

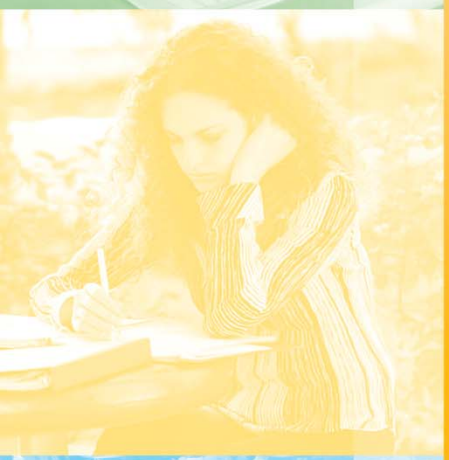


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DEB exams ...resourcing schools

Pre-Leaving Certificate Examination, 2011

Construction Studies – Part 1 (Theory)

Marking Scheme

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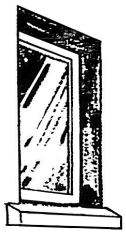
Pre-Leaving Certificate Examination, 2011

Construction Studies – Part 1 (Theory)

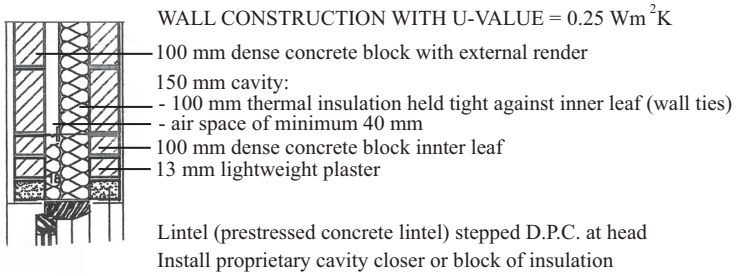
Ordinary Level
Marking Scheme (200 marks)

Answer Question 1 and **three** other Questions. **All Questions 50 Marks**

1. The sketch shows a new dwelling house with a timber casement window fitted in a 350 mm external concrete block wall with an insulated cavity. The wall is plastered on both sides. (50)



(a) To a scale of 1:5, draw a vertical section through the lintel and window head. The section should show all the construction details from 350 mm above and 200 mm below the top of the window frame. Indicate the typical sizes of **four** main components.
Note: It is not necessary to show sash detail on your drawing.



Construction details

Any 8: **(8 × 4m)**

- external plaster, 18 mm //
- outer leaf, 100 mm //
- cavity air space, 50 mm //
- insulation, 100 mm //
- wall ties //
- inner leaf, 100 mm //
- internal plaster, 15 mm //
- stepped D.P.C. //
- thermal bridge //
- head detail window frame //
- reinforced concrete lintels // *etc.*

Any 4 typical dimensions **(4 × 1m)**
Scale **(4m)**, Draughtsmanship **(4m)**

(b) Indicate clearly on your drawing the position of the damp-proof course (D.P.C.). **(6m)**

** Clear detail on sketch showing stepped D.P.C.

2. **(a)** Explain in detail any **three** of the following terms as they apply to concrete: (50)

Any 3: **(3 × 12m)**

- segregation

  Any 4: (4 × 3m)
  – occurs when cement and aggregates start to separate //
  – results in poor quality concrete //
  – avoided by using good quality aggregate //
  – depends on water/cement ratio – ideally between 0.4 and 0.7:
    – water content //
    – cement content and age //
    – use of chemical admixtures // *etc.*

- formwork

  Any 4: (4 × 3m)
  – boarding generally made from timber / steel / plastic //
  – holds concrete in place while setting //
  – designed to support concrete //
  – designed to be easily removed and not damage concrete //
  – left in position for 28 days // *etc.*

- slump test

  Any 4: (4 × 3m)
  – used to check water content of batches of concrete //
  – test carried out to ensure the consistent workability and strength of concrete //
  – test also used to check the water / cement ratio of a mix //
  – test carried out using a truncated cone, steel tamping rod, measuring tape and smooth surface //
  – 0 - 50 mm slump = low workability //
  – 50 - 75 slump = medium workability //
  – test used widely on site to check workability of mix // *etc.*

- reinforcement

  Any 4: (4 × 3m)
  – the use of steel bars to reinforce concrete //
  – the steel bars / mesh are placed in position and concrete is poured into position //
  – used to increase the tensile strength of a concrete mix //
  – steel is ribbed or twisted to give better bond with concrete //
  – used in floor, lintel, cill, beams, columns, foundation construction //
  – important that reinforcement is correctly placed to give maximum strength /
  – important that reinforcement is not exposed // *etc.*

Further answers overleaf

- curing.

  Any 4: (4 × 3m)
  - the process of preventing the loss of moisture from the concrete while maintaining a satisfactory temperature regime //
  - keeping the concrete damp for a period of time after placing minimizes any tendency to cracking and allows it to develop the strength necessary to resist such stresses as may arise during subsequent drying //
  - in winter the following precautions may be taken:
    - keep formwork in position for longer //
    - protect the top of the concrete with insulating material //
    - insulate steel formwork //
    - ensure that the temperature of the concrete is not less than 5°C during mixing, placing and early curing //
    - ensure that aggregates are not frozen
  - in summer the following precautions may be taken:
    - formwork should be left in position for as long as possible to prevent the concrete from drying out too quickly //
    - cover the formwork with a suitable material in order to insulate it from the heat of the sun //
    - when the formwork has been struck the concrete may be covered for a further period as curing progresses //
    - keep the surface damp; do not allow it dry out too quickly // *etc.*

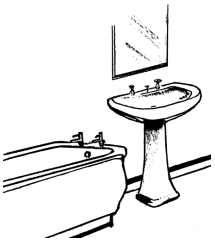
(b) List **two** situations where ready-mixed concrete is usually used in the construction of a new dwelling house.

Any 2: **(2 × 3m)**
- foundations //
- concrete sub floors //
- screeds //
- construction of piers /columns //
- concrete roofs //
- concrete work using formwork // *etc.*

(c) Discuss **two** advantages of using ready-mixed concrete instead of concrete mixed on site.

Any 2: **(2 × 4m)**
- greater control over quality of mix //
- less storage space required on site to store necessary materials //
- concrete can be placed easily in position by truck, or a pump can be used //
- speeds up time to place concrete // *etc.*

3. **(a)** Using a ***single-line labelled diagram***, sketch a system to supply **hot** water to a wash hand basin and a bath in a bathroom, as shown in the accompanying sketch. (50)



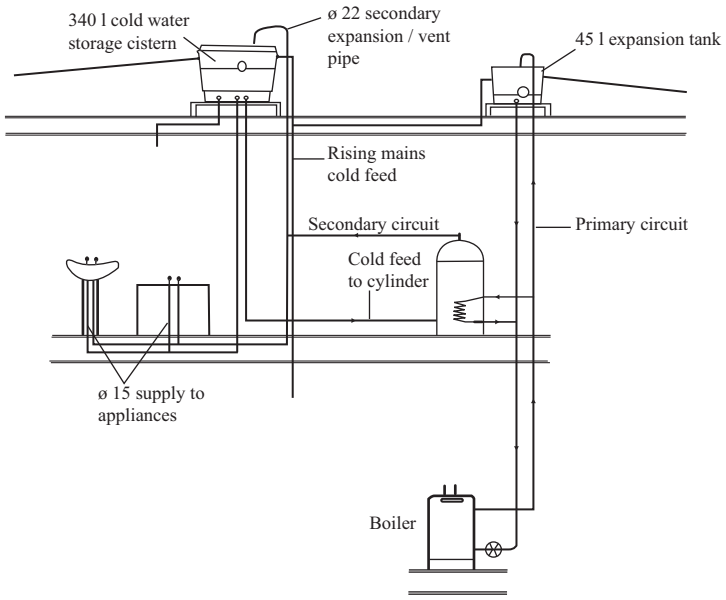
Include the following in your diagram:

- hot water cylinder
- water storage tank
- boiler
- pipe work to wash hand basin and bath
- all necessary valves.

Any 8: **(8 × 4m)**

– rising main //
– storage tank //
– cold feed to WH cylinder //
– feed to boiler //
– boiler //
– return to HW cylinder //
– HW take-off to bathroom //
– expansion pipe //
– valves //
– pipe sizes // *etc.*

Quality of sketch **(8m)**



(b) Using notes and ***neat freehand sketches***, show **one** method of preventing heat loss in the hot water system. **(10m)**

Any suitable method:

– insulate pipes //
– insulate HW cylinder //
– have a short run of pipe between the boiler and the cylinder //
– use zoned heating // *etc.*

Sketch (5m), Note (5m)

4. Planning permission must be obtained before any new dwelling house can be built. (50)

(a) State **two** reasons why it is necessary to apply for planning permission to erect a dwelling house.

Any 2: **(2 × 9m)**

- it is a legal requirement before any building can be built //
- a new development must be in line with the development plan for the region //
- it regulates all building work //
- it controls the height, shape, design and location of buildings //
- the council or local authority in the region must be made aware of any new developments taking place in the area //
- it helps to ensure that buildings are attractive and environmentally friendly //
- all residents in the area must be aware of any new developments in their area // *etc*.

