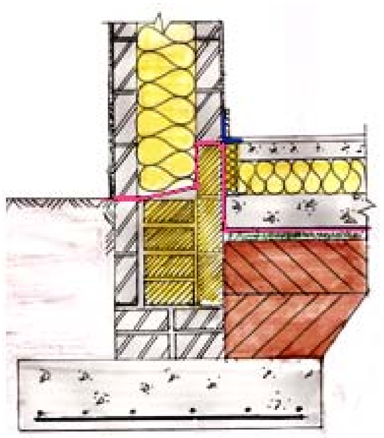
Raft foundation





- Hardcore
- Concrete raft
- Steel mesh reinforcement
- Radon barrier
- Insulation
- DPC 150mm min. aboveGL.

Traditional strip foundation - reasons



- Suitable for moderately firm clay sub soil
- Easily constructed, easily filled and levelled
- Economical in terms of materials, especially aggregate, cement and mild steel
- Economical in terms of labour.

Raft foundations - reasons

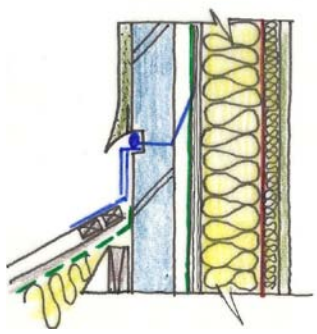
- Suitable for soils of poor load-bearing capacity
- Faster to set out and remove – saves on labour costs
- Reduction in settlement as the loads are spread evenly over the entire area of the house
- Mesh reinforcement reduces the risk of differential settlement
- Allows for a change of internal layout as load-bearing walls may be positioned anywhere on the raft.

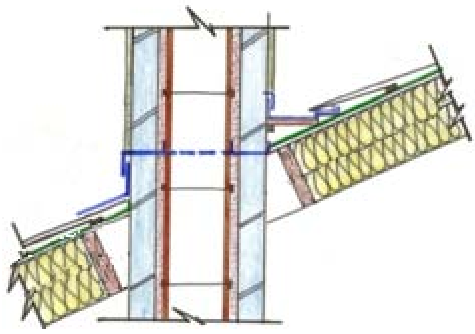
Any other relevant points

8(c) To ensure the maximum strength of concrete in a foundation

- Correct site preparation. The bottom of the trench should be level and free of loose soil particles
- Use of good quality materials – clean aggregates correctly sized
- Correct batching of fine and coarse aggregates, batching by weight is the most accurate, correct water /cement ratio
- Correct placement of reinforcement - should be designed by structural engineer Reinforcement – minimum cover of 75 mm to prevent corrosion
- Concrete should be allowed cure before any blockwork is placed on the foundation (28 days recommended)
- Concrete should be protected from extreme heat or cold during the curing process
- Too high a water / cement ratio (ideal 0.6) - mix too wet - greatly weakens the concrete
- Use sulphate resisting cement where necessary
- Correct vibration/compaction of the concrete to ensure that there are no air voids in the foundation
- Avoid excessive vibration as this may lead to a segregation of the aggregates
- Placement of concrete – should not be dropped from a height.

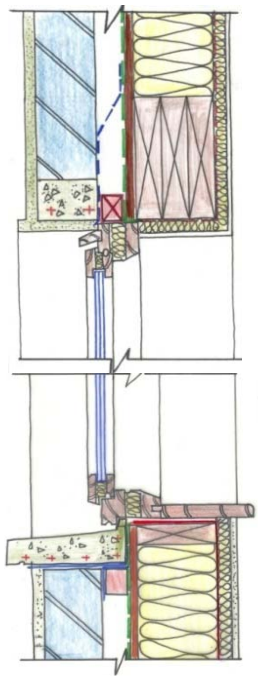
Ceist 9 (a)





Location 1

- Lead back gutter welted under slate
- Roofing membrane carried under battens and taped to chimney with proprietry tape
- Cover flashing at back of chimney to overhang lead gutter.



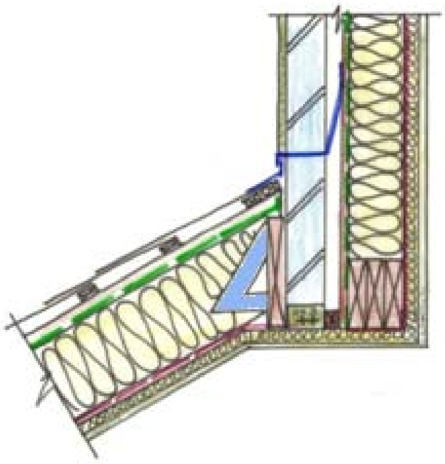
Location 2

- Stepped DPC ensures moisture does not penetrate to inside leaf
- Anti capilliary groove at sash opening
- Weather strip at top of window to ensure rain does not penetrate
- Mastic sealant around window to prevent driven rain from reaching inside leaf.

Location 3

- Cill wrapped in DPC
- Second layer of DPC around cavity barrier
- Anti capillary groove incorporated into cill design
- Mastic sealant around window opening
- Airtight tape between frame cill and internal wall.

