**Coimisiún na Scrúduithe Stáit**

State Examinations Commission

# Leaving Certificate 2017

# Marking Scheme

# Construction Studies

## Higher Level

V2

**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**

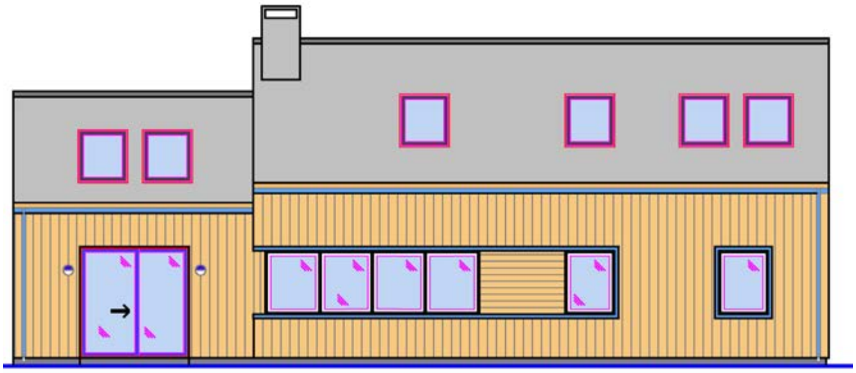
Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in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

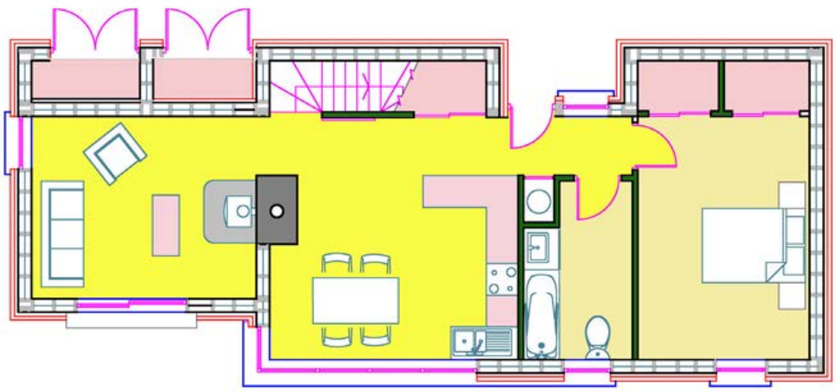
**Coimisiún na Scrúduithe Stáit**
***State Examinations Commission***

*Scrúdú Ardteistiméireachta, 2017*

# *Staidéar Foirgníochta*

## *Teoiric – Ardleibhéal*



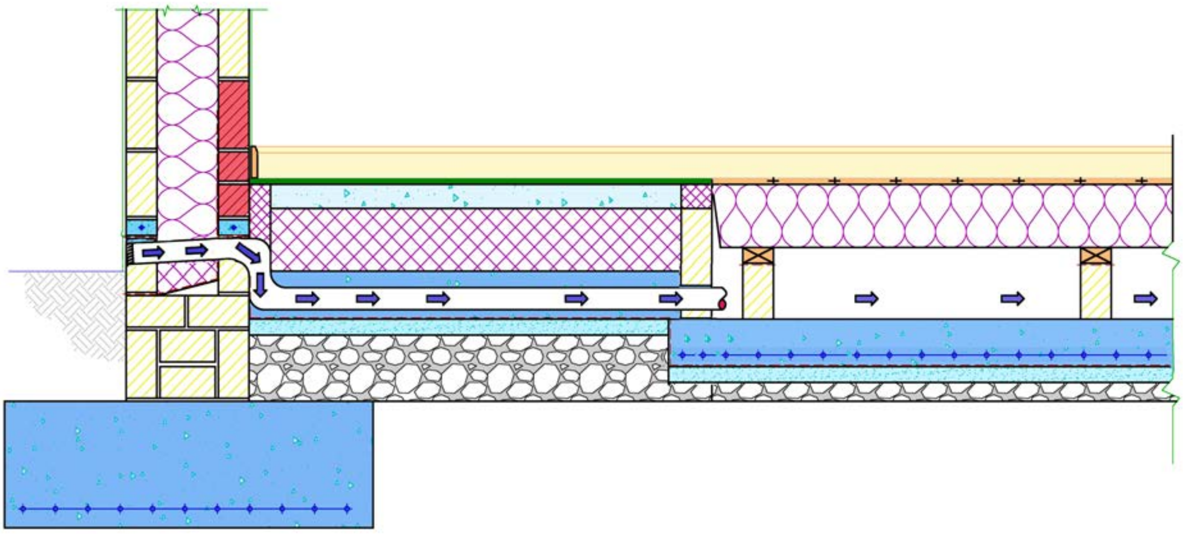


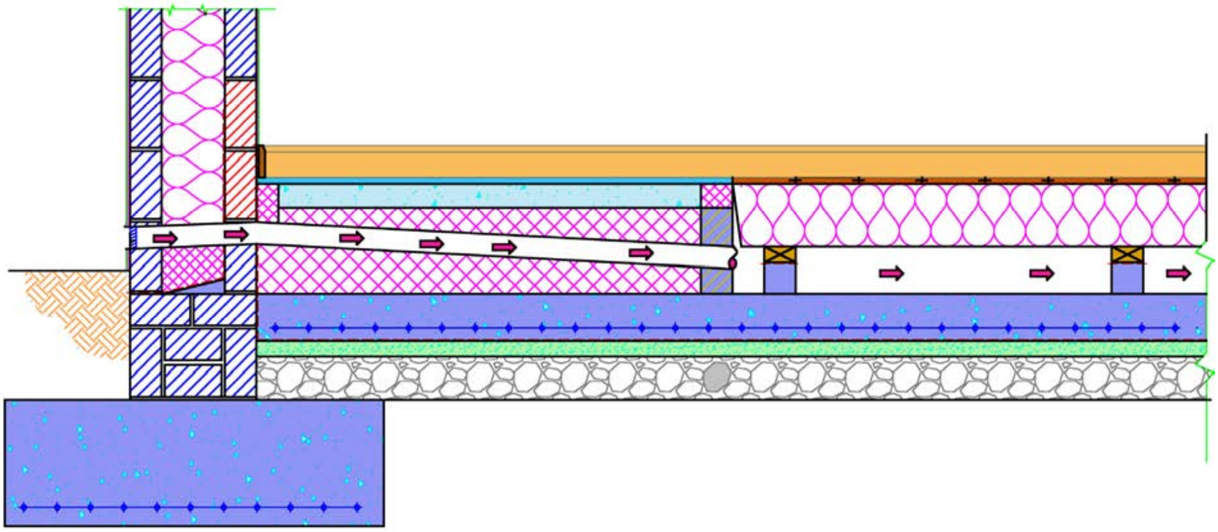
# *Construction Studies*

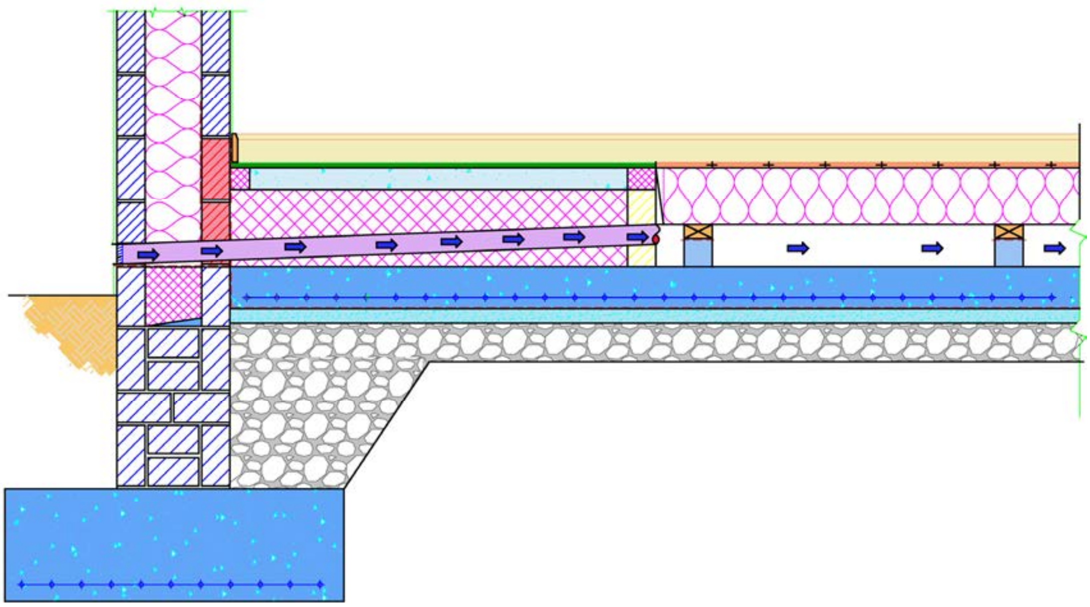
## *Theory – Higher Level*

**Note:** *Notes and graphics are for illustration and are not exclusive or exhaustive, other relevant notes and graphics are acceptable as responses and will be credited accordingly.*

**Ceist 1. Typical details of foundation, wall, concrete floor and suspended timber floor – such as:**







**Foundation – typical details**
- foundation slab typical – 1200 mm × 400 mm
- typical depth below ground - 1000 – 1200 mm
- typical reinforcement - 12mm mild steel bars at 100 mm centres
- solid blockwork to ground level as shown
- concrete typical – 25-35 newton, mechanically compacted.

**Wall – typical details**
- external plaster finish, scud coat, undercoat, floated sand /cement finish coat
- 100 mm concrete block outer leaf
- 200 mm full-fill insulated cavity
- basalt coated low-conductivity wall ties
- 100 mm concrete block inner leaf
- low conductivity blocks – Quinn lite or similar to inside leaf at floor level
- 15 mm internal skim coat or cement /sand render– 2 coats or lime plaster internal render.

**Floor 1 - typical details**
- 150 × 18 mm skirting set in mastic for airtightness
- tile finish
- fine screed typical - 100mm
- 200 mm to 300 mm eps insulation
- 150 mm concrete subfloor
- radon barrier on 50 mm sand blinding
- 200 mm compacted hardcore.

**Floor 2 - typical details**
- tongue-and groove flooring: 18-25 mm typical
- 200 × 40 mm joists at 400 mm centres
- netting or similar over joists to hold insulation
- 200 mm insulation between joists
- tassel plate on tassel walls with DPC beneath.

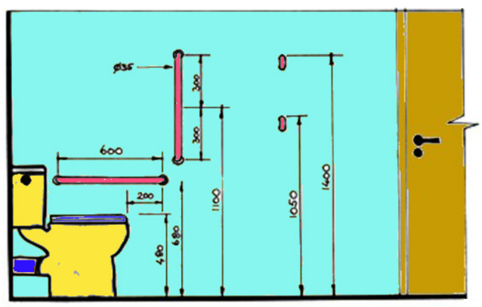
**Ventilation - typical details**
- ducting – rigid or flexible 75 to 100 mm typical
- through external wall and concrete floor to ventilate timber floor
- vent on external wall.

**Ceist 2 (a) Redesign of bathroom for lifetime use**


**(a) Two functional requirements of a bathroom designed for lifetime use such as:**
- width of door – 850 min - 900 to 1000 mm recommended
- turning circle for wheelchair – 1500mm to 1800 min diameter, 2000 mm best
- suitable height of washbasin, space for wheelchair beneath
- spatula type lever taps, or sensor taps
- grab rails to toilet, shower and wash basin – drop-down and fixed
- clothes hooks at low level
- shower tray level with floor, no upstand or use wetroom layout
- non-slip floor covering or non-slip tiles
- baby-changing facility provided
- light switch at appropriate height for all users or motion or heat sensors for automatic lights
- door-lock that allows for release of the lock from the outside
- pull cord emergency alarm
- low-level handle to window for person in wheelchair.