(b) Describe in detail the purpose of any **three** of the following documents when making an application for planning permission for a new dwelling house:

Any 3: **(3× 8m)**

- site notice

  Any 4: (4 × 2m)
  - it must be set up on the site in a clear and visible location //
  - it should be A4 size //
  - it should be erected on site two weeks prior to planning application //
  - it remains in place for 5 weeks after planning authority receives the application //
  - it should state the date the notice was erected //
  - the name of the planning authority should be stated //
  - it should give the townland and postal address //
  - it should state type of permission being sought //
  - it should give details where application can be inspected //
  - the applicant or agent must sign the notice //
  - it must be replaced if it gets damaged //
  - copies of site notice must be included with planning application // *etc.*

- site layout map

  Any 4: (4 × 2m)
  - it shows the proposed layout of the buildings on the site //
  - it is a map to a scale of 1:1500 //
  - it shows distances of buildings from roads and boundaries //
  - it shows entrance point to main road //
  - the position of the site notice clearly marked //
  - it shows floor levels //
  - it shows north point and scale of drawing // *etc*.

- newspaper notice

  Any 4: (4 × 2m)
  – it must be featured in a newspaper circulating in the area //
  – it must be published two weeks prior to application being made //
  – the planning authority must receive the application within two weeks of the publication of the notice //
  – copies of newspaper advertisement must be sent in with the application form //
  – the type of application must be specified //
  – it gives the location of where the application can be inspected //
  – it should state than an observation may be made on payment of a fee //
  – each planning authority gives a list of approved newspapers // *etc*.

- application form. (4 × 2m)
  – it is obtained from the local planning office //
  – it contains information about the name and address of the applicant //
  – it details the type of planning permission being sought //
  – it gives details on the build // *etc.*

- site location map.

  Any 4: (4 × 2m)
  – it gives the location of the site //
  – it gives an outline of the site in red //
  – it shows the OS sheet number //
  – it shows north point //
  – it gives the scale of the map (1:2500) //
  – six copies must be included with planning application form // *etc*.

(c) Discuss in detail **two** reasons why a planning authority may refuse a planning application.

Any 2: **(2 × 4m)**
– the application does not comply with the development plan for the region //
– the proposed building will not blend in with the existing buildings or surroundings //
– services, *e.g.* sewage not available or no space for a septic tank //
– the road is not suitable for extra traffic //
– the entrance to a new build may be unsafe for traffic and residents //
– the application form is not completed correctly // *etc.*

5. A new extension to a dwelling house has a timber flat roof supported on a 350 mm concrete block wall with an insulated cavity as shown in the accompanying sketch. (50)

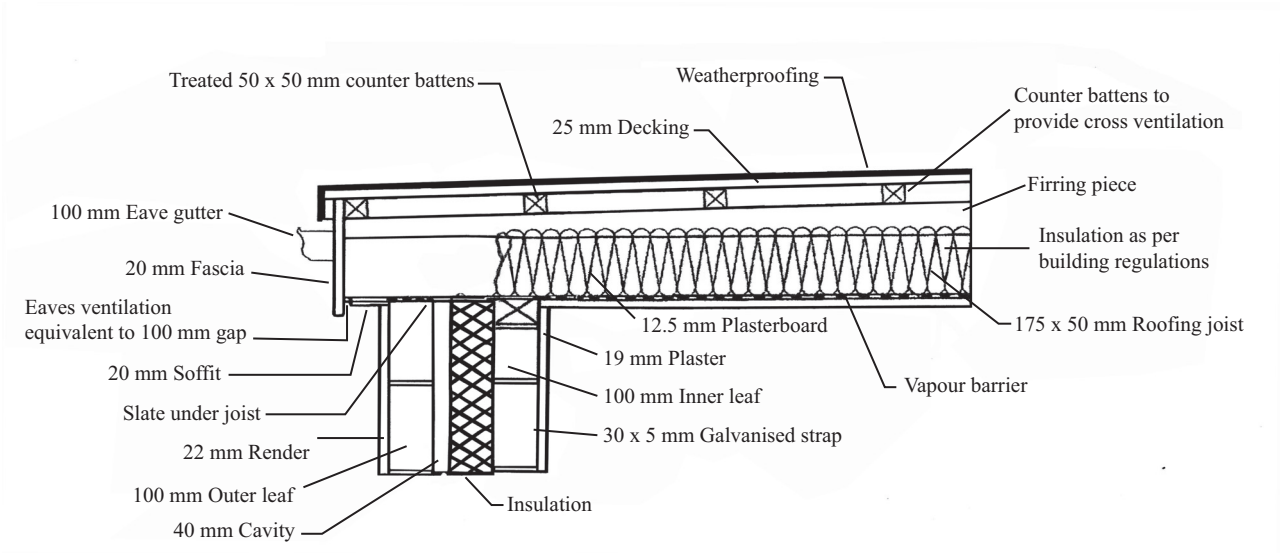
(a) To a scale of 1:5, draw a vertical section through the eaves of the flat roof. Show all the construction details from 400 mm below the wallplate to the top of the roof surface and include one metre length of roofing joist. Label all the roof components and give their typical sizes.

Construction details

Any 12: **(12 × 3m)**

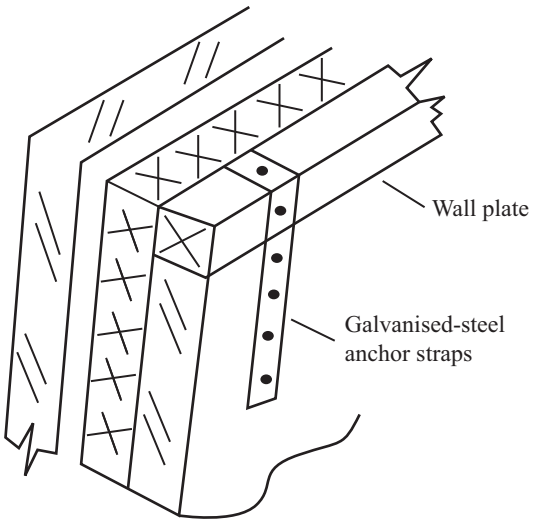
- external plaster //
- outer leaf, 100 mm //
- cavity airspace, 50 mm //
- insulation, 100 mm //
- wall ties //
- inner leaf, 100 mm //
- internal plaster //
- wallplate, 100 × 75 mm //
- roofing joints, 175 ×50 mm //
- plasterboard, 12.5 mm //
- vapour barrier //
- insulation in roof //
- firring pieces //
- battens for cross ventilation (50 × 50 mm) //
- decking, 25 mm //
- felt waterproof covering //
- soffit, 20 mm //
- facia, 20 mm
- gutter //
- eave ventilation // *etc*.

Scale **(4m)**, Draughtsmanship **(4m)**



(b) Using a neat ***freehand sketch***, show how the wallplate is fixed securely in position on the wall.

Sketch of any suitable method **(6m)**



6. **(a)** List **three** specific safety precautions to be observed in **each** of the following situations: (50)

- using an angle grinder to cut mild steel reinforcing bars

Any 3: **(3 × 4m)**
– use safety goggles //
– wear safety boots //
– wear ear protection //
– ensure steel bar is held securely //
– ensure angle grinder and cables are in good condition //
– keep work area free of people // *etc.*

- slating a steeply pitched roof

Any 3: **(3 × 4m)**
– workers should wear all necessary protection equipment //
– suitable and secure scaffolding should be set up to provide platform for workers //
– correct handrails / toe-boards / netting should be used //
– materials stored on roof should not overload the battens or roof structure at any one point //
– use proper, well-maintained roofing ladders //
– a safety harness should be worn //
– any form of completed roof should be treated as fragile //
– slate should not be cut on the roof - this operation is best carried out at ground level //
– work should be carried out during good weather conditions // *etc.*

- using a router to shape the edge of a piece of timber.

Any 3: **(3 × 4m)**
– use the correct safety protection, ear muffs / safety glasses / dust mask / protection //
– ensure the cutter is fixed correctly in machine //
– ensure the power cable is away from cutter while the machine is in operation //
– make sure the cutter has fully stopped before resting machine on bench //
– switch off power supply when making any adjustments to the cutter //
– all leads and cutters should be safe and in perfect condition //
– the router should not be switched on when the cutter is in contact with the work piece // *etc.*

(b) Show, using ***neat freehand sketches***, the safety signs to indicate that the following personal protection equipment must be worn:

- ear muffs **(4m)**

- a hard hat **(4m)**

Any 2 suitable sketches.

(c) Outline **two** additional safety precautions that a worker on a construction site should take to ensure personal safety.