Location 4

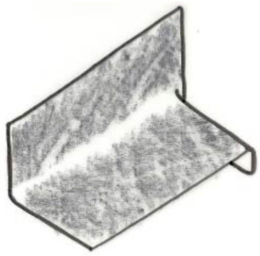


- Stepped DPC to prevent moisture penetration to inside leaf
- Cover flashing used at junction with roof and wall
- Roof membrane carried onto wall and taped to masonry using proprietary tape.

(b) Suitable materials

Lead

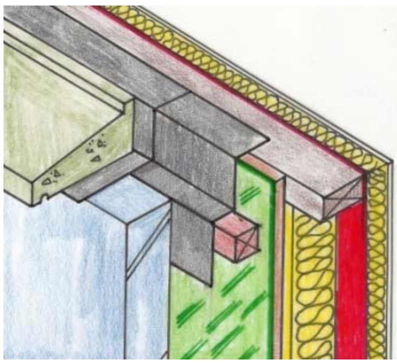
- Widely used around chimneys
- Flexible and resistant to corrosion
- Can accommodate moderate movement without compromising its effectiveness
- Readily available and easily worked
- Can be shaped quite easily.



Flexible plastic DPC

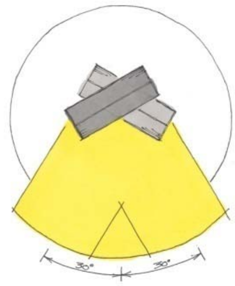
- Readily available and inexpensive
- Highly resistant to corrosive materials in mortar.

(c) Preventing moisture penetration



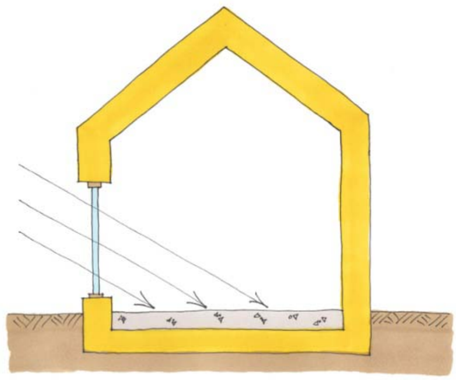
- Ensures prolonged life and avoids degradation of timber frame
- If thermal insulation becomes damp its effectiveness is reduced
- Avoids mould growth on internal walls
- Ensure all openings are correctly detailed and sealed to prevent ingress of moisture
- All brickwork to be correctly pointed
- Breather membrane to be correctly fixed ensuring moisture cannot penetrate while at the same time allowing vapour within the structure to exit through diffuse porous membrane
- Keep timber away from moisture-bearing material such as masonry
- Fungal decay will occur when timber is in prolonged contact with damp masonry
- Ensure all openings are detailed correctly and sealed
- All brickwork to be correctly pointed.

Q 10 (a) Building orientation:
In general, a Passive House should be oriented so that the glazed façade is due South or within 30° of South. This orientation will maximise solar gain as the sun tracks across the sky. This is especially important during the cold winter months when the sun angle is low and daylight hours are reduced.



It is possible to build to the Passive House standard on a site where the ideal orientation is not possible but it usually requires higher levels of insulation and very careful design of the fenestration to ensure maximum solar gain and minimum heat loss through the building fabric.

Thermal mass:
Thermal mass describes the ability of a material to absorb and store heat. A concrete floor is the most common form of thermal mass in a typical Passive House.

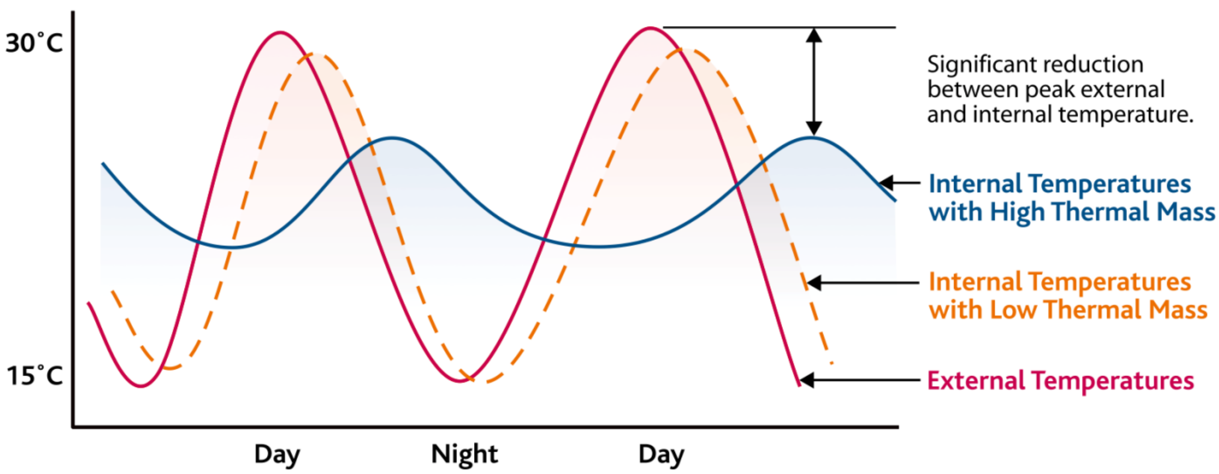


Thermal mass is a useful way of regulating indoor temperature. Solar gain through the windows is absorbed by the concrete floor. During the summer, this helps to stabilise the internal temperature and prevent overheating. During the winter, solar energy absorbed by the floor helps to heat the home and reduce energy consumption.

