Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE 2011

MARKING SCHEME

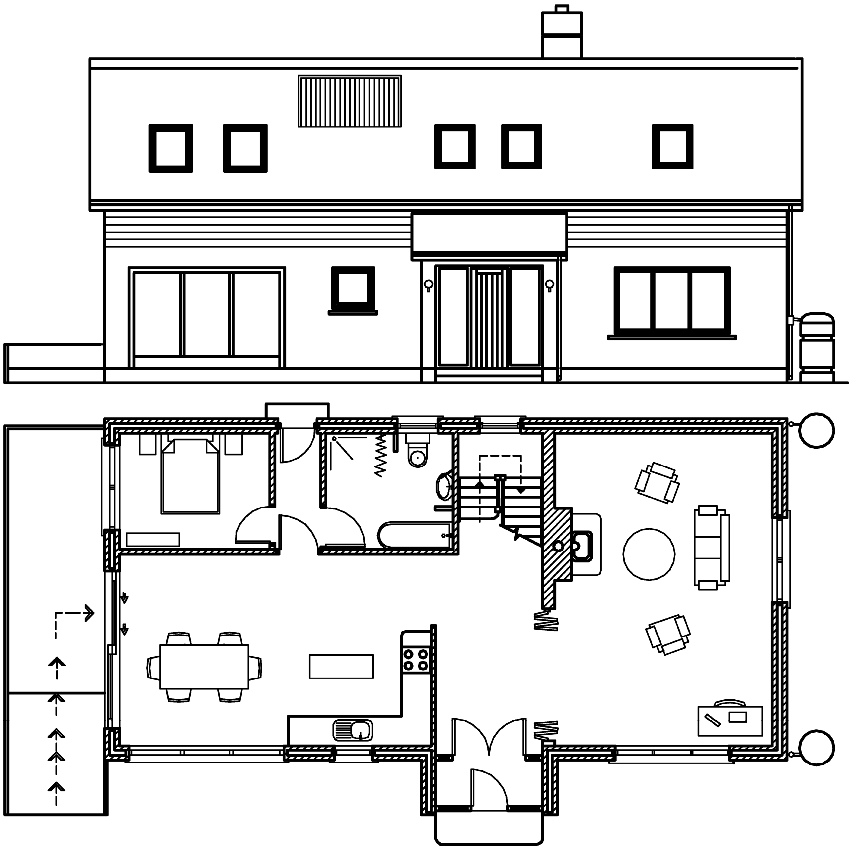
CONSTRUCTION STUDIES

HIGHER LEVEL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

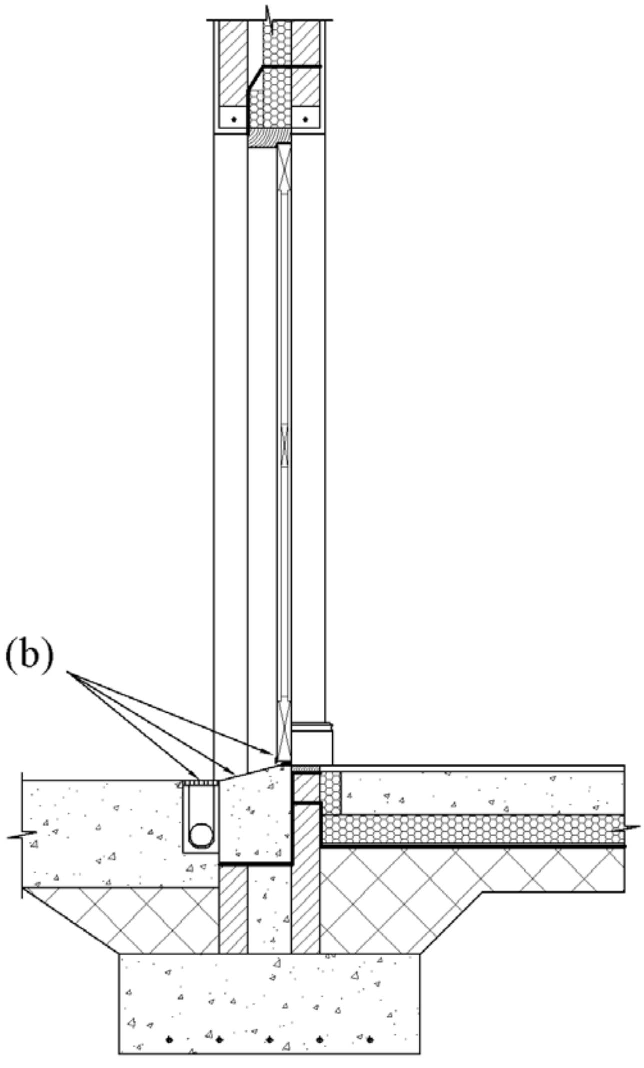
Scrúdú Ardteistiméireachta 2011

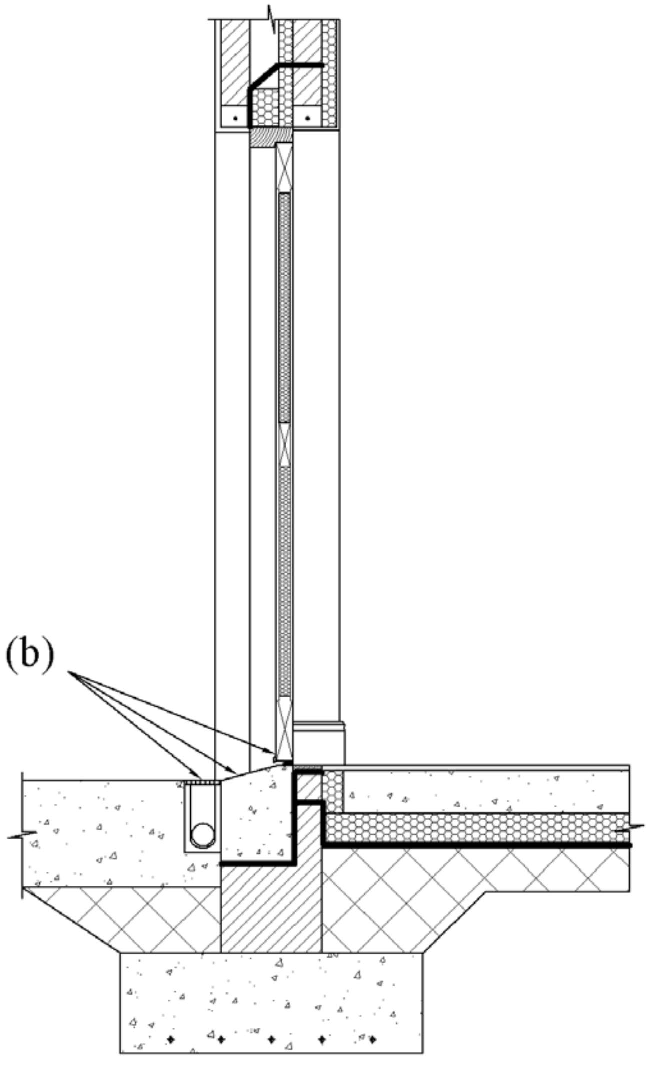
Staidéar Foirgníochta
Teoiric – Ardleibhéal



Construction Studies
Theory – Higher Level
SAMPLE SOLUTIONS

Ceist 1





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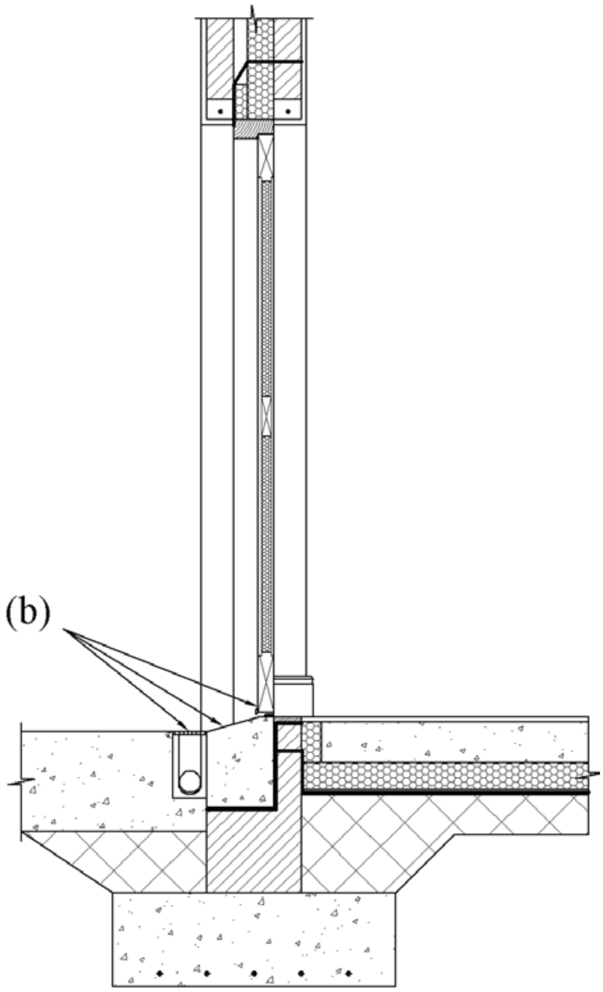
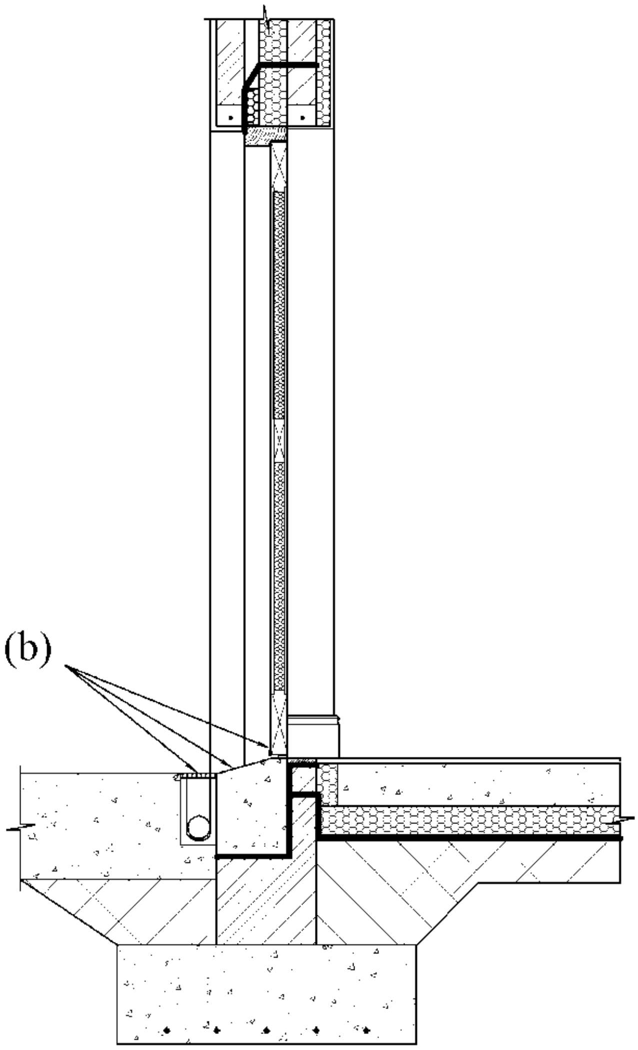
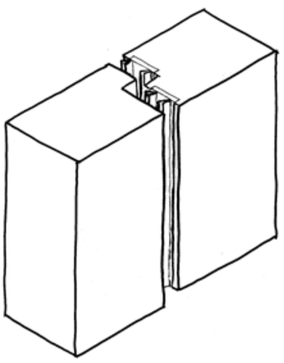