Any 2: **(2 × 3m)**

– wear all the correct safety equipment //
– have completed the 'safe pass' training course //
– wear a high visibility jacket //
– wear the correct footwear //
– be familiar with all safety site notices and take heed of them //
– be aware of machinery operating on the site //
– use power tools correctly and be aware of their limits - use a 110 volt power supply to all power tools on the site // *etc.*

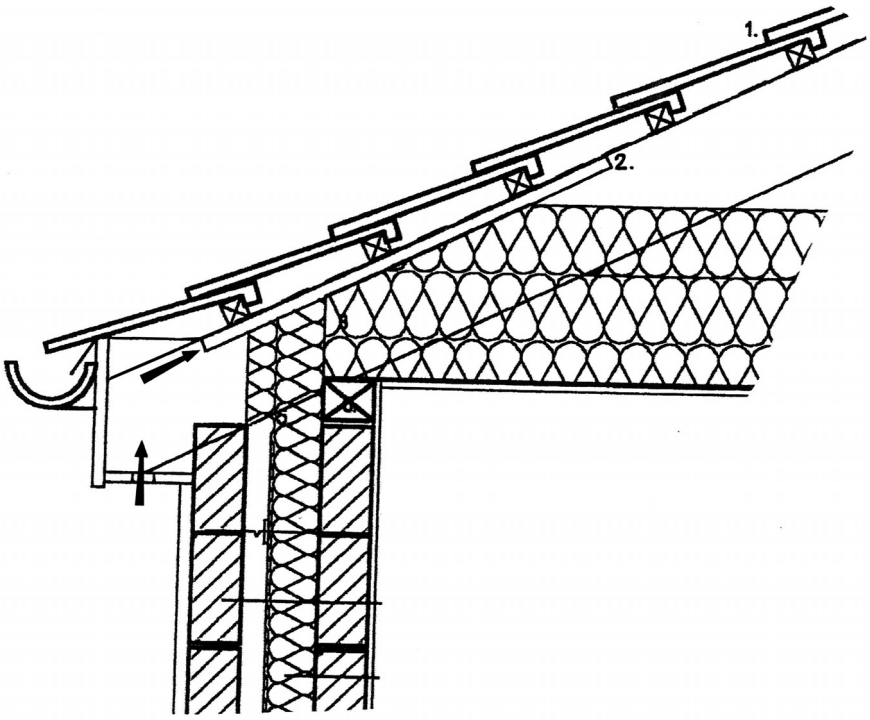
7. All new dwelling houses should be properly insulated at the construction stage. (50)

(a) Using notes and ***neat freehand sketches***, show a method of providing thermal insulation at the construction stage for a dwelling house in **each** of the following locations:

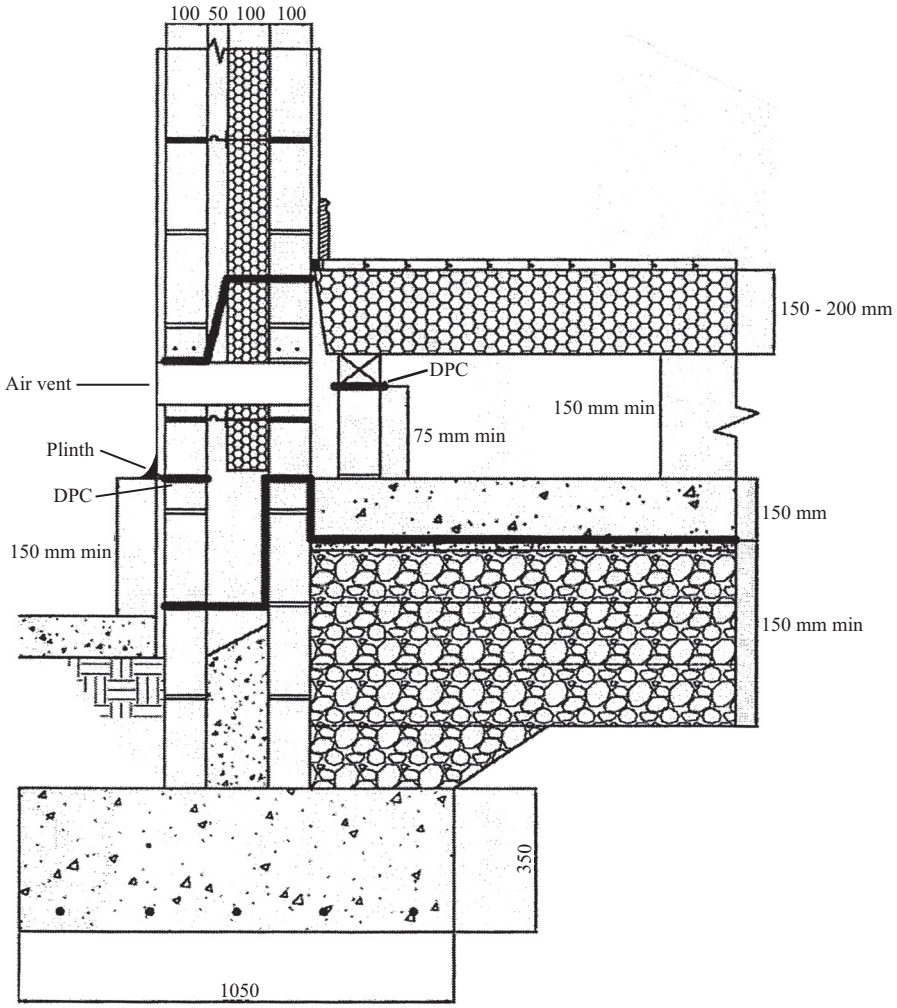
- attic space
- external cavity wall.

Clearly indicate on your sketches the type of insulation used and the typical thickness required.

- attic space **(19m)**
  - Sketch (12m)
  - Insulation in position (2m)
  - Correct thickness of insulation (2m)
  - Type of insulation (3m)
- rockwool, fibreglass, cork, sheep wool insulation may be used //
- insulation laid to a minimum depth of 200 mm //
- insulation laid between joists //
- care taken to allow ventilation in attic space over insulation //
- insulate around cold water storage bank but not under it // *etc*.



- external cavity wall. **(19m)**
  - Sketch (12m)
  - Insulation in position (2m)
  - Correct thickness of insulation (2m)
  - Type of insulation (3m)
  - urethane insulation //
  - 100 mm thickness //
  - insulation fixed to inner leaf of cavity wall //
  - held in position by wall ties // *etc.*



(b) Discuss in detail **three** advantages of using thermal insulation in a dwelling house.

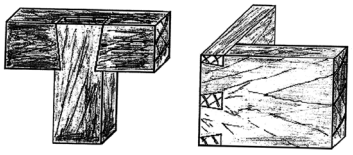
Any 3: **(3 × 4m)**

- helps to reduce heat loss in a building //
- saves money on heating costs //
- helps to reduce danger of condensation on surfaces //
- eliminates cold bridge effect at windows and doors //
- insulation on pipes helps prevent pipes bursting due to frosty weather // *etc.*

8. Explain, with the aid of notes and ***neat freehand sketches***, any **five** of the following: (50)

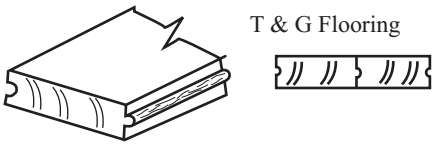
Any 5: **(5 × 10m)**

- dovetail joint



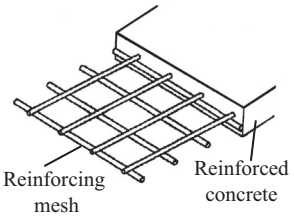
Any 2: (2 × 5m)
Note (3m), Sketch (2m)
– may be a tee halving dovetail or a box dovetail joint//
– it is widely used joint in woodwork //
– it is a very strong and attractive joint //
– it is used in drawer construction //
– the two main parts are called tails and pins //
– the slope is 1:6 for hardwoods //
– the slope is 1:8 for softwoods // *etc*.

- T & G flooring



Any 2: (2 × 5m)
Note (3m), Sketch (2m)
– manufactured boards to have tongue on one side and groove on opposite side //
– boards are available in different widths //
– normally 25 mm thick //
– boards normally laid on flooring joists //
– nailed or secret-nailed in position // *etc.*

- reinforced mesh

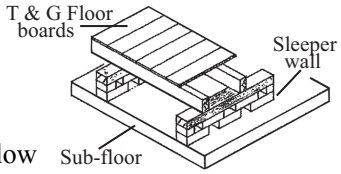


Any 2: (2 × 5m)
Note (3m), Sketch (2m)
– comes in grid form //
– used when large areas of concrete are being cast //
– used in raft foundation construction and solid floor construct
– available with bars wielded together //
– diameter of bars vary from 6 mm to 25 mm // *etc*.

- wall tie

Any 2: (2 × 5m)
Note (3m), Sketch (2m)
– used to link the internal and external leafs in a cavity wall //
– helps the wall act as one unit by connecting the inner and outer leaves //
– made from stainless steel, galvanised steel or polypropylene //
– holds insulation in position //
– are fixed at 900 mm apart horizontally and 450 mm vertically //
– the shape of the wall tie includes a drip which sheds the water away from the inner wall or leaf // *etc*.

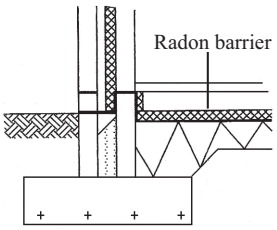
- sleep wall / dwarf wall



Any 2: (2 × 5m)
Note (3m), Sketch (2m)
– a special wall built to support suspended ground floors //
– wall built with blocks or brick on concrete sub-floor //
– a honeycomb construction leaves spaces in the wall to allow air circulation //
– D.P.C. is placed on top of the sleeper wall - this carries the floor joists //
– allows space for plumbing and electrical materials //
– minimum height of the wall is 150 mm // *etc*.