Supplementary information on Thermal Mass:
A combination of three properties is required for a material to provide a useful level of thermal mass:

- high specific heat capacity – to maximise the heat that can be stored per kg of material, high density – to maximise the overall weight of the material used
- moderate thermal conductivity – so that heat conduction is in sync with the heat flow in and out of the building.

Heavyweight construction materials such as brick, stone and concrete have these properties. They combine a high storage capacity with moderate thermal conductivity. This means that heat transfers between the material's surface and the interior at a rate that matches the daily heating and cooling cycle of buildings.

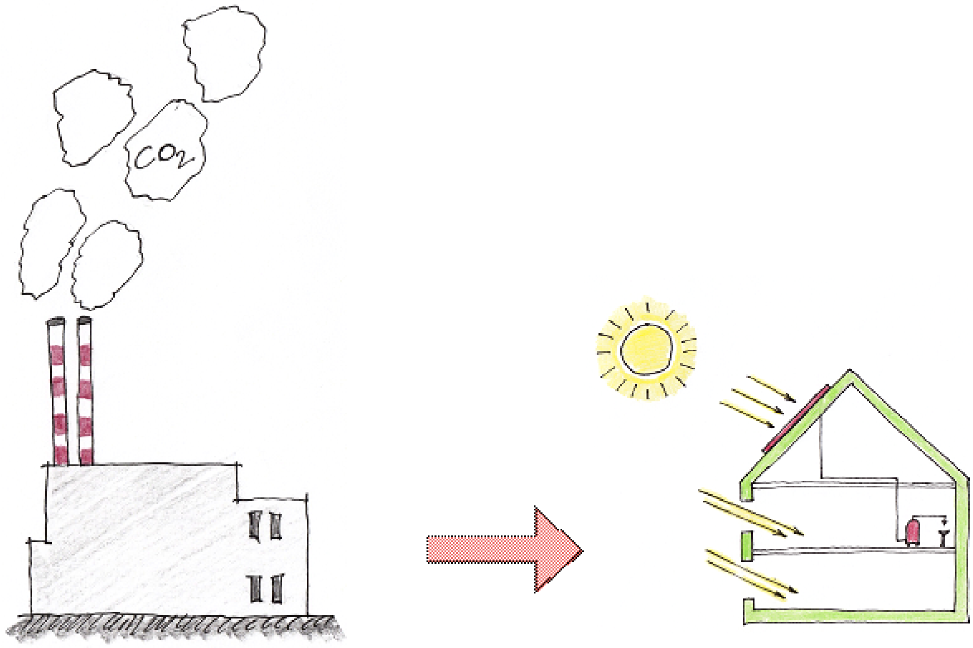


Some materials, like wood, have a high heat capacity, meaning that their thermal conductivity is low, which limits the rate at which heat is absorbed. Steel can also store a lot of heat, but in contrast to wood, steel possesses a very high rate of thermal conductivity, which means heat is absorbed and released too quickly to create the lag effect required to match the daily heating and cooling cycle of buildings.

Primary energy demand:

Primary energy demand is one of the key energy performance evaluation criteria that a Passive House must meet for certification. Total primary energy demand must not exceed 120kWh/m^{2}a. A typical passive house, built recently, would have a primary energy demand of between 60 and 70kWh/m^{2}a.

The primary energy demand is the total energy consumed for all requirements (i.e. space heating, water heating, ventilation and all electricity use).