*Any other relevant points.*

Ref: *Building for Everyone – A Universal Design Approach – National Disability Authority.* www.universaldesign.ie

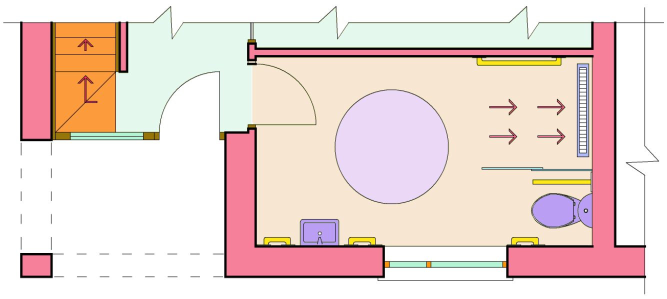


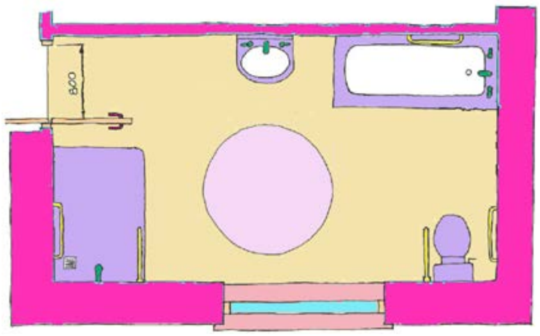
**(b)** ***Two advantages to providing a bathroom suitable for lifetime use by converting the office A.***
**Advantages – any two of the following – such as:**

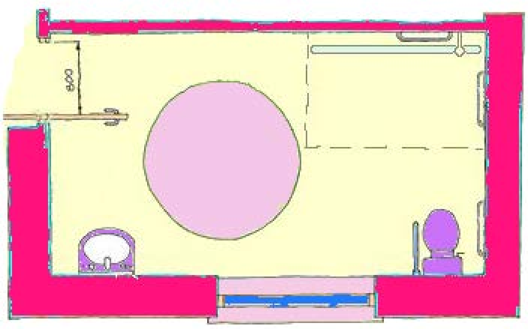
- conversion cheaper than new build - cost savings on construction – an extension at **B** with associated costs not needed
- little disruption during conversion of office – at front of house so owners can live in house as conversion takes place
- external ventilation, window and access from vented lobby already present in front office
- the design integrity of the existing dwelling house is maintained
- access for visitors to W.C. is more convenient by proximity to the front door
- existing office large enough to accommodate wheelchair access – universal design
- increased distance of bathroom from food preparation and consumption areas
- existing natural light to the utility room at the back of the dwelling is not restricted
- links with nature preserved - existing back garden remains undisturbed - existing size, plants, green area and trees maintained, contact with nature good for wellbeing of occupants.

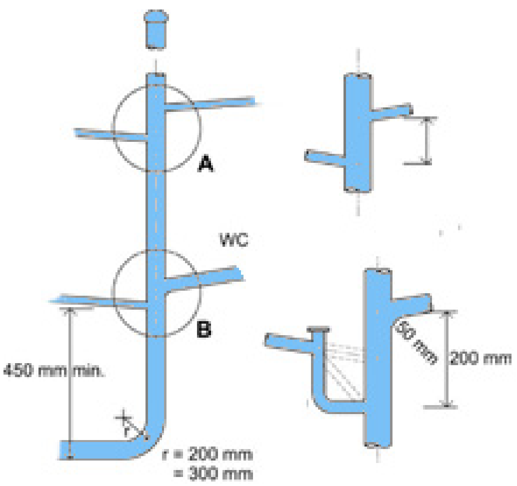
*Any other relevant points that outline advantages.*

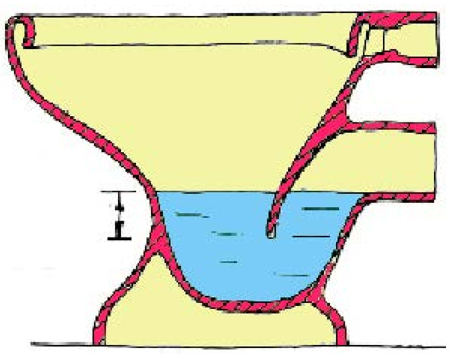
**(c)** **A proposed design layout for the bathroom at A, and design detail that will prevent the penetration of sewer gases into the bathroom at the W.C.** such as:

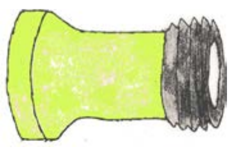






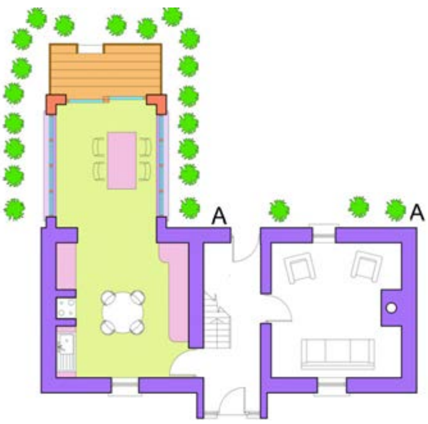
**Ceist 3 (a) – addition of extension 12 m$^2$ to optimise daylight into both the extension and the kitchen and provide an open-plan kitchen/dining/living**

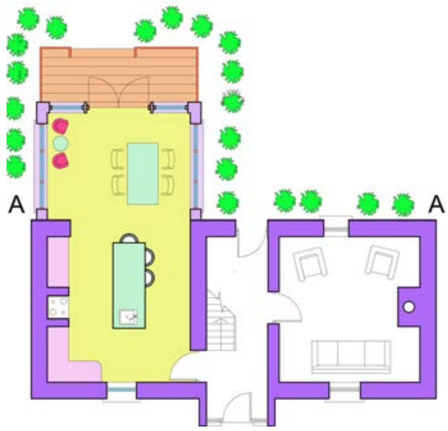
- **A-A** rear is south facing, glazed area of extension to the south for sunlight and daylight
- roof light windows on extension to allow natural light to both extension and kitchen
- rear window removed and opening formed to allow open-plan layout
- opening to be widened for open-plan design – lintels over opening
- glazing increased at southern, eastern and western elevations
- floor to ceiling glazing and roof lights increase natural light
- install high performance windows - low-e, triple glazing
- remove a portion of the rear wall of the house to allow sunlight and solar gain deep into the original kitchen/dining area - must be completed in accordance with structural engineer's specification
- allows a visual connection between the old and new areas giving a greater sense of space
- sliding, folding or swing doors to garden to bring outside in and to link garden/nature to extension for wellbeing of occupants

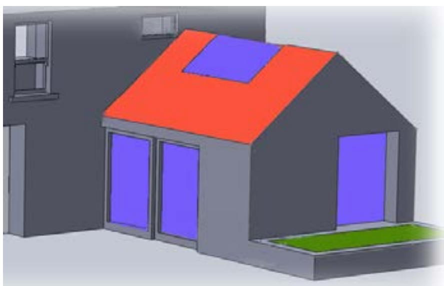

- kitchen/dining area is maintained with a seating/family area in the extension - this allows a connection between family members while activities such as cooking/playing/homework/watching TV are taking place
- maintaining existing kitchen/dining area also reduces expense
- extensions such as described can reduce the levels of natural light and solar gain to the existing kitchen/dining room. Including roof lights, offsetting extension or increasing roof pitch with roof lights as indicated are examples of how levels of natural light and solar gain can be maintained.

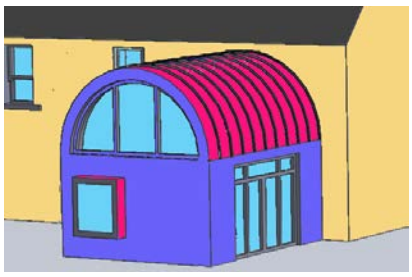
**(b) Three reasons for proposed design choices – such as**

- glazing to south east and west walls to get day long sunshine and natural light into room and into existing house – morning, midday and evening sunshine into house
- existing house has small windows – limited passive solar gain and increased heating costs
- high performance low-e glazing allows light and heat into both extension and house – people are phototropic and move towards the light
- open-plan layout allows sunlight to enter into main house and enhance the life of the occupants

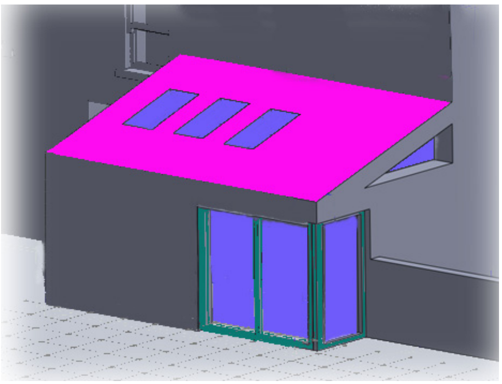
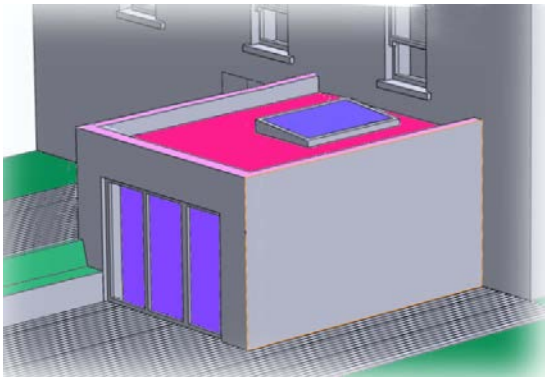


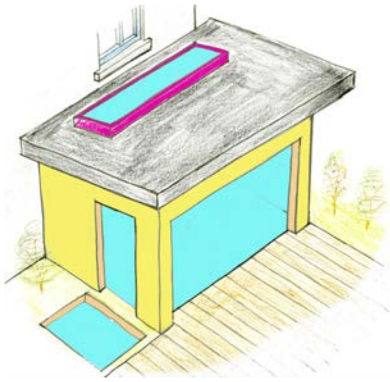





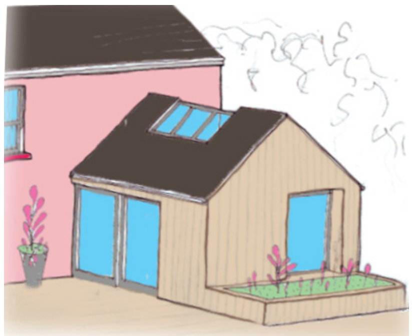
- bringing the outside in through sliding/swing doors and low level glazing fosters visual delight
- flexible open-plan layout allows spaces to be reconfigured to meet changing needs
- open-plan layout facilitates persons with reduced mobility.

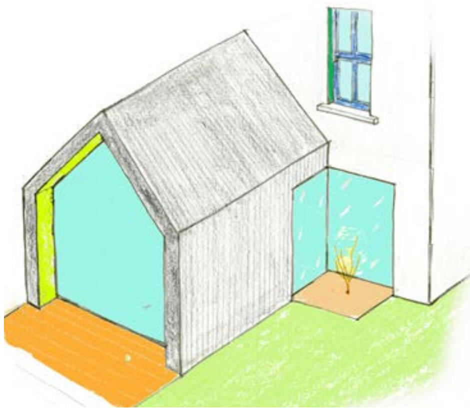
 

**(c) Two advantages of building an extension to the farmhouse shown – such as:**



- there is an existing high quality vernacular house on site – extending it maintains the character of the house but enhances its possibilities
- benefit from existing rear garden, trees, shrubs, plants – enhances wellbeing and creates a pleasant indoor atmosphere, close to nature – sounds, sights, smells, changing seasons
- low environment impact – the extension is small in size but increases the flexibility of kitchen/dining/ living space
- low environmental demands – services such as water, electricity, sewage treatment, roads etc. are already on site, minimum disruption needed to greatly enhance the living space
- modest scale, modest costs, low borrowing requirements
- highest thermal standards – orientation, insulation, airtightness – low operating cost to heat and light
- single storey facilitates roof lights for penetration of natural light and sunlight
- minimum energy required to extend – opening with lintels formed in rear wall – no specialised components or steel lintels needed, so minimum environmental impact and low embodied energy
- modest scale is environmentally sustainable - small spans, restricted material requirements, compact form, easy to manage, clean and maintain
- occupants can live in house while extension is being built, extension built first, last task is to form opening between extension and existing house – cost effective
- increases living space and allows for individual requirements and preferences of owners to be incorporated into the farmhouse design and layout
- provides a more light-filled comfortable interior space taking advantage of natural sunlight if extension is appropriately designed
- increased levels of solar gain due to the extra glazing on the southern façade results in a more comfortable living space
- reduction in energy consumption in lighting and heating will decrease the carbon footprint of the farmhouse
- allows for open-plan living which most families now prefer due to the demands of contemporary life
- including appropriate glazing, which extends to ground level in the extension will help to extend visually the internal space and helps to bring the outside inside – close to nature.

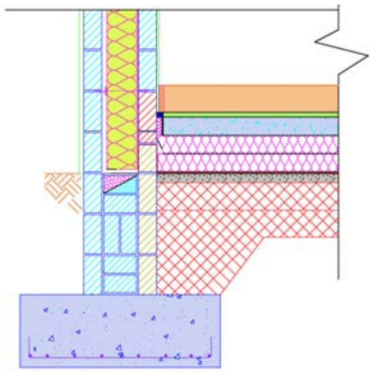




- appropriate, well designed extensions to traditional vernacular buildings will serve as exemplars of good practice to those in the locality who may own, or might be considering purchasing such a building
- demonstrates a respect for maintaining vernacular building and tradition and will encourage others in the locality to consider a similar approach.