- radon barrier

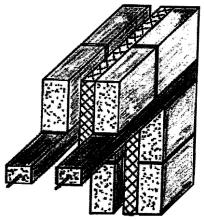
Any 2: (2 × 5m)
Note (3m), Sketch (2m)



– is used to prevent radon gas entering a building //
– is a continuous membrane placed under the floor of a dwelling house //
– it is joined on to the inner leaf of the external wall and extends across the cavity to the external leaf //
– the radon barrier replaces the former D.P.M. //
– the radon barrier is placed on top of the sand blinding of the hardcore //
– the sand blinding prevents damage to the radon barrier //
– all joints and service penetrations must be fully and carefully sealed //
– the radon barrier should be installed by trained personnel //
– available in rolls and gauge normally 400 mm // *etc*.

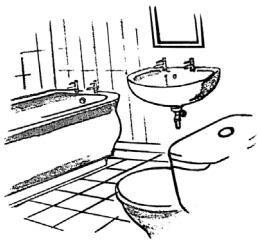
- pre-stressed concrete lintel.

Any 2: (2 × 5m)
Note (3m), Sketch (2m)



– ready-made concrete units pre-stressed during manufacture //
– used to span window and door openings //
– the lengths vary to suit different door and window openings //
– the cross section size is 150 × 65 or 100 × 65 //
– the lintel is manufactured using concrete with a high tensile steel cable //
– the cable is stretched in a special mould //
– concrete is then poured into the mould around the cable //
– when the concrete is set the cable is released putting the concrete in compression //
– they help to speed up the construction of buildings // *etc.*

9. A main bathroom is located on the first floor of a dwelling house as shown in the accompanying sketch. The single stack system is used to discharge soil and waste from the dwelling house. (50)

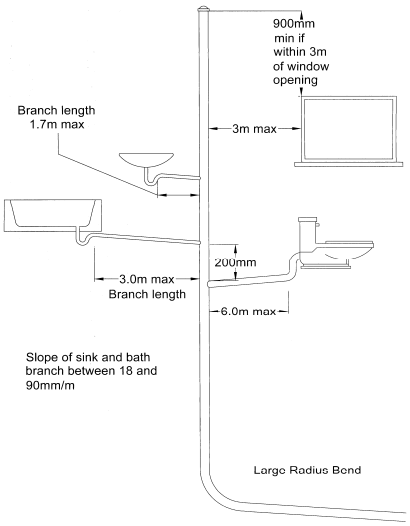


(a) Using notes and ***neat freehand sketches***, show the typical pipe layout to remove waste from the first-floor bathroom using the single stack system. Show clearly all pipework to the wash hand basin, toilet (WC) and bath.

Any 6: **(6 × 6m)**

– single stack, 100 mm //
– stack extending over windows //
– large radius at base //
– WC / WHB and bath connections //
– pipe sizes / branch lengths

Quality of sketch **(6m)**



(c) Indicate on your drawing **one** design detail that prevents foul odours entering the bathroom from the waste discharge system.

Any 1: **(8m)**

– stack extends above window //
– traps at WC / WHB / bath

DEB exams

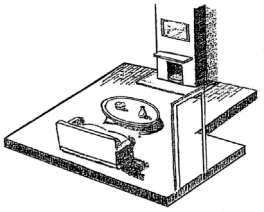
Pre-Leaving Certificate Examination, 2011

Construction Studies – Part 1 (Theory)

Higher Level
Marking Scheme (300 marks)

Answer Question 1 and **four** other Questions. **All Questions 60 Marks**

1. The sketch shows an open fireplace located on an external wall in a domestic dwelling. The external wall is a 350 mm concrete block wall with an insulated cavity and is supported on a traditional strip foundation. The house has a solid concrete floor with hardwood timber flooring.



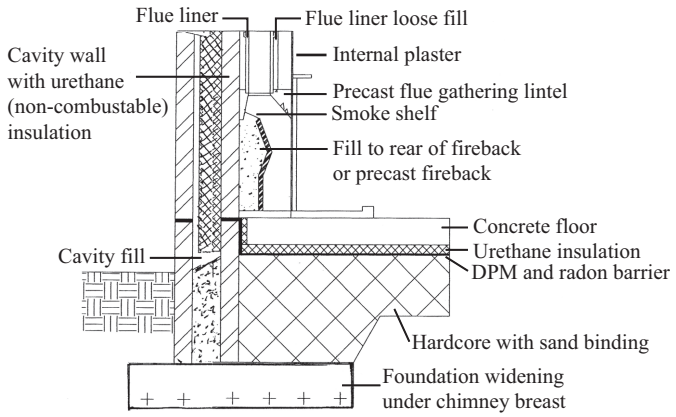
(60)

(a) To a scale of 1:5, draw a vertical section through the ground floor, hearth and fireplace. The section should show all the construction details from the bottom of the foundation to the top of the first flue liner. Include **four** typical dimensions on your drawing.

Vertical through open fireplace

Any 10: **(10 × 4m)**
Drawing (3m), Notation (1m)

- reinforced concrete strip foundation //
- correct depth of foundation //
- cavity wall detail //
- cavity fill //
- D.P.C. in wall //
- fireback //
- fireplace lintel //
- flue gathering //
- flue liner //
- fireback fill //
- support wall for chimney breast //
- concrete floor //
- external rendering //
- internal plasterwork //
- wall ties // *etc.*



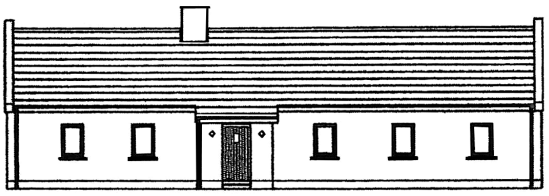
Any 4 typical dimensions **(4 × 1m)**
Scale **(4m)**, Draughtsmanship **(4m)**

(b) Indicate clearly on the drawing **two** design details that would prevent downdraught in a chimney.

Any 2: **(2 × 4m)**

- a smoke shelf should be clearly shown on the drawing //
- the drawing should show precast flue gathering lintel, which aids the flow of flue gases //
- using flue liners with min 194 mm diameter will ensure efficient draft in fireplace //
- correct sizing of throating (300 mm × 100 mm)

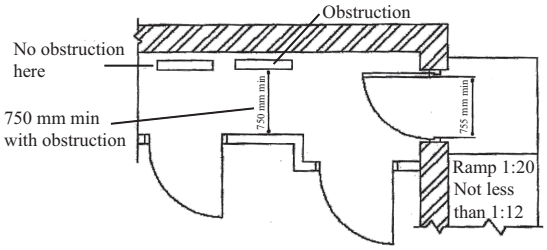
2. It is proposed to design and build a new bungalow for a person in a wheelchair, as shown by the accompanying sketch. (60)



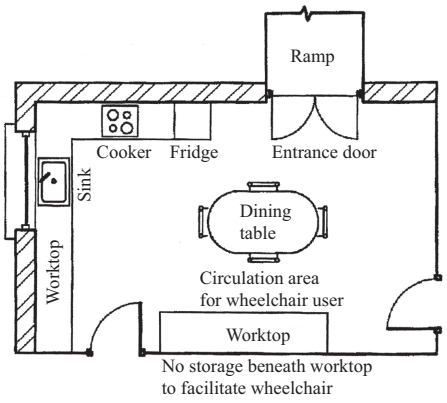
(a) Using notes and ***freehand sketches***, outline any **three** areas that need specific consideration to ensure suitability for a person in a wheelchair.

Any 3: **(3 × 10m)**
Notes (5m), Sketch (5m)

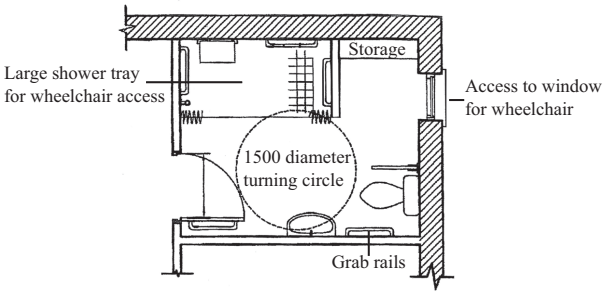
– entrance / hallway //
Notes (5m), Sketch (5m)



– kitchen / dining //
Notes (5m), Sketch (5m)



– bathroom //
Notes (5m), Sketch (5m)



** Accept any other relevant area.

(b) Select **one** of the areas outlined at **(a)** above and, using notes and ***freehand sketches***, show **three** specific design considerations to ensure that it is suitable for a person in a wheelchair. Indicate on your design sketches typical dimensions as appropriate.