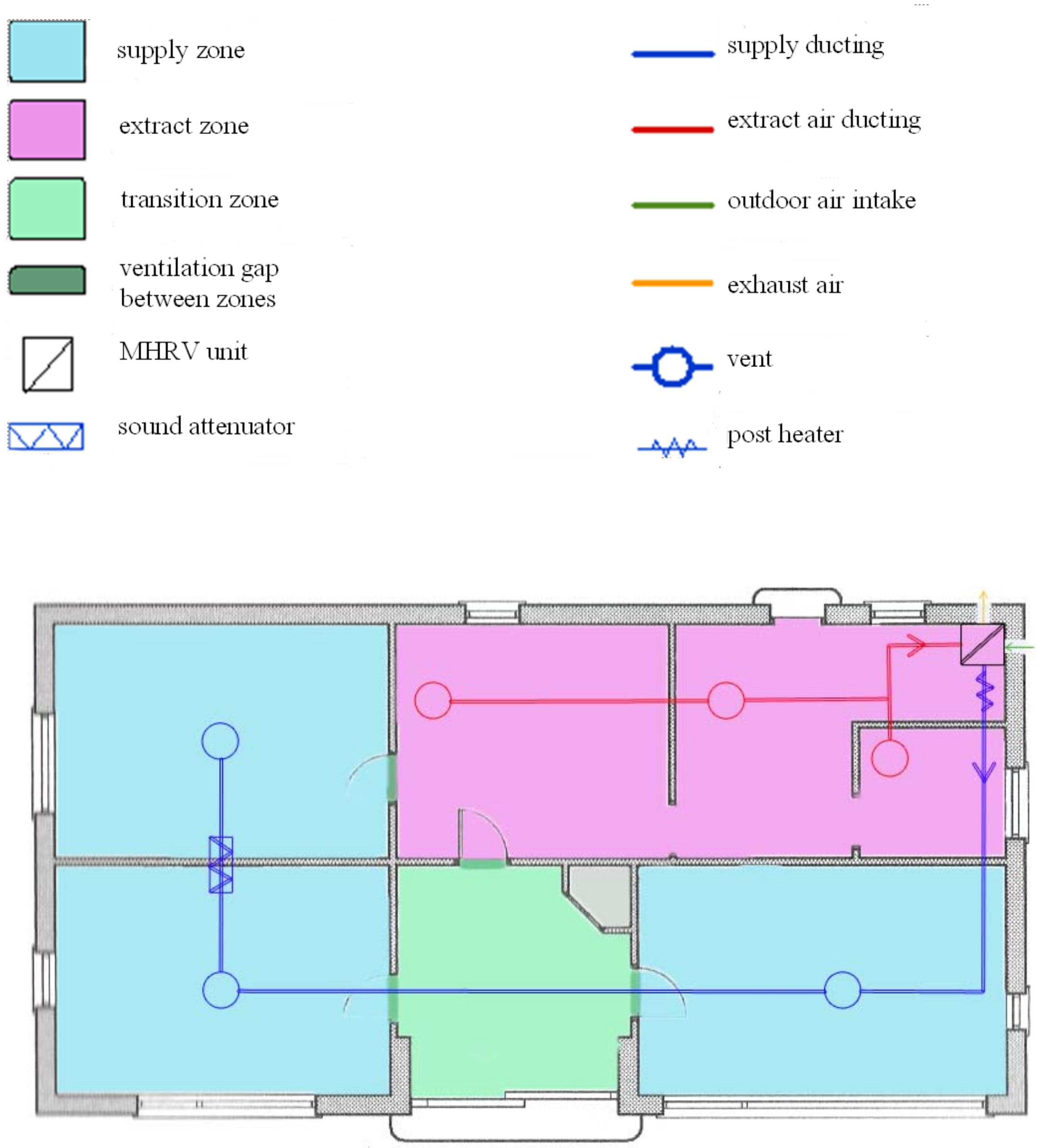
Supplementary information on Primary Energy Demand:

Primary energy is energy in its natural form. Examples of primary energy sources include non-renewable energy sources like oil, coal, natural gas and uranium or renewable sources like solar, wind or wave energy. These raw fuels and other forms of energy can be converted into usable forms of energy called secondary energy. Examples of secondary energy include fuel oil (e.g. kerosene, diesel) and electricity. The conversion of primary energy sources into secondary energy consumes energy as the raw fuel has to be extracted, refined and transported from where it is produced to where it is consumed.

Each form of energy has an energy conversion factor that tells us how much primary energy is required to provide a single unit of secondary energy. For most forms of energy this factor is low. For example, natural gas has a low conversion factor because it is used in the home in raw form. However, electricity that is produced in a coal burning power station has a high conversion factor because of the high level of energy consumed to mine the coal, transport it (e.g. from Poland) and convert the energy in the coal into electricity. Energy is used at every step of this process.

For most forms of energy used in the home, this means that for every unit of secondary energy consumed 1.1 units of primary energy are required. However, for electricity this value, called the conversion factor, is 2.4 (i.e. for every unit of electricity consumed approximately 2.4 units of primary energy are required). This is because of the high amount of energy 'lost' when carbon based fuels are burned to generate electricity. The conversion factor fluctuates depending on the fuel sources used and the amount of electricity generated at different power stations. The Sustainable Energy Authority of Ireland provides an up-to-date conversion factor for use in calculations.

(b)



How a mechanical heat recovery ventilation system works:

Mechanical ventilation heat recovery is used in passive houses to provide a continuous controlled supply of fresh, clean air. This ensures that the internal temperature of the home is maintained at 20°C all year round.

Moist, warm air (‘extract air’) is extracted from the kitchen, bathroom and utility room and drawn through a filter into the MHRV unit. At the same time, ‘outdoor air’ is drawn through a separate filter into the MHRV unit. The outdoor air passes through a fine filter to ensure dust, pollen and other contaminants are removed - this provides better air quality than simply opening a window.

In the MHRV unit, the ‘extract air’ and the ‘outdoor air’ do not mix - instead, they pass through a heat exchange unit. This unit is made up of a number of very thin metal or plastic plates. The heat in the extract air heats one side of each plate. The outdoor air passes on the other side of the plate and absorbs this heat energy. The outdoor air is now warm and filtered and is now called ‘supply air’. The ‘supply air’ is pumped to the living spaces (‘supply zones’).