**Ceist 4 (a) - functional requirements of an external wall such as:**

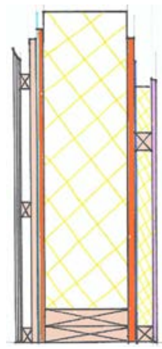
- keep the occupants safe, dry and warm and sheltered from the elements
- prevent the transfer of heat to the outside or to the inside of the dwelling
- provide for the reduction of noise from outside and inside
- anchor roof to walls and support the floors/upper floor(s) and roof
- spread the superimposed loads evenly over the foundations
- provide robust openings for doors and windows
- have sufficient structural integrity to avoid cracks or other failure under load
- provide low-maintenance, climate-proof exterior surfaces and finishes
- have no cold bridges and be designed to have low embodied energy
- prevent the formation of condensation and dampness
- prevent interstitial dampness
- prevent the uncontrolled passage of air through the structure
- prevent the ingress of water
- prevent access of vermin to the building and the roof space
- be aesthetically pleasing and be in keeping with the surroundings of the dwelling
- provide a means of carbon sequestration.



*Any other relevant points*

**Concrete block wall**

- cavity prevents moisture ingress
- full-fill insulation
- internal render for airtightness
- concrete blocks strong and robust
- external plaster durable and weather resistant.

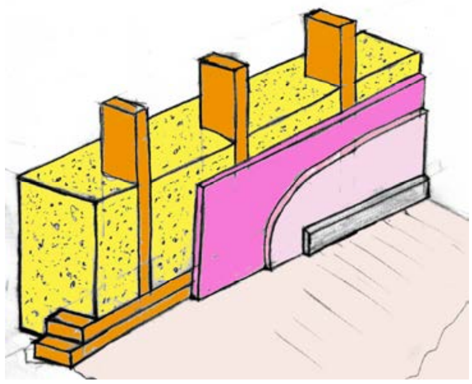


**Timber frame with rainscreen**

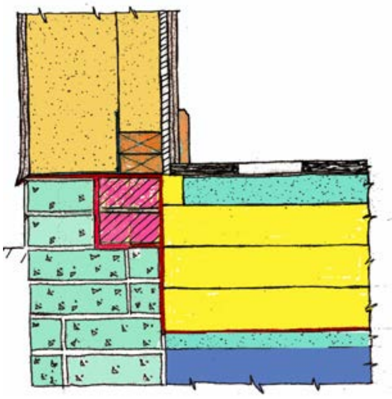
- T&G cedar or lapped larch or Douglas Fir sheeting on counter battens for weatherproofing and ventilation
- moisture resistant layer
- OSB/plywood racking internally and externally
- full-fill insulation in timber frame
- airtightness layer internally
- service cavity to avoid penetrations of airtight layer.

**Rendered wall of timber frame and hemp-lime construction**

- Tradical hempcrete or similar hemp/lime - sprayed or cast to 300 mm – 500 min thickness on one side or on both sides of timber frame
- structural timber frame with hempcrete/well compacted
- Heraklith boards or similar to opening for airtight tape
- internal surface two coats of render
- external leaf of hempcrete – sprayed - or cast in temporary formwork



- rendered externally – two coats of hemp-lime render
- eaves overhang of sufficient depth to provide adequate cover – depending on exposure to elements
- external lime render or hemp/ lime render
- lime plaster or, cork and lime thermal plaster (Diathonite) or similar to inside or lined with breathable board and lime plaster finish
- natural paint finish – breathable
- no vapour barriers, open diffuse structure to walls.



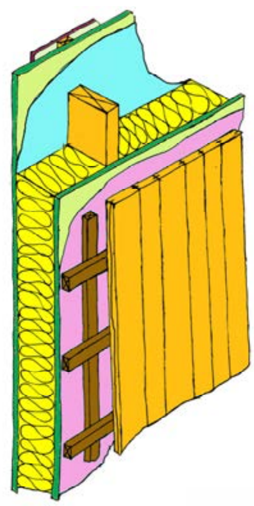
Ref: Hemp Lime Construction: Bevan & Woolley: ISBN 978-1-84806-033-3
Building with Hemp: Steve Allin: ISBN 978-0-955109-1-7
Low Impact Building: Tom Wolley: ISBN 978-1-4443-3660-3
www.ecologicalbuildingsystems.com

***Cavity wall of concrete block construction* - environmental considerations – such as**
**Positives:**
- the materials are robust and long lasting – will not rot or degrade
- the wall has robust outer and inner surfaces – weather resistant
- the concrete block inner leaf provides increased mass which act as a heat sink supporting a constant temperature.

***Negatives:***
- manufacture of cement releases large amounts of $CO_2$ into the atmosphere
- high embodied energy - great energy demand for quarrying, crushing stone and transporting heavy aggregates, stone is burned at $1400^0$ C, huge energy demands
- concrete is a poor thermal insulator, dense and transfers heat easily, but good as heat sink
- greater energy input needed to raise the temperature of the larger mass within the insulated building envelope
- longer construction time and difficult to sequence work by diverse trades
- increased need for supervision of on-site processes
- need for scaffolding over longer construction phase
- need for substantial drying-out time prior to final fitting and decorating the building.

**Ease of construction**
- easy to construct - skilled tradespeople, blocklayers and plasterers readily available
- use of standard concrete blocks simplifies ordering and delivery
- most construction completed on site, reduced risk of costly error.

**Timber frame construction with vertical cedar cladding as an external rainscreen:**
***Positives: environmental considerations***
- the use of wood and other organic materials reduces carbon emissions and act as a carbon store over the life of the building
- wall can be built to any specified width, allowing higher levels of thermal insulation, reduced heat loss and faster heat-up time
- increased range of wall finishes available – stains and preservatives
- cedar is highly resistant to rot
- cedar does not need stains and preservatives.

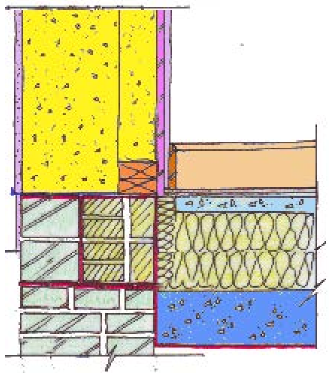


***Negatives***

- timber cladding needs periodic maintenance over life of building
- poor maintenance shortens life cycle of building leading to earlier replacement with ensuing energy use in reconstruction
- careful detailing required to prevent ingress of water
- without replanting, felling of trees for timber reduces global $CO_2$ sequestration.

***Ease of construction - Positives:***

- wood is easy to cut, light to lift and pleasant to handle
- lightweight components, no need for heavy lifting equipment on site
- easier to build for self-builders and non-professionals seeking to build their own shelter
- timber-frame details readily available – e.g. Walter Segal method and Dominic Stevens architect – irishvernacular.com
- wall components can be manufactured on site if desired
- fast construction times – components can be manufactured off-site and erected quickly on prepared foundations
- dry construction - little drying out time
- accurately designed and manufactured components – tighter tolerances in construction
- easy inclusion of service cavities – no chasing of walls required
- more freedom in the design of living spaces – larger clear spans possible
- easy achievement of air-tightness using appropriate tapes
- reduced requirement for scaffolding
- lighter buildings – impact on foundation design
- earlier closing in of building – walls and prefabricated roof quickly erected - allowing for electrical and plumbing trades and quick fitting and decoration.



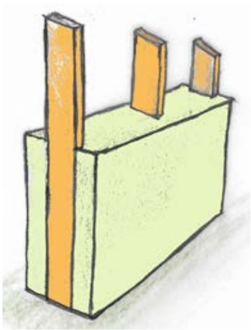
***Negatives:***

- high level of accuracy demanded in construction of foundations
- detailed pre-planning demanded at all stages of manufacture, assembly and erection
- dry storage of materials required on site.

**Rendered wall of timber frame and hemp-lime construction *environmental considerations***

***Positives**:*

- use of sustainable materials – hemp is one of the fastest growing plants
- low energy input in manufacture and transport of materials
- fast growing hemp sequesters $CO_2$ for the life of the building
- naturally breathable wall
- reduced use of plastics/membranes and other industrially manufactured materials
- lime plaster finish internally enhances feeling of warmth and is aesthetically pleasing.



***Negatives:***

- land diverted from food production to produce raw material
- hemp grown under licence, may be difficult to source
- airtightness not easily achieved
- hemp-lime wall not load-bearing, load-bearing frame has to take weight of floors and walls.

**Ease of construction - *Positives:***

- trade skills similar to those needed for timber-frame construction
- hemp/lime mix can be mixed on site – simple shuttering for wall construction
- reduced drying-out time
- building can be roofed and closed in quickly leading to efficiencies in finishing times
- less liable to disruption due to unsuitability of weather.

***Negatives:***

- construction skills may not be available locally
- wall-type relatively new so specific knowledge may not be readily available
- materials may be scarce, have to be imported or difficult to source – expensive.

*Any other relevant points*

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

| Material Element | Conductivity k | Resistivity r | Thickness T(m) | Resistance R |
|---|---|---|---|---|
| Ext. Surface Resistance | | | | 0.048 |
| External Render | | 2.170 | 0.016 | 0.03472 |
| Concrete Block | | | | 0.210 |
| Polystyrene Insulation | 0.037 | 27.027 | 0.025 | 0.67568 |
| Plasterboard | 0.160 | 6.25 | 0.0125 | 0.078125 |
| Int. Surface Resistance | | | | 0.104 |
| | | | Total R | 1.151 |
| | | | **U-value** | **1/R= 0.869** |

**5(b)** $U = 1/R_t$ R = T/k, R = T × r
Resistance for required U-value of 0.15 = 1/0.15 = 6.6666 $m^2$ K / W

Resistance of existing wall =1.151$m^2$ K / W

Difference in Resistance = 6.6666 – 1.151 = 5.5156 $m^2$ K / W

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

5.5156 = T/0.037

T = 5.5156 × 0.037 = 0.20408 metres

Thickness of required Expanded Polystyrene insulation = 204.08mm. **204 - 205 mm** acceptable.

Alternative calculation methods are also acceptable.

**5(c)** Cost of heat lost annually through the wall
U-value of upgraded wall = 0.15 W/$m^2$ K

Area = 140 $m^2$ Temp difference = 12

- Heat loss formula: = U -Value × area × temp. diff

  0.15 x 140 x 12 =252Watts.(Joules / sec)

- Heating period p/a: 60 × 60 × 8 × 7 × 36 = 7,257,600 seconds (2,016 hours)

- Kilo joules p/a:

  $\frac{7,257,000 \times 252}{1000}$ = 1,828,915.2 kJ

- Litres p/a: ( Note: Calorific value of 1 litre oil = 37350 kJ) Cost p/a: 1 litre of oil costs 98 cent.

  $\frac{1,828,915.2 \text{ kJ}}{37,350\text{kJ}}$ = 48.9669litres

48.9669 × 0.98 = €47.9876

Cost of heat loss annually through wall = **€47.99**

Alternative method:

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

$$(1) = \frac{0.15 \times 140 \times 12 \times 7{,}257{,}600 \times 0.98}{37{,}350 \times 1000}$$

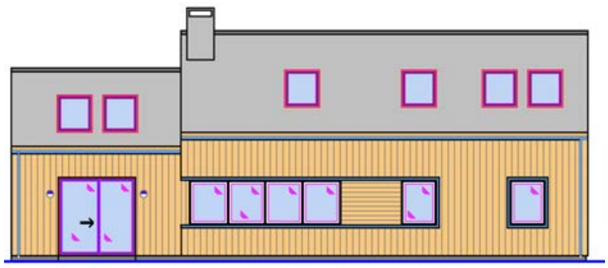
$$= \frac{1{,}792{,}336{,}896}{37{,}350{,}000}$$

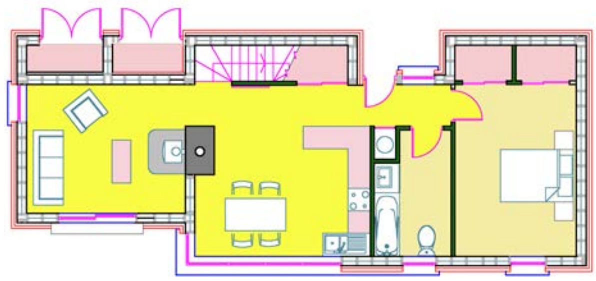
$$= €47.9876$$

Cost of heat loss annually through wall = **€47.99**

**Ceist 6**

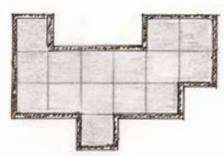
**(a) Importance of eco-friendly design in the 21st century – such as**



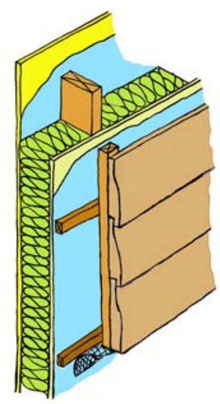


- ethical living and ethical building a must for the 21st century
- cannot have a sustainable planet without sustainable buildings
- one planet supplies all our needs – and stores our waste – we need to tend it carefully
- diminishing natural resources, fossils fuels such as oil, coal, gas are non-renewable and diminishing
- the more we use of them, the less that is left for future generations
- a new ethic is required, doing very much more, with very much less for very much longer - buildings consume about 40% of total energy use – to mine and process the raw materials, to transport the materials often over long distances, and to process and construct the buildings.