Any other relevant detail

Ceist 2 (a)

Functional requirements of a roof

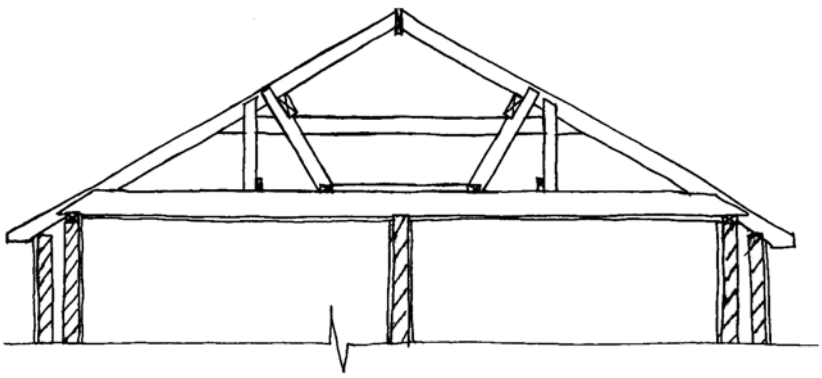
- Weather resistant: should be able to protect the building from the elements -rain snow, wind and sun)
- Structural stability:- must be capable of supporting all imposed loads - both dead and live loads and designed resist lateral movement
- Durability: - the structure should be long lasting and require little maintenance. Joists pressure treated with boron preservative to ensure longevity
- Thermal insulation :- should provide a level of thermal comfort for its occupants, keep heat in during the winter and resist excessive heat gain during the summer
- Ventilation :- the roof must be adequately ventilated in order to prevent condensation build up and possible fungal attack
- Fire resistant :- The roof should resist fire to allow time for occupants to escape
- Sound insulation :- the structure should resist the infiltration of noise from outside
- Accommodate services such as a water tank, attic storage etc

Any other relevant information

2(b)

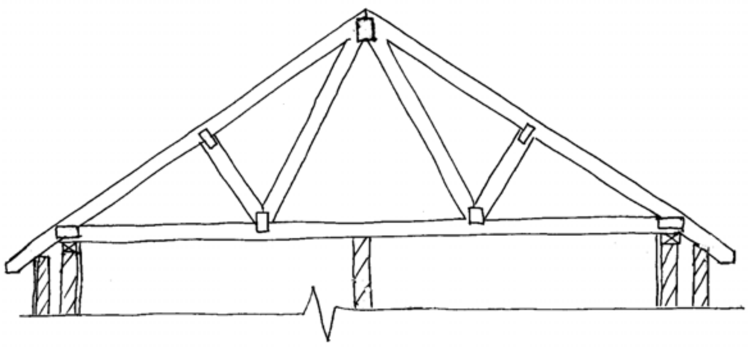
(1) Traditional cut / purlin roof

Typical sizes for domestic construction
Rafter 200 × 50 mm
Ceiling Joist 225 × 50 mm
Strut 125 × 50 mm
Runner 125 × 50 mm
Hanger 125 × 50 mm
Purlin 175 × 75 mm
Wallplate 100 × 75 mm

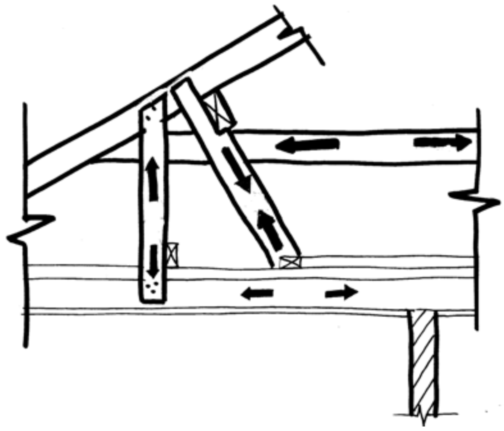


(2) Prefabricated Roof (W truss)

Typical sizes for domestic construction
Rafter 170 × 45 mm
Ceiling tie 220 × 45 mm
Compression webs 120 × 45mm
Tension webs 120 × 45mm
Bracing 100 × 25mm
Wallplate 100 × 75mm
Gang nail plate

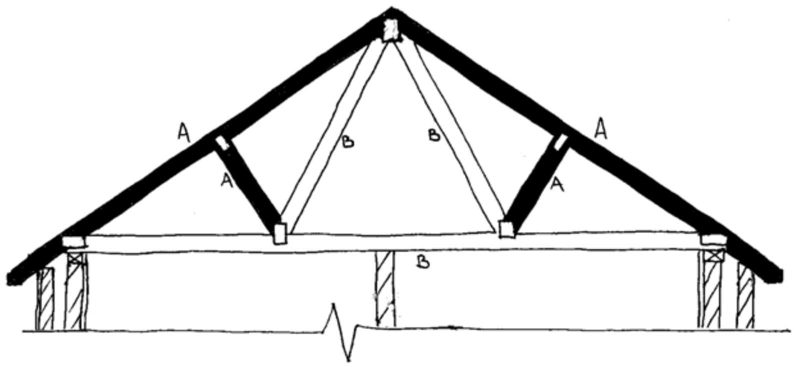


Purlin roof



- The purlin supports the rafter
- The strut supports the purlin
- The load-bearing wall supports the ceiling joist and strut

Prefabricated roof



- Principle of triangulation
- Webs under compression and tension ensure a rigid structure

  A: Compression
  B: Tension

2(c)

Purlin/cut roof:

- Can be designed for conversion of the attic space to living accommodation later
- Does not require the use of a mechanical assistance during construction
- Easy to convert the attic space for storage
- Local labour employed in cutting and erection
- Does not require specialist equipment/ mechanical presses to manufacture

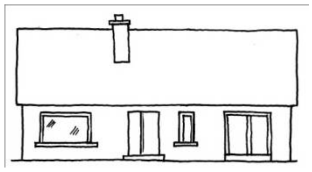
Pre-fabricated trussed roof:

- Fast and easy to erect
- Less time on site – almost independent of weather
- Economical use of material (section size is small) – environmentally sustainable
- Structural integrity guaranteed for span – forces calculated
- Stress graded, pre-seasoned wood used
- Accurate uniform factory made trusses
- No load bearing internal wall required

Any other relevant information

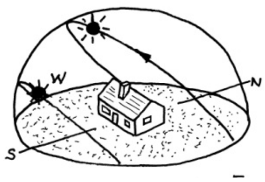
Ceist 3

(a) Redesign of external envelope of house

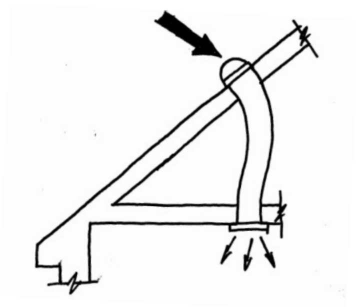


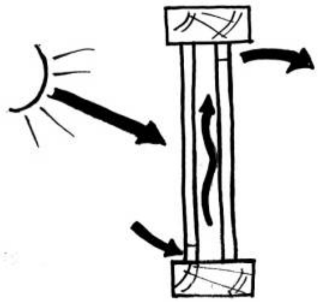
Proposed changes dependent on budget and subject to planning permission. A phased approach based on cost.

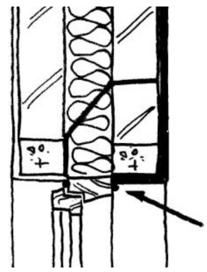
Windows and glazing



- Increase glazing on southern and western elevations of dwelling
- Install high performance windows - low-e double and triple glazing
- Install high performance window frames with thermal break
- Ensure junctions between windows and walls are airtight
- No cold bridging during retro fit
- Shutters/heavy curtains to retain heat at night
- Tinted glass to reduce glare
- Dwell vent windows may be installed for natural ventilation
- Incorporate sky tunnel into roof for natural light to north facing rooms

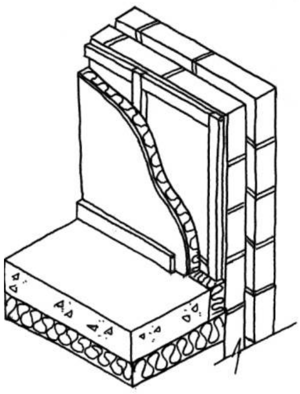


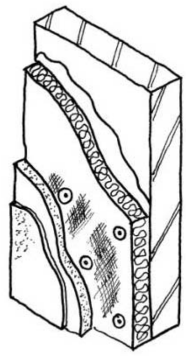


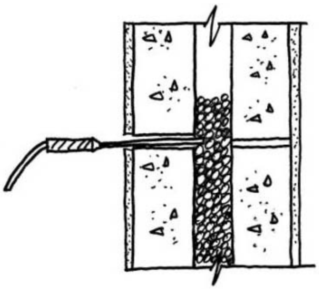


Walls

- Increase level of thermal insulation to minimum current building regulations of 0.21 W/m^2K
- External insulation/cavity fill insulation/internal dry lining







Internal Dry Lining

- Insulation materials – cork, wood fibre, sheep's wool, rigid phenolic foam, EPS insulation 80 mm min
- May be fixed with adhesive dabs, mechanical fixings or on battens
- Finishing plaster coat may be applied