During cold weather a post heater is used to raise the temperature of the incoming air to ensure a constant comfortable temperature of 20°C is maintained in the home at all times. During warm weather a ‘summer bypass’ is used to bypass the heat exchanger so the supply air does not cause overheating.

A sound attenuator is used to ensure that noise does not travel between the bedroom and the dining room.

(c) Two design considerations for location of the MHRV unit:

energy conservation:

- ideally the MHRV unit should be located within the thermal envelope of the dwelling - this reduces the likelihood of heat loss through the supply air ducting from the MHRV unit to the living spaces
- the unit should be located so as to minimise the length of ducts - supply and extract rooms should be grouped - for example, in the house shown in part (b) the extract rooms are grouped.

maintenance:

- the unit should be located in an accessible area to facilitate routine maintenance - for example, the exhaust air filter and the outdoor air filter would typically need to be replaced annually. In cities where air quality is poorer the filters may need to be replaced every few months.

noise:

- the MHRV unit should be located where the noise generated by the fans will not cause a disturbance - the Passive House standard requires that the sound produced by the MHRV unit does not exceed 25 decibels

aesthetics:

- the MHRV unit is an appliance - like a washing machine or tumble dryer - it may be preferable to locate it in a utility room or within a cabinet in the kitchen.

Question 10 – alternative

It is worth questioning whether a large house built to passive standards but remote from schools, shops or workplace, may in the long term be less sustainable than a modestly-sized home built within walking or cycling distance from daily destinations

- Putting sustainability and environmental considerations at the heart of every design decision
- Energy audit for lifetime use shows that it is not just the primary energy needs of the house itself should be considered
- Large amounts of energy and materials are required to service a remotely located house – requiring electricity, telephone, broadband, water services, sewage, roadways etc.
- The further away from distribution hub, the higher the material and labour costs to provide essential services required for modern living
- A modestly-sized home built within walking or cycling distance from daily destinations is more sustainable, as proximity to services – schools, shops, libraries, playing pitches social / leisure amenities etc - will not require huge expenditure of energy – people can access these services by cycling, walking, bus or rail - which is more sustainable than the continual use of the private car to meet all such needs.

The cost of energy required to power but also to transport goods and people from place to place will increasingly form part of the debate on sustainability.

- Oil and gas are non-renewable and their stocks are rapidly depleting
- Over one third of all energy is used to transport goods and people
- The further away from services a house is located, the higher the transport costs required to access these services, e.g. school for young people, place of work for parents etc.

Passive living is not just a factor of the energy rating of the fabric of the house, but of an holistic approach to how we as a society think about dwelling

- The sustainability debate has to be broadened to include a wider consideration than the Building Energy Rating (BER) of the house itself
- A holistic approach to living looks at all factors relating to energy use, not just confined to the performance of the building fabric
- Living in urban areas and in eco communities needs to be promoted
- A paradigm shift is needed to accept urban / community living as a desirable option – proximity to schools, work and leisure facilities
- Doing more with less for longer has to be promoted as a sustainable ideal
- 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
- Thinking globally and acting locally
- Some people need to live in the countryside – farmers, gardeners etc – a balance between needs of people and sustainable living criteria.

How we think about the reuse of existing space in the first instance and about the appropriateness of scale.

- We in Ireland build the largest houses in the EU, highest floor area per person in EU
- Large is greedy of the earth's resources
- Many existing urban centres in decay while we develop suburban estates and locate shopping centres on the periphery of towns – needing a car to access these facilities
- Houses and shops falling into decay in town centres, making town centres dilapidated and unattractive
- The construction process to be informed by a sustainable ethos – considering the embodied energy of materials and specifying renewable materials of low embodied energy where possible

- A need to rethink how we use existing space – evaluate whether it is better to redevelop existing buildings or build new – better to reuse existing buildings
- An ethically informed decision as to how we use space – develop agile, flexible, compact, multi-functional spaces which can be easily modified / heated for lifetime use
- The design team to take a holistic approach – to consider buildings in their social setting - the interconnections between building form, building components, building envelope, building systems and services, transportation costs, lifetime use to reduce energy use
- At the design stage, environmental considerations to be at the centre of the decision-making process – use existing buildings where possible
- An ethical responsibility on the design team to design and build sustainable and deep green
- Ethically responsible design implies the integration of passive strategies and innovative technologies to maximise the building performance
- The individual building needs to be considered as part of the greater whole – how it sits in the neighbourhood - the impact of location affects the independence, mobility, health, longevity and quality of life of occupants. Well designed and well connected neighbourhoods that are walkable are attractive neighbourhoods in which to live
- Well designed, constructed and compact buildings last for centuries, people become familiar with them and value and care them
- Build deep green dwellings of durable construction which will last for centuries and will not need to be upgraded
- Low initial build costs means higher costs over lifetime use – compact, flexible and deep green buildings are a must for this century of increasingly scarce resources.