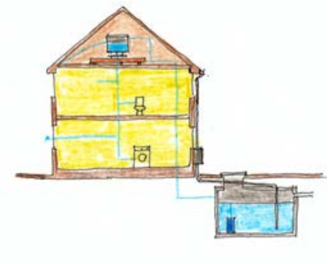
**(b) Three features of the design that make the house an eco-friendly house - such as:**



- the house - except for foundations, ground floor, chimney stack and internal plasterboard for fire-proofing - is entirely constructed from wood
- wood is renewable, carbon neutral and has low embodied energy
- simple building form appropriate to eco-friendly design
- the native larch finish on the exterior, is carbon neutral and reduces the embodied energy of the house, giving a low-carbon construction
- larch cladding is naturally durable and needs no preservatives – can be flame charred as a finish
- reduced transport costs as larch is available in Ireland and does not have to be imported or transported long distances
- lightweight timber-frame building needs smaller foundations – eco-friendly
- the use of timber-frame construction leads to renewable materials providing storage of $CO_2$ sequestered from the atmosphere
- the large areas of glazing, which are south-facing, lead to solar gains which help to reduce the use of non-renewable fossil fuels for space heating
- there are no windows to the north, thus reducing heat loss and helping conserve energy



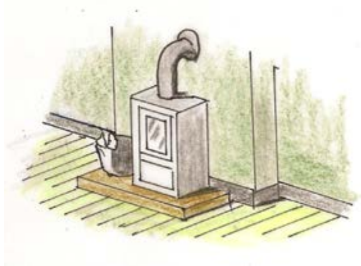
- external storage space to the north, at rear, builds a buffer zone to outside, reducing heat loss through the cold north facing external walls
- the stove and flue are placed against an inner chimney stack of high thermal mass, increasing the storage of heat and keeping the heat within the fabric of the house
- wood burning stoves are carbon neutral and are about 70% efficient
- purposely designed open-plan, naturally lighted layout with no corridors, all space is useable, no wasted floor area – 1.5 storeys for maximum use of upper floor area
- compact circulation areas and no corridors
- hot press adjacent to bathroom and kitchen and stove, short pipe runs and reduced hot water run off
- the compactness of the design reduces the volume of the air to be heated
- the area and orientation of the fenestration support the use of passive solar gain to complement space heating
- the compact footprint of the building reduces the area of the exterior envelope of the building, helping to conserve materials and heat.



**6(c) - Two features that could be added to the design that would further reduce the operating costs of the house.**

***Adding to the building fabric***

- storm porch to be constructed at entrance to prevent direct access and reduce heat loss
- second external door to be fitted to rear hallway to form storm lobby
- internal doors fitted to zone sitting room from kitchen/dining room
- increase size of windows and roof light windows on southern façade to increase solar gain.

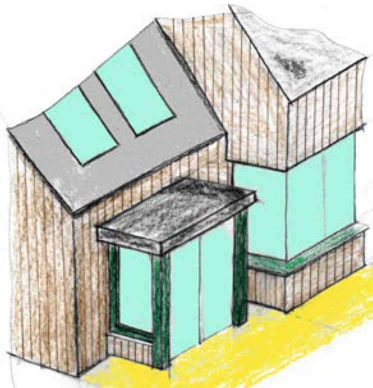


***Install evacuated tubes***

- evacuated tubes to be fitted on front roof - southern elevation - to provide up to 60% of hot water requirements - less electricity required, thus reduced operating costs.

***Install photovoltaic (PV) panels to generate on-site renewable energy***

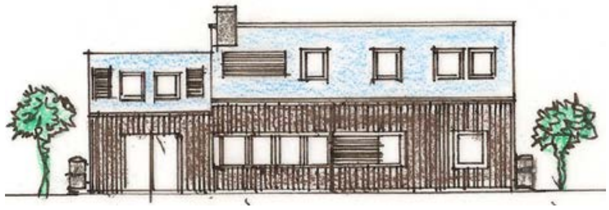
- photovoltaic (PV) panels to be fitted on front(South) roof, which convert solar energy, sunlight, into electrical energy
- photovoltaic panels can be used to supplement electricity supplied from the grid
- photovoltaic panels reduce the use of mains electricity by replacing some of the mains power with electricity from renewable sources
- average annual consumption of electricity per household is about 3.0 to 4.7 kW – an area of 21m$^2$ of photovoltaic panels produces about 3.12 kW of electricity
- lithium-ion batteries are being developed to store electricity generated by photovoltaic panels – e.g. Tesla Powerwall home batteries which store enough energy to allow a household go off-grid.



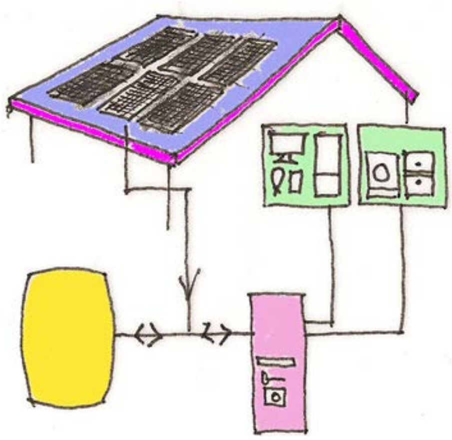
***Wind generator to generate electricity from the wind***

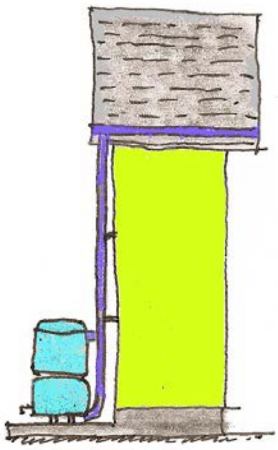
- wind speed and height of turbine are critical for electricity generation
- a turbine should be a minimum of 10.0 m above the roof or any other obstruction within 100.0 m - such as buildings or trees, to reduce turbulence, which reduces efficiency and causes undue wear
- micro – turbines generate very little electricity - a few hundred watts as used on caravans and are not suitable for supplying power to a dwelling house

- a micro turbine between 1.5 m and 2.0 m in diameter may provide about 10% of the average power use of a house - 4700 kWhr/year
- turbines vary in size and power output, from 1.5 m to 2.0 m in diameter suitable for a single dwelling, ranging from 5 or 6 kW turbines to 2-3 megawatts for community-owned turbines
- most small wind turbines generate direct current (DC) electricity
- off-grid systems require battery storage and an inverter to convert DC electricity to AC alternating current, as used for mains electricity
- a controller is also required to ensure the batteries are not over-or under-charged.
- battery storage not required if connected to the grid.



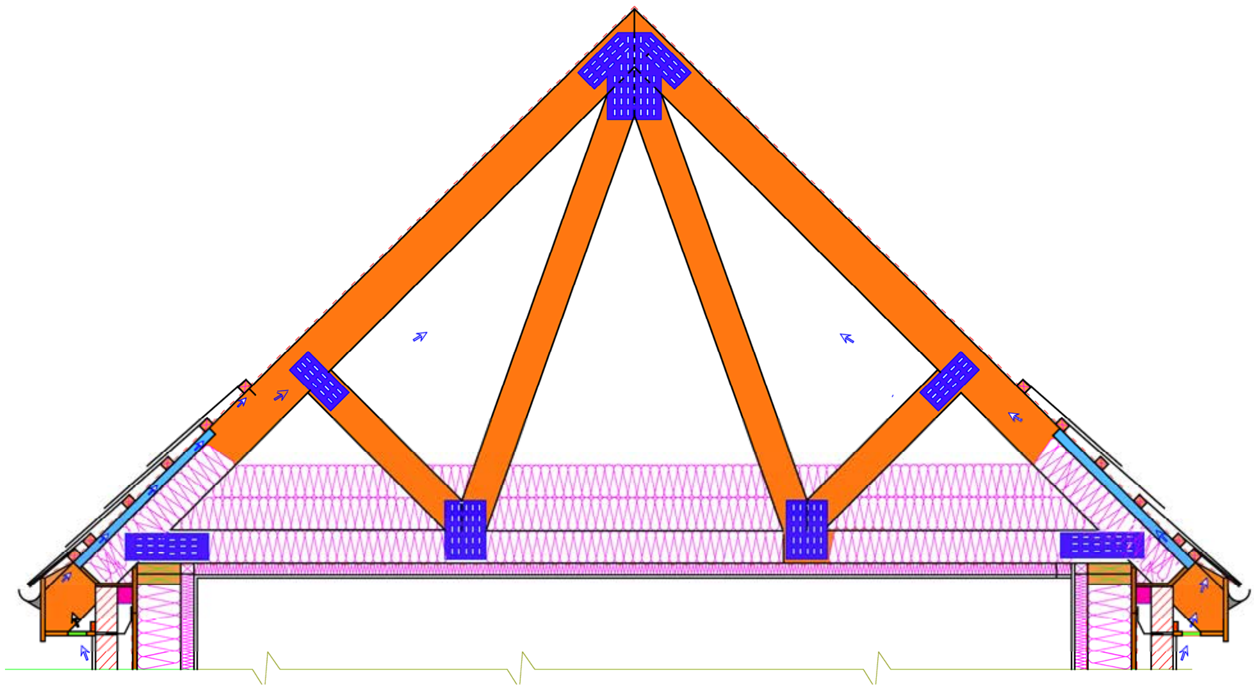
**Rainwater harvesting**
- collect rainwater from roof and stored in containers for reuse
- inexpensive rainwater butts can be placed at downpipe, water used for watering plants etc.
- rainwater can also be collected and stored in a larger capacity tank usually placed underground in the rear garden
- water is filtered and pumped into house to be used for flushing toilet and watering flowers.





## Ceist 7

**Prefabricated trussed rafters - pitched slated roof and wall of timber frame construction - typical details**

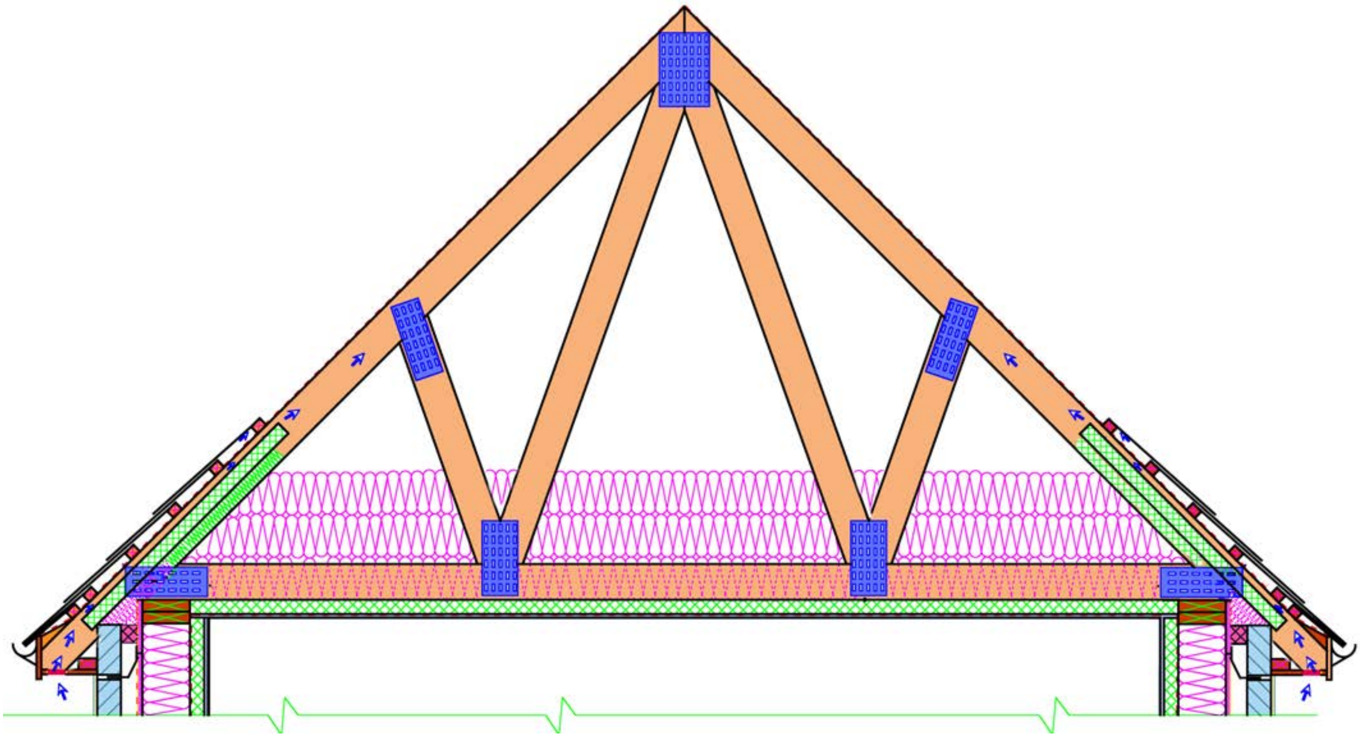


### Roof - typical

- slates on battens 50 × 40 mm
- breather membrane sealed and taped
- air space to provide ventilation to roof - 30 mm minimum
- wood fibre board or PIR insulation board, or similar, to create ventilation channel to rafters
- trussed rafters - ceiling joists, struts and hangers - typical 150 to 200 × 40 mm at 600 mm centres
- fascia and soffit – soffit with air vent as shown and tilting fillet
- 3 layers insulation total 600 mm at ceiling level
- Plasterboard with bonded polystyrene - or similar - to walls and ceiling – fireproofing and heat retention
- airtightness tape at junction of wall and ceiling.

### Walls - typical

- 18 mm external render and 100 mm solid concrete block
- PIR or similar high density insulation as cavity closer
- racking board – 9mm to 18 mm OSB, Smartply or similar for stability
- breather membrane sealed and taped to external surface of board
- cavity and stainless steel wall brackets set in blockwork and fixed to racking board
- 200 × 400 mm vertical studs at 400mm centres
- 200 × 400 mm doubled headpiece for
- breather membrane fixed to inside surface, with two layers of plasterboard or
- plasterboard with bonded polystyrene - or similar – fixed internally – for fireproofing and heat.

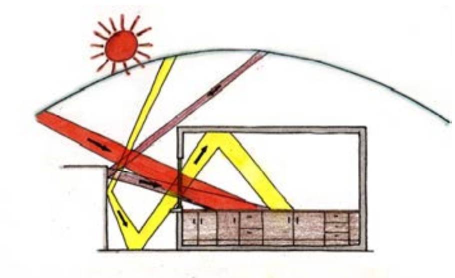


***Other appropriate roof detailing accepted***

**Ceist 8 (a)**

***Natural Light***


- countertops are the primary task areas in kitchens - careful consideration must be given to the lighting plan for the kitchen
- use of light meter to help in the design of lighting plan
- design to provide even lighting while avoiding excessive glare
- careful placement of windows to reduce dependence on artificial lighting
- light from sky above most efficient – roof lights, light tunnels, domes and light panels
- natural light aids positive mental attitude and a general sense of well being - phototropic
- natural light and sunlight enhance occupant comfort creating a calm environment
- natural light connects occupants with the outdoors
- natural light enhances clarity and colour definition.



***Artifical light***

- provides safe and effective illumination for preparing, cooking and eating
- consideration given to energy efficiency of light source – strip LEDs
- provide task lighting to specific locations - sinks, countertops, hobs, islands
- use of sensor lighting reduces energy consumption
- locate and position lighting to allow ease of maintenance
- use of diffused light helps soften atmosphere within the kitchen
- can be used to highlight kitchen cabinetry
- may be ceiling mounted, wall mounted or fixed to cabinets
- lighting may be movable to suit various tasks
- glass doors and glass shelves in kitchen cabinets allow diffuse light to filter into room.

Reference:
101 Rules of Thumb for Low Energy Architecture by H Heywood. ISBN: 987 1 85946 481 6 - Publishers: RIBA.

**(b) Degree of efficiency method.**

**Formula:** $$Li = Lo \times WF \times E \times \frac{\text{Window area}}{\text{Floor area}}$$

**Li** = Lux required

**Lo** = Standard Overcast Sky (C.I.E. = 5,000 Lux)

**WF** = Window factor is the reduction in incident light due to Window Position – on a Vertical Wall. Constant value of 0.5

**E** = Efficiency coefficient: - Reduction for Reflections, Obstructions, Glass, etc. Constant value of 0.4

$$500 = 5{,}000 \times 0.5 \times 0.4 \times \frac{\text{Window area}}{4.8 \times 3.5}$$

$$500 = 5{,}000 \times 0.5 \times 0.4 \times \frac{\text{Window area}}{16.8}$$

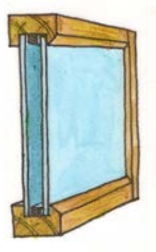
$$500 = 1{,}000 \times \frac{\text{Window area}}{16.8}$$

$$500 = \frac{1{,}000\ W}{16.8}$$

$$500 \times 16.8 = 1{,}000\ W$$

$$8400 = 1000\ W$$

$$W = \frac{8400}{1000}$$

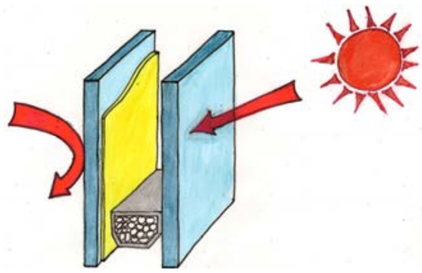


**Window area = 8.4 m²**

**(c) Advances in glazing technology**

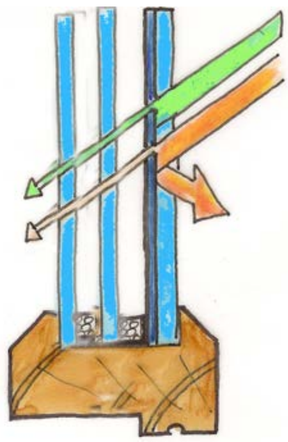
**Insulated Glazing Units (IGU)**

- double or triple glazed units hermetically sealed to form a single unit
- cavity filled with argon or krypton gas giving a much lower u-value
- aerogel technology is being developed which allows even greater insulating properties.



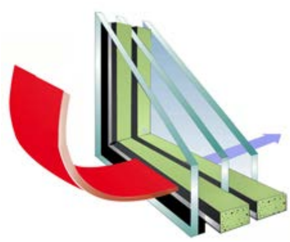
**Low Emissivity (Low-E) Glazing**

- microscopically thin metallic layer is placed on inside surface of glass pane
- low-e coating allows the suns short wave radiation to pass through to the inside
- re-radiated heat from inside the dwelling in long wave form is reflected back into the room.

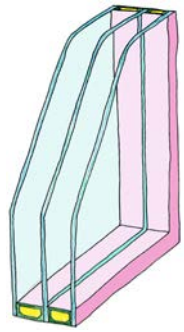


**Dynamic Glass/Smart Glass**

- enables glass to change tint when necessary to reduce glare and heat load
- provides greater levels of comfort for the occupant
- electrochromic : metallic oxide layers fixed to surface of glass
- low voltage electric current passed through layers
- thermochromic glass reacts and tints to the heat of the sun.

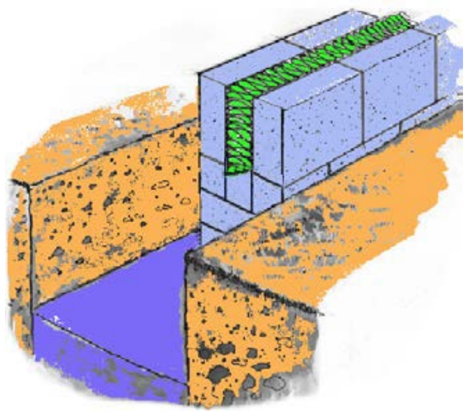


**Warm edge spacer**



- warm edge spacer insulate the edges of a sealed unit and keep the panes of glass apart
- warm edge spacers are made of an insulating plastic composite material which acts as a barrier to heat loss
- the insulating plastic has low heat conductivity and thus reduces the amount of heat lost through the sealed unit
- warm
- edge spacers lose little heat, hence the name 'warm edge' and as a result less heat is lost through the windows, heating bills are lower and condensation is avoided at the edges.

**Ceist 9**. **(a) Show the typical design detailing of the foundation**.
**Reasons for dimensions specified depth of trench below ground**

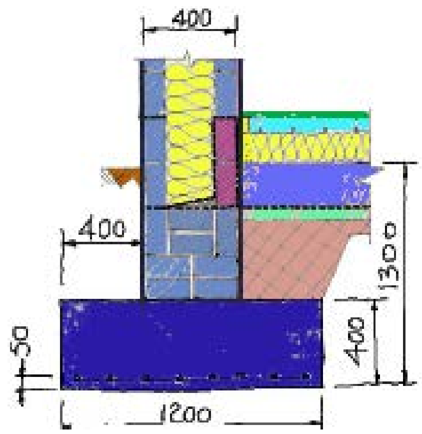


- typically 1000 - 1200 mm below ground level and below frost line,

so there is no movement of soil owing to freezing and thawing
- usually solid, compacted soil at this level
- further depth if required until solid base is achieved.

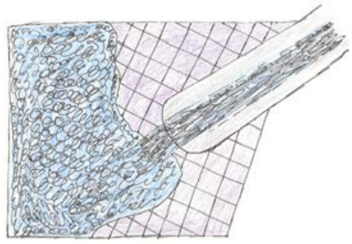
**width of trench**
- typically wall thickness × 3, 1200 mm
- to spread the load over wide area
- to provide for sufficient reinforcement
- to allow workers lay the blockwork to ground level
- to provide level base for wall

**reinforcement**
- typically 12 mm mild steel bars longitudinally and traverse
- tied at junctions
- 50 mm cover to bars to prevent ingress of water, water causes the bars to rust and expand, resulting in spalling of the concrete and reduction in strength.

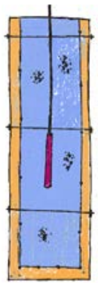



**9(b) Mixing: - For maximum strength of concrete**
- ensure aggregates and water are free from impurities and contaminants
- batching of aggregates must be accurate and comply with required strength
- if batching by volume, consideration must be given to the bulking of fine aggregates
- mechanical mixing best – readymix
- in extreme weather protect aggregates from frost and direct sunlight
- proportion and size of aggregate impacts strength of concrete
- smaller aggregate gives increased workability but reduces strength.

**Placing:**
- the batch of concrete should be workable enough to allow placing without voids being formed
- extra water to increase workability leads to weaker concrete
- the wet concrete should be carefully placed, avoid dropping from height as this will lead to separation of the mix with coarse aggregate sinking to the bottom and fine aggregate floating on top
- preparation of formwork is essential to ensure that it will not be deflected by the weight of the concrete
- the surfaces of the formwork should be treated with oil to stop adhesion of the concrete
- the formwork should be watertight to avoid the water-cement paste being washed out.

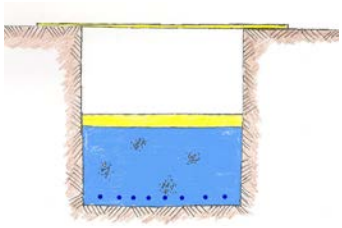


**Compacting**:

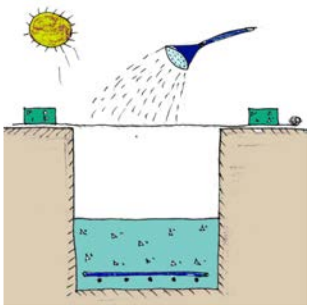


- it is important that the aggregates and the water-cement paste are firmly in close contact to ensur e that the chemical reaction occurs evenly throughout
- a tamping beam is used to compact the concrete as it is placed in layers
- ideally mechanical vibration to be used to aid compaction
- the mechanical vibration causes air bubbles to rise to the top and collapses any voids
- care should be taken to avoid contact between the vibrator and the formwork which can cause separation of the coarse and fine aggregate close to the formwork.

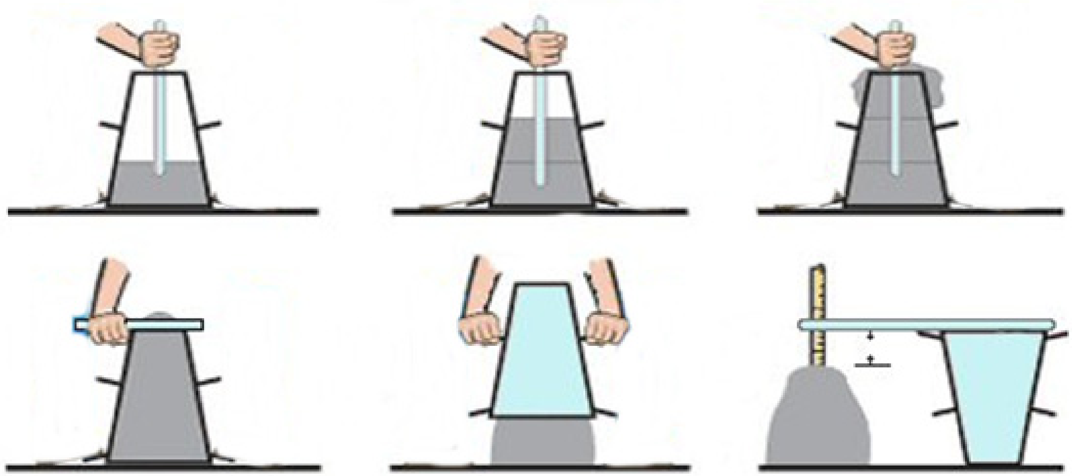
**Curing:**



- the initial setting begins immediately on mixing and the concrete should be placed within approximately thirty minutes
- curing is the process by which concrete continues to gain strength following the initial set curing is continuous for hours, days, weeks and even years
- newly placed concrete should be kept damp through the early stages of curing - sketch
- in hot weather this may involve the protection of the top surface of the concrete with a moisture-retaining fabric (hessian material) and apply misting water over the hessian at reqular intervals
- the longer concrete is kept moist the stronger and more durable it becomes
- in cold weather concrete protected from frost using straw/jute/polythene/ insulation - see sketch.



**(c) Slump Test**



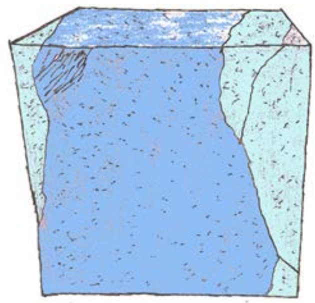
**Procedure:**

- clean the internal surface of the mould and apply oil
- place the mould on a smooth horizontal non-porous base plate
- fill the mould with the prepared concrete mix in 3 approximately equal layers
- tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mould
- for the subsequent layers, the tamping should penetrate into the underlying layer
- remove the excess concrete and level the surface with a trowel
- clean away the mortar or water leaked out between the mould and the base plate
- raise the mould from the concrete immediately and slowly in vertical direction

- measure the slump as the difference between the height of the mould and that of high point of the specimen being tested
- the greater the slump, the weaker the concrete
- batches for the same job, i.e. foundations - should have the same slump.

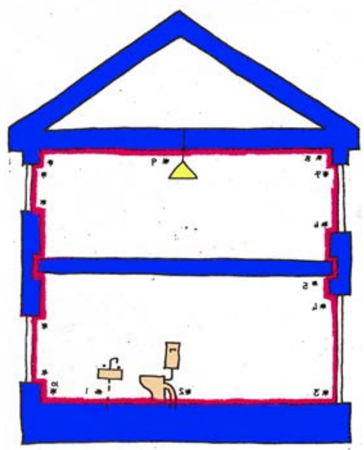
**Cube Test**

- the cube test assesses the strength of concrete used in a structure, by selecting a sample cube of the concrete and by testing that sample
- clean and lightly oil all surfaces of the steel cube mould
- select a representative sample of concrete
- place the concrete in the mould in three equal layers
- tamp each layer 6 times with the tamping rod
- clean off surplus concrete and rub exposed top surface smooth using a steel trowel
- store the concrete cube overnight internally and ensure an ambient room temperature is maintained
- strike the steel mould after 12 hours

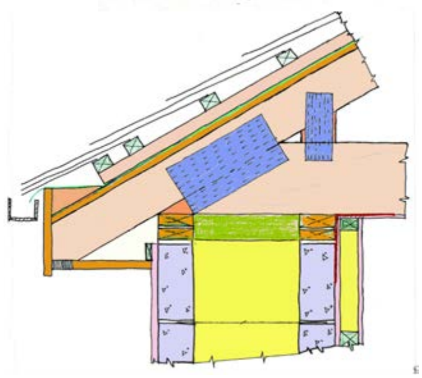


- record essential information-(date/ strength/ location) on the top surface of the cube using a waterproof marker
- store the concrete cube in a designated heated water storage tank until collected and brought to the testing facility
- cubes may be tested at 7 day intervals starting from the date of pouring (7, 14, 21, 28 days)
- cubes are tested using Uniformly Distributed Loading, UDL applied at constant increasing pressure - to destruction
- the crushing strength is recorded as N/mm$^2$ .

**Ceist 10 (a) Airtightness:**

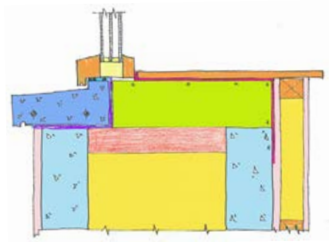


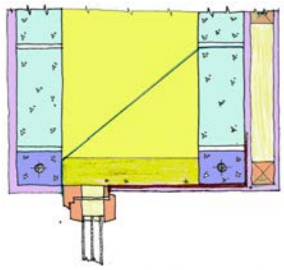
- an airtight building incorporates a layer in the external envelope which inhibits the movement of air
- airtightness layer prevents air leakage from the internal environment, it also prevents the infiltration of cold air
- airtightness contributes to an improved thermal comfort, improved efficiency of the thermal insulation layer and eliminates moisture ingress to the building structure
- plastering internally is sufficiently airtight, issues can arise due to the penetration of mechanical and electrical services. The inclusion of a service cavity inside the plastered/airtightness layer can improve the effectiveness of the airtightness layer



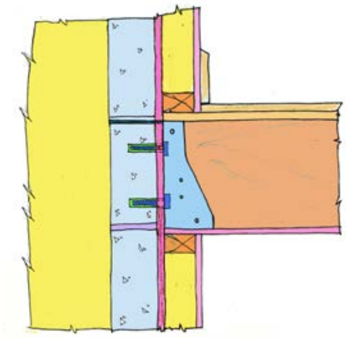
- an airtight building must be properly ventilated to ensure adequate levels of fresh air to the occupants
- the airtightness layer must be installed correctly, preferably by trades that have been trained and are familiar with the principles of airtightness. All other tradespeople on site should be familiar with the principles of airtightness to avoid unnecessary penetrations to the airtightness layer
- to achieve passivehaus certification the level of airtightness should be tested with a “blower door test”. The standard that must be achieved is 0.6ac/h – 0.6 air changes per hour.

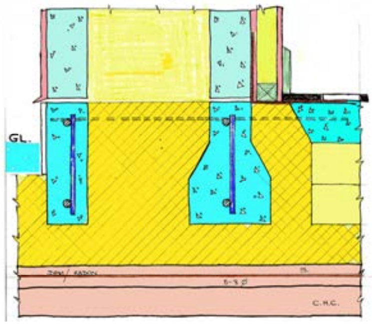
**Indoor Air Quality**

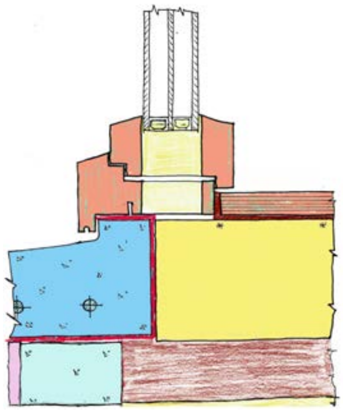




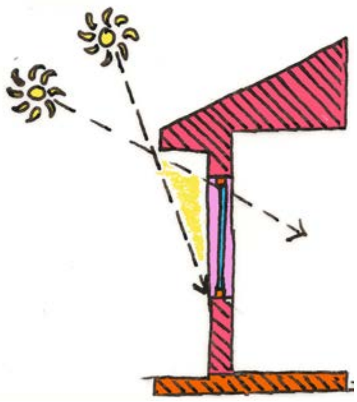
- in a passive house mechanical ventilation must be provided due to the high levels of airtightness required in the building structure
- this is generally provided as a centralised whole building solution, such as a Mechanical Heat Recovery with Ventilation system. MHRV systems extract warm damp air from "wet" rooms such as kitchens and bathrooms, this air is then used to pre-heat the cool fresh incoming air which is supplied to living spaces of the building
- there are decentralised systems developed as solutions for ventilating passive homes such as single room ductless systems
- MHRV systems filter the outdoor air ensuring that clean, dust and pollen free air is supplied to all of the building
- relative humidity of the indoor air should be in the range 30%-60% to ensure a comfortable environment for occupants
- internal $CO_2$ levels must be below 1000ppm
- the temperature of all internal surfaces, such as walls, ceiling and windows, must not be below 12.6$^{o}$c to prevent condensation and mould growth.



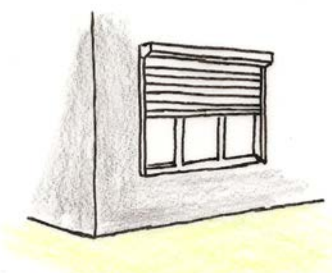


**Solar Shading**

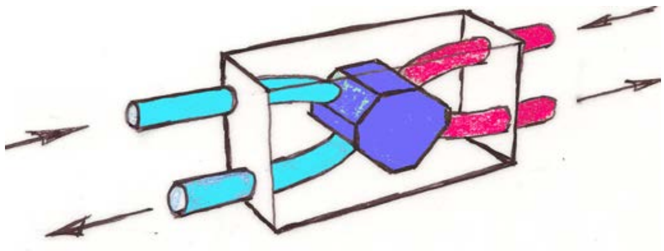


- a passive house depends largely on solar gain for much of its space heating requirements, this typically requires large areas of glazing on the southern façade of the building. in summer or during periods of prolonged sunshine this can lead to overheating of the building unless solar shading is provided
- solar shading can be designed as an integral part of the building structure such as an overhang of the roof or a brise-soliel
- such systems are based on the principle that in summer the sun is at a much steeper angle than the winter sun. a correctly designed overhang or brise-soleil will significantly reduce the solar gain during the summer period while having little impact on the solar gain during the winter period
- blinds and shades will reduce solar gain but will also impact the level of natural light entering the building
- dynamic glass which is standard float glass with an electrochromic coating applied on one of the surfaces automatically adjusts its tint in response to solar irradiation, thus controlling the level of solar gain to the building
- mechanical external shading such as adjustable brise-soleil, external roller blinds, awnings and sliding screens can be adjusted and used to control solar gain. However, many of these systems will impact on the levels of natural light entering the building.



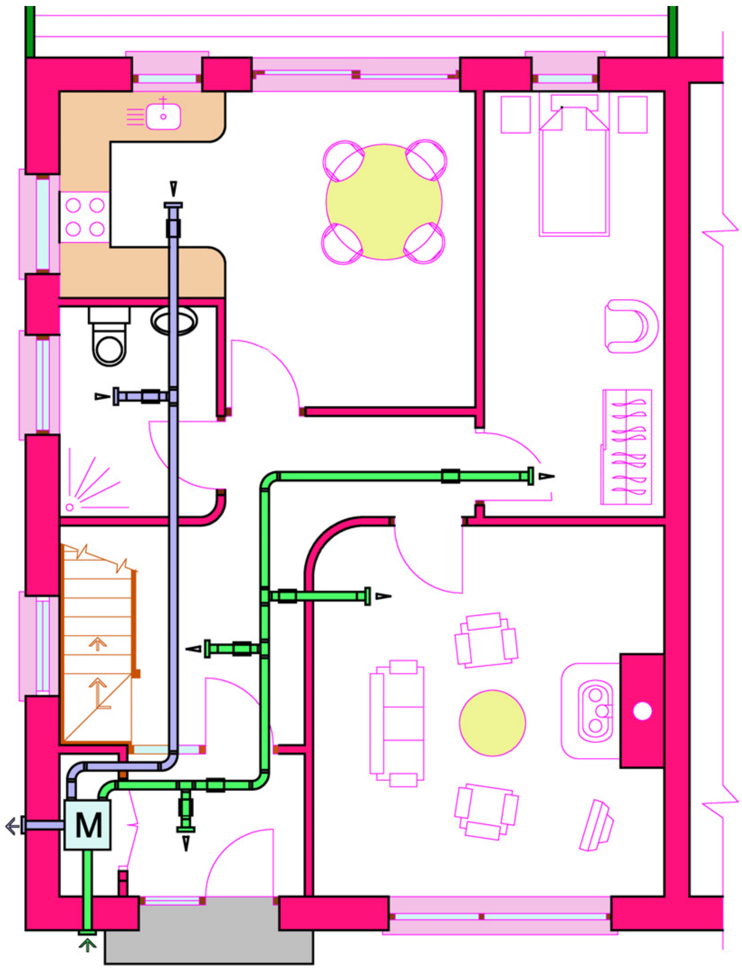
**10(b) How a mechanical heat recovery ventilation system works:**

- a MHRV system provides a constant supply of clean fresh pre-heated air to a building while also removing moisture laden air from "wet rooms" such as bathrooms and kitchens
- the unit is generally located within the insulation layer of the building on an external wall, from this a carefully designed arrangement of ductwork extracts warm moist air from rooms such as bathrooms and kitchens
- the warm air is passed through a heat exchanger that pre-heats cool fresh incoming air, the incoming air also passes through a particle filter that removes dust and pollen ensuring that the air supplied to the house is clean
- fresh, clean pre-heated air is now pumped through another separate arrangement of ductwork to strategic locations in the living spaces of the building, thus ensuring an adequate supply of preheated, fresh, clean air throughout the building.