Any 3: **(3 × 10m)**
Notes (5m), Sketch (5m)

– entrance / hallway //
  – main entrance to be accessible for wheelchair user //
  – doorways to have clear opening of 750 mm and 800 mm //
  – avoid door saddle boards - if used they should be bevelled and have a max thickness of 10 mm //
  – door handles and light switches located at height of 900 mm to 1200 mm //
  – avoid radiators or furniture near door openings //
  – ramped access to front door //
  – minimum unobstructed width of 900 mm for corridors //
  – all floors kept at same level //
  – there should be access to a WC from the entrance without the need to negotiate steps // *etc.*

  ** Any appropriate sketch.

– kitchen //
  – must have adequate space for wheelchair to turn (1500 mm diameter) //
  – light switches and electric sockets at correct heights for wheelchair user //
  – all doorways kept clear for easy access and exit //
  – all frequently used appliances such as toaster, microwave and kettle to be accessible //
  – work surfaces at correct heights //
  – open space under worktop at sink to allow knee space //
  – open shelving / pull out units for easy access to food items, utensils, *etc.* //
  – non-slip floor surfaces //
  – no changes in floor levels //
  – circular table for ease of movement //
  – dishwashers, washing machines, *etc.* to be built in under work surfaces // *etc.*

  ** Any appropriate sketch.

– bathroom //

  Wash hand basin
  – wall mounted WHB - no pedestal - to allow close access //
  – use of lever style taps //
  – provide 700 mm clear knee space beneath WHB //

  Grab rails
  – vertical and horizontal grab rails fitted at required positions //
  – horizontal grab rails 700 mm above floor, 600 mm long and fitted 200 mm from any corner //
  – vertical grab rails starting 700 mm above floor, 600 mm long and of 35 mm diameter //
  – pull handle fitted to inside of door // *etc.*

  Shower
  – flush finished shower tray or wet room design //
  – fabric shower curtain for ease of use //
  – shower min 1000 × 1000 mm for ease of access - 2000 × 1000 mm preferable //
  – flip-up shower seat 450 mm above tray //
  – lever controls on shower for temperature and flow
  – shower head adjustable in height 1200 to 2200 mm above tray // *etc.*

Floor

– non-slip floor finishes //
– drainage to internal gulley with floor gently sloped to gulley //
– gulley situated for easy access //
– stainless steel grid to gulley // *etc.*

WC

– push-button flushing on WC //
– spatula type lever handle fitted to transfer side of cistern to obviate reaching over to flush
– WC seat to finish 450 – 460 mm above floor // *etc.*

Any other relevant points

– wheelchair access to window // *etc.*

** Any appropriate sketch.

– bedrooms //
  – bed at correct height //
  – open shelving / pull out units for easy access to goods //
  – non-slip floor surfaces //
  – no changes in floor levels //
  – light switches and electric sockets at correct heights for wheelchair user //
  – easy access to windows // *etc.*

  ** Any appropriate sketch.

3. A small rural dwelling house constructed in the 1960s is shown in the accompanying sketch. A survey has revealed the presence of rot on the joists and rafters at the eaves. The survey has also revealed the presence of dampness on the walls. (60)

(a) Discuss, using notes and ***freehand sketches***, **two** possible causes of rot at the eaves of the dwelling house. **(2 × 10m)**

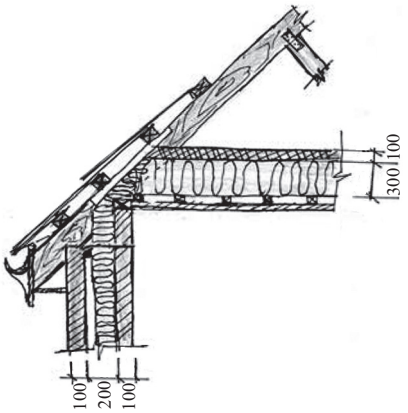
Notes (5m), Sketch (5m)

- lack of ventilation at eaves leading to condensation in the roof space //
- untreated timber, susceptible to fungal attack //
- intersititial condensation in the roof space as a result of lack of vapour barrier //
- lack of eaves ventilator //
- ventilation blocked by insulation which has been packed too tightly //
- broken tiles allowing dampness to penetrate //
- old buildings having no roofing felt leading to water penetration //
- blocked gutters and down pipes leading to overflowing gutters // *etc.*

(b) Describe, using notes and ***freehand sketches***, the correct design detailing that would prevent the occurrence of rot in the dwelling house. **(2 × 10m)**

Note (5m), Sketch (5m)
Sketch showing design detailing

- properly ventilated roof space to avoid condensation
- correct positioning of roofing felt into gutter to ensure safe transmittance of water



(c) The presence of dampness in the walls may be as a result of condensation. Outline the possible causes of condensation in buildings and discuss, using notes and ***freehand sketches***, the remedial measures that could be taken to prevent the formation of condensation.

Causes of condensation

Any 4: **(4 × 2m)**

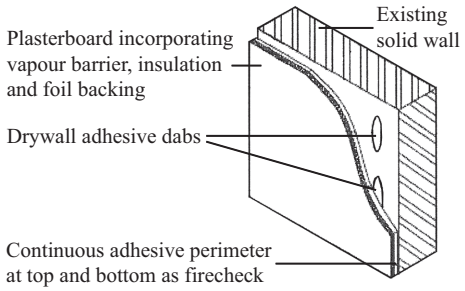
– lack of adequate ventilation
– cold bridging around window cills due to lack of insulation
– low air temperature ensuring moisture unable to remain in vapour form in the air
– moisture generated in the home not being removed at source by mechanical ventilation
– wall temperature below dew point of the wall // *etc.*

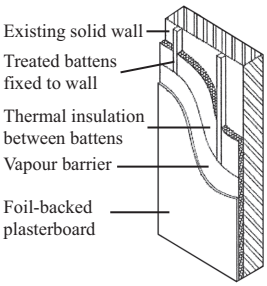
Remedial measures to be taken to avoid condensation

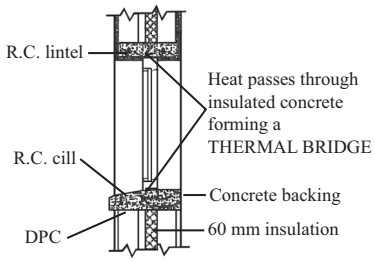
Note (6m), Sketch (6m)

Any 1: **(12m)**

– correct insulation in external walls //
– use of cavity fill or dry lining //
– mechanical ventilation to remove moisture laden air







4. A new extension has been constructed to a dormer bungalow to provide additional space for a new bathroom as shown in the sketch. The new extension has a solid concrete floor with a tiled finish. The existing bungalow has a suspended timber floor.

(60)

(a) To a scale of 1:10, draw a vertical section through the external wall and the ground floor showing both floor constructions. The section should show all the construction details from below the foundation to above finished floor level and include the abutment of both floors.

Solid floor

Any 6: **(6 × 3m)**

– tile finish //
– concrete subfloor, 150mm //
– thermal bridge //
– 100 mm insulation //
– D.P.M. / radon barrier //
– sand blinding //
– hardcore, 100 mm min //
– air duct pipe

Scale **(4m)**, Draughtsmanship **(4m)**

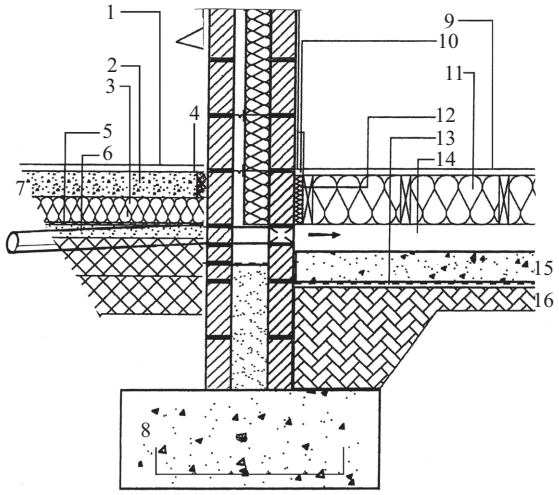
Existing suspended floor

Any 6: **(6 × 3m)**

– 25 mm flooring - T &G flooring //
– joists //
– insulation in floor //
– wallplate 100 mm × 75 mm //
– D.P.C. //
– tassle wall (minimum 75 mm) //
– concrete subfloor 100 / 150 mm //
– radon barrier //
– blinding sand //
– hardcore, 100 mm min

New separating wall **(3 × 3m)**

– cavity wall //
– air vent //
– D.P.C. in walls



1. Floor finish (timber, floor-boards tiles, etc.
2. 150 mm concrete slab
3. 100 mm insulation of conductivity 0.03 W/m K floor insulation to tightly abut blockwork wall
4. Perimeter insulation with a min. R-value of 0.75 m^2K/W
5. DPW radon barrier
6. Blinding sand
7. 150 mm hardcore
8. Concrete foundation
9. Floor finish (timber, floor-boards tiles, etc.
10. Seal between wall and floor air barrier with a flexible sealant or seal gap between skirting board and floor with tape or a flexible sealant
11. Insulation between joists where mineral wool quilt insulation is used. The insulaton is supported on polypropylene netting or a breather membrane draped over joists and held against their sides with staples or battens. The full thickness of insulation should extend for the width between joists, insulating cut to fit tightly beween them.
12. Perimeter insulation with a minimum R-value of 0.75 m KW DPM/radon barrier
13. Ensure block with a maximum thermal conductivity of 0.20 W/m K in the direction of heat flow is used and that block is suitable for use in foundations in all conditions. Wall insulation installed below the wall DPC must be fit for purpose with regards to water absorption
14. Ventilated subfloor
15. Concrete
16. Hardcore

** New separating wall construction may be solid wall construction, old cavity wall or new. Mark appropriately to detail shown.

(b) Indicate clearly on the drawing a method of providing cross-ventilation between the two floors.