Three guidelines that would promote the development of environmentally sustainable housing in Ireland. **…such as**

- Make universal design principles the norm - build robust, agile, resilient and flexible housing suitable for lifetime use
- Upgrade building regulations to make sustainability a condition of planning
- Promote urban renewal / regeneration on sustainable principles, grant aid people to refurbish decaying urban buildings
- Build only deep green buildings – energy calculated over lifetime use
- Adopt purposeful design strategies for neighbourhoods - to include cycle and walking paths, interconnected green car-free and safe walk/cycle routes
- Design for higher urban densities to reduce energy needs and to promote a sense of community and belonging
- Publish deep green planning guidelines to be implemented for all housing developments
- Promote urban living as an attractive option, to live in community and not in isolation
- Design flexible buildings to meet changing needs from birth to old age – lifetime use and universal design principles applied, plan for climate change
- Design modest scale of buildings, easy to heat, maintain, clean
- Design multi-use buildings – retail ground floor, residential over
- Promote a holistic approach to development – not once-off housing
- Promote housing clusters, eco -villages as exemplars of sustainable living
- Provide grants/incentives to encourage sustainable design, education to focus on sustainability and energy use - low embodied energy design
- Promote concept of a good neighbourhood – one where one can spend all one's life with neighbours and friends and feel supported in all life stages through a culture of mutual care
- Promote concept of urban / community living as desirable, purposeful, supportive and communal …..

Any other relevant, cogent, well argued points

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scrúdú Ardteistiméireachta 2013

Staidéar Foirgníochta
Teoiric – Ardleibhéal

Construction Studies

Theory – Higher Level
Marking Scheme

Ceist 1

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Any 10 points × 4 marks ***(Drawing 3, Annotation 1)***	
Closed String String capping Pitch line Riser / rise Tread / going Glue blocks / Wedges Newel post Jointing of string to newel post Jointing of handrail to newel post Balusters / Stairs & landing Landing – 500 mm Handrails Trimmer Landing joists / Hanger / notching Flooring Plasterboard ceiling	**4** **4** **4** **4** **4** **4** **4** **4** **4** **4**
Dimensions of 3 structural members ***(3 × 2 marks)***	**6**
Typical handrail heights (***2 × 2 marks)***	**4**
Scale and Drafting	**6**
(b) ***Marks for each of 2 design features (2 × 2 marks)***	
Design detail 1	**2**
Design detail 2	**2**
Total	**60**

Ceist 2

Performance Criteria		Maximum Mark
(a) Discussion ***(3 × 9 marks)***		
Training		**9**
Vigilance		**9**
Teamwork		**9**
(b) Possible risks to personal safety (4 × 3 marks) ***Safety procedures note and sketch (4 × 3 marks)***		
Using a ladder on site Risk 1 Risk 2 **Fitting a window** Risk 1 Risk 2		**3** **3** **3** **3**
Using a ladder Safety procedure 1 Safety procedure 2 **Fitting a window** Safety procedure 1 Safety procedure 2	 Note & sketch Note & sketch Note & sketch Note & sketch	**3** **3** **3** **3**
(c) Best practice guidelines when using electrical tools on site (3 × 3 marks)		
Guideline 1 Guideline 2 Guideline 3		**3** **3** **3**
Total		**60**

Ceist 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Discussion (4 × 10 marks)	
Proposed design for the extension	
Note	**10**
Sketch	**10**
Revised Layout	
Note	**10**
Sketch	**10**
(b) 4 Reasons × 5 marks each	
Increased sunlight into the interior of the house	
Reason 1	**5**
Reason 2	**5**
Improve the view to the rear garden	
Reason 1	**5**
Reason 2	**5**
Total	**60**

Ceist 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) 9 × 4 marks (Sketch 3 Annotation 1)	
Wood burning stove Radiators Zone control mechanism Zone thermostats Header / expansion tank/storage 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 Solar pump Cylinder (twin coil) Control panel Expansion vessel Thermal reducing vessel	**4** **4** **4** **4** **4** **4** **4** **4** **4**
Sizes of pipework (***any 2***) ***(2 × 2 marks)***	**4**
(b) Two design considerations (2 × 6 marks)	
Design consideration 1 *Note 3 marks & sketch 3 marks* Design consideration 2 *Note 3 marks & sketch 3 marks*	**6** **6**
(c) Discuss advantages and disadvantages of heating system (4 × 2 marks)	
Advantage 1 Advantage 2 Disadvantage 1 Disadvantage 2	**2** **2** **2** **2**
Total	**60**

Ceist 5

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Thermally broken wooden frame (15 marks)	
Correct tabulation	**2**
Wood	**3**
Insulation (Urethane)	**3**
External surface / Internal surface	**2**
Total resistance	**2**
U-Value *(1 mark for formula)*	**3**
(a) Triple glazed, low-e, soft coat unit (15 marks)	
Glass	**3**
Argon gas	**3**
External surface / Internal surface	**2**
Low-e glazing	**2**
Total resistance	**2**
U-value *(1 mark for formula)*	**3**
(b) (2 points × 7 marks)	
Thermal properties	**7**
Environmental considerations	**7**
(c) Window head detail	
Notes / Annotations	**8**
Sketch	**8**
Total	**60**