External Insulation

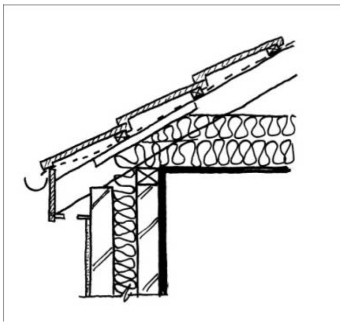
- Fixed with mechanical fixings
- Rigid insulation fixed with adhesive and anchor bolts
- Fibreglass mesh fixed over insulation
- Acrylic render applied 2coats approx. 3mm each coat
- 300 mm recommended but may be restricted by overhang at eaves and gables

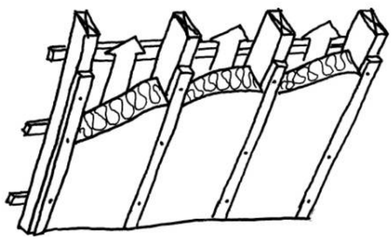
Cavity Fill Insulation

- Holes drilled in external walls
- 800mm horizontally, 1350mm vertically
- Insulation bead / cellulose with bonding agent pumped into cavity
- Holes are filled

Roof

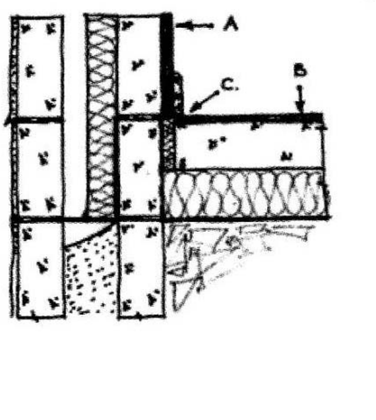
- Increase level of insulation in attic to conform to minimum current building regulations 0.16 W/m^2K with insulated ceiling or 0.20 W/m^2K
- May need to increase thickness of rafter with batten fixed to underside of rafter
- Place insulation between rafters (ensure vent space of 50 mm)
- Ensure 50 mm airspace between underside of felt and insulation
- Full fill insulation between rafters with membrane on warm side, breathable on outside, counter batten to create airspace





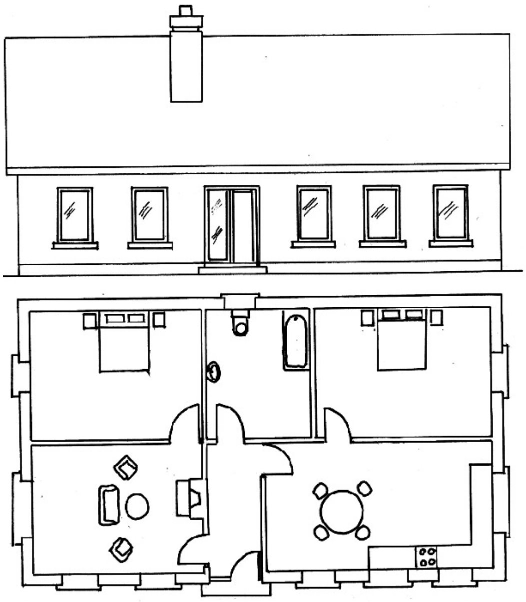
Floor

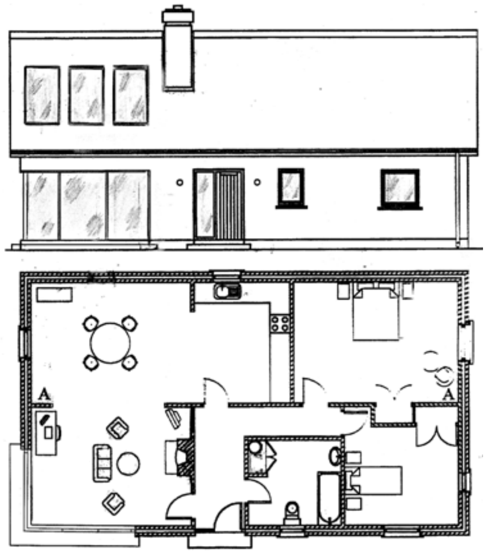
- Insulated floor slab to prevent heat loss to ground 100mm to 300 mm
- Extend insulation as far below floor as possible
- Insulation up-stand at wall and floor junction to prevent cold bridge
- Air continuity barrier at wall and floor sealed with flexible sealant or tape
- Floor finish to incorporate material with high thermal mass e.g. quarry tiles



Suggested Layout Modification

- Glazing increased at southern and western elevations, minimal on northern elevation
- Rooflights inserted into roof – sized proportionate to roof and placed aesthetically
- Open up interior space to benefit from increased glazing





More extensive –

- Infrequently used rooms positioned at the northern end of the dwelling
- Bathroom moved from front to north/rear of house
- Bedroom relocated to north
- Dining room moved to front /south of house to avail of morning and day long sunshine
- Open plan on southern elevation to allow free movement of heated air
- Load bearing wall A-A remains in place, spaces created by inserting lintels
- Non load bearing walls removed or relocated
- Tiled floor in kitchen area to increase thermal mass

(b) Discussion

Windows

- As front of house is south facing, increasing glazing to south and west will allow more sunlight and heat into house
- Tall windows allow deeper heat penetration into room
- Low-e soft coat glazing to retain heat gained during the day
- Use super insulated spacers min gap 12 – 16 mm between panes.
- Use high performance thermally broken frames for windows and doors to reduce heat loss
- Argon or krypton filled double or triple glazed units
- Can use larch or treated softwood for joinery and are environmental sustainable
- Must provide airtightness and prevent air leakage

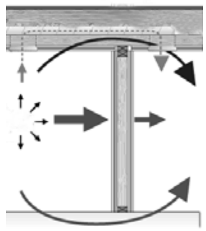
External Walls
- Thermal performance of walls needs to be up graded to meet current building regulations
- All air leakage routes need to be taped and sealed (outlet pipes etc, window and door openings)

Roof
- Rooflight windows inserted into roof
- Ceiling raised above rooflights to allow greater sunlight penetration
- Junction between ceiling and external wall taped and sealed for airtightness
- Air blower test to ensure all joints are sealed.

Any other relevant points

Ceist 4(a)

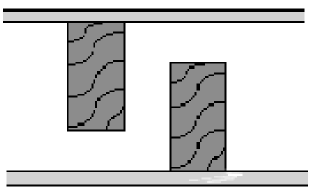
(i) Mass
- The Mass Law states that the sound insulation of a single leaf partition is proportional to its mass per unit area
- The mass of a structure has an effect on the way in which it restricts the transmittance of sound – see sketch for transmitted, absorbed, reflected sound
- As sound waves pass through dense materials, their amplitude decreases and thus the sound level drops – attenuated sound
- The greater the mass, the greater the reduction in sound transmittance
- According to the mass law, theoretically there is a 6dB increase in sound insulation for each doubling of mass. In practice the increase is found to be about 5dB
- Sound insulation depends on the frequency of the sound
- The sound insulation increases by about 5dB when the frequency of the sound is doubled
- Mass is used to increase sound insulation – e.g. in wooden floors when sand pugging is used between the joists
- The principle of mass is used in party walls to ensure good sound insulation between adjacent houses – party walls are solid and of high mass



(ii) Completeness
- The more complete the fabric, the less transmittance of sound - small gaps provide routes for the the transmission of sound
- It is essential that a structure is complete if it is to effectively prevent sound transmission
- It is essential that all gaps - such as those around pipes and between doorframes and walls be filled to reduce sound transmission
- Windows be carefully sealed at junctions
- Particular attention should be paid to gaps that might occur at joins between floors and walls or ceilings
- The completeness of a structure depends upon airtightness and uniformity
- Blockwork – joints to be filled and wall plastered to ensure completeness
- It is important that there is uniformity of sound insulation in a structure. An area of poor insulation such as an unsealed door will have an effect greater than its relative area

(iii) Isolation
- Discontinuous construction is effective in reducing sound transmission
- Each time sound encounters a different material, energy is lost and sound transference is dimisished – the sound level drops
- Advantage can be taken of isolation to improve sound insulation

- Flanking transmission of sound through rigid links in structures increases sound transmittance
- Ensuring that there is no continuity between adjacent parts of a structure will lead to a decrease in sound transfer - stepped studs as in sketch
- Double / triple glazing reduces sound transmittance
- Double windows with a space of at least 150 mm between are good sound insulators
- Unconnected - isolated - floating floors increase sound insulation



Any other relevant information

(b) Reasons why sound might be transmitted

- Poor workmanship allowing routes for transmittance of sound
- There may be gaps in the structure. The mortar joints may not be completely filled
- Inadequate mass of the party wall
- Junction of the party wall with side walls or with roof not sealed correctly

Design detailing to improve the sound insulation properties of the wall

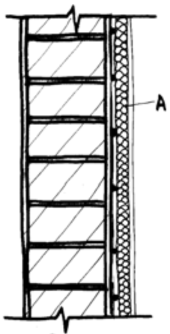


Fig 4.1

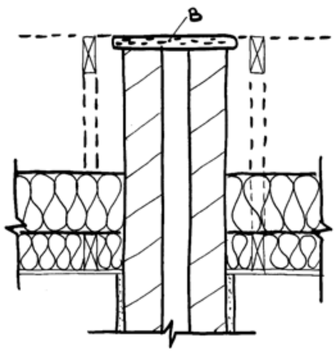


Fig 4.2

- The mass ot the wall could be increased by adding additional layers of plasterboard
- Fig 4.1 (A) shows a sound insulating panel fixed to the party wall. This will reduce the amount of airborne sound that can be transmitted
- Stagger joints in plasterboard using two layers to prevent sound pathways
- Fig 4.2 party walls should extend to the roof in the attic space and be sealed with an absorbent material such as mineral wool
- Air tightness - all gaps to be sealed with tape or a flexible sealant
- An isolated parallel partition could be constructed
- Joists should not bear on the party wall but run parallel to the party wall.