**10(c) Locating the MHRV unit in the hallway as shown has advantages - such as:**

- it is located on an external wall so extract and intake ducts can be taken directly out through the external wall
- it is positioned away from the living spaces and bedrooms therefore minimising the impact of noise from the unit
- the unit is contained in a press, minimising any visual impact it may have
- the location of the unit in the hallway allows easy access for regular maintenance and filter change
- its location in the internal environment, inside the insulation layer minimises any heat loss that may occur in ducting.



**Ceist 10**.
While there are undoubtedly many buildings whose heritage values dictate that they should be preserved unchanged, the reality is that few are of such importance that they and their settings are not capable of being remodelled to accommodate new uses - especially where they have outlived the functions for which they were constructed, and where adaptation and reuse is the most viable option for extending their lifespans and preserving the vitality of their urban locations.
The alternative is to let them fall into disuse and disrepair, along with the ensuing deterioration of their urban environments. By Paul Keogh. VOL 6 THE RIAI ANNUAL REVIEW 2015/2016.

Discuss the above statement in detail and propose **three** best practice guidelines that would promote the adaptation and reuse of heritage buildings built after 1800, to prevent them from falling into disuse and disrepair.

Discussion of the above statement– such as:

- heritage buildings of distinctive character need to be preserved as far as possible unchanged. These buildings bestow a sense of character on many villages, towns and cities. Such heritage buildings give a distinctive character and unique sense of place - genius loci - to many villages and towns
- distinctive heritage buildings express a continuity with the past, reflecting the style, construction techniques and materials of the past
- heritage towns and villages attract tourism, giving a vibrancy to the community
- heritage buildings express a value system of design and craft excellence. Such buildings become exemplars of best practice and repositories of learning for future generations of architects, engineers and craft persons
- restoring an old building develops in the present generation a sense of care for the past
- heritage buildings provide a location for the acquisition and practice of preservation skills and techniques, the buildings become sites of learning for the next generation of conservation architects, engineers and craft persons - preservation knowledge can be handed on from the specialists
- adapting heritage buildings for new uses provides a site of learning for architects and engineers

- the challenge posed is whether to preserve a heritage building in its original state when the reason for its use has ceased - a railway building with no train line, a church building without a congregation, a school without pupils, a courthouse with no court - or to modify and upgrade the building to make it suitable for a new use
- if the re-use of a building is not considered then it is likely to degrade, fall into disuse and disrepair and eventually may have to be demolished and the heritage value is lost forever
- buildings allowed fall into disrepair pose a safety risk and may have to be demolished, upgrading for reuse extends the lifespan of the building and protects some of its heritage value
- buildings often outlive their original uses - the present-day uses of buildings will, in many instances, be very different to the functions for which they were first designed and built – technologies change and the function of buildings change
- no building lasts forever, all buildings degrade over time and need continuous refurbishment – roof and floor timbers, wooden windows rot and decay, slates and stone degrade etc. so upgrading forms part of the life cycle of a building
- many houses from the Georgian period are in need of an upgrade so that they can continue be lived in and used, some such houses are large by today's standards, designing for reuse extends their lifespan
- the structure of heritage buildings often needs thermal upgrading, fire upgrading, upgrading for universal access and these of necessity upgrade the fabric of the building
- rather than allow a building fall into disrepair and disuse, best-practice guidelines for reuse encourage uses that meet a need today, and remodelling is necessary to make the building suitable for a new use

- guidelines aim to ensure that such sensitive modifications are allowed and that these do not provide an unnecessary impediment to reuse
- as a general rule, the original building should be legible and the new alterations should not mask or distort the integrity of the original structure
- adaptation and remodelling should be respectful of the structure, aesthetic and beauty of the original building and interventions should, where possible, be reversible
- costs are important and should not be so prohibitive as to deter the modification and remodelling of an old building
- remodelling should take account of the immediate surroundings of the building to be refurbished
- in some cases the interior of the building may have to be reconfigured to make the building useful - the focus should be on maintaining the integrity of the exterior of the building, the interior being reimagined to suit the priorities imposed by the new use of the building
- upgrading heritage buildings in both rural and urban areas helps to bring back the charm of urban living and breathes new life into derelict buildings and areas
- architects can reimagine new uses and new layouts by creative yet realistic plans
- the upgrading and reuse of a heritage building can bring new uses, new tenants, new businesses, and a new vitality to the surrounding area
- restoring a heritage building as a mixed use building for young and elderly, together with provision for the arts, artists' studios, art galleries, cafes etc. can bring back life and energy to a derelict area
- modifications often require some intrusion, such as fitting a lift, widening doors, toilets for universal design, to make the building suitable for universal access, these have to be carefully considered
- successful upgrading of existing buildings can lead to a new vitality in the areas upgraded and provide examples of good practice and offer a pattern as to how such approaches could be adopted
- building on past experience should lead to the avoidance of mistakes and should lead to a new appreciation of the importance of tradition, having heritage buildings envisioned in new ways, light-filled, lean, beautiful, delightful and a joy to behold.

**Three** best practice guidelines that would promote the adaptation and reuse of heritage buildings built after 1800, to prevent them from falling into disuse and disrepair – such as

- successful refurbishments/adaptations should be promoted as exemplars of best practice and should encourage others to follow example – dissimulation of skills learned in restoration work
- conservation grants and financial supports should be provided for individuals and organisations undertaking a refurbishment for reuse of a heritage building
- centres of excellence for designers and craft persons should be established to train professionals in conservation methods and techniques
- guidelines for best practice should be widely disseminated to ensure broad design-based expertise
- conservation architects/designers should form part of the design team to ensure best advice
- the new use to which it is proposed to put the building should be specified, clearly stating those elements that are essential if the building is to successfully meet the new requirements
- all works identified as essential to the successful re-use of the building should be incorporated into a refurbishment plan
- the refurbishment should be as true as practicable to the original layout, materials and construction processes used in the initial construction
- the new should be distinct, discernible and legible, with quality materials equal to that of the original
- priority should be given to the successful adaptation of the building to a new use or uses - successful upgrading is dependent on the extent to which the building meets the requirements of its new function
- where appropriate, public money and resources should be used to encourage thoughtful refurbishment
- the wider community benefits when the amenity value of a street or area is enhanced by refurbishment and reuse of a heritage building.

***Any other relevant, cogent, well-argued points.***

Coimisiún na Scrúduithe Stáit
*State Examinations Commission*

# *Staidéar Foirgníochta*

## *Teoiric – Ardleibhéal*

# *Construction Studies*

## *Theory – Higher Level*

## *Marking Scheme*

## CEIST 1

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| ***Foundation/concrete ground floor/suspended timber ground floor*** ***(12 points × 4 marks)*** ***8 points from foundation and external wall,*** ***4 points from suspended timber floor*** ***(Drawing 3, Annotation 1 )*** | |
| **foundation and external wall**<br>• R.C foundation<br>• dead blockwork and cavity wall above floor level<br>• wall insulation and thermal block<br>• external render and internal render<br>• stepped dpc and dpc at floor level<br>• lintels and vent for ducting<br>• hardcore and sand blinding<br>• radon barrier/dpm<br>• concrete floor detail<br>• perimeter insulation to wall and floor insulation<br>• floor tiles and skirting<br><br>**Suspended timber floor**<br>• subfloor (under dwarf/tassle walls)<br>• radon barrier<br>• hardcore and blinding<br>• dwarf/tassle/sleeper walls<br>• wall plates and dpc<br>• floor joists<br>• floor insulation<br>• floorboards | **4**<br>**4**<br>**4**<br>**4**<br>**4**<br>**4**<br>**4**<br>**4**<br><br>**4**<br>**4**<br>**4**<br>**4** |
| Scale<br>Drafting *(Excellent 8, Good 6, Fair 4)* | **8** |
| ***(b) Design detailing for cross ventilation*** | **4** |
| **TOTAL** | **60** |

## CEIST 2

| PERFORMANCE CRITERIA | | MAXIMUM MARK |
|---|---|---|
| ***(a) two functional requirements of a bathroom*** | | ***(4 × 6 marks)*** |
| **Functional requirement 1** | Note | **6** |
| | Sketch | **6** |
| **Functional requirement 2** | Note | **6** |
| | Sketch | **6** |
| ***(b) two advantages of converting the existing office A (2 × 6 marks)*** | | |
| **Advantage 1** *(3 for point, 3 for discussion)* | | **6** |
| **Advantage 2** *(3 for point, 3 for discussion)* | | **6** |
| ***(c) proposed design layout for the bathroom at A (6 × 4 marks)*** | | |
| Location of shower area | | **4** |
| Location of W.C. | | **4** |
| Location of wash basin | | **4** |
| Grab rails | | **4** |
| Dimensions of turning circle/door/any 2 dimensions | | **4** |
| Design detail to prevent the penetration of sewer gases<br>Separate Sketch | | **4** |
| | **TOTAL** | **60** |

## CEIST 3

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| **(a) *Design layout at farmhouse:*** ***(4 × 8 marks)*** | |
| **Kitchen/Extension $12m^2$** | |
| **Optimising daylight** | |
| Note/annotation | **8** |
| Sketches | **8** |
| **Open plan** | |
| Note/annotation | **8** |
| Sketches | **8** |
| ***(b) Three reasons for proposed design layout*** ***(3 × 6 marks)*** | |
| **Reason 1** | **6** |
| **Reason 2** | **6** |
| **Reason 3** | **6** |
| ***(c) Two advantages of building an extension*** ***(2 × 5 marks)*** | |
| **Advantage 1 (2 point,3 discussion)** | **5** |
| **Advantage 2 (2 point, 3 discussion)** | **5** |
| **TOTAL** | **60** |

## CEIST 4

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| ***(a) Three functional requirements of external wall (6 × 4 marks)*** | |
| **Functional requirement** 1 (Note and Sketch) | **4**<br>**4** |
| **Functional requirement 2** (Note and Sketch) | **4**<br>**4** |
| **Functional requirement 3** (Note and Sketch) | **4**<br>**4** |
| ***(b) Choice of high performance wall (any two) 2 × (5,5,2 marks)*** | |
| **Concrete block construction**<br>Note<br>Sketch<br>Dimensions | **5** |
| **Timber frame construction**<br>Note<br>Sketch<br>Dimensions | **5**<br>**2**<br>**5** |
| **Timber frame and hemp-lime construction**<br>Note<br>Sketch<br>Dimensions | **5**<br>**2** |
| ***(c) Discussion of each wall type selected (4 × 3 marks)*** | |
| **Wall type 1**<br>Environmental consideration<br>Ease of construction | **3**<br>**3** |
| **Wall type 2**<br>Environmental consideration<br>Ease of construction | **3**<br>**3** |
| **TOTAL** | **60** |

## CEIST 5

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| ***(a) U-value of external wall*** | ***(9 × 3 marks)*** |
| Tabulation/methodology | **3** |
| External surface resistance | **3** |
| External render | **3** |
| Hollow block | **3** |
| Polystyrene | **3** |
| Plasterboard | **3** |
| Internal surface resistance | **3** |
| Total resistance | **3** |
| U-Value of external wall (1 mark for formula) | **3** |
| ***(b) Wall A*** | ***(6 × 3 marks)*** |
| Formula **U=1/R** | **3** |
| R value for 0.15 using **R=1/U** | **3** |
| R value for calculated U-Value from part (a) | **3** |
| Difference in resistances (required resistance) | **3** |
| Application of formula R = T/k | **3** |
| Required thickness of insulation | **3** |
| ***(c) Annual heat loss through specified wall*** | ***(5 × 3 marks)*** |
| Heat loss formula and calculation | **3** |
| Heating duration for one year | **3** |
| k/Joules calculation for one year | **3** |
| Litres of oil for one year | **3** |
| Annual cost of heat loss | **3** |
| **TOTAL** | **60** |

## CEIST 6

| Performance Criteria | Maximum Mark |
|---|---|
| ***(a) Two advantages of eco-friendly design*** | ***(2 × 5 marks)*** |
| **Advantage 1** | **5** |
| **Advantage 2** | **5** |
| ***(b) Three eco-friendly features*** | ***(6 × 5 marks)*** |
| **Feature 1** (Note and Sketch) | **5**<br>**5** |
| **Feature 2** (Note and Sketch) | **5**<br>**5** |
| **Feature 3** (Note and Sketch) | **5**<br>**5** |
| **(c)** ***Two additional features*** | ***(4 × 5 marks)*** |
| **Feature 1** (Note and Sketch) | **5**<br>**5** |
| **Feature 2** (Note and Sketch) | **5**<br>**5** |
| **TOTAL** | **60** |

**CEIST 7**

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| **(a) *Vertical section through wall and roof structure*** <br> ***(12 × 4 marks) drawing 3 marks, annotation 1 mark*** | |
| **Roof Details** **(any 6 × 4 marks)** <br> • Ridge level - apex <br> • 4 Courses of slates <br> • Battens 50 × 30 - 40 mm <br> • Breather membrane, tilting fillet <br> • Prefabricated roof trusses at 400-600 centres <br> • 300-600 mm insulation to ceiling <br> • Gypsum plasterboard <br> • Facia, soffit, gutter (any 2) <br> • Ventilation | 4 <br> 4 <br> 4 <br> 4 <br> 4 <br> 4 |
| **Wall Details** **(any 5 × 4 marks)** <br> • Double headplate 200 × 50 <br> • Vertical stud framework 200 × 50 @400 centres <br> • Insulated service cavity <br> • Vapour barrier to ceiling and wall-joints sealed and taped <br> • 12.5 mm gypsum plasterboard and hardwall skim finish <br> • Airtight tape at wall and ceiling junction to ensure airtightness <br> • Insulation 200 mm <br> • Racking board 9-20 mm OSB or plywood <br> • Breather membrane with taped joints <br> • Vapour diffusion cavity/wall ties/cavity closer (any two) <br> • 100mm concrete block outer leaf <br> • 15-20 mm – 2 coats render | 4 <br> 4 <br> 4 <br> 4 <br> 4 |
| Both walls | 4 |
| Scale & <br> Drafting *(Excellent, good, fair)* <br> *(8 6 4)* | 8 |
| ***(b) Three typical roof dimensions*** ***(3 × 1 + 1 mark)*** | |
| Typical dimensions | 4 |
| **TOTAL** | **60** |

**CEIST 8**

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| ***(a) providing light on work surface*** | ***(4 × 4 marks)*** |
| **Natural light** (Note and Sketch) | **4**<br>**4** |
| **Artificial light** (Note and Sketch) | **4**<br>**4** |
| ***(b) Window area calculation (20 marks)*** | ***(6 × 3 marks)+2 marks*** |
| Formula<br>Correct entry into formula<br>Floor area<br>Lo × WF × E<br>Solve for w (window area) line 1<br>Solve for w (window area) line 2 | **3**<br>**3**<br>**3**<br>**3**<br>**3**<br>**3** |
| Window area | **2** |
| ***(c) Glazing technology advancement*** | ***(6 × 4 marks)*** |
| **Advancement 1** (note 4 marks, sketch 4 marks) | **4**<br>**4** |
| **Advancement 2** (note 4 marks, sketch 4 marks) | **4**<br>**4** |
| **Advancement 3** (note 4 marks, sketch 4 marks) | **4**<br>**4** |
| **TOTAL** | **60** |

## CEIST 9

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| **(a)** ***Typical design detailing of foundation*** | ***(5 × 4 marks)*** |
| Sketch of foundation<br>Note<br>Position of reinforcement<br>Three typical dimensions<br>Reasons for dimensions specified | **4**<br>**4**<br>**4**<br>**4**<br>**4** |
| ***(b) Ensure the maximum strength of concrete in the foundation*** | ***(8 × 3 marks)*** |
| Mixing (note and sketch) | **3**<br>**3** |
| Placing (note and sketch) | **3**<br>**3** |
| Compacting (note and sketch) | **3**<br>**3** |
| Curing (note and sketch) | **3**<br>**3** |
| ***(c) Test to measure consistency of concrete*** | ***(2 × 8 marks)*** |
| Note<br>Sketch | **8**<br>**8** |
| **TOTAL** | **60** |

## CEIST 10

| PERFORMANCE CRITERIA | MAXIMUM MARK |
|---|---|
| **(a) Passive house design - *any 2*** | ***(4 × 6 marks)*** |
| **Airtightness** | |
| notes | **6** |
| sketches | **6** |
| **Indoor air quality** | |
| notes | **6** |
| sketches | **6** |
| **Solar shading** | |
| notes | |
| sketches | |
| **(b) MHRV system** | ***(4 × 6 marks)*** |
| Line diagram of room layout | **6** |
| Design for ducting to MHRV unit | **6** |
| Direction of airflow in ducts | **6** |
| Description of how system works | **6** |
| **(c) Two advantages of siting MHRV unit in hallway** | ***(2 × 6 marks)*** |
| **Advantage 1** | **6** |
| **Advantage 2** | **6** |
| **TOTAL** | **60** |

**CEIST 10 (Alternative)**

| PERFORMANCE CRITERIA | | |
|---|---|---|
| ***Discussion of Statement*** | ***(3 × 10 marks)*** | |
| **Discussion** – point 1 | *(4 for point, 6 for discussion)* | **10** |
| **Discussion** – point 2 | *(4 for point, 6 for discussion)* | **10** |
| **Discussion** – point 3 | *(4 for point, 6 for discussion)* | **10** |
| ***Three best practice guidelines*** | ***(3 × 10 marks)*** | |
| **Recommendation** 1 | *(4 for point, 6 for discussion)* | **10** |
| **Recommendation** 1 | *(4 for point, 6 for discussion)* | **10** |
| **Recommendation** 1 | *(4 for point, 6 for discussion)* | **10** |
| | **TOTAL** | **60** |

Coimisiún na Scrúduithe Stáit
*State Examinations Commission*

*Scrúdú na hArdteistiméireachta 2017*
*Leaving Certificate Examination 2017*

# *Scéim Mharcála*
# *Marking Scheme*

*(150 marc)*

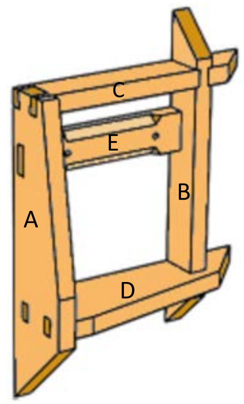
## *Staidéar Foirgníochta*
## *Triail Phraticiúil*

## *Construction Studies*
## *Practical Test*

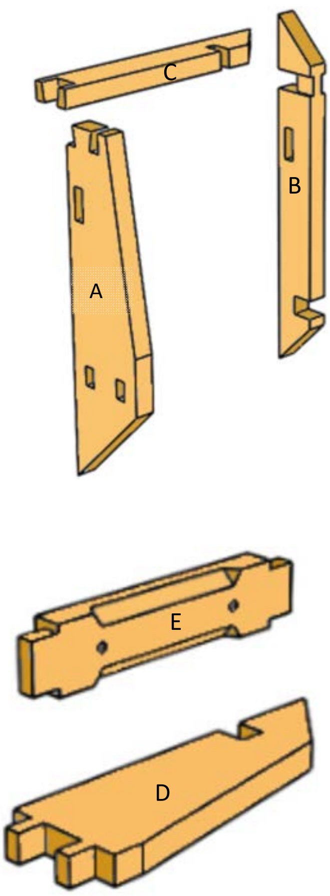
# Marking Scheme – Practical Test

**Note:**

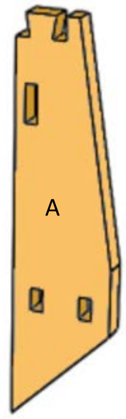
The artefact is to be hand produced by candidates without the assistance of machinery. However the use of a battery powered screwdriver is allowed. Where there is evidence of the use of machinery a penalty applies.
Component is marked out of 50% of the marks available for that procedure.

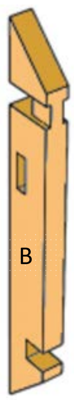


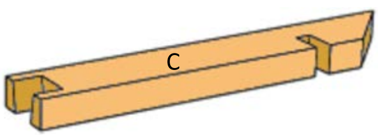

| (i) | OVERALL ASSEMBLY | MARKS |
|---|---|---|
| 1 | Overall quality of assembled artefact | **10** |
| 2 | Design and applied shaping to edges<br>• design *(3 marks)*<br>• shaping *(3 marks)* | **6** |
| | **Total** | **16** |

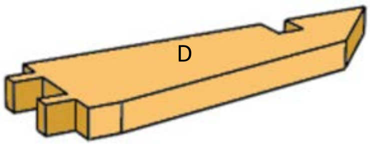


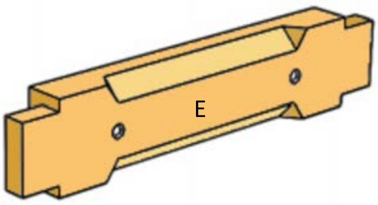

| (ii) | MARKING OUT | Marks |
|---|---|---|
| 1 | Piece **A**<br>• joints - dovetail *(3 marks)*<br>- mortices *(3 × 2 marks)*<br>• slopes *(2 × 1 mark)* | **11** |
| 2 | Piece **B**<br>• joints - bottom trench *(2 marks)*<br>- mortice *(2 marks)*<br>- top trench *(3 marks)*<br>• slopes *(2 × 1 mark)* | **9** |
| 3 | Piece **C**<br>• joints - dovetail pins *(3 marks)*<br>- trench *(2 marks)*<br>• slope *(1 mark)* | **6** |
| 4 | Piece **D**<br>• joints - tenons *(2 × 2 marks)*<br>- trench *(2 marks)*<br>• slopes *(2 × 1 mark)* | **8** |
| 5 | Piece **E**<br>• joints - bare faced tenons *(2 × 3 marks)*<br>• stopped chamfers *(2 × 2 marks)* | **10** |
| | **Total** | **44** |

| PIECE A | (iii) | PROCESSING | Marks |
|---|---|---|---|
|  | 1 | Dovetail *(6 marks)* | **6** |
| | 2 | Mortice *(4 marks)* | **4** |
| | 3 | Two mortices *(2 × 4 marks)* | **8** |
| | 4 | Shaping sloped edges *(2 × 2 marks)* | **4** |
| | | **Total** | **22** |

| PIECE B | (iv) | PROCESSING | Marks |
|---|---|---|---|
|  | 1 | Bottom trench *(3 marks)* | **3** |
| | 2 | Mortice *(4 marks)* | **4** |
| | 3 | Top trench *(9 marks)* | **9** |
| | 4 | Shaping sloped edges *(2 × 2 marks)* | **4** |
| | | **Total** | **20** |

| PIECE C | (v) | PROCESSING | Marks |
|---|---|---|---|
|  | 1 | Dovetail pins *(4 marks)* | **4** |
| | 2 | Trench *(3 marks)* | **3** |
| | 3 | Shaping sloped edge *(2 marks)* | **2** |
| | | **Total** | **9** |

| PIECE D | (vi) | PROCESSING | Marks |
| --- | --- | --- | --- |
|  | 1 | Two tenons ***(2 × 4 marks)*** | **8** |
| | 2 | Trench ***(3 marks)*** | **3** |
| | 3 | Shaping<br>sloped edges ***(2 × 2 marks)*** | **4** |
| | | **Total** | **15** |

| PIECE E | (vii) | PROCESSING | Marks |
| --- | --- | --- | --- |
|  | 1 | Barefaced tenons<br>• vertical sawing ***(2 × 3 marks)***<br>• cutting across grain ***(2 × 3 marks)*** | **12** |
| | 2 | Shaping stopped chamfer ***(2 × 4 marks)*** | **8** |
| | 3 | Drilling and countersinking hole ***(2 × 2 marks)*** | **4** |
| | | **Total** | **24** |

Coimisiún na Scrúduithe Stáit

*State Examinations Commission*

***Form A***

**Leaving Certificate Examination 2017**

# *Construction Studies*

## *Assessment of Candidates' Practical Coursework*

**Examination Number:** ______

***Type of Project:***

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

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