Ceist 6

PERFORMANCE CRITERIA	Maximum Mark
(a) Features of design - Suitable for first time buyers (6 × 5 marks)	
Feature 1	
Note	**5**
Sketch	**5**
Feature 2	
Note	**5**
Sketch	**5**
Feature 3	
Note	**5**
Sketch	**5**
(b) Discussion - Suitable for first time buyers (3 × 10 marks)	
Modest in scale (*4 for point, 6 for discussion*)	**10**
Easy to modify (*4 for point, 6 for discussion*)	**10**
Proximity to services (*4 for point, 6 for discussion*)	**10**
Total	**60**

Ceist 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) 9 points × 5 marks - (4 marks detail, 1 mark annotation)	
Hardcore Sand Blinding Radon Barrier Subfloor and screed ***or*** Floor slab Insulation Hearth 20mm floating hardwood floor Internal block wall Lintel / flue gatherer Plaster Flue liners Lime sand fill / vermiculite Cast iron flue from stove Airtight seal to wall Stove Independent air supply Cleaning access	**5** **5** **5** **5** **5** **5** **5** **5** **5**
3 typical dimensions ***(3 × 2 marks)***	**6**
Scale & Drafting	**6**
(b) Safe removal of smoke and flue gasses (1 × 3 marks)	
Design detail	**3**
Total	**60**

Ceist 8

Performance Criteria	Maximum Mark
(a) Two functional requiremnets of a foundation (4 × 5 marks)	
Functional requirement of foundation 1	
Note	**5**
Sketch	**5**
Functional requirement of foundation 2	
Note	**5**
Sketch	**5**
(b) Typical design detailing (4 × 5 marks)	
Traditional strip foundation	
Notes	**5**
Sketches	**5**
Raft foundation	
Notes	**5**
Sketches	**5**
Recommendation (3 marks) Reasons (2 × 4 marks)	
Recommendation for foundation	**3**
Reason 1	**4**
Reason 2	**4**
(c) 3 best practice guidelines (3 × 3 marks)	
Guideline 1	**3**
Guideline 2	**3**
Guideline 3	**3**
Total	**60**

Ceist 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three locations (6 × 6 marks)	
Location 1	
Note	**6**
Sketch	**6**
Location 2	
Note	**6**
Sketch	**6**
Location 3	
Note	**6**
Sketch	**6**
(b) Damp proof material (2 × 6 marks)	
Damp proof material 1 (specification 3 marks) (advantages 3 marks)	**6**
Damp proof material 2 (specification 3 marks) (advantages 3 marks)	**6**
(c) Discuss importance of avoiding moisture penetration (2 × 6 marks)	
Discussion 1	**6**
Discussion 2	**6**
Total	**60**

Ceist 10

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***Discussion of 2 design details (note 6 marks & sketch 6 marks)***	
Note 1	**6**
Sketch 1	**6**
Note 2	**6**
Sketch 2	**6**
(b) Mechanical heat recovery with ventilation system (4 × 6 marks)	
Room layout	**6**
MHRV location	**6**
Ducting layout including direction of airflow	**6**
Explanation of how the system works	**6**
(c) ***Design considerations in siting MHRV unit (2 × 6 marks)***	
Design consideration 1	**6**
Design consideration 2	**6**
Total	**60**

Ceist 10 **(Alternative)**

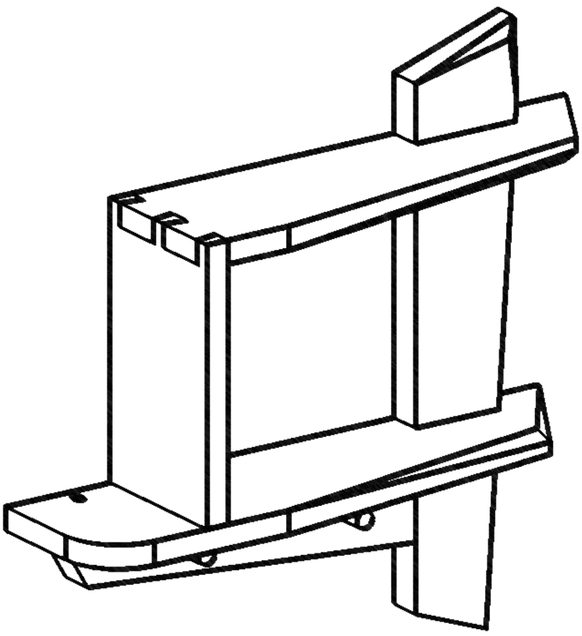
PERFORMANCE CRITERIA	MAXIMUM MARK
Discussion of Statement (3 × 10 marks)	
Discussion – point 1 (***4 for point, 6 for discussion***)	**10**
Discussion – point 2 (***4 for point, 6 for discussion***)	**10**
Discussion – point 3 (***4 for point, 6 for discussion***)	**10**
Three Guidelines (3 × 10 marks)	
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 2013
Leaving Certificate Examination 2013

Scéim Mharcála
Marking Scheme

(150 marc)