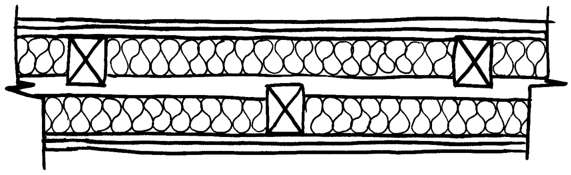
Any other relevant information

(c) Typical double stud partition construction

Layer	*Typical sizes*
Timber stud @ 400 mm centres	75mm × 50mm
Plasterboard	2 × 12.7mm
Mineral wool insulation	60 mm on each side
Sole/Head Plate	75mm × 50mm

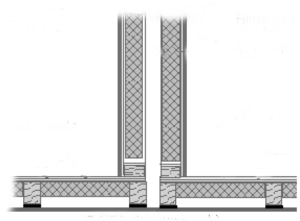
Mass

- Increased layers of plasterboard increases the mass of the partition
- This will reduce the amount of sound - particularly high frquency sound - that will pass through
- Party wall could be thickened by building another layer on one side



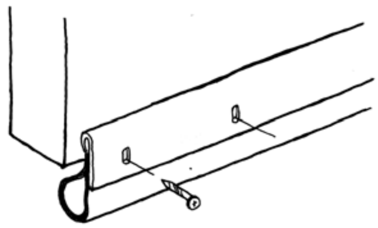
Isolation

- Double leaf isolated partition reduces the pathways through which sound can travel - *see sketch*
- Seperate sole plates and head plates for each side of the partition
- Fibrous material such as mineral wool to reduce sound transmittance

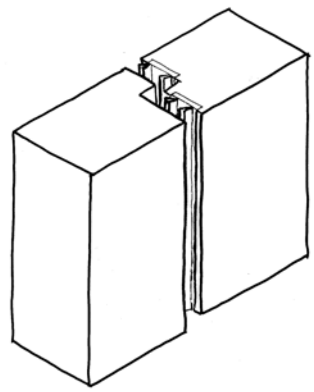


Completeness

- Any gaps in the structure will greatly reduce the sound insulating properties of the partition
- Airtightness, all gaps to be sealed with tape or a flexible sealant.
- Doors to be well fitted and sealed with an acoustic gasket
- Rubber seal at bottom of door



Any other relevant information



Ceist 5 (a)

Material Element	Conductivity k	Resistivity r	Thickness T(m)	Resistance R
Ext. Surface				0.048
Ext. Render		2.170	0.015	0.03255
Hollow Block			0.215	0.210
Air Space			0.010	0.170
Int. Plasterboard	0.160		0.012	0.075
Int. Surface				0.104
Total Resistance				0.63955

Formulae: R=T/k R=T x r U= 1/R^t

U Value: U = 1 /0.63955= 1.563599 **W/m^2** K

Q.5 (b) To find the thickness of expanded polystyrene insulation required

Determine the Resistance for a U-value of 0.27 W/m^2 K

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

R = 1/ U value R = 1/ 0.27 =3.703 **m^2** K / W

Resistance for required U-value of 0.27 = 3.703 **m^2** K / W

Resistance for existing U-value of 1.563599 =0.63955 **m^2** K / W

Difference in Resistance = 3.703 - 0.6395 = 3.06345 **m^2** K / W

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

3.089 = T/0.037

T = 3.06345 x 0.037 = 0.1133476 metres

Thickness of required Expanded Polystyrene insulation = 113 mm

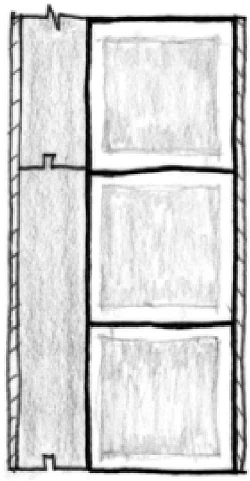
Q. 5 (c) Two disadvantages of hollow concrete block construction

- Thermal / cold bridges created with each hollow concrete block – heat loss
- Ribs in block cause cold bridges
- No insulation in the hollow concrete block itself – heat loss
- No insulation in the external wall – hence substantial heat loss
- No insulation between plasterboard and wall - heat loss
- Hollow concrete block impractical to fill retrospectively – to retrofit - with insulation
- Risk of dampness penetration through the hollow concrete block

Any other relevant information

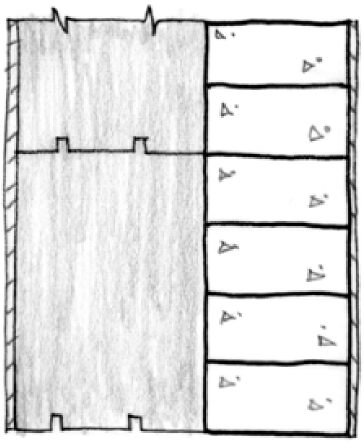
External Wall Type (a) 350mm block wall with cavity or timber frame - such as

- External. render - sand and cement.
- Outer leaf - concrete block
- Cavity 50mm
- Insulation rigid - 100mm polystyrene
- Wall ties
- Inner leaf concrete block
- Internal. render – sand/cement



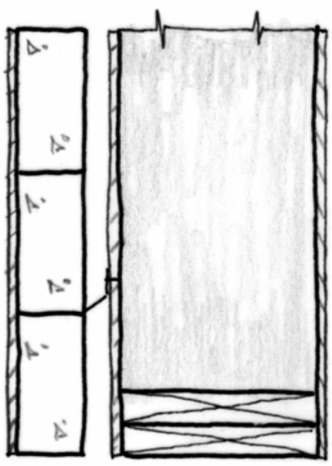
External Wall Type (b)

- Hollow concrete block filled with rigid insulation
- Insulation rigid – 300 mm fitted externally
- External acrylic renders – two coats each c. 3mm
- Internal render – sand and cement



External Wall Type (c)

- Concrete block on flat – 225 mm - with rigid insulation fitted externally
- Insulation rigid 300 mm
- External acrylic renders – two coats each c.3 mm
- Internal render – sand and cement



External Wall Type (d)

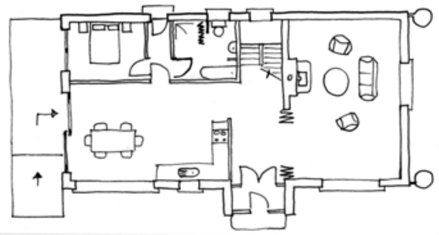
- Timber frame with external concrete block
- External render sand/cement
- External leaf concrete block
- Cavity 50 mm and wall ties
- Sheathing membrane
- Stud timber 100 – 300mm
- Insulation fitted full depth of stud
- Internal plasterboard

Any other suitable external wall type / details

Q. 6 (a)

Scale

- Sustainability at the core of this design – doing more with less for longer and leaving more for future generations
- Small footprint of house requires less materials and therefore less embodied energy to construct and maintain
- Reduced concrete requirements for foundations and floors
- External wall of mixed materials - wood and concrete block - reducing concrete demand and promoting use of renewable materials - wood



- Design for economy of materials, pitched roof and 1.5 storey design allows for extra bedrooms & bathroom in attic space which is economical in terms of space & materials required
- Modesty of scale, open plan floor area – reduced energy requirements to construct and maintain – lower embodied energy
- One room width, standard joist sections for span, no need for RSJs or oversized components
- Reduced costs and energy requirements at build stage and to maintain
- Open plan fosters living in community, not isolated
- Glazing for thermal comfort and for beauty - light and heat drenched by natural means from careful planning at design stage.

Any other relevant points

Rainwater Harvesting System

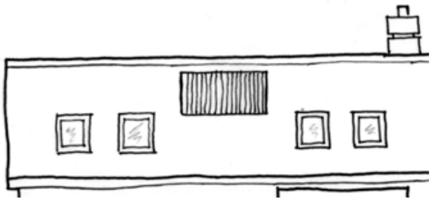
- Design collects rainwater from front & rear roof surfaces and stores this water in above-ground storage tanks
- Above-ground storage system relatively inexpensive to install – less embodied energy requirements
- Modular storage units allow for increased storage facility
- Use of rain water reduces quantity of expensive treated drinking quality water which alternatively enables economical use of expensive, scarce and limited natural resources.
- Rainwater may be used to water plants, gardens and lawns

- Rainwater may be used to flush toilets, provided a filter is used to exclude organisms that encourage fungal growths.

Any other relevant points

Solar Panels

- The design incorporates a solar collector that can provide between 40% - 60% of domestic hot water requirements depending on time of year
- This renewable energy source 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.

Any other relevant points

Roof lights

- Provide more daylight and thermal gain for longer period than vertical dormers
- Facing the brightest sky, three times more light than vertical glazing, no shading
- Less need for artificial light and burning of fossil fuels and associated CO_2 emissions
- Reduced demand for fossil fuels and reduced costs
- Other environmentally sustainable design features such as wood burning stove, wood pellet stove, draught lobby, zoned heating, etc

Any other relevant points

6 (b) Form of the House

Narrow Plan

- South facing facade, south facing living areas i.e. kitchen, dining and sitting rooms which are all one room wide gain maximum benefit from sun
- Reduced demand for heating using fossil fuels reduces costs and CO_2 emissions.

Any other relevant points

Economical Use of Space

- Kitchen & dining area combined is economical use of space
- Modest size ground floor bedroom
- Small rooms conserve heat & reduces fossil fuel / energy requirements
- Reduced burning of non-renewable energy i.e. fossil fuel
- Less CO_2 emissions

Any other relevant points

Pitched Roof

- Designed to maximise attic space as living area – economy of materials
- Enables maximum use of attic space - providing two extra bedrooms and bathroom
- Less materials – less embodied energy less CO_2
- Enables fitting of solar panels at optimum angle of 45° for maximum efficiency and solar gain

Any other relevant points

Q. 6 (b)
Materials and Labour
External Wooden Cladding

- Purposeful design to reduce embodied energy - timber - carbon neutral reduces need for concrete
- Locally grown timber has less embodied energy less transportation costs
- 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 and do not require treatment with chemical preservatives
- Use of sustainable, renewable, and durable timbers reduce the use of concrete which has a high embodied energy

Any other relevant points

Concrete

- Design shown excludes all round the house footpath
- Footpath and ramp provided on one narrow end of house - amount of concrete reduced by 66%
- Concrete made from Portland Cement has high embodied energy
- Portland cement produces 900Kg 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 – "Slag"
- Concrete made from GGBS cement has a much lower embodied energy
- Low Carbon Concrete uses 50% Normal Portland Cement and 50% GGBS cement which reduces the CO_2 emissions
- By using low carbon concrete in the footpath CO_2 emissions are further reduced
- While GGBS is imported into Ireland the embodied energy value is still considerably low compared to that required to extract raw material from the landscape and its subsequent manufacturing costs.
- Low Carbon Concrete has a significantly less damaging impact on the environment.