Method clearly shown on drawing **(7m)**

5. It is proposed to improve the thermal efficiency of a dwelling house by installing triple-glazed windows. (60)

(a) Calculate the U-value of the new triple-glazed windows given the following data:

Glass: triple-glazing	thickness	5 mm
Space between panes	width	8 mm

Thermal data of glazing:

Conductivity of glass	(k)	1.02 W/m °C
Resistance of airspace between panes	(R)	0.15 m^2 °C/W
Resistance of internal surface	(R)	0.12 m^2 °C/W
Resistance of external surface	(R)	0.08 m^2 °C/W

Any 7 lines: **(7 × 4m)**
Correct U-value calculation **(4m)**

Layer	**Thickness**	**Conductivity**	**Formula**	**Resistance**
Units	Metres	W/m °C		m^2 °C /W
External surface				0.08
Glass (outer)	0.005	1.02	T/K	0.0049
Air space				0.15
Glass (middle)	0.005	1.02	T/K	0.0049
Air space				0.15
Glass (inner)	0.005	1.02	T/K	0.0049
Air space				0.12

– total resistance = 0.5147 //
– U-value = 1 / total resistance //
= 1 / 0.5147 //
= 1.943 W/m^2 °C

(b) Using the thermal data below and the U-value obtained at **5(a)** above, calculate the cost of the heat lost annually through the new triple-glazing in the dwelling house:

Area of triple-glazing	42 m^2
Average internal temperature	18 °C
Average external temperature	6 °C
U-value of triple-glazing	as calculated in 5(a) above
Heating period	9 hours per day for 38 weeks per annum
Cost of oil	73 cent per litre
Calorific value of oil	37350 kJ per litre
1000 watts	1 kJ per second

Any 5: **(5 × 5m)**
Correct cost calculation **(3m)**

– formula: rate of heat loss = U-value × area of glazing × temperature difference //
– = 1.943 × 42 × (18 – 6) //
– = 1.943 × 42 × 12 //
– = 979.272 watts (J / s)

– heating period p/a = s × min × hr × days × weeks //
– 60 × 60 × 9 × 7 × 38 = 8618400 s //

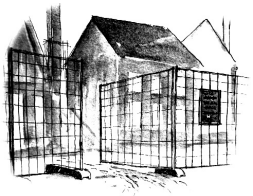
– kilo joules p/a
– $\frac{979.272 \times 8618400}{1000}$ = 8439758 kJ

– litres p/a (calorific value of 1 litre of oil = 37350 kJ)
– $\frac{8439758}{37350}$ = 226 litres

– cost p/a (1 litre costs 73 cent)
– 226 × 0.73 = €164.98 per year

6. Poor planning during the Celtic Tiger years has led to many unfinished and unoccupied developments in urban areas.

(a) Discuss in detail, using notes and ***freehand sketches***, **three** planning guidelines that should be observed to avoid inappropriate development in urban areas in the future.



(60)

Any 3: **(3 × 6m)**

– local development plan to take into consideration of economic development //
– greater control on types of developments //
– limit to number of developments in area //
– take into consideration environmental, economic and social dimensions //
– examine the likely and long term effects on the environment of any proposed development //
– adequate consideration must be taken into account of any significant adverse effects of the development //
– take into account environmental impact of materials used in the construction process and the disposal of waste products //
– use of renewable resources in construction industry //
– high level of thermal insulation in buildings // *etc.*

(b) Describe in detail how you would submit a planning application, making reference to all the legal documents required.

Any 6: **(6 × 5m)**

– application form from local authority completely filled out //
– site notice has been set up in the correct position (2 copies with planning application) //
– advertisement in local newspaper (2 copies with planning application) //
– full set of building drawings and specifications (6 copies) //
– site location map with site outline clearly marked (6 copies) //
– site layout plan showing drains, *etc*. (6 copies) //
– percolation test //
– fee //
– full description of development

(c) Explain, in terms of planning, what is meant by each of the following:

- outline planning permission; **(6m)**

  Any 2: (2 × 3m)

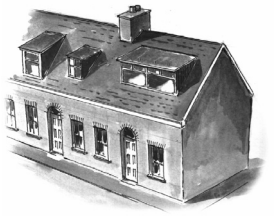
  – used to establish if planning authority agrees in principle with the proposed building plan //
  – detailed drawings not required //
  – adds value to land price // *etc.*

- retention. **(6m)**

  Any 2: (2 × 3m)

  – seeking permission to retain an existing building //
  – planning permission not given for building //
  – detailed drawings and all planning documents required //
  – if application is turned down the building has to be demolished // *etc.*

7. A terrace of townhouses is shown in the accompanying sketch. With dwellings located in such close proximity, the transmission of sound is of particular concern to the residents. (60)



(a) Using notes and ***freehand sketches***, show **two** design details that would limit the transmission of sound between the houses.

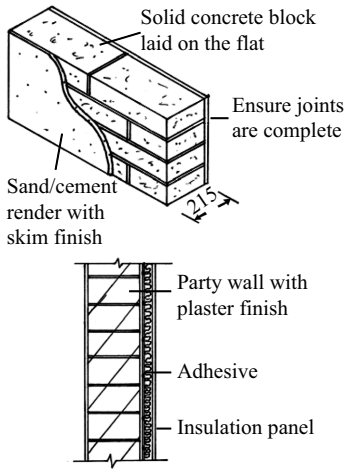
Any 2: **(2 × 16m)**

Note (8m), Sketch (8m)

Solid Concrete Block Wall

- employs the Mass Law to achieve a minimum mass of 415 kg/m^2 for party walls //
- A typical concrete block laid on the flat (215mm wide) with a sand / cement render and skin finish on both sides will achieve the required mass //
- in an existing dwelling, adding plasterboard increases the mass of the wall. This method has a limited effect. An insulated board may be fixed on both sides of the wall. A parallel partition is a further possibility //
- mortar should be uniform and well filled to leave no gaps in the structure //
- joists should not bear on the party wall but run parallel to the party wall. This is achieved in houses with a maximum span of 6.0 m //
- where the span is greater than 6.0 m specific detailing by a structural engineer may be required //
- avoid plumbing installations in the party wall //
- party walls should extend to the roof in the attic space and be sealed with an absorbent material at roof level // *etc.*

** Accept any other relevant points.



(b) Discuss any **two** sound insulation principles which would influence your design details.

Any 2: **(2 × 8m)**

– Heaviness
  – relates to the Mass Law, which states that the sound insulation of a wall is proportional to its mass per unit area
  – thus, an increase in mass will improve the sound insulation properties of a wall // *etc.*

– Flexibility
  – flexible materials are good at absorbing sound //
  – the use of an absorbent quilt /resilient layer reduces the transmission of sound // *etc.*

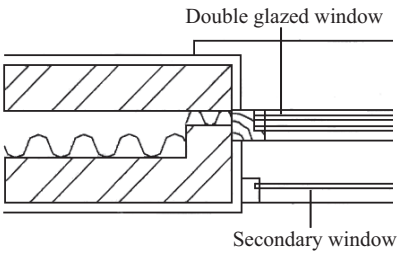
– Isolation
  – requires the mechanical separation of opposite surfaces of a wall so that there is a discontinuity of construction // *etc.*

– Completeness
  – eliminating small gaps in the structure, improving air tightness and uniformity of insulation improves overall acoustic properties // *etc.*

(c) The terrace is located close to a main road. Discuss how you would improve the sound insulation properties of the terrace with specific reference to traffic noise. **(12m)**

Note (6m), Sketch (6m)

– install double/triple glazing //
– ensure building is airtight //
– plant hedging close to boundary to deflect traffic noise //
– build low boundary wall to deflect traffic noise //
– install secondary window to reduce transmittance of sound // *etc.*



8. A wood-burning stove fitted with a back boiler is used to provide central heating and hot water in a two-storey dwelling house. (60)

(a) Using notes and a ***single-line diagram***, show a design layout for the pipework necessary to provide central heating and hot water in the dwelling house. Show **three** radiators on each floor.