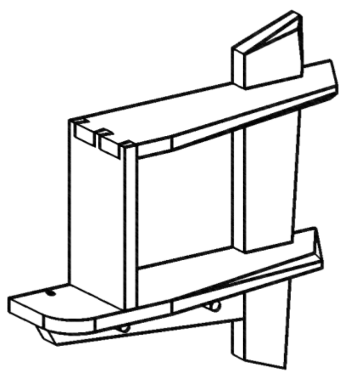


Staidéar Foirgníochta
Triail Phraticiúil

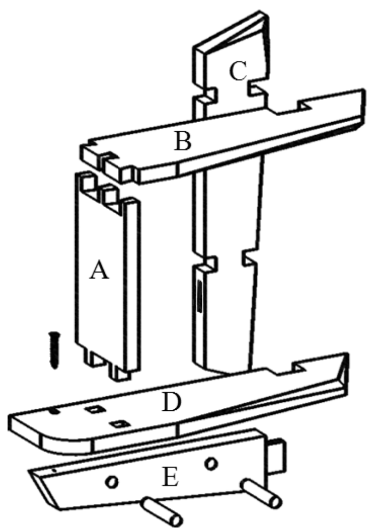
Construction Studies
Practical Test

Construction Studies 2013
Marking Scheme – Practical Test

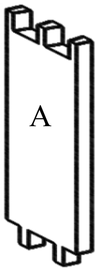
Note:
The artefact is to be hand produced by candidates without the assistance of machinery. However the use of a battery powered screwdriver is allowed.
Where there is evidence of the use of machinery for a particular procedure a penalty applies.
Component is marked out of 50% of the marks available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

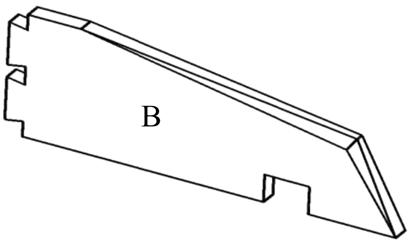


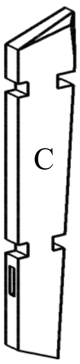
A	OVERALL ASSEMBLY	MARKS
1	Overall quality of assembled artefact	**8**
2	Dowel located and fitted correctly	**4**
3	Design and applied shaping to edges • design *(3 marks)* • shaping *(4 marks)*	**7**
	Total	**19**

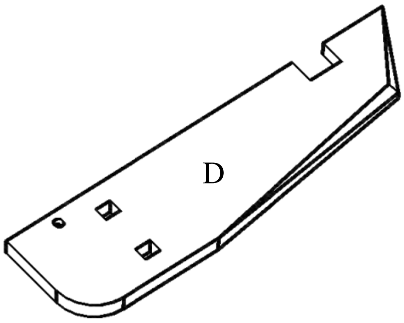


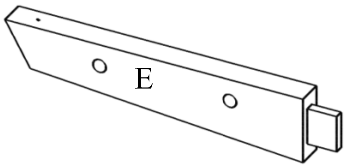
B	MARKING OUT	Marks
1	Piece **A** • dovetails *(2 × 3 marks)* • tenons *(2 × 2 marks)*	**10**
2	Piece **B** • joints - dovetails *(2 × 3 marks)* - trench *(2 marks)* • slopes and chamfers *(4 × 1 mark)*	**12**
3	Piece **C** • joints - trenches *(4 × 2 marks)* - mortice *(2 marks)* • slopes and chamfers *(5 × 1 mark)*	**15**
4	Piece **D** • joints - trench *(2 marks)* - mortices *(2 × 2 marks)* • slopes, chamfers & curve *(5 × 1 mark)*	**11**
5	Piece **E** • joint- tenon *(2 marks)* • slopes *(2 × 1 mark)*	**4**
	Total	**52**

PIECE A	C	PROCESSING	Marks
	1	Two tenons *(2 × 3 marks)*	**6**
	2	Dovetail pins • vertical sawing *(4 × 1 mark)* • cutting across grain *(2 × 3 marks)*	**10**
		Total	**16**

PIECE B	D	PROCESSING	Marks
	1	Two dovetails *(2 × 5 marks)*	**10**
	2	Trench *(3 marks)*	**3**
	3	Shaping • sloped edges *(2 × 1 mark)* • chamfers *(2 × 1 mark)*	**4**
		Total	**17**

PIECE C	E	PROCESSING	Marks
	1	Trenches • sawing across the grain *(8 × 1 mark)* • paring trench *(4 × 1 mark)*	**12**
	2	Mortice *(4 marks)*	**4**
	3	Shaping • sloped edges *(3 × 1 mark)* • chamfers *(2 × 1 mark)*	**5**
		Total	**21**

PIECE D	F	PROCESSING	Marks
	1	Two mortices *(2 × 3 marks)*	**6**
	2	Trench • sawing shoulders *(2 × 1 mark)* • paring trench *(1 mark)*	**3**
	3	Shaping • sloped edges *(2 × 1 mark)* • forming curve *(2 marks)* • chamfers *(2 × 1 mark)*	**6**
	4	Holes - screw • drilling and countersinking screw *(2 marks)*	**2**
		Total	**17**

PIECE - E	G	PROCESSING	Marks
	2	Tenon *(6 marks)*	**6**
	3	Shaping sloped edges *(2 × 1 mark)*	**2**
		Total	**8**

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