Any other relevant points

Local Materials

- The use of locally available materials reduces transport costs, reduces CO_2 emissions and demand for scarce & expensive fossil fuels
- Stone for hardcore best sourced locally
- Timbers for roof, partitions, floors to be sourced from a local supplier / sawmill

Any other relevant points

Labour

- The use of locally available labour reduces transport costs and CO_2 emissions
- Using local labour also encourages the development of skills – both traditional and modern
- Employing local labour maintains employment and creates sustainable communities
- Reduces need for imported goods and services, more energy efficient
- Simple form – the less is the more - can be built from local store of skills – no specialised processes

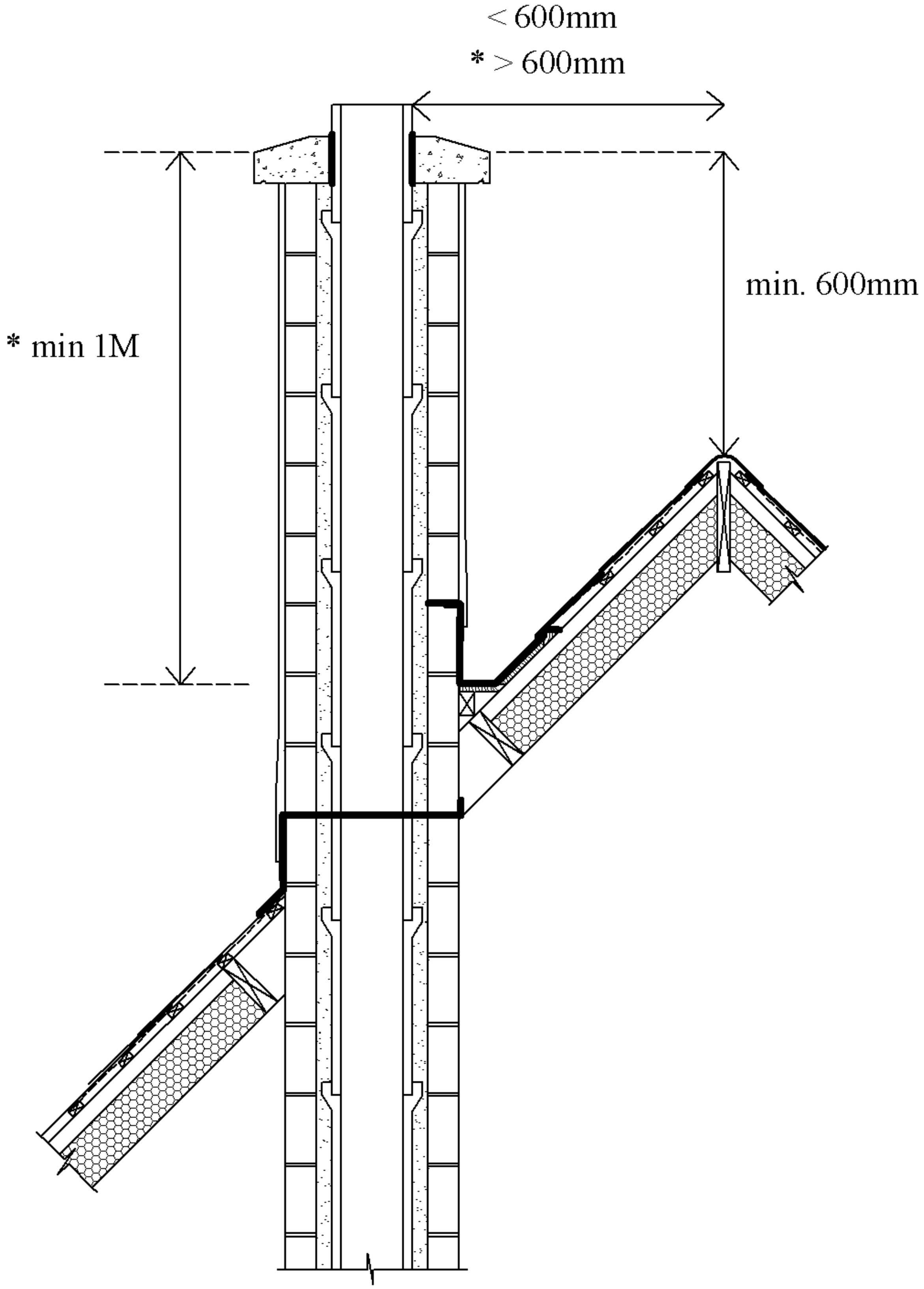
Any other relevant points

Design for Lifetime Use

- Universal design principles facilitate design for people of all ages and abilities – especially for persons of restricted mobility - temporary and permanent
- Ramp provides persons with ease of access, wheelchair users, person with pram, buggy, child in arms, shopping, aged - slope 15°
- Doors wide enough to facilitate wheelchair access – 800 mm min easy to navigate internally
- No ground floor steps internally, ease of movement and full floor space accessible to all
- Ground floor bedroom and wheelchair accessible bathroom facilities lifetime use
- Decking allows easy of outside use in summer
- Sockets and light switches fixed at lower levels – 900mm – 1200mm

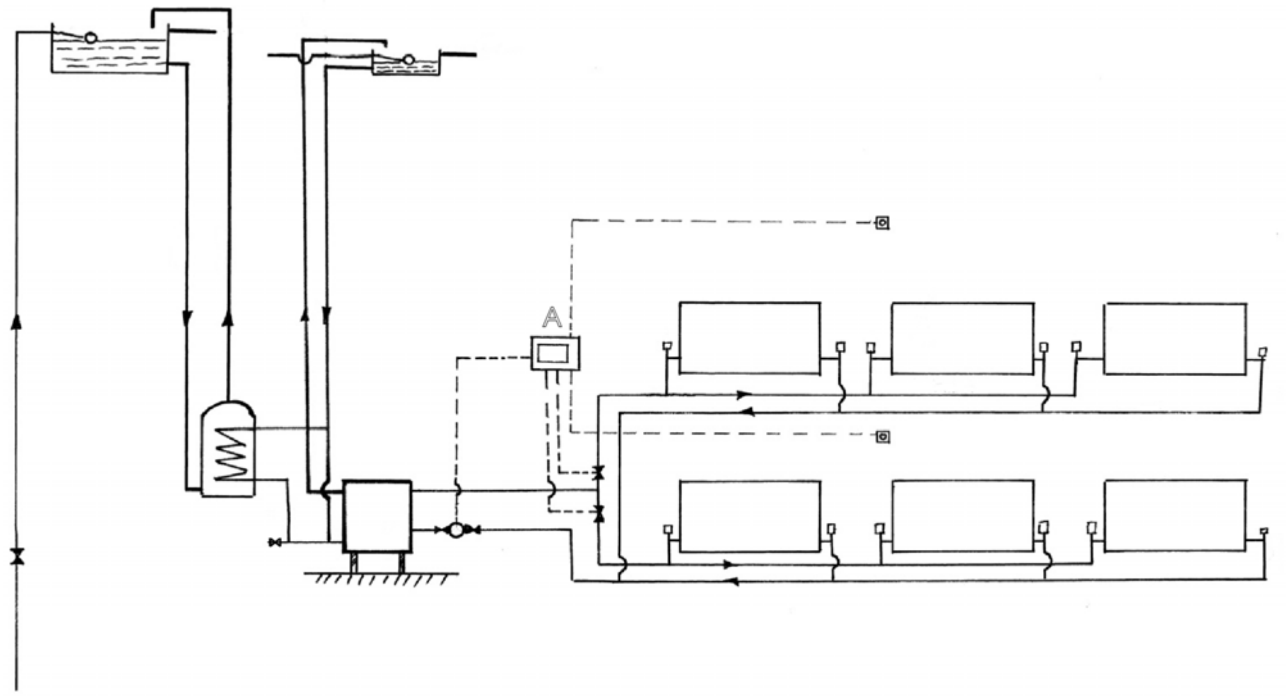
Any other relevant points

Ceist 7



Any other relevant detail

Ceist 8 (a)

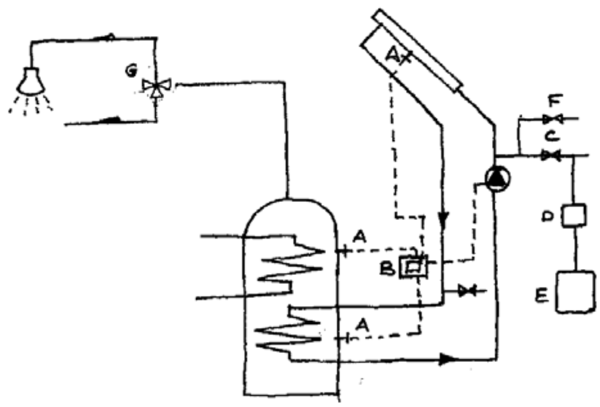


Control Valves

- Control valves located on return
- Each radiator to have hand wheel/thermostatic valves on flow, lockshield valves on return, and air bleed valve on radiators
- Isolating/drain valves located on return
- A :- Electronic control panel

Typical pipe sizes

- 22 mm flow and return
- 15 mm on upstands to radiators
- 28 mm expansion



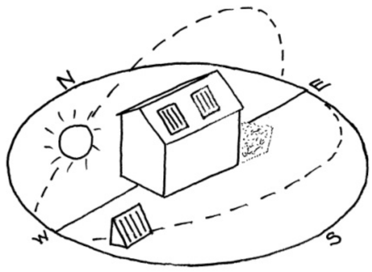
(b) Modifications

- Increased capacity hot water cylinder 300 litres
- Twin coil cylinder
- Blending valve on domestic system
- Electronic control system
- Temperature sensors A
- Cooling vessel D
- Control panel to regulate temperature
- Expansion vessel on solar return E
- Safety valve on flow F
- Mixing valve at G
- Pressure release valve - PRV

(c) Siting of panels

Orientation

- Northern Hemisphere the sun travels across the southern sky, from East to West
- Panels to be orientated facing South or 15° due East or West of South



Inclination

- Angle of inclination varies with seasons and also depends on latitude – from 40° to 60° angles for panel
- Rule of thumb – for Ireland angle of inclination of 45°
- No shading for optimum performance, Trees; chimneys and other buildings could also impact.
- Solar collectors will provide up to 60% of domestic hot water.
- Panels are generally mounted on a roof, either flush with tiles / slates (integrated), or above the tiles or slates (on-roof).
- Solar panels can be heavy – depends on surface area
- Roof may need to be reinforced to safely carry extra load
- Panels can also be fixed on side of house or at ground level with angle adjustment to maximize use
- Ground-mounted systems allow the panels to be oriented directly south, at the optimum tilt angle
- Ground mount systems require suitable land space, and they look industrial
- May be at greater risk of damage
- Tracker panel are designed to follow movement of sun.

Ceist 9 (a)

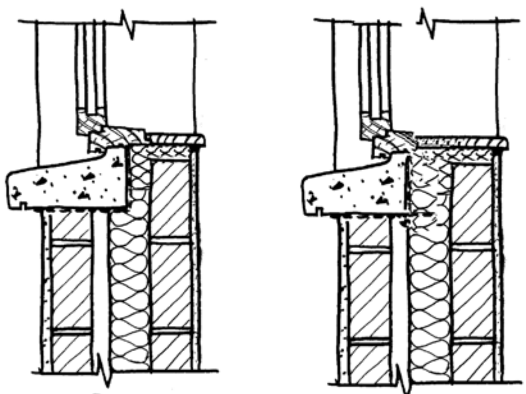


Fig 9.1

- A thermal/cold bridge occurs where a portion of a structure has a high thermal conductivity resulting in pathways through which significant heat is lost. This lowers the overall thermal insulation properties of the structure
- Thermal Bridging may be due to poor design detailing, poor workmanship or a lack of adequate insulation
- In Fig 9.1 a proprietary cavity closer or block of insulation is used behind the sill. This separates the outer leaf from the inner leaf and provides a thermal break between the two structures

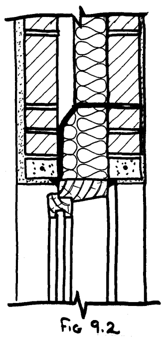


Fig 9.2

- Fig 9.2 a fireproof, high density block of insulation is used to close the cavity and eliminate thermal bridging
- All gaps should be sealed with a flexible sealant or tape to increase air tightness
- Walls should have a minimum airspace of 40 mm
- Double/triple glazed, low-e argon filled, thermally broken windows

- Fig 9.3 a proprietary cavity closer or block of high density fireproof insulation is used to eliminate cold bridging
- Gap between wall plate and eaves vent to be completely filled with insulation
- 450 mm of insulation between and over the ceiling joists
- Fig 9.3. Block with a minimum thermal conductivity of
- 0.20 W/m K is used.

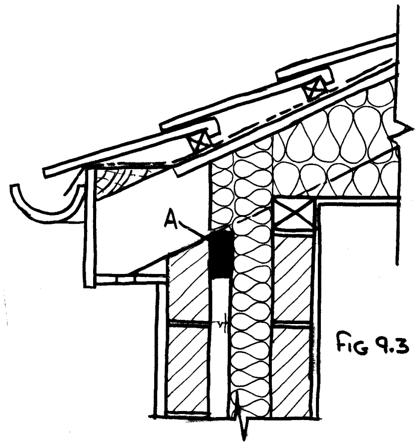


FIG 9.3

Floor insulation

- Perimeter insulation with a minimum R-value of 0.75m^2 K/W.
- Ensure wall insulation is installed at least 225mm below the top of the floor
- All junctions to be sealed with a flexible sealant or taped airtight

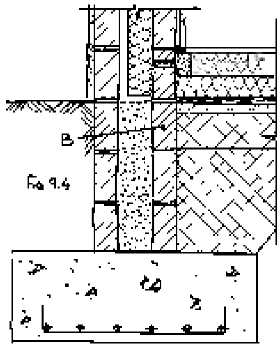


Fig 9.4

- Fig 9.5 shows an insulated steel lintel
- Internal insulation and insulation in the lintel eliminates thermal bridging

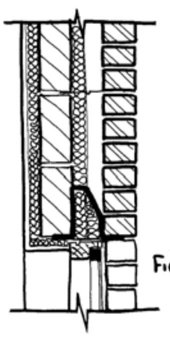


FIG 9.5

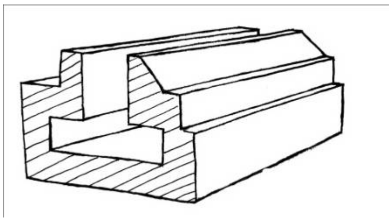
9(b) Advantages of eliminating thermal bridges

- Prevents heat loss through fabric at critical junctions
- Improves the thermal comfort of the house
- Saves money as less heat is required
- Reduces the amount of fossil fuels - oil/gas - needed to heat home
- Reduces carbon footprint and CO_2 emissions of the building
- Thermal bridging can cause condensation, which can cause dampness and mould growth, therefore no thermal bridging results in more healthy building

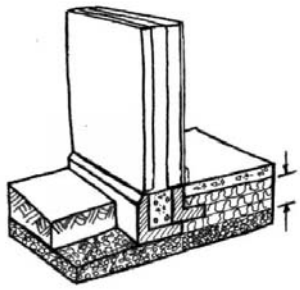
Any other relevant information

Ceist 10 (a)

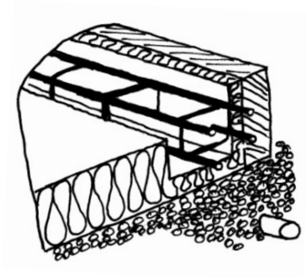
Foundations suitable for passive house



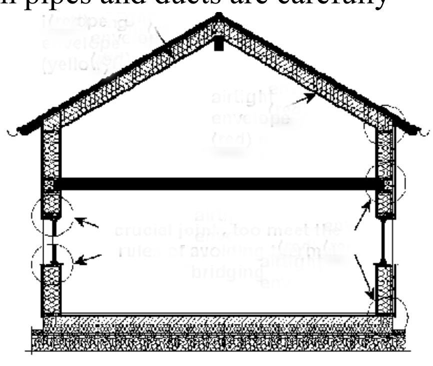
- Well insulated Passive Slab foundations when building a Passive house.
- Steel reinforcement is used in the ring beam and floor slab to distribute loads and prevent cracking in the concrete.
- Foundations wrapped in expanded polystyrene used (EPS) 100 mm – 400 mm in thickness to prevent clod bridge and continuous heat loss through the foundations into the surrounding ground
- Services incorporated into foundation to avoid unsightly waste pipes on side of house
- Internal load-bearing walls are built on a thickened floor slab on EPS 300 mm so there are no internal foundations
- Less concrete is required because there are no internal foundations
- For insulated foundations, compacted washed hardcore 18 – 35mm of 400 mm to 600 mm in depth of blinded with 3 – 8 mm sand blinding under EPS
- Drainage channel inserted to avoid frost heave in winter
- Hardcore should be clean and free from organic matter to allow moisture pass through unimpeded
- Lower carbon footprint of the house.
- The heat losses are greatly reduced with all cold bridges eliminated.



Airtight building envelope

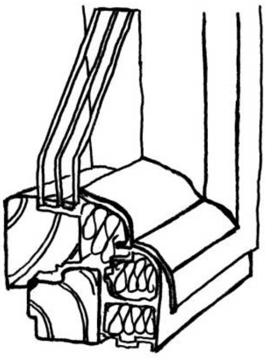


- Airtight construction is essential to prevent the uncontrolled escape of preheated air and meet thermal comfort requirements
- If a construction is not sufficiently airtight, moist room air will leak into the construction, condense and cause damage
- Conventional room plastering (gypsum or lime plaster, cement plaster or reinforced clay plaster) is sufficiently airtight, but allows vapour diffusion
- Rule of the red line – continuous red line at design stage to show airtight barrier
- It is important, that the airtight envelope is continuous, without interruptions
- Good airtightness reduces the amount of noise, dust, pollen etc. that enters the building
- Airtightness prevents uncontrolled heat loss
- Membrane overlapped and sealed - joints and all penetrations from pipes and ducts are carefully sealed
- An airtight building must be properly ventilated to provide continuous fresh air to the occupants
- Air leakage through unsealed joints must be less than 0.6 times the house volume per hour i.e. 0.6 ac/h – 0.6 air changes per hour
- Prevent penetrations of the airtight layer by mechanical and electrical services – or where penetrated, seal with grommets
- Design in a service cavity in walls and ceilings to prevent puncture of airtight membrane.

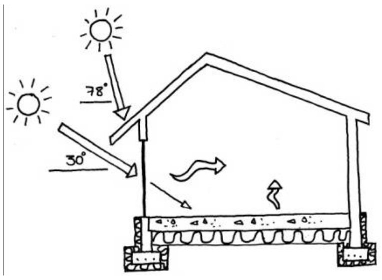


Windows and Glazing

- The U-value of Passive House windows lower than 0.8 W/m²K with triple glazing
- Design for reduced north facing glazing
- The use of larger areas of glazing on the south elevation to maximise the amount of sunlight available especially in the short days of winter
- Three panes of glass separated by special low-conductivity spacers
- High solar energy transmittance of glass (g ≥50) which allows solar radiation to penetrate the glass and contribute towards heating of the dwelling
- A low emissivity (low-e) soft coat on panes which reduces solar radiation back out through the glass
- The frame must be well insulated and also be thermally broken.
- Windows may be outward opening to maximize room space

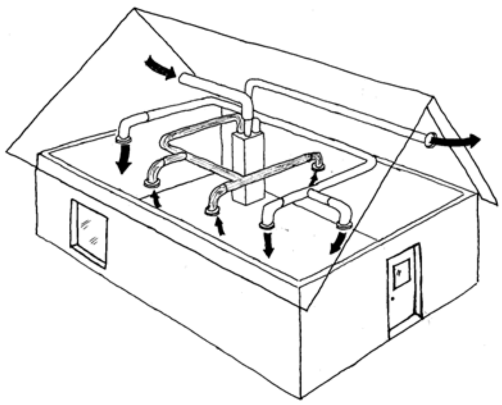


- Triple glazing ensure excellent sound insulation from outside noise
- Design to prevent overheating in summer - blinds, brise soleil, overhangs, awnings, deciduous trees to south etc. which allow low sun to enter in winter but prevent the high sun entering in summer
- Sunpath, elevation 78° summer and 30° in winter.



(b) How a MHRV system works

- The function of a MHRV system is to supply continuous fresh air in the right volume to the interior
- A passive house is ventilated using a mechanical heat recovery with ventilation – MHRV - system which incorporates air to air heat recovery
- Exhaust air is extracted from rooms that typically produce heat, such as kitchens and bathrooms - air passes through a heat exchanger where the heat is transferred from the preheated air to the incoming cold fresh air
- Preheated fresh air extracted from outgoing stale air raises temperature of incoming fresh air - reduces the need to completely heat the fresh air as it enters the building



- Place MHRV unit downstairs – in utility room – for ease of access to change filters - dirty filters contaminate incoming air – filters changed every six months
- Stale exhaust air and clean fresh air do not mix.

(c) Advantages of MHRV

- Continuous supply of the correct volume of fresh air to all rooms
- Controlled rate of air flow
- A lowering in humidity levels reducing mould and fungus growth
- Filters prevent pollen and other allergens from entering house
- Reduced dependency on fossil fuels to heat air
- Only two breaches of external building fabric
- Healthy home: less pollen, less allergies and less dust mites

- Can be remotely controlled (RF)
- 93% of heat in stale air may be recovered and used to preheat incoming air.

Disadvantages

- Complete dependence on mechanical system for fresh air provision
- Filters need regular replacement with associated costs
- Lack of access if MHRV unit in attic – could result in contaminated air from dirty filters
- High initial cost associated with installation
- Requires specialist skill to install
- Windows must be kept closed when system in use
- Can get contaminants in ductwork if not in continuous use
- Cannot use open fire must – must use room sealed stove with separate fresh air intake from outside
- Ducting must be designed in at design stage
- Fans can be noisy, especially if ducts are undersized
- Dependent on electricity to run

Question 10
Good neighbourhood – satisfy daily needs

- A sustainable neighbourhood is a mixed neighbourhood with a mixture of private housing and social and affordable housing
- A sustainable neighbourhood is one that is attractive to live in - has less dependency on the car for daily activities, less pollution, less congestion, and less noise
- Need for more people to live urban areas to maximise energy use, urban design to make positive contribution – green areas having landscaped public spaces, easy maintained trees, shrubs and plants. Homes/apartments easy to maintain to create pleasing neighbourhood which will attract people and enable them to live there throughout life
- A good neighbourhood is people centred, compact, has a good public transport system and is designed to be inclusive of all irrespective of health, physical ability or social status
- Live local – think global - identity with local place gives sense of belonging.
- Impact of location affects independence, mobility, health, longevity and quality of life. Urban areas that are walkable and well connected are attractive neighbourhoods in which to live
- A good neighbourhood encourages people to live as a creative engaged member of local community, know at least ten neighbours, children attend local - walk or cycle to school –
- Safety a feature of good urban design – creating friendly safe streets and public spaces, e.g. centrally located public spaces, parks, playgrounds, social areas where passive surveillance is possible.
- Numbers of people enjoying the public realm – parents with children, teenagers enjoying meeting up, outdoor seating for all to enjoy - allows passive surveillance giving a safe and secure neighbourhood for all – contrary to gated, guarded and private
- Integrated public spaces designed to be overlooked by surrounding homes so that they are safe to use – overlooked safe play areas for children, roads and parking areas designed and integrated into development. Well managed public spaces that are attractive, easy to reach, with good public lighting, bins strategically placed and open to all create a good neighbourhood
- Civic centres, community centres, crèches, library, church, sport and leisure facilities all sited locally so that car is not necessary to access such facilities

Well connected neighbourhoods – walkable not isolated neighbourhoods, routes easy to navigate, public spaces not dominated by the car, traffic speed controlled by design such as having different road colours, rumble strips, narrowing of road to reduce speed – well designed public realm.

- Safe and green routes for pedestrians and cyclists – safe walkable school routes to encourage students to become active - walk and cycle to school

People can live at any stage of their lives – regardless of physical ability or social status

- Integrated not stratified communities, mixed communities of younger / older people – younger people to help vulnerable and older people, drop by for a visit, do the shopping, help people of restricted mobility, integration of all into local communities. Mixture of building types, larger family homes, smaller apartments/houses for older and younger at affordable prices

Inclusive design –

- Buildings designed to universal design principles to facilitate ease of access by all – lifts and ramps for people of restricted mobility so that they can live in their local community, facilities for different ages, children, parents, elders, sport and leisure facilities, pitches in the immediate neighbourhood
- Spaces that are compact and facilities within easy reach are used more often
- Locality to have identity giving community a strong sense of local place – giving people a strong connection to the area in which they live – a culture of care for everybody in the locality
- A good neighbourhood has recognisable features - local pride of place, with focal points such as historic building or site, preservation of heritage to give local a sense of the unique - be it historical, cultural or visual
- Energy efficient homes designed to maximise passive solar energy - dual aspect, windows located to avoid views into the home from other houses, adequate internal and external storage, decent standard of amenities

A wide variety of things to do in the neighbourhood – active and leisure activities

– a good neighbourhood promotes a good mix of activities – diverse mix of shop types, facilities, work places, designed for changing use home office, commercial activities at street level - apartment block with mixture of retail ground floor spaces and residential accommodation over

- Pitches, libraries, public spaces, amenity areas, leisure facilities etc. within easy reach.

Three recommendations to create sustainable urban neighbourhoods …such as

- Educate to change paradigm – to build robust, resilient and safe urban neighbourhoods which are attractive to all for lifetime use
- Provide amenities locally to allow people walk and cycle to work and to leisure activities – cycle and walking paths, interconnected green car-free safe walk/cycle routes
- Build in clusters and higher densities to reduce energy needs and to encourage a sense of community and belonging
- Develop integrated public transport systems
- Clear sustainable planning guidelines to be implemented for all urban developments
- Consultation between planning authorities and local communities to encourage sustainable planning to make urban living an attractive option, learning to live in community and not in isolation
- Urban renewal / regeneration on sustainable principles
- Flexible design of buildings to meet changing needs from birth to old age – lifetime use and universal design principles applied, plan for climate change - modest scale of buildings, easy to heat, service, clean
- Multi-use buildings – retail ground floor, residential over
- Houses of low-environmental impact – embodied energy calculated for all materials

- Use of renewable energies - solar panels, on-site generation of electricity where possible, energy saving electrical fittings, LEDs, A-rated appliances, orientation
- Provide grants/incentives to encourage sustainable design, education to focus on sustainability and energy use - low embodied energy design
- Incentivise car pooling / car sharing
- 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
- Develop exemplars of good practice in urban design as outlined in *Urban Design Manual – A Best Practice Guide (2009). Department of the Environment, Heritage and Local Government – www.environ.ie*
- Promote concept of urban living as desirable, purposeful, communal having a culture of care, with people giving voluntarily of their time to enhance the quality of life for all members of the neighbourhood.

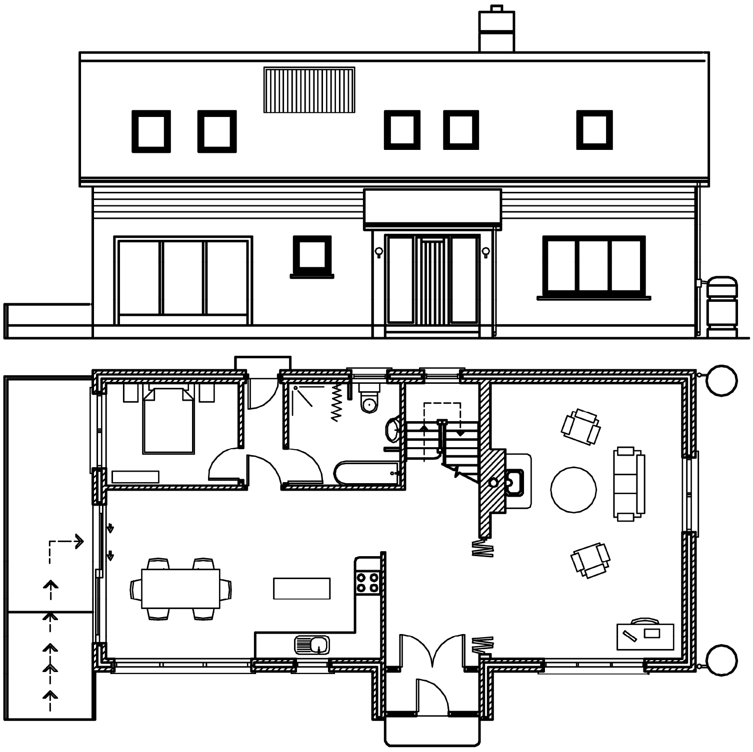
Any other cogent, well argued points

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scrúdú Ardteistiméireachta 2011

Staidéar Foirgníochta

Teoiric – Ardleibhéal



Construction Studies

Theory – Higher Level

MARKING SCHEME

CEIST 1

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Any 11 points x 4 marks (Drawing 3 Annotation 1)	
Blockwork Hardcore min 150mm with sand blinding Radon barrier/DPM Floor insulation 150mm min subfloor Tile Sloped concrete cill DPC behind and underneath concrete cill Drainage channel Level surface Proprietary threshold - 15mm Door and seal Frame head Airtightness Lintels Stepped dpc Cavity insulation Internal / external render	**4** **4** **4** **4** **4** **4** **4** **4** **4** **4** **4**
Scale & Drafting	**8**
(b) ***4 marks for each of 2 applicable design details***	
Two Design details	**8**
Total	**60**

CEIST 2

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) ***3 requirements**, (note 4 marks, sketch 4 marks)*	
Functional requirement 1 Notes Sketches	**4** **4**
Functional requirement 2 Notes Sketches	**4** **4**
Functional requirement 3 Notes Sketches	**4** **4**
(b) Roof types (2 × 5marks). Design detailing (2×4 marks). Sizes (2 ×3 marks)	
Name of roof type 1 Sketch and note of design ensuring structural stability 3 typical dimensions	**3** **6** **3**
Roof type 2 Sketch and note of design ensuring structural stability 3 typical dimensions	**3** **6** **3**
(c) ***Recommendation (4 marks)**. Reasons* **(*2 × 4 marks)***	
Recommendation Reason 1 Reason 2	**4** **4** **4**
Total	**60**

CEIST 3

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Revised design detailing (4× 10marks)	
Design detailing :- External envelope	
Note	**10**
Sketch	**10**
Design detailing :- Layout	
Note	**10**
Sketch	**10**
(b) Reasons - (2 × 10marks)	
Reason - external envelope	**10**
Reason - layout	**10**
Total	**60**

CEIST 4

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) *Mass, completeness, isolation (note 4 marks, sketch 4 marks) each*	
Mass Notes Sketches	**4** **4**
Completeness Notes Sketches	**4** **4**
Isolation Notes Sketches	**4** **4**
(b) Reasons for sound transmission (2 × 4 marks) ***Revised design detail for a party wall (note 4 marks, sketch 4 marks)***	
Reason 1	**4**
Reason 2	**4**
Design detail note	**4**
Design detail sketch	**4**
(c) ***Revised design for a stud partition (5 × 4 marks)***	
Revised design - note Revised design – sketch Sound insulation principle 1&2 Materials used Typical dimensions	**4** **4** **4** **4** **4**
Total	**60**

CEIST 5

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) 9 points × 3 marks for each point –	
Correct tabulation	**3**
External surface	**3**
External render	**3**
Concrete hollow block	**3**
Air space	**3**
Internal plasterboard	**3**
Internal surface	**3**
Total Resistance	**3**
U Value (1 mark for the formula)	**3**
(b) (5 × 3 marks each)	
Resistance for U-value of 0.27 (2 marks for formula R=1/U)	**3**
Existing Resistance from part (a)	**3**
Difference in Resistances	**3**
Application of Formula R = T/k (1 mark for formula)	**3**
Required thickness of insulation	**3**
(c) ***(3 × 6 marks)***	
Disadvantage 1 and discussion	**6**
Disadvantage 2 and discussion	**6**
Recommendation and notes/sketches (3 × 2 marks)	**6**
Total	**60**

CEIST 6

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Three design features: (3 × 14 marks)	
Design feature 1 Note Sketch	**8** **6**
Design feature 2 Note Sketch	**8** **6**
Design feature 3 Note Sketch	**8** **6**
(b)Detailed discussion of the following factors in choosing materials for an environmentally sustainable house (3 × 6 marks)	
Form of house	**6**
Materials and labour	**6**
Design for lifetime use	**6**
Total	**60**

CEIST 7

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) 11 points × 4 marks - drawing 3 marks, annotation 1 mark	
Chimney stack (any 4) Blockwork Render Flue liners Fill Chimney capping	**4** **4** **4** **4**
Flashing (any 3) Cover flashing Under flashing Lead flashing to rear gutter Lead apron/tray	**4** **4** **4**
Roof structure (any 4) Fillet piece/Gutter Rafter Felt/breathable membrane Battens Slates Trimmer	**4** **4** **4** **4**
Scale & Drafting	**8**
(b) ***4 marks for each of 2 correct design details***	
Design detail 1 Design detail 2	**4** **4**
Total	**60**

CEIST 8

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) 8 × 4marks (Sketch 3 Annotation 1)	
Wood burning stove Radiators zone 1 Zone control mechanism Header or expansion tank Feed to expansion tank Cold feed from expansion tank Expansion pipe or expansion vessel Flow pipes to radiators Return pipes to radiators Radiator valves Zone thermostats Pump and valves (pump, 2 isolating valves, drain off - any 2)	**4** **4** **4** **4** **4** **4** **4**
Sizes of pipework (2 sizes)	**4**
(b) Any 4 × 4marks (Sketch 3 Annotation 1)	
Solar panel Flow & Return Pump Cylinder (twin coil) Pipe sizes Temperature sensors Control panel Expansion vessel Thermal reducing vessel Safety valve Mixing valve	**4** **4** **4** **4**
(c) Preferred location	
Location (note 3 marks, sketch 3 marks)	**6**
Factor 1	**3**
Factor 2	**3**
Total	**60**

CEIST 9

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) *3 locations, (note 6 marks, sketch 10 marks) each*	
Location 1 Notes Sketches	**6** **10**
Location 2 Notes Sketches	**6** **10**
Location 3 Notes Sketches	**6** **10**
***(b) Advantages** (2×6 marks)*	
Advantage 1 Advantage 2	**6** **6**
Total	**60**

Ceist 10

PERFORMANCE CRITERIA	MAXIMUM MARK
(a) Notes and Sketches (4 × 6marks)	
Note 1 Sketch 1	**6** **6**
Note 2 Sketch 2	**6** **6**
(b) Description notes and sketches (2 × 10 marks)	
Note Sketch	**10** **10**
(c) Two advantages (2 × 4 marks) ***Two disadvantages (2 × 4 marks)***	
Advantage 1 Advantage 2	**4** **4**
Disadvantage 1 Disadvantage 2	**4** **4**
Total	**60**

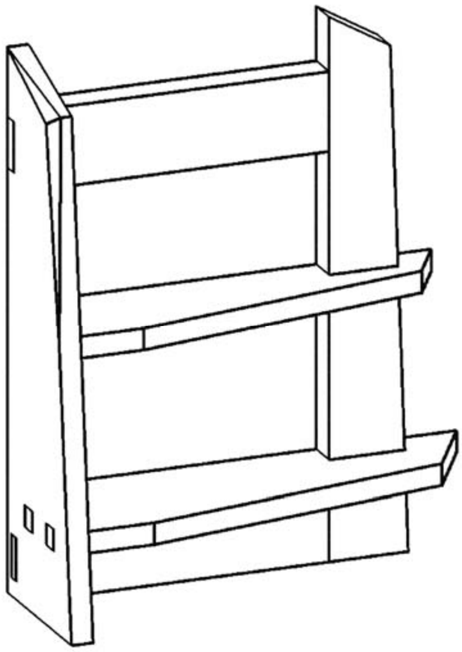
Ceist 10 (Alternative)

PERFORMANCE CRITERIA	
Discussion of Statement (3 × 10 marks)	
Discussion – point 1 (4 for point, 6 for discussion) Discussion – point 2 (4 for point, 6 for discussion) Discussion – point 3 (4 for point, 6 for discussion)	**10** **10** **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 2 (4 for point, 6 for discussion)	**10**
Total	**60**

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Scrúdú Ardteistiméireachta 2011
Leaving Certificate Examination 2011

Scéim Mharcála
Marking Scheme
(150 marc)

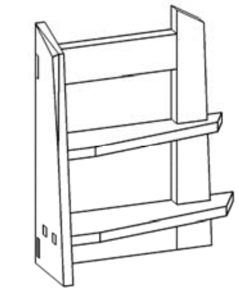


Staidéar Foirgníochta
Triail Phraiticiúil

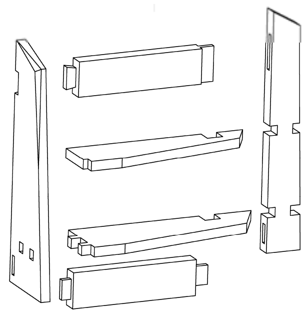
Construction Studies
Practical Test

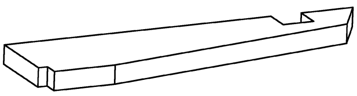
Construction Studies 2011
Marking Scheme – Practical Test

Note:
The artifact is to be hand produced by candidates without the assistance of machinery. 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.

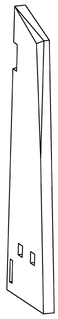


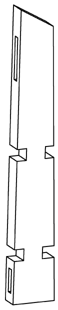
A	OVERALL ASSEMBLY	Marks
1	Overall quality of assembled artifact	**7**
2	Design and applied shaping of edge • design • shaping *(2 × 2 marks)*	**4**
	Total	**11**



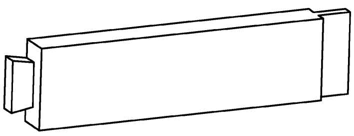


B	MARKING OUT	Marks
1	Left side – vertical • joints *(5 × 2 marks)* • slopes *(2 × 1 marks)* • chamfers *(2 × 1 marks)*	**14**
2	Right side – vertical • joints - mortices *(2 × 2 marks)* • - housed *(2 × 2 marks)* • slopes *(2 × 1 marks)*	**10**
3	Bottom rail • joints - tenons *(2 × 3 marks)*	**6**
4	Top rail • Joints - dovetail *(3 marks)* - tenon *(2 marks)*	**5**
5	Bottom shelf • joints - tenons *(2 × 2 marks)* • - trench *(2 marks)* • slopes *(2 × 1 mark)*	**8**
6	Top shelf • slopes *(2 × 1 mark)* • joints - notch *(1 mark)* • - trench *(2 marks)*	**5**
	Total	**48**

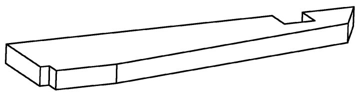
LEFT VERTICAL	C	PROCESSING	Marks
	1	Bottom mortice *(2 marks)*	**2**
	2	Twin mortices *(2 × 2 marks)*	**4**
	3	Stopped trench *(4 marks)*	**4**
	4	Dovetail socket *(3 marks)*	**3**
	5	Shaping slopes *(2 × 2 marks)*	**4**
	6	Two chamfers *(2 × 2 marks)*	**4**
		Total	**21**

RIGHT VERTICAL	D	PROCESSING	Marks
	1	Two mortices *(2 × 3 marks)*	**6**
	2	Trenches • Sawing vertically *(8 × 1 mark)* • Paring trenches *(4 × 1 mark)*	**12**
	3	Shaping slopes *(2 × 2 marks)*	**4**
		Total	**22**

BOTTOM RAIL	E	PROCESSING	Marks
	1	Tenons • Sawing vertically *(2 × 3 marks)* • Sawing across the grain *(2 × 3 marks)*	**12**
		Total	**12**

TOP RAIL	F	PROCESSING	Marks
	1	Dovetail • sawing vertically *(1 mark)* • slopes *(2 × 2 marks)* • shoulders *(3 × 1 mark)*	**8**
	2	Tenon • sawing vertically *(2 × 1 mark)* • sawing shoulders *(2 × 1 mark)*	**4**
		Total	**12**

<table>
<tr><th>BOTTOM SHELF</th><th>G</th><th>PROCESSING</th><th>Marks</th></tr>
<tr><td rowspan="4"></td><td>1</td><td>Two tenons (2 × 4 marks)</td><td>8</td></tr>
<tr><td>2</td><td>Trench
• Sawing vertically (2 × 1 mark)
• trenching (1 mark)</td><td>3</td></tr>
<tr><td>3</td><td>Shaping slopes (2 × 2 marks)</td><td>4</td></tr>
<tr><td></td><td>Total</td><td>15</td></tr>
</table>

<table>
<tr><th>TOP SHELF</th><th>H</th><th>PROCESSING</th><th>Marks</th></tr>
<tr><td rowspan="4"></td><td>1</td><td>Trench
• sawing vertically (2 × 1 mark)
• trenching (1 mark)</td><td>3</td></tr>
<tr><td>2</td><td>Stopped housing (2 marks)</td><td>2</td></tr>
<tr><td>3</td><td>Slopes (2 × 2 marks)</td><td>4</td></tr>
<tr><td></td><td>Total</td><td>9</td></tr>
</table>