Domestic hot water supply

Any 5: **(5 × 3m)**
Sketch (2m), Annotation (1m)

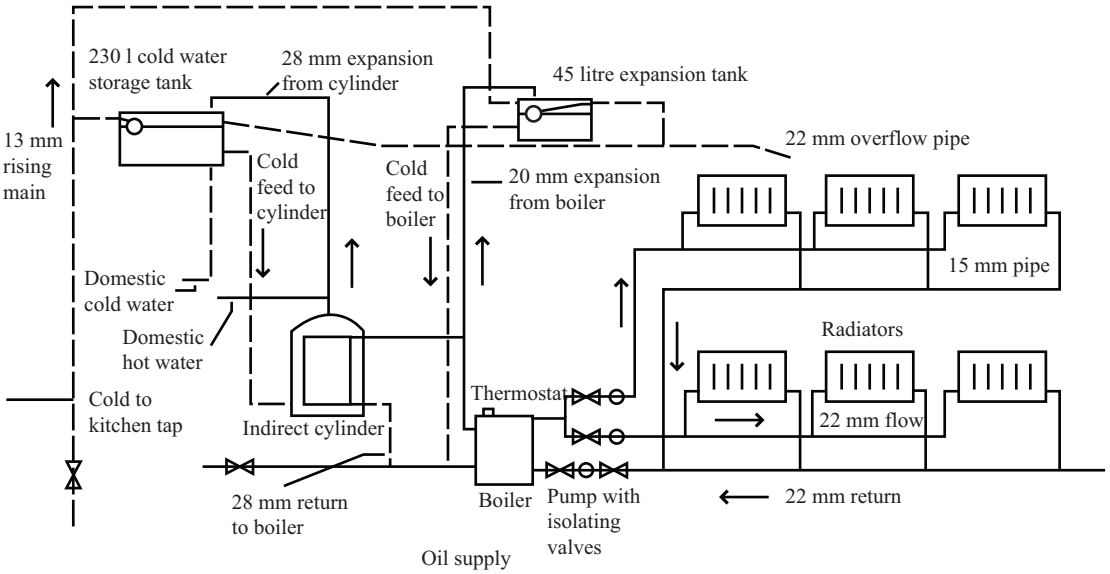
– rising main //
– ballcock //
– cold water storage tank //
– overflow pipe //
– hot water cylinder //
– primary flow and return //
– boiler //
– hot water draw off //
– expansion pipe

Central heating supply

Any 6: **(6 × 3m)**
Sketch (2m), Annotation (1m)

– radiators //
– header / expansion tank //
– expansion pipe //
– pipes to radiators //
– return pipes from radiators //
– thermostatic valve //
– lockshield valve //
– gate and drain valve

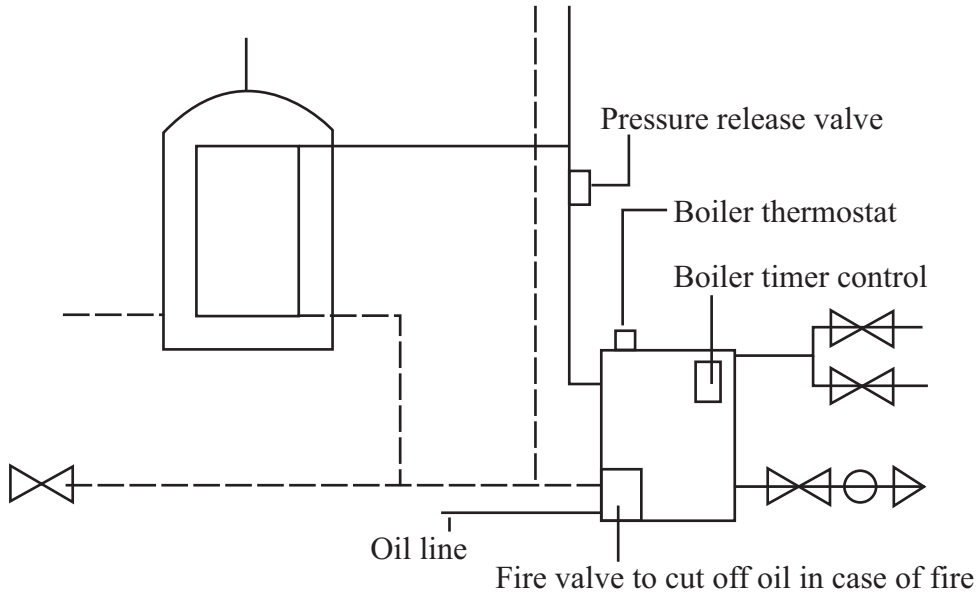
Quality of sketches **(3m)**



(b) Indicate clearly on your diagram **three** valves necessary to ensure the safe functioning of the central heating system and write a short note explaining the function of each.

Any 3: **(3 × 4m)**
Note (2m), Sketch (2m)

– fire valve to cut of oil supply to the boiler in case of fire //
– thermostat on boiler to cut of heating if temperature gets too high //
– timer switch on boiler //
– pressure release valve on the primary flow



(c) Outline **three** design details that should be incorporated into a central heating system to ensure the economical use of fuel.

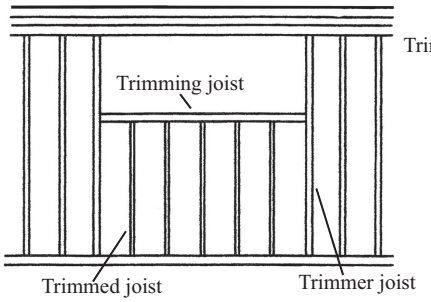
Any 3: **(3 × 4m)**

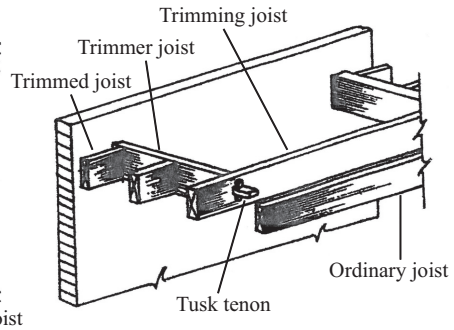
– zoned heating: motorised valves operated by time-switches or room thermostats control the flow of hot water to radiators in zones //
– zoned heating: a heating programmer controls the switching on/off of the system and also provides time control //
– room thermostats control individual room temperatures should be controlled using valves or equivalent forms of devices //
– thermostatic radiator valves shut off the heat to specific radiators at set room temperatures //
– handwheel valves isolate and control individual radiators
– design for short pipe runs to prevent excessive heat loss //
– insulate all hot pipes //
– design to ensure that the boiler and hot water storage cylinder are located close together // *etc.*

9. Correct construction of the upper floors of a dwelling house plays a significant role in making a building structurally sound. (60)

(a) Using notes and ***freehand sketches***, show the layout of joists to accommodate a stair opening in an upper floor. The stairwell is located on an external wall of the dwelling house.

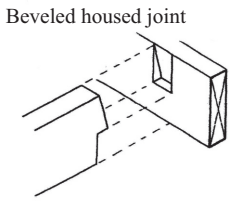
good sketch of joist layout **(9m)**
joist at external wall **(3m)**
trimmer joist clearly shown and labelled **(3m)**
trimmed joist shown and labelled **(3m)**
trimmed joist **(3m)**
flooring joists **(3m)**

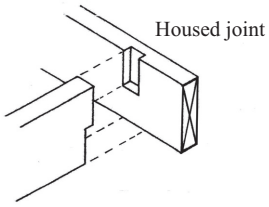


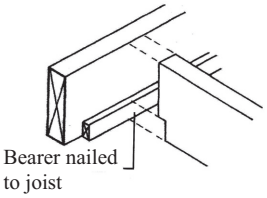


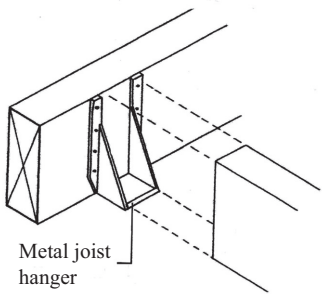
(b) Using notes and ***freehand sketches***, show the correct design detailing required for the following: **(2 × 12m)**

- trimmer joist to trimmed joist
  Note (6m), Sketch (6m)
  – housed joint //
  – checking out joist to fit over lath nailed to trimmer //
  – use of metal joist hanger







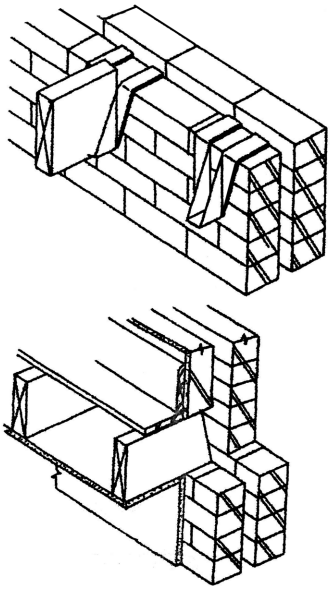


- joist to external wall
  Note (6m), Sketch (6m)

  Any 1:

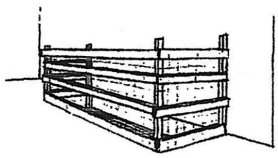
  Galvanised steel joist hangers
  – built into blockwork at the required height //
  – must ensure they are level //
  – joists nailed through hanger using galvanised steel nails // *etc.*

  Joists built into blockwork
  – must have 90 mm bearing on wall //
  – must not project into cavity //
  – preservative applied to joist ends // *etc*.



(c) Describe the precautions that should be observed to ensure the safety of workers prior to the installation of the stairs. **(4 × 3m)**

– provide warning signs around the danger //
– fit a guard rail around the opening //
– use netting and toe boards to prevent items falling through the opening //
– all workers should wear correct personal safety equipment // *etc.*

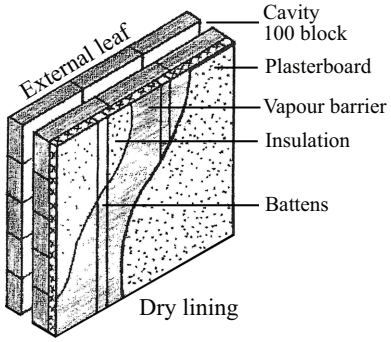


10. A garage adjoining a dwelling house is to be converted into additional living space for a family. The garage was constructed with 225 mm solid blockwork, has a pitched roof and single-glazed timber windows. (60)

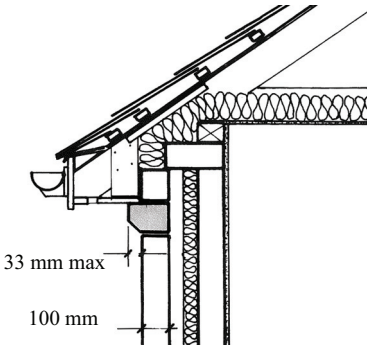
(a) Using notes and ***freehand sketches***, show clearly how the thermal performance of the room conversion can be improved.

Any 3: **(3 × 8m)**
Note (4m), Sketch (4m)

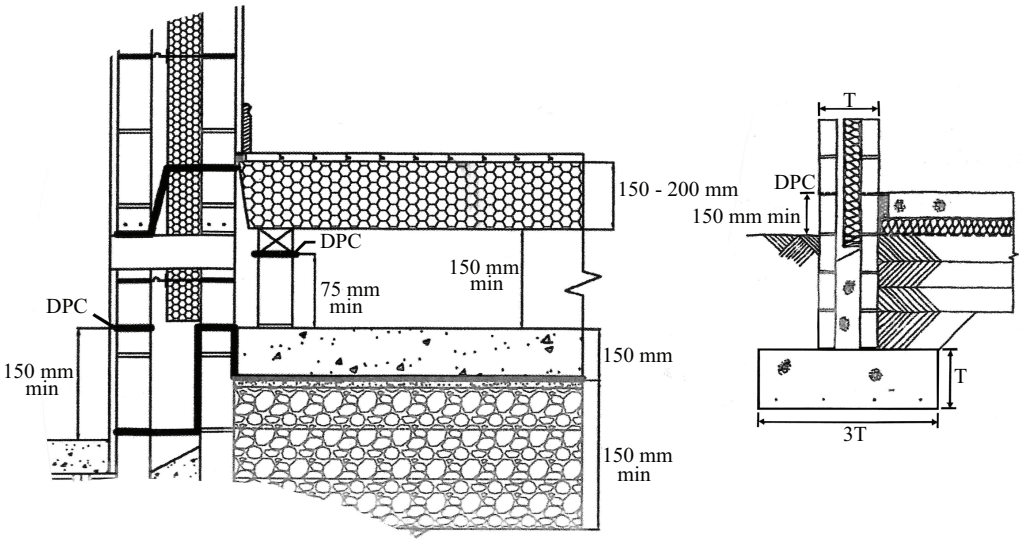
– walls //
  – use of dry lining fixed to inner surface of external wall //
  – treated battens 50 × 25 are fixed to inner wall //
  – insulation placed between battens //
  – vapour barrier fixed over wall //
  – plasterboard 12 mm screwed to battens //
  – plastered with skim coat and painted //
  – insulated dry lining may be mechanically fixed to inner lea



– roof //
  – place insulation in roof space //
  – rockwool, fibreglass or sheep wool insulation used //
  – should be min depth of 200 mm with second layer over joists //
  – insulation placed between ceiling joists and over them //
  – must allow ventilation in attic space above insulation



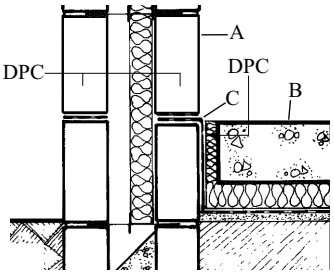
– floors //
  – ensure D.P.M. is in position //
  – floor must be sealed with a suitable sealer //
  – addition floor insulation could be laid and a new concrete subfloor laid //
  – a good quality carpet and underlay could be used //
  – use of timber floor fixed to battens with insulation fitted between //
  – use of suspended timber floor construction if space available //
  – proper seals to prevent air flow



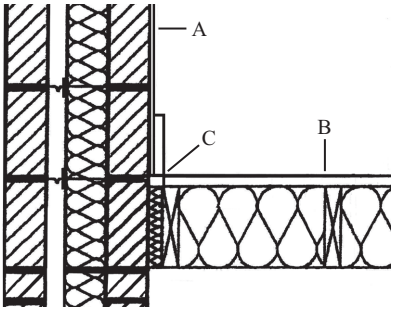
(b) Identify **two** possible air leakage routes in the room conversion. Using notes and ***freehand sketches***, show clearly the correct design detailing that will improve the airtightness at each air leakage route identified.

Any 2: **(2 × 8m)**
Note only (max. 5m)

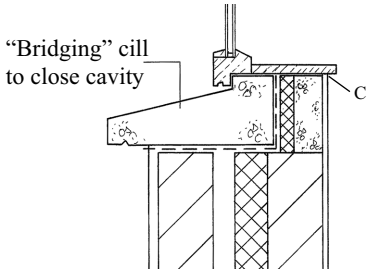
– concrete ground floor and external wall //
  – air barrier continuity //
  – seal between wall (A) and floor (B) barriers with a flexible sealant (C) //
  – seal between skirting board and floor with flexible sealant // *etc.*



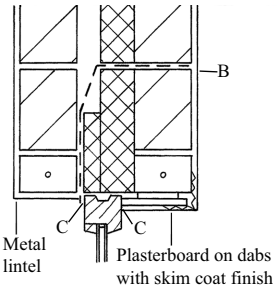
– suspended timber floor with external wall //
  – air barrier continuity //
  – seal between wall (A) and floor (B) barriers with a flexible sealant (C) //
  – seal between skirting board and floor with flexible sealant // *etc.*



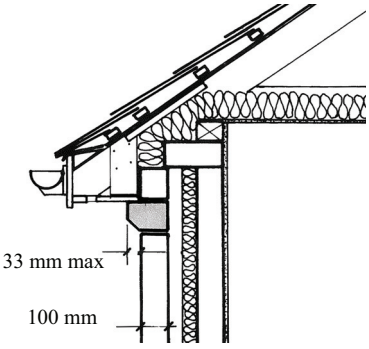
– window cill detail in external wall //
  – air barrier continuity //
  – flexible sealant (C) applied to all interfaces between internal air barrier and the window frame and window board //
  – seal between external wall and the window frame with flexible sealant // *etc.*



– window head detail in external wall //
  – air barrier continuity //
  – flexible sealant (C) applied to all interfaces between internal air barrier (B) and the window frame //
  – seal between external wall and the window frame with flexible sealant // *etc.*



– eaves / external wall //
  – air barrier continuity //
  – seal between internal air barrier between wall and ceiling plaster with an approved tape // *etc.*



(c) Describe a test that can be used to determine the airtightness of the room conversion. Outline **two** advantages of improved airtightness in the new living space.

Test for airtightness **(12m)**
Any 4: (4 × 3m)
- seal all air leakage openings, *i.e.* door windows vents //
- fit a high-powered fan (blower door) to the external doors of the building //
- high-pressure difference produced between inside and outside of building results in air flow through building defects //
- smoke pencil used to demonstrate the areas where air leakage is occurring //
- thermal imaging could also be used // *etc.*

Advantages
Any 2: **(2 × 4m)**
- helps to significantly reduce heat loss //
- eliminates unwanted cold air, draughts //
- must be designed for continuous fresh air supply //
- increases thermal comfort //
- reduces energy costs in saving fuel //
- prevents condensation of indoor moist warm air penetrating the structure resulting in interstitial condensation //
- reduces risk of decay of building fabric //
- air leakage can amount to up to half of all heat losses in modern buildings
- the revised Building Regulations require mandatory 'Air Tightness Test' // *etc.*

OR

10. ''The form, material and construction methods of older buildings illustrate the ecological adaptation of rural society to its varied environments and closely reflect traditional, economic and social structures. Newer buildings reflect the rapid pace of recent social changes in the countryside, many showing a sharp break with earlier forms and building materials and lacking regional distinctiveness.''

Atlas of the Irish Rural Landscape, 2nd edition
Cork University Press, 2009

Discuss the above statement in detail and propose **three** guidelines that would help create environmentally sustainable housing in rural Ireland.

Any 3: **(3 × 10m)**
- form //
  - domestic buildings generally smaller in size //
  - generally one fireplace //
  - labour intensive construction //
  - notion of privacy //
  - small size with few rooms
- materials //
  - gathered locally //
  - slate, stone wood, thatch, local colour //
  - in harmony with locality
- construction methods //
  - traditional materials //
  - traditional construction methods
- ecological adaptations //
  - simplicity of materials //
  - easily and locally resourced

– rural society //
  – houses dispersed around countryside //
  – houses built in clusters //
  – farm houses sub-divided for family //
  – houses built onto

– rapid change //
  – change from rural to urban //
  – improved transportation methods //
  – employment trends //
  – housing developments //
  – new materials and machinery available //
  – world design trends

– lack of regional distinction //
  – use of pattern books in design //
  – mass production of building products //
  – international design awareness

Guidelines for sustainable housing in rural Ireland
Any 3 **(3 × 10m)**

– energy analysis of any design…low embodied energy design //
– raise public awareness of sustainable design principles //
– use non-toxic materials //
– build to a modest scale to meet needs //
– build close to amenities where possible //
– build in clusters where possible – avoid ribbon development //
– use sustainable energies, *e.g.* wind, solar //
– provide grants to encourage sustainable design //
– build with regard to future generations //
– adapt / restore existing buildings where possible // *etc.*

** Accept other relevant guidelines supported by reasonable argument.

Notes: