



Pre-Leaving Certificate Examination, 2014

Construction Studies

Marking Scheme

Ordinary Pg. 2

Higher Pg. 15

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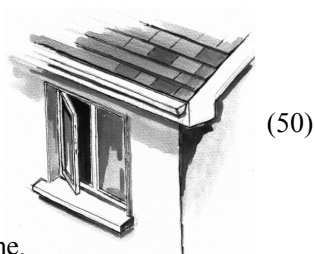
Construction Studies

Ordinary Level
Marking Scheme (200 marks)

Answer Question 1 and **three** other questions.

All Questions 50 Marks

1. A double glazed timber casement window is fixed in the external wall of a newly built dwelling. The external wall is a 350 mm concrete block wall with an insulated cavity. The fixed frame of the window is 100 mm × 75 mm. The wall is plastered on both sides.



- (a) To a scale of 1:5, draw a vertical section through the lintel and fixed window head. The section should show the typical construction details from 200 mm below to a level 350 mm above the top of the window frame. Include **three** typical dimensions.

Note: Sash head not required.

Construction details

Any 10: (10 × 3m)

- 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 at window frame //
- reinforced concrete lintels // etc.

** Any alternative detailing which complies with current building regulations is acceptable.

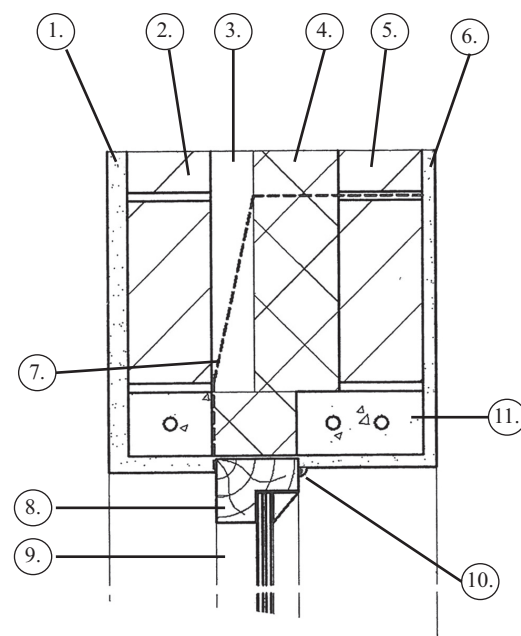
Any 3 typical dimensions (3 × 2m)

Draughtsmanship, accuracy and scale (8m)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.

- (b) On your drawing, show the position of the damp proof course (D.P.C.). (6m)

** Accept clear detail showing stepped D.P.C.



1. 18 mm render
2. 100 mm block work
3. 50 mm cavity
4. 100 mm insulation
5. 100 mm blockwork
6. 15 mm plaster
7. stepped D.P.C.
8. 100 x 75 window head
9. double glazing
10. airtight seal
11. precast concrete lintels

OR

10. “Good builders were very conscious of the outward appearance of their work and took great care to improve and enhance it, while the use of purely local materials always ensured that the finished structure fitted smoothly into its environment, and did not shock it or do violence, as do some misguided efforts of ‘modern’ fashion in building.”

IRISH COUNTRY HOUSEHOLDS (1985)
Kevin Danaher

Discuss the above statement in detail and propose **three** guidelines that would promote the development of environmentally sustainable housing.

Discuss:

Any 3: (3 × 10m)

Point (4m), Discussion (6m)

** Points may included the following.

- good builders / architects made sure that they designed buildings that were well proportioned with a modesty of scale relative to the demands of the time //
- they had a sense of belonging and permanence with a style formed through evolution over generations //
- in general they used materials that were in the area or nearby and always used the best quality available, long lasting and durable. These were stones, slates, tiles and thatch //
- plaster and pebble dash were also in widespread use //
- the workmanship was generally of a very high standard as there were many highly skilled craftsmen. They took great pride and satisfaction in their work //
- particular attention was paid to location and positioning of the buildings taking account of the surrounding area and making sure that the building sat comfortably in its environment //
- ornamentation and design were noticeable but not overdone or obtrusive, e.g. quoins on corners of buildings, reveals around windows and doors, pitched roofs, good balance, proportion and layout //
- modern designs, practices and materials may not have the same visual coherence as traditional buildings because of the wide and varied range of materials being used today //
- the designs, shapes and proportion in many houses and adjacent houses are not related or co-ordinated. This is particularly evident in the rural countryside. In some cases, designs, features and practices from other countries are to be seen. Perhaps some of these may be more acceptable in suburban areas //
- many new materials and practices from abroad have influenced the changes in modern building in Ireland. These need to be used judiciously and with taste if they are not to detract from the environment in which they are built //
- the use of imitation stone, very large windows, inappropriate strong colours, low pitched roofs, flat roofs, non-matching boundary walls and entrances are all elements of modern fashion in building over the past half century that have shocked and violated the environment and harmed the countryside //
- unsuitable styles copied from pattern books designed for totally different landscapes and locations //
- houses built as investments by speculators, as a second house and holiday homes. Many properties not well maintained, not having a sense of belonging // etc.

** Accept other relevant points supported by reasonable argument.

Guidelines:

Any 3: (3 × 10m)

Point (4m), Discussion (6m)

- use of local materials //
- employ of local tradesmen //
- houses designed and built to blend in with the natural environment //
- use of landscaping //
- house built to proportions that blend in with the surrounding // etc.

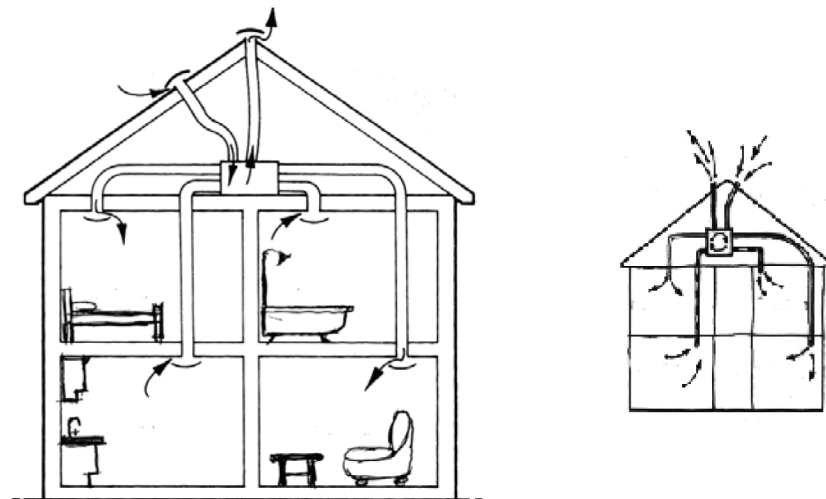
** Accept other relevant guidelines supported by reasonable argument.

- (b) Describe, using notes and freehand sketches, how a Mechanical Heat Recovery with Ventilation (MHRV) system operates for a Passive House. (16m)

Note (8m), Sketch (8m)

- removes pre-heated air from kitchen, bathroom and utility rooms //
- conducts this pre-heated air to air exchange unit, where heat is extracted //
- the extracted heat is used to heat fresh, colder air //
- a separate ducting system distributes warm fresh air throughout the house using an independent ducting system //
- the extracted air and the fresh air from the outside do not mix //
- system collects up to 93% of heat from exhaust air in dwelling //
- filters are fitted to prevent allergens and pollen entering the dwelling //
- provides constant flow of fresh air around the house //

** Accept any other appropriate material.



- (c) Discuss in detail **two** advantages and **two** disadvantages of Passive House construction.

Advantages

Any 2: (2 × 5m)

- good for the environment //
- saves money in heating costs //
- no need for expensive heating systems //
- suits open plan layouts //
- lifetime use //
- well-designed houses // etc.

** Accept any other appropriate answer(s).

Disadvantages

Any 2: (2 × 5m)

- extra cost of initial build //
- solar gains not great in Ireland //
- high level of construction techniques need high quality tradesmen //
- high level of detailing can be time consuming //
- not well understood by the Irish public // etc.

** Accept any other appropriate answer(s).

2. In times of economic difficulties many house holders are improving the thermal properties of their homes by increasing the insulation in various parts of their homes. (50)

- (a) Using notes and neat freehand sketches, suggest a suitable type of insulation and show how it could be fitted in the following locations:

- the un-insulated external cavity wall **and**

Insulation type (3m)

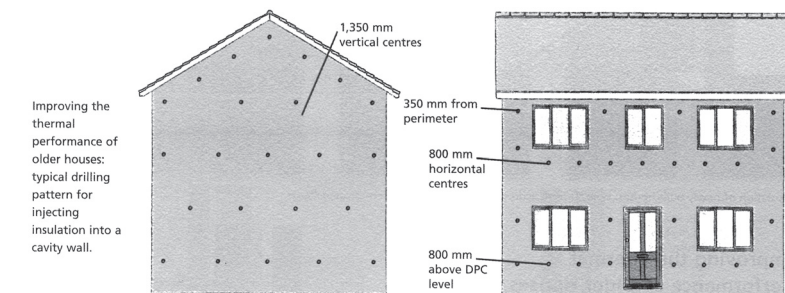
Notes (8m)

- fitting of Polystyrene particles in the cavity //
- holes are drilled in the walls at regular intervals. Both top and bottom //
- foam is pumped into the cavity space at high pressure //
- the holes are then filled with mortar // etc.

** Accept any other appropriate answer(s).

Sketch (8m)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.



- the cold water storage tank in the attic.

Insulation type (3m)

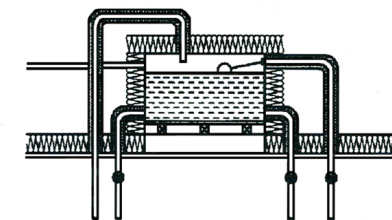
Notes (8m)

- the sides of the tank are covered with the chosen insulation //
- the lid of the tank also has insulation on top of it //
- no insulation is fitted under the tank, this allows heat to rise from the rooms below //
- all pipes are insulated // etc.

** Accept any other appropriate answer(s).

Sketch (8m)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.



- (b) List **three** advantages of improving the thermal properties of a dwelling house.

Any 3: (3 × 4m)

- helps to reduce heat-loss in the home //
- saves money on heating costs //
- improves comfort levels in the home //
- helps reduce the risk of condensation on surfaces //
- eliminates the cold bridge effect which can occur at windows and doors //
- insulation on pipes helps to prevent pipes bursting due to freezing weather // etc.

** Accept any other appropriate answer(s).

3. (a) Using a single-line labelled diagram, show the pipework necessary to supply hot water to a wash hand basin, as shown in the sketch.

Include the following in your diagram:

- rising main
- water storage tank
- hot water cylinder
- location of all necessary valves.

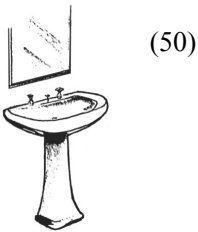
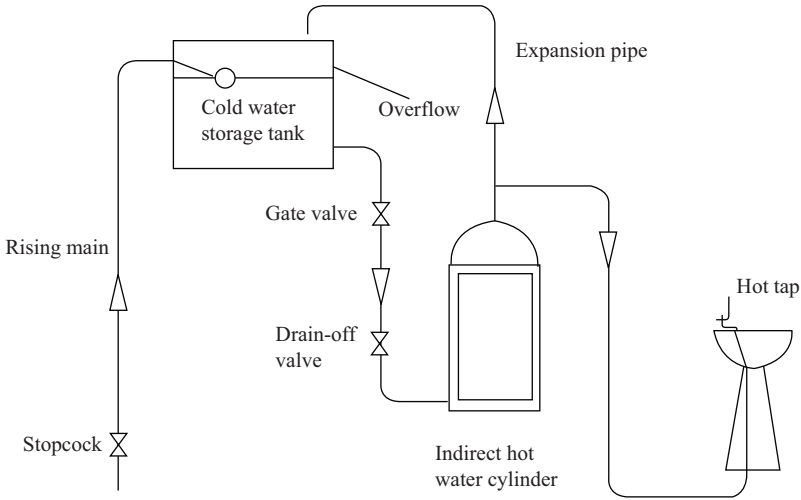
Any 8: (8 × 4m)

- rising main 15 mm //
- ballcock and valve //
- water storage tank //
- overflow 22 mm //
- gate valve //
- cold feed //
- drain-off valve //
- indirect hot water cylinder //
- expansion pipe //
- connection to wash hand basin // etc.

** Any alternative detailing which complies with current building regulations is acceptable.

Draughtsmanship, accuracy and scale (8m)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.



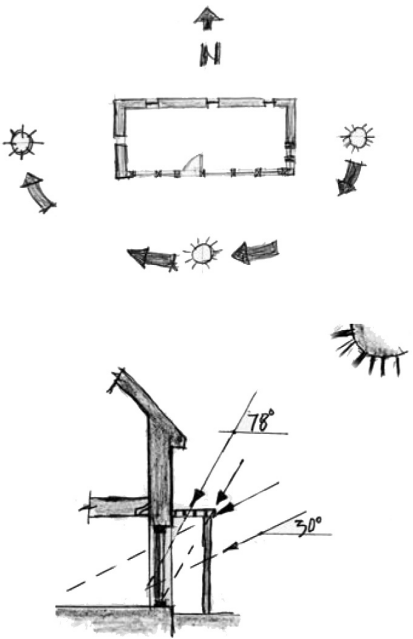
(50)

orientation and shade

Note (6m), Sketch (6m)

- south-facing building to maximise sun gain //
- triple glazed low-e argon filled to maximise sun gain in south-facing glazing //
- keep glazing to north to a minimum //
- position all living rooms on south-facing elevation //
- large overhanging roofs to reduce sun and provide shade in summer //
- use of window blinds to prevent direct sunlight in summer //etc.

** Accept any other appropriate material.

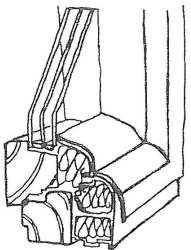
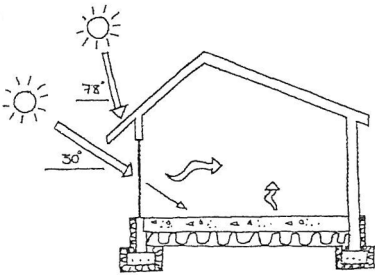


windows and glazing.

Note (6m), Sketch (6m)

- deep plan, south facing //
- max glazing to south, main living in this area //
- min glazing to north, least used areas //
- triple e – glazing //
- roof lights to improve natural lighting // etc.

** Accept any other appropriate material.

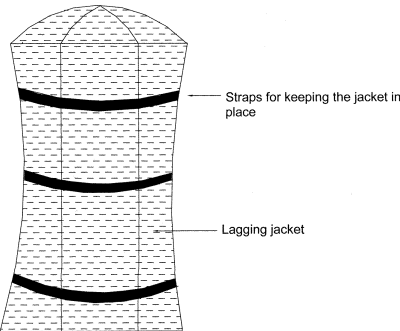
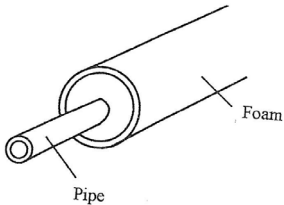


(b) Show, using notes and neat freehand sketches, one design detail that should be used to prevent heat loss in the hot water system. (10m)

Note (5m), Sketch (5m)

- insulate all pipes //
- have short runs //
- use a pre-insulated hot water cylinder //
- use zoned heating // etc.

** Accept any other appropriate material.



10. (a) Using notes and freehand sketches, discuss in detail the importance of any **two** of the following in the design of a Passive House:

Any 2: (2 × 12m)

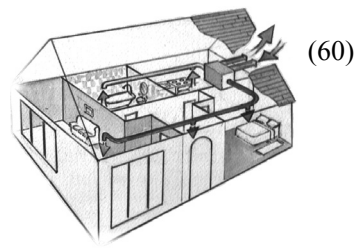
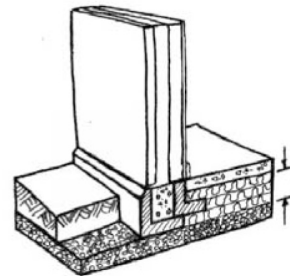
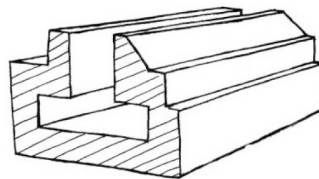
- foundations suitable for a passive house

Note (6m), Sketch (6m)

Key Points

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

** Accept any other appropriate material.



(60)

4. A traditional strip foundation is commonly used in modern dwelling house construction.

(50)

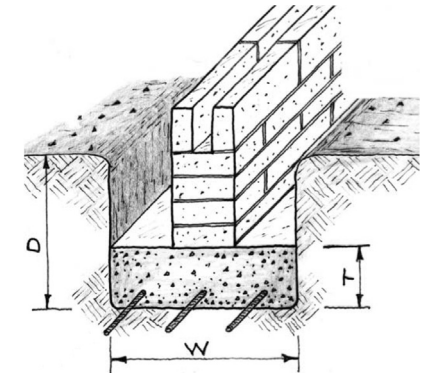
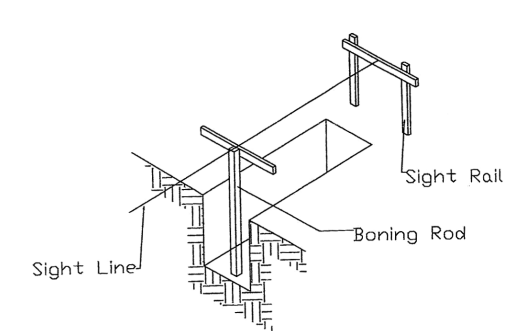
- (a) Using notes and neat freehand sketches, describe the construction of a traditional strip foundation for the external wall of a dwelling house under the following headings:

- construction of the foundations

Notes (7m)

Sketch (3m)

- must be built to current building regulations //
- the corners of the building are identified using profile boards, these are used to locate the position of the trenches //
- a mechanical excavator is used to dig the trenches //
- the trench may require shoring, depending on the depth and soil condition //
- levels at the bottom of the trenches are constantly checked using spirit levels / laser levels / Theodolite and levelling staff //
- all loose soil is removed //
- wooden pegs are driven into the ground to correct height of the foundation //
- reinforcement is laid in the trench at required height and spacing //
- ready-mixed concrete is poured into the trench //
- the concrete is levelled and the foundations are left for several days to set before wall can be constructed //



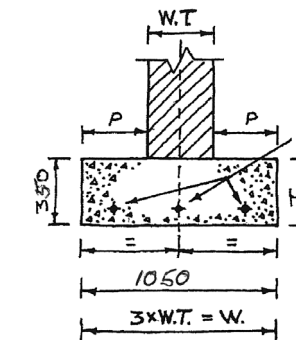
** Accept any other appropriate material.

- depth and width of the trench

Notes (7m)

Sketch (3m)

- the depth of the foundation (D) depends on soil type and weight of the structure to be built //
- a minimum depth of 600 mm is advised //
- the bottom of the trench must be below the frost line, 1000 mm is safe for Ireland //
- the width (W) of the foundation is usually three times the wall thickness (WT) i.e. cavity wall 350 mm wide then the foundation will be 1050 mm //



** Accept any other appropriate material.

- thickness of concrete in the foundation

Notes (7m)

Sketch (3m)

- the minimum thickness (T) is normally the width of the wall *i.e.* 350 mm // *etc.*

** Accept any other appropriate material.

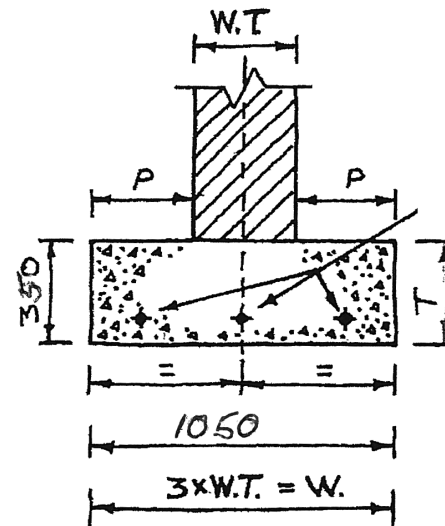
- position of 350 mm cavity wall on the foundation.

Notes (7m)

Sketch (3m)

- the wall should be positioned in the centre of the foundation //
- the projections (P) on both sides must be equal // *etc.*

** Accept any other appropriate material.



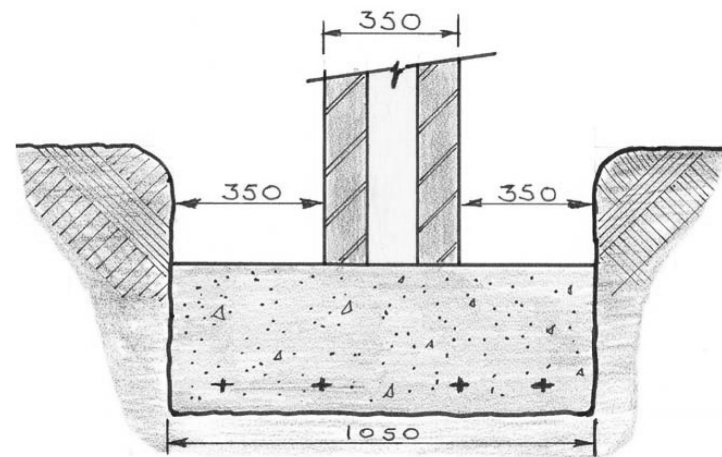
- (b) On your sketch, show **one** design detail to ensure the foundation is strong enough to support the cavity wall. Include **two** typical dimensions.

Any 2 typical dimensions (**2 × 1m**)

Draughtsmanship, accuracy and scale (**8m**)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.

** Sketch should include reinforcement bars in position.



- (b) Discuss in detail **two** advantages of applying external insulation when thermally upgrading a dwelling.

Any 2: (**2 × 6m**)

- prevents heat loss through fabric at critical junctions //
- increased level of insulation can be achieved through external insulation //
- improves the thermal comfort of the house //
- saves money as less heat is required //
- reduces the amount of fossil fuels - oil/gas - needed to heat home //
- reduces carbon footprint and CO₂ emissions of the building //
- correct detailing will eliminate thermal bridging //
- thermal bridging can cause condensation, which can cause dampness and mould growth, avoiding thermal bridging results in a more healthy building //
- increased value in house // *etc.*

** Accept any other appropriate answer(s).

9. The drawing shows an outline section through a 350mm external wall of a house with an insulated cavity. The owner of the dwelling has decided to thermally upgrade the dwelling by the use of external insulation

- (a) Select any **three** locations from those circled on the sketch and show clearly, using notes and annotated freehand sketches, the typical design detailing required when fixing external insulation.

Any 3: (3 × 16m)

Eaves

Notes (8m), Sketches (8m)

- eaves detailing may need to be altered depending on thickness of insulation //
- insulation carried into eaves space to ensure continuity of insulation // *etc.*

** Accept any other appropriate answer(s).

Window cill

Notes (8m), Sketches (8m)

- window cills to be cut flush with external wall and windows moved to outer edge of existing wall //
- preformed aluminium cills fitted //
- all internal window abutments taped and sealed with mastic sealant //
- detailing to eliminate all thermal bridging // *etc.*

** Accept any other appropriate answer(s).

Window head

Notes (8m), Sketches (8m)

- frames moved to outer edge of external wall //
- all window detailing taped and sealed with mastic sealant //
- insulation in contact with frame to eliminate thermal bridge // *etc.*

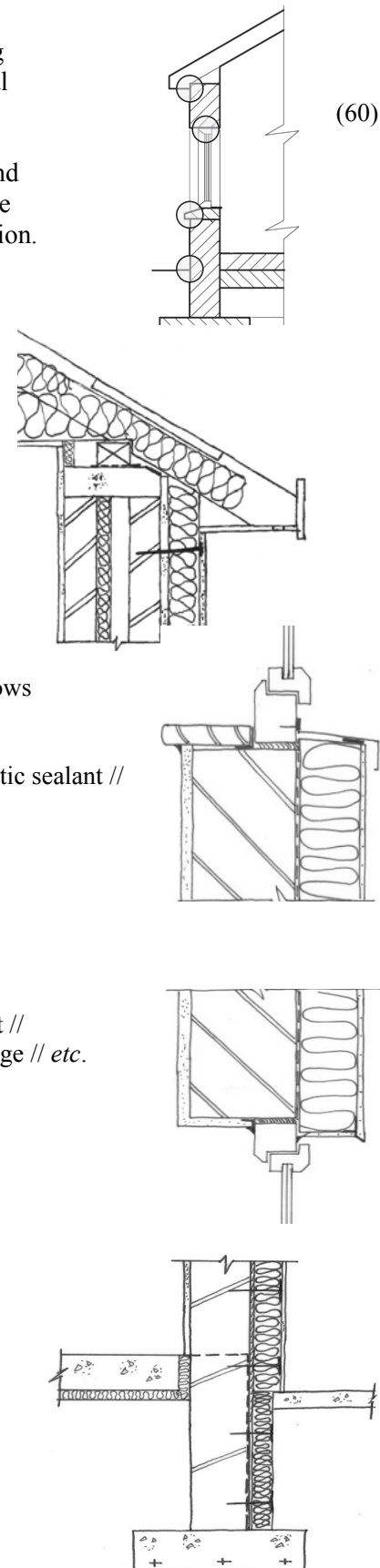
** Accept any other appropriate answer(s).

Ground level

Notes (8m), Sketches (8m)

- fixed with mechanical fixings //
- rigid insulation fixed with adhesive and anchor bolts //
- fibreglass mesh fixed over insulation //
- acrylic render applied 2 coats approx. 3mm each coat //
- 80 mm - 300 mm depending on eaves overhang //
- insulation carried below ground level to foundation //
- low water absorption EPS - type XPS - used below ground to rising wall // *etc.*

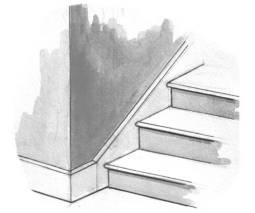
** Accept any other appropriate answer(s).



5. The sketch shows a portion of a closed string timber stairs suitable for a dwelling house.

(50)

- (a) To a scale of 1:5, draw a vertical section through the bottom three steps of the stairs. Show the string, treads and risers and give their typical sizes.



Any 6: (6 × 5m)

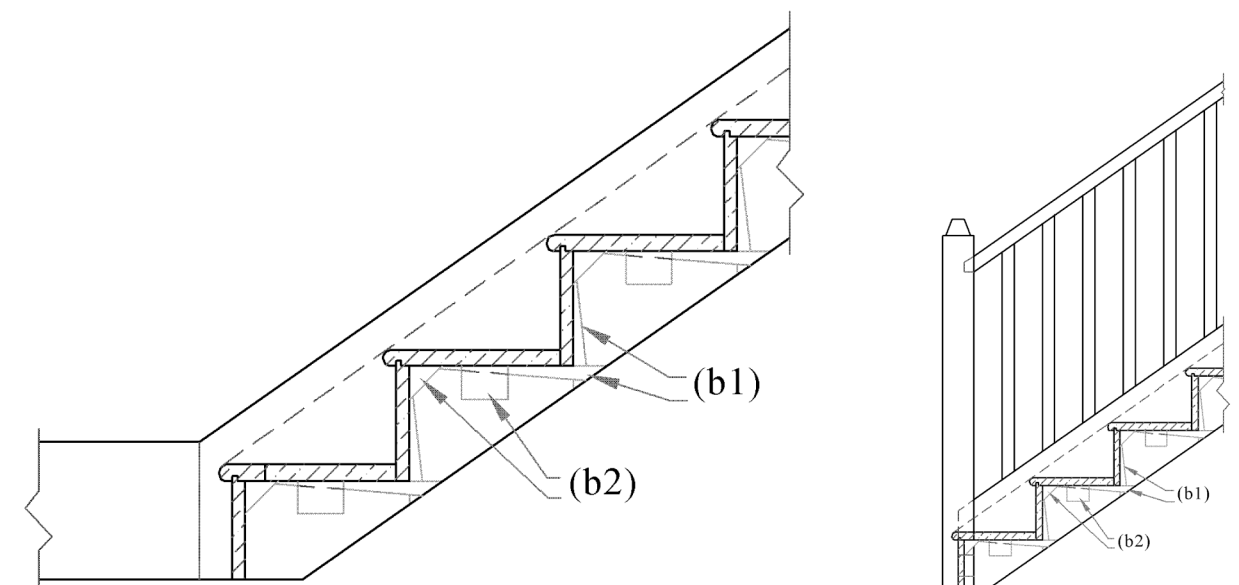
- string, typical 250 × 50 mm //
- treads $R \times 2 + G = 550 \text{ mm} - 700 \text{ mm}$ minimum going 220 mm //
- nosing 16 mm minimum //
- riser $R \times 2 + G = 550 \text{ mm} - 700 \text{ mm}$ maximum 220 mm //
- wedges //
- glue blocks //
- joint between tread and riser //
- pitch line //
- bottom three steps //

** Any alternative detailing which complies with current building regulations is acceptable.

Any 3 typical dimensions (3 × 2m)

Draughtsmanship, accuracy and scale (8m)

** Excellent 8 marks, Good 6 marks, Fair 4 marks.



- (b) Show on your drawing one design detail which will ensure that the stairs does not creak when in use.

Any 1: (6m)

- vertical wedges fitted behind the risers (b1) //
- horizontal wedges fitted beneath the treads (b1) //
- glue blocks fitted to the risers (b2) //
- glue blocks fitted to the treads and the string (b2) //
- threaded bars to hold strings together //

** See diagram above.

** Accept any suitable method.

6. (a) List **two** specific safety precautions to be observed in **each** of the following situations and give **one** reason for each safety precaution listed: (50)
- using a scroll saw to cut a curved piece of timber
Safety precautions (2 × 4m)
Reasons (2 × 2m)
 Any 2:
 - wear / use correct safety equipment //
 - user must have adequate training on the machine //
 - ensure no loose clothing and long hair is tied back //
 - full concentration must be given to the task in hand //
 - ensure the machine is in proper working order and *i.e.* the blade is correctly secured //
 - all safety guards must be in position //
 - ensure the machine is set to the correct speed // *etc.*
 ** Reason must be appropriate to safety precaution given.
 ** Accept any other appropriate answer(s).
 - using electric power tools outdoors
Safety precautions (2 × 4m)
Reasons (2 × 2m)
 Any 2:
 - they should only be used in dry conditions //
 - the correct voltage must be used //
 - all tools should be properly earthed //
 - work should be carried out in good underground conditions //
 - wear / use correct safety equipment // *etc.*
 ** Reason must be appropriate to safety precaution given.
 ** Accept any other appropriate answer(s).
 - using a ladder when painting an external wall of a building.
Safety precautions (2 × 4m)
Reasons (2 × 2m)
 Any 2:
 - make sure the correct ladder is used for the job //
 - check the ladder is in good working condition //
 - ensure the ground is firm and stable //
 - the angle of the ladder should be at 75 degrees //
 - check for overhead cables // *etc.*
 ** Reason must be appropriate to safety precaution given.
 ** Accept any other appropriate answer(s).
- (b) Sketch **two** safety signs that should be displayed at the entrance to a construction site and explain the purpose of **each** sign.
- Any 2: (2 × 7m)
 Note (4m), Sketch (3m)
- e.g. hard hat
 – to be worn by visitors and workers on site, it offers protection from falling objects //
- e.g. steel toe capped boots
 – to be worn by workers on site, they offer protection to the feet //
- e.g. high visibility jackets
 – to be worn by all visitors and workers on site, to ensure people are clearly visible//
- ** Accept any other appropriate answer(s).

- (c) Using notes and freehand sketches, outline **two** tests that may be carried out on an underground drainage system to ensure the pipe network is air and water tight.

Any 2: (2 × 7m)
 Notes (4m), Sketches (3m)

Water test

- one end of the pipe is plugged //
- the pipeline and up-stands are filled with water //
- this is maintained for twenty four hours //
- it is done before backfilling //
- it is a popular and reliable test //
- the pressure can be increased by increasing the height of up-stands // *etc.*

** Accept any other appropriate answer(s).

Air test

- temporary up-stand pipes with 90° bends are inserted into end of pipe runs //
- one end of the pipe is sealed //
- pressure fitted hence it can withstand a high amount of pressure without failing //
- an airline and pump are connected to other end //
- air is pumped into the pipe //
- pressure is maintained for three minutes //
- easy test with instant results // *etc.*

** Accept any other appropriate answer(s).

Smoke test

- carried out same way as air test //
- smoke is pumped through the pipe before plugging the end //
- pressure is maintained //
- the pipe is observed to see if smoke is escaping //
- this test is not recommended for uPVC pipework // *etc.*

** Accept any other appropriate answer(s).

8. A properly designed and constructed sewage system is essential for the safe removal of waste from a domestic house in a rural area.

- (a) Using notes and freehand sketches, discuss **three** typical design details of an underground drainage system that ensure the safe removal of waste from a dwelling house to its septic tank.

Any 3: (3 × 6m)

Notes (4m), Sketches (2m)

- self venting //
- self cleansing //
- easy access for inspection at junctions and manholes //
- pipes laid in straight lines with as few direction changes as possible //
- pipes laid straight to even gradients between inspection chambers, access junctions and manholes //
- must have adequate access points and rodding points for cleaning //
- manholes maximum distance of 90 m apart //
- the system must have adequate ventilation //
- piping normally of uPVC material, usual lengths of 6 m, easy to join and very strong //
- 100 mm diameter pipes normally used and laid at a gradient of 1 in 40 // etc.

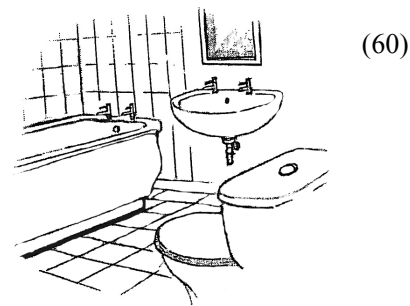
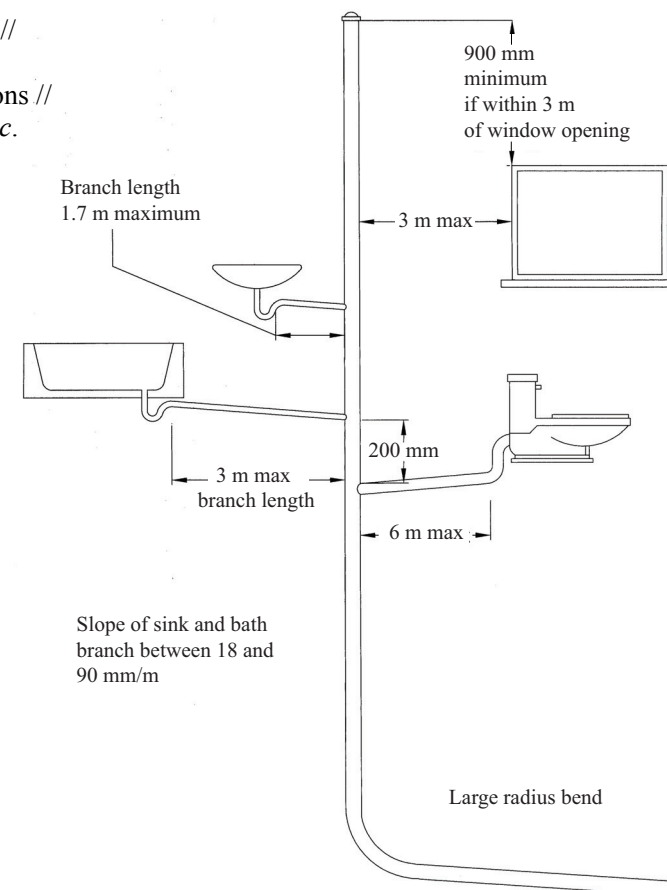
** Accept any other appropriate answer(s).

- (b) The accompanying sketch shows a bathroom on the first floor of a dwelling house. Using notes and a single-line diagram, show a typical pipe layout of a single stack system to remove waste safely from the bathroom.

Any 6: (6 × 4m)

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

Draughtsmanship (4m)



(60)

7. Before a new house can be built it is necessary to apply for planning permission from the local county council.

(50)

- (a) Discuss **two** reasons why it is necessary to apply for planning permission before a new house can be built.

Any 2: (2 × 7m)

- it is a legal requirement before any building can be built //
- any 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 county 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 //
- residents in the area must be aware of any new developments in the area //
- it prevents the danger of unsafe buildings //
- proper regulation of sewage and waste disposal //
- ensures that buildings blend easily with their surroundings //etc.

** Accept any other appropriate answer(s).

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

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.

** Accept any other appropriate answer(s).

- 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 that an observation may be made on payment of a fee //
- each planning authority gives a list of approved newspapers // etc.

** Accept any other appropriate answer(s).

- 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 (rural area) or 1:1000 (urban area) //
 - six copies must be included with planning application form // *etc.*

** Accept any other appropriate answer(s).
- 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.*

** Accept any other appropriate answer(s).
- application form.
Any 4: (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, *e.g.* finishes, colours, textures *etc.* // *etc.*

** Accept any other appropriate answer(s).

- (c) Explain what is meant by outline planning permission and describe **one** situation where a person might wish to apply for outline planning permission.

Explain

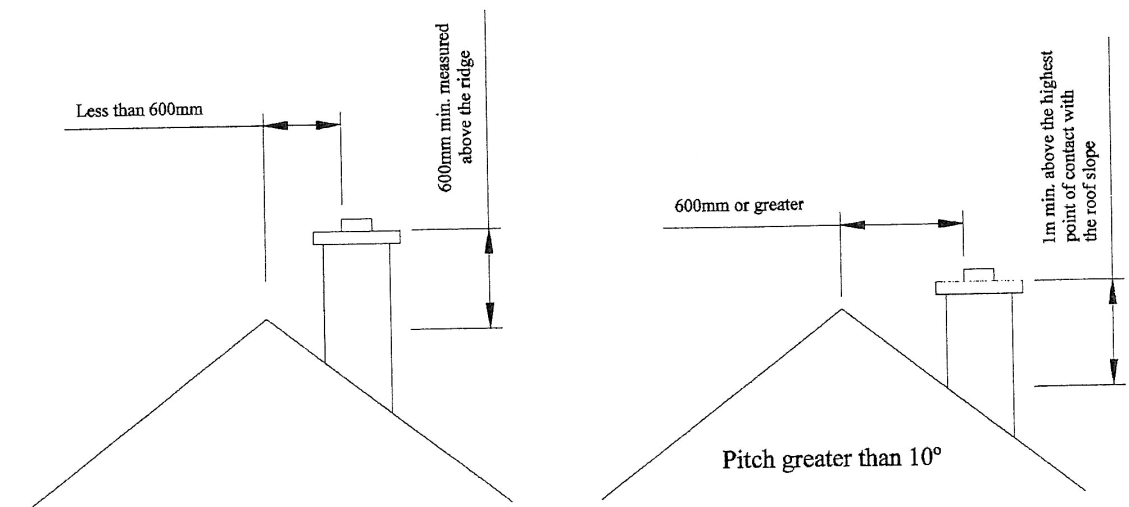
- Any 2: (2 × 4m)
- outline permission is used to establish if the planning authority will agree in principle to the development //
 - it is a general permission for the site //
 - this is not concerned with the exact technical detailing of the development //
 - detailed drawings are not needed //
 - it does not allow the development to proceed as it is not permission to build // *etc.*
- ** Accept any other appropriate answer(s).

Situation

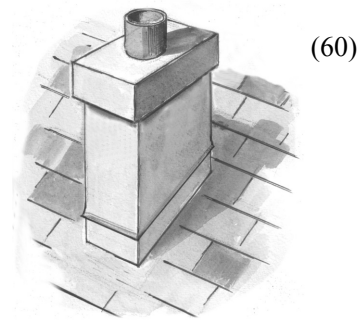
- Any 1: (4m)
- if a person or company is interested in buying a site for building purposes //
 - outline planning increases the value of the property //
 - application for outline permission gives a person an indication of how the planning authority will approach the development //
 - less documentation and less expense involved //
 - no detailed plans needed //
 - they will find out if planning authorities have any difficulties with development, *i.e.* heritage, road access, visual impact, percolation areas and proximity to other buildings *etc.* // *etc.*
- ** Accept any other appropriate answer(s).

- (b) Using notes and freehand sketches, show the necessary design detailing to prevent the occurrence of down draught in a chimney.

- Any 3: (3 × 4m)
- chimney should be a minimum of 1 metre above a flat roof //
 - chimney should be a minimum of 1 metre above the highest point of contact with the roof slope if the chimney is 600 mm or more away from the ridge //
 - chimney should be a minimum of 600 mm above the ridge if less than 60 mm from the ridge //
 - extend all chimneys above the ridge //
 - there should be a smoke shelf in the chimney design //
 - take the site into account when designing the house, *i.e.* will the house be on a sheltered hillside or near a high building *etc.* // *etc.*
- ** Accept any other appropriate answer(s).



7. A concrete block chimney passes through a pitched roof as shown in the accompanying sketch. The chimney is finished with a sand / cement render and the roof is pitched at 45 degrees.

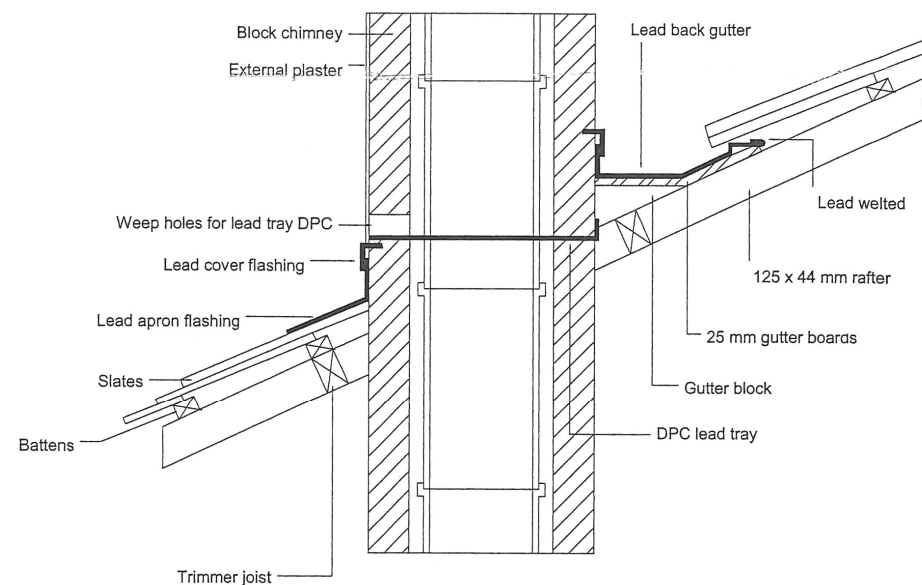


- (a) To a scale of 1:5, draw a vertical section through the roof. Show clearly all the constructing details at the roof / chimney intersection to prevent water penetration, include one course of slates both sides of the chimney. Include **three** typical dimensions on your drawing.

Any 10: (10 × 4m)

- blockwork for chimney //
- flue liner in position //
- external plaster //
- D.P.C. lead tray in correct position //
- weep holes for lead D.P.C. tray //
- lead cover flashing //
- rafters //
- trimmer joist //
- felt //
- slating laths //
- slates //
- back gutter block //
- lead back gutter // etc.

Scale (4m), Draughtsmanship (4m)



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

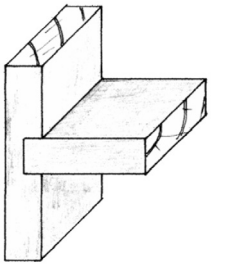
Any 5: (5 × 10m)

- housing joint

Note (5m), Sketch (5m)

- the housed or housing joint is widely used in woodwork //
- it is a simple but effective method of joining two pieces of wood together //
- it is ideal for shelving //
- this joint may also be used for the division of a wooden box //
- the joint can be strengthened using glue or pins //
- the horizontal piece fits into the trench formed on the upright //
- the stopped housing joint may also be used and gives a neater appearance // etc.

** Accept any other appropriate answer(s).

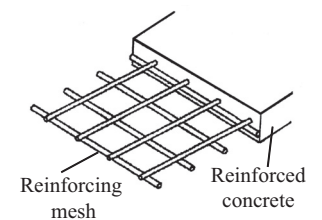


- reinforced concrete

Note (5m), Sketch (5m)

- steel bars or steel mesh placed in concrete //
- gives tensile strength to concrete //
- used in raft foundation construction and solid floor construction //
- used in lintels and cills //
- placed at the bottom of the concrete being cast //
- diameter of bars vary from 6 mm to 25 mm // etc.

** Accept any other appropriate answer(s).

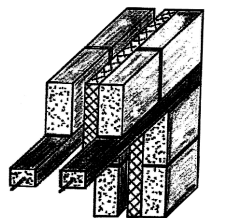


- concrete lintel

Note (5m), Sketch (5m)

- ready-made concrete units pre-stressed during manufacture //
- used to span the opening over a window or door //
- the lengths vary to suit different door and window openings //
- it transfers the load from above the door or window to the wall at either side //
- the lintel carries the weight of the block work //
- the cross section size is 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.

** Accept any other appropriate answer(s).

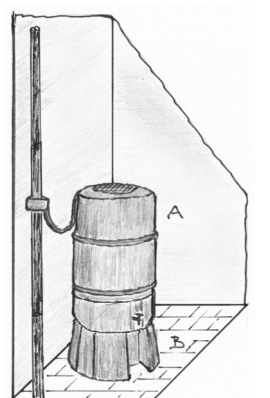


- rainwater butt

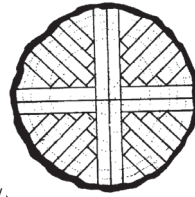
Note (5m), Sketch (5m)

- this is a type of barrel or tank 'A' used to collect rainwater from roofs //
- the butt is part of a rainwater harvesting system //
- it is connected to the downpipe from the gutter //
- it is fitted with an overflow system //
- the butt has a tap at the base and a special base 'B' is also available //
- capacity is from 100 to 300 litres //
- some models may have a submersible pump fitted allowing for watering of plants or washing of vehicles // etc.

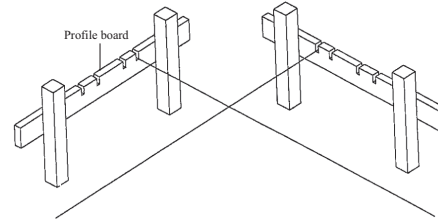
** Accept any other appropriate answer(s).



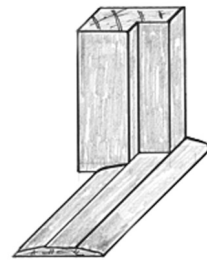
- quarter sawing
 - Note (5m), Sketch (5m)
 - method to convert logs into useable timber //
 - also called radial sawing //
 - the sawing is carried out by cutting in line or parallel to the rays //
 - produces good quality boards that are stable and wear well //
 - produces attractive grain pattern in hardwoods (silver grain in oak) //
 - an expensive method of conversion //
 - it is a labour intensive method as the log has to be rotated for each cut // *etc.*
- ** Accept any other appropriate answer(s).



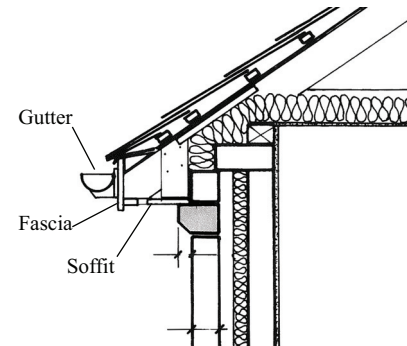
- profile boards
 - Note (5m), Sketch (5m)
 - a timber horizontal rail fixed to two vertical posts that are fitted into the ground //
 - used to mark the position and the width of the foundation trenches //
 - they also show the width of the walls //
 - profiles are set up clear of the trenches so as not to obstruct excavation work //
 - placed at all corners and at the end of cross walls // *etc.*
- ** Accept any other appropriate answer(s).



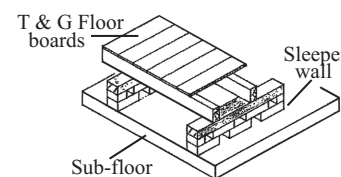
- door saddle
 - Note (5m), Sketch (5m)
 - made of hardwood or softwood of typical section 110 x 15 //
 - it is fixed at the bottom of the door frame //
 - the saddle is cut and shaped to fit neatly around the frame //
 - it gives clearance between floor and the bottom of the door //
 - it forms a neat finish to the space under the door //
 - it also covers the joint between two different floor coverings // *etc.*
- ** Accept any other appropriate answer(s).



- fascia board
 - Note (5m), Sketch (5m)
 - decorative board at the front of eaves //
 - the gutter is attached to the fascia //
 - it is made from plastic or timber //
 - the fascia will support the soffit //
 - fascia is attached to the rafters // *etc.*
- ** Accept any other appropriate answer(s).



- sleeper wall
 - Note (5m), Sketch (5m)
 - 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.*
- ** Accept any other appropriate answer(s).



- (b) With reference to the design shown, discuss in detail, using notes and freehand sketches, the importance of **each** of the following when ensuring the house has a low environmental impact:
- scale and layout (8m)
 - Note (5m), Sketch (3m)
 - narrow plan, the house is only one room wide and glazing to ensure passive solar energy will reach all rooms //
 - house construction is small in scale, it requires smaller quantities of materials and will be easier to build //
 - modesty of scale ensures less excavation, materials for construction ensuring less disruption to natural environment //
 - combined kitchen and dining area is economical use of space //
 - low lying building which will not break the skyline //
 - infrequently used room positioned on the cold north side of the house //
 - less materials used in the construction //
 - compact building reduces the surface to volume which will help to reduce the heat loss // *etc.*
 - ** Accept any other appropriate answer(s).
 - energy efficiency (8m)
 - Note (5m), Sketch (3m)
 - rainwater butt at the side of the house reducing water consumption //
 - solar panels on the roof reducing energy use //
 - only one chimney, used for a stove instead of an open fire //
 - large south-facing windows allowing for maximum solar gain //
 - draught porch reducing heat loss // *etc.*
 - ** Accept any other appropriate answer(s).
 - flexibility of the design. (8m)
 - Note (5m), Sketch (3m)
 - allows for lifetime use //
 - easy to change layout //
 - easy to add extensions //
 - easy to disassemble the build // *etc.*
 - ** Accept any other appropriate answer(s).

6. The elevation and ground floor plan of a house are shown. The house has two bedrooms and a bathroom in the attic space. The external wall is a concrete block wall with an insulated cavity. The house is designed to have a low environmental impact.



- (a) Using notes and freehand sketches as appropriate, discuss in detail **three** planning guidelines that should be observed when designing a new house in a rural area to have low environmental impact.

Any 3: (3 × 12m)
Note (6m), Sketch (6m)

Landscape

- house should match in with landscape //
- house should not be obtrusive //
- check out existing building styles in area //
- check existing building traditions for the area // etc.

** Accept any other appropriate answer(s).

Maintain existing features

- respect and retain the existing local landscape //
- plant trees and shrubs at building stage //
- house should not break the skyline, choose site with gentle fold or slope //
- avoid planting exotic plants and evergreen trees along site boundaries //
- conserve all existing stone walls // etc.

** Accept any other appropriate answer(s).

Design and form

- house to suit the area, should not compete with the surrounding topography //
- building materials should be sourced locally //
- materials to match in with local building materials and techniques //
- buildings should be solid and of simple construction techniques //
- single room wide dwelling //
- build an entrance porch where appropriate //
- windows to have vertical emphasis // etc.

** Accept any other appropriate answer(s).

Orientation

- take into account prevailing wind direction //
- take into account path of the sun //
- use of passive solar energy design //
- design of shelter planting to winds and provide privacy // etc.

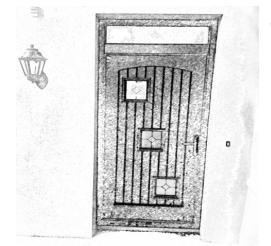
** Accept any other appropriate answer(s).

Access and road boundaries

- must have safe access to / from public roads //
- avoid high walls //
- entrance to respect natural contour of the land //
- driveway to blend in with existing roadway //
- ensure the scale of the house is in sympathy with the size of the site and other surrounding buildings // etc.

** Accept any other appropriate answer(s).

9. The sketch shows a timber front door of a newly constructed dwelling house.



- (a) Recommend a suitable timber for the door and give **two** reasons for your choice.

Wood (2m)

Reasons (2 × 4m)

Any 1:
- teak //

- Any 2:
- resistant to moisture and insect attack //
 - very stable timber //
 - provides a good surface for painting //
 - it glues and works well //
 - hardwood material // etc.

- red deal / Scots pine //

- Any 2:
- easy to work, plane and cut //
 - provides good finish when painted or varnished //
 - reasonably priced //
 - strong and stable //
 - easily available // etc.

- oak // etc.

- Any 2:
- very resistant to decay //
 - very strong and heavy timber //
 - provides a good surface for painting //
 - it glues and works well //
 - hardwood material // etc.

- ash //

- Any 2:
- resistant to moisture and insect attack //
 - very stable timber //
 - provides a good surface for painting or varnishing //
 - it glues and works well //
 - hardwood material // etc.

** Reasons given must be appropriate for chosen wood.

- (b) Show, using notes and neat freehand sketches, the steps involved in preparing and painting the new timber door.

Notes (6 × 4m)

Sketches (4m)

Any 6: (6 × 4m)

- if the finish is to be applied outdoors, make sure weather conditions are correct, dry calm day //
- ensure that the wood has a moisture content of less than 18% //
- make sure the surface of the wood is clean, dry and free from dust and dirt //
- timber should be sanded to provide a smooth surface for paint //
- all dust should be removed using a clean cloth and white spirits //
- apply the finish using a good quality brush //
- apply even coats and finish in the direction of the grain //
- lightly sand between coats // etc.

** Accept any other appropriate material.

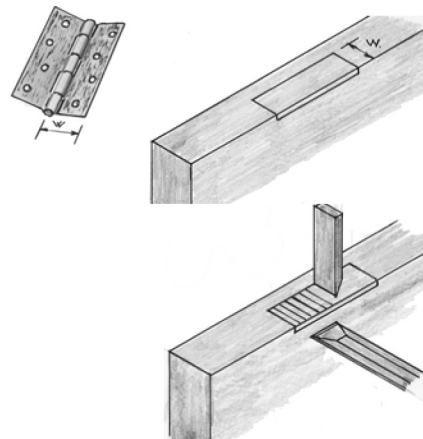
** Quality of sketch, Excellent 4 marks, Good 3 marks, Fair 2 marks.

- (c) Sketch a suitable hinge for this door and show, using notes and neat freehand sketches, the steps involved in fitting **one** hinge to the door.

Any 2: (2 × 6m)

- a butt hinge is normally used for this door //
- the position of the hinge is marked on the door edge //
- two lines are marked to show the ends of the hinge //
- the width of the hinge is used to set the marking gauge //
- the gauge is also used to mark the thickness of the hinge leaf //
- a sharp bevel edged chisel is used to remove the waste //
- a router with jig is often used //
- the trench is slightly sloped on the outer edge // etc.

** Accept any other appropriate answer(s).



- (b) The owner wishes to upgrade the thermal properties of the wall and has chosen to use the external insulation method of fixing expanded polystyrene to the external surface. Given the thermal conductivity (k) of the expanded polystyrene as 0.037 W/m °C, calculate the thickness of insulation required to achieve a U-value of 0.27 W/m² °C.

Any 5: (5 × 3m)

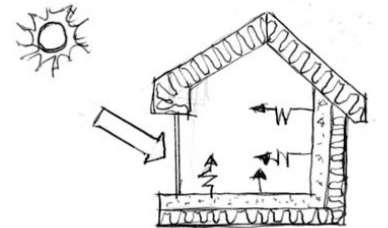
Correct cost calculation (3m)

- U-value = 1 / total resistance
- New U-value = 0.27 W/m² °C
- ⇒ New total resistance = 1 / U-value = 1 / 0.27 = 3.70 m² °C/W or 3.7037 m² °C/W
- Resistance for new insulation layer = New total resistance - Old total resistance = 3.70 - 1.0678 = 2.6322 m² °C/W or 2.6359 m² °C/W
- Thickness / Conductivity (T/K) = Resistance (R) = 2.6322
- ⇒ T / 0.037 = 2.6322
- ⇒ T = 2.6322 × 0.037 = 0.0974 m or 0.0975 m
- ⇒ Thickness of insulation required = 97 mm

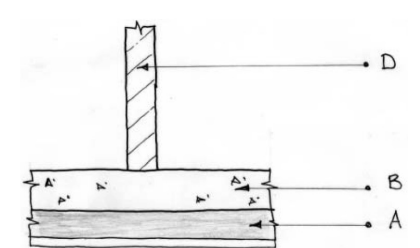
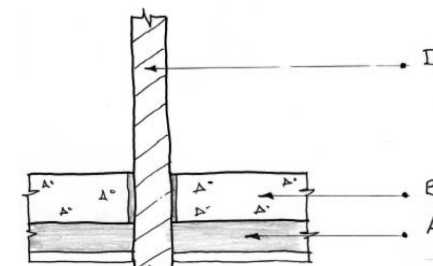
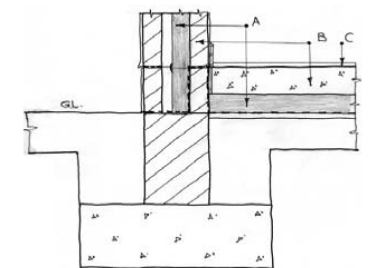
- (c) Using notes and freehand sketches, discuss the importance of thermal mass in improving the thermal performance of a dwelling house. (10m)

Notes (5m), Sketch (5m)

- thermal mass improves thermal performance and enhances thermal comfort thus requiring less use of fossil fuels //
- dense materials such as brick, stone, concrete, glass, marble are most effective in storing and releasing substantial quantities of thermal energy //
- buildings that utilise thermal mass to increase thermal comfort depend on the principles of passive solar heating: Passive Solar Collection & Passive Solar Storage //
- in Ireland's mild climate, solar gain can make a substantial contribution (20%) to space heating requirements //
- thermal mass may best be utilised as a passive heating strategy in residential buildings //



- A: Rigid insulation;
- B: Concrete;
- C: Ceramic tile;
- D: Concrete internal walls.



5. (a) Calculate the U-value of the external wall of a house built over thirty years ago, given the following data: (60)

External render	thickness	19 mm
Concrete block outer leaf	thickness	100 mm
Un-insulated cavity	width	100 mm
Concrete block inner leaf	thickness	100 mm
Internal plaster	thickness	16 mm

Thermal data of external wall:

Resistance of external surface	(R)	0.55	m ² °C/W
Conductivity of external rendering	(k)	0.460	W/m °C
Conductivity of concrete blocks	(k)	1.440	W/m °C
Resistance of cavity	(R)	0.18	m ² °C/W
Conductivity of internal plaster	(k)	0.460	W/m °C
Resistance of internal surface	(R)	0.123	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				0.550
Cement rendering	0.019	0.460	T/K	0.0413
Concrete block outer leaf	0.100	1.440	T/K	0.0694
Cavity				0.1800
Concrete block inner leaf	0.100	1.440	T/K	0.0694
Plaster	0.016	0.460	T/K	0.0347
Internal surface				0.1230

- total resistance = 1.0678 //
- U-value = 1 / total resistance //
- = 1 / 1.0678 //
- = 0.936 W/m² °C

Construction Studies

Higher Level
Marking Scheme (300 marks)

Answer Question 1 and **four** other questions.

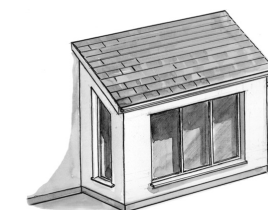
All Questions 60 Marks

1. A double glazed hardwood window is fitted in the cavity wall of a new building, as shown in the accompanying sketch. The external wall is a 350 mm concrete block wall with an insulated cavity. The wall is plastered and constructed to latest building regulations. (60)

- (a) To a scale of 1:5, draw a vertical section through the wall and window. The section should show the typical construction details from 300 mm below the concrete cill to 300 mm above the head of the double glazed window.

Any 10: (10 × 4m)

Drawing (3m), Notation (1m)



Cill detail

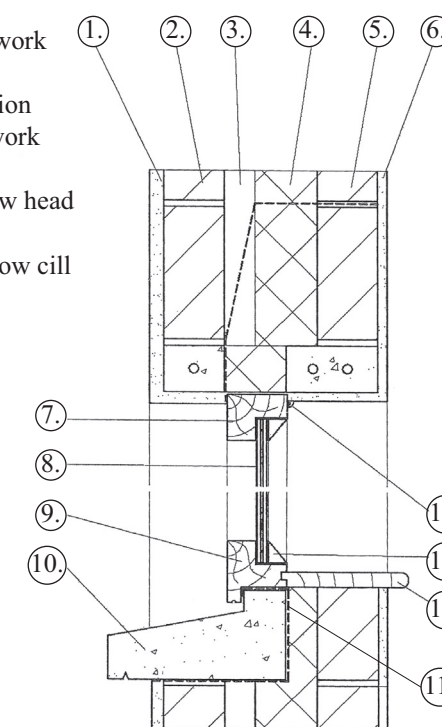
- concrete cill 275 × 100 mm//
- drip on cill //
- insulation at back of cill //
- infill //
- external / internal plaster //
- outer leaf //
- 50 mm airspace //
- 100 mm insulation //
- wall ties at correct centres //
- cavity closed with proprietary cavity barrier //
- window section //
- window board //

1. 19 mm render
2. 100 mm block work
3. 50 mm cavity
4. 100 mm insulation
5. 100 mm blockwork
6. 15 mm plaster
7. 100 x 75 window head
8. double glazing
9. 100 x 275 window cill
10. concrete cill
11. sealant
12. window board
13. glazing bead
14. airtight seal

Head detail

- pre-stressed concrete lintel //
- stepped D.P.C. //
- cavity closed with insulation //
- window frame in position //
- cavity wall construction // etc.

Scale (4m), Draughtsmanship (4m)



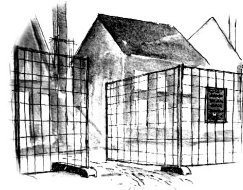
- (b) Indicate on your drawing **two** specific design details that ensure moisture does not penetrate to the inner leaf of the new building.

Any 2: (2 × 6m)

** Accept any correct detailing.

2. The safety of workers and correct safety procedures are concerns for all professions engaged in working on an active building site.

(a) Identify **two** possible risks to personal safety associated with **each** of the following:



(60)

- carrying out a deep excavation on a building site

Any 2: (2 × 3m)

- risk of person falling into trench //
- risk of trench collapse //
- could cause risk to surrounding structures //
- risk of machinery driving into the trench //
- risk of damage to underground cables and service pipes // *etc.*

** Accept any other appropriate answer(s).

- working around a stairwell on an upper floor before the stairs are fitted

Any 2: (2 × 3m)

- risk of falling through the stairwell opening //
- risk of building items and debris falling through the opening //
- risk of being hit by falling objects if under the stairwell // *etc.*
- risk to workers' safety while climbing up or down from upper floor //

** Accept any other appropriate answer(s).

- erecting scaffold around a building to allow maintenance work to be carried out.

Any 2: (2 × 3m)

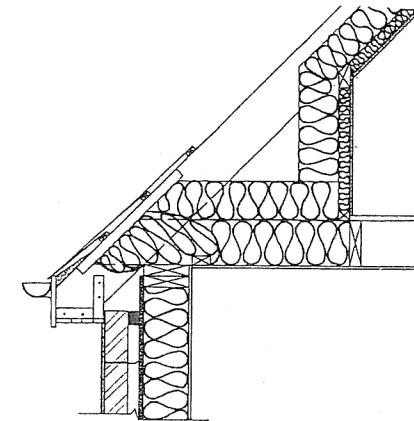
- risk of person falling from scaffold //
- risk of tools / materials falling //
- risk of scaffold moving or falling //
- risk to workers' safety while climbing onto the scaffold //
- incorrect use of scaffold, being overloaded with materials making it unsafe // *etc.*

** Accept any other appropriate answer(s).

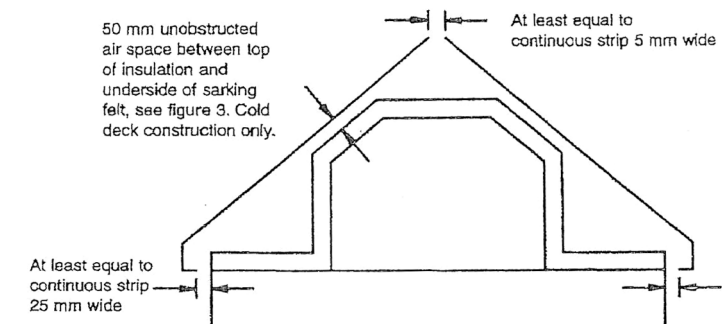
Typical detail at Purlin / strut

- rafters 150 x 50 mm //
- Purlin 100 x 75 mm //
- struts 100 x 50 mm //
- braces 100 x 50 mm //
- plasterboard //
- vapour barrier //
- tongue and groove flooring //
- ventilation space //
- insulation // *etc.*

** Accept any other appropriate answer(s).



** Insulation at the eaves.



** Air circulation route.

4. (a) Discuss in detail, using notes and freehand sketches, **three** functional requirements of a roof suitable for a dwelling house.

Any 3: (3 × 8m)

Notes (4m), Sketch (4m)

- weather resistant - provide protection from rain, snow, wind and sun //
- durability - must survive time, correct selection of correct materials //
- structural stability - must support all loads on the roof, live and dead //
- thermal insulation - must provide high level of insulation, prevent heat loss in winter and overheating in summer //
- ventilation - required to avoid build up of condensation in structure which could lead to fungi attack on materials in structure //
- fire resistant - must provide occupants with adequate time to escape in the case of fire //
- storage space for water tank, attic storage and possible living space // etc.

** Accept any other appropriate answer(s).



(60)

- (b) The owner of a dwelling has decided to convert the attic space to accommodate an extra bedroom. The roof structure was constructed using traditional cut rafter method. Using notes and freehand sketches, show the construction details necessary to accommodate the new living space. Indicate clearly the ventilation and insulation detailing for the roof structure and include **three** typical dimensions on your drawing.

Construction details (10m)

Ventilation (8m)

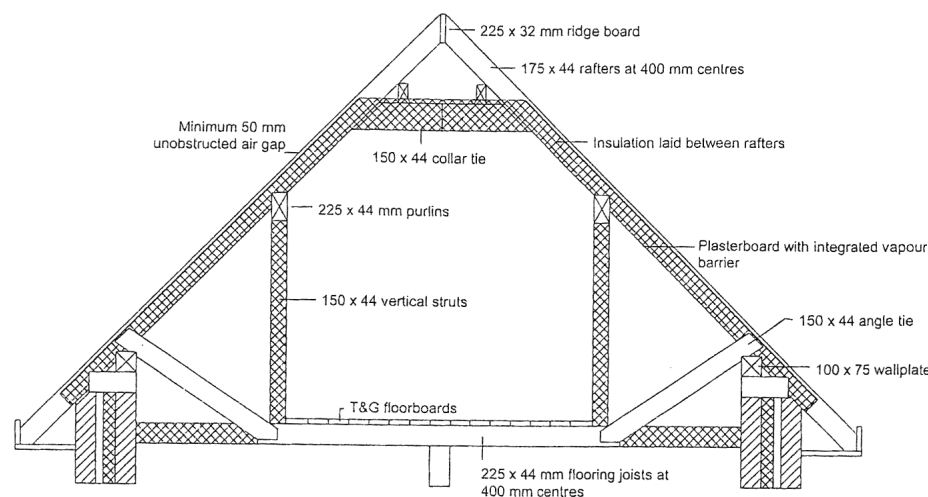
Insulation (8m)

Quality of sketch (10m)

Typical detail at eaves

- air vents at eaves //
- 1½ slates at eaves //
- eaves ventilator //
- ceiling joists 225 x 50 mm @ 400 centres //
- wallplate 100 x 75 mm //
- purlin 225 x 44 mm //
- rafters 175 x 44 mm //
- slating laths //
- roofing felt //
- insulation // etc.

** Accept any other appropriate answer(s).



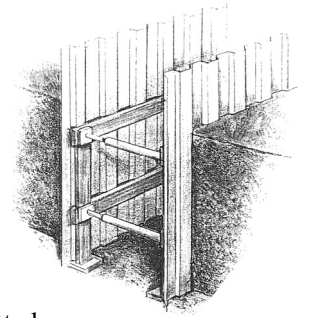
- (b) Using notes and freehand sketches as appropriate, outline **two** specific safety procedures that should be observed to eliminate **each** risk identified at 2(a) above.

- carrying out a deep excavation on a building site

Any 2: (2 × 4m)

- the sides of the trenches should be taken out at safe angle //
- trenches should be supported to prevent collapse //
- keep the area sealed off //
- place warning signs in key positions //
- a guard rail should be fitted around the opening // etc.

** Accept any other appropriate answer(s).

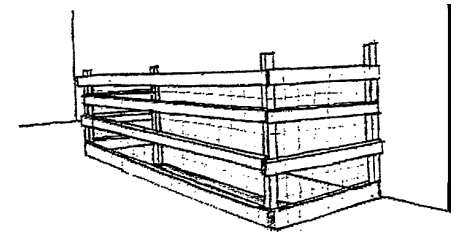


- working around a stairwell on an upper floor before the stairs is fitted

Any 2: (2 × 4m)

- provide warning signs around danger //
- guard rail to be fitted around the opening //
- use of netting and toe boards to prevent items falling through opening // etc.

** Accept any other appropriate answer(s).

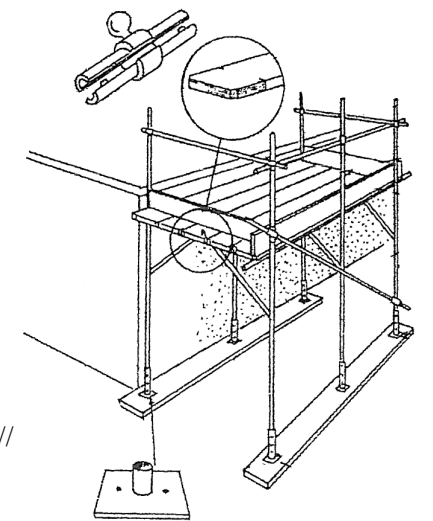


- erecting scaffold around a building to allow maintenance work to be carried out.

Any 2: (2 × 4m)

- adequate training for all workers involved in erecting scaffolding //
- must have a suitably prepared base for the scaffold to be built on //
- scaffolding must have protective guard rails and toe boards //
- regular inspection must always be carried out on scaffolding //
- safety mesh netting must be provided to protect workers and general public from falling debris //
- all platforms to be fully boarded //
- braces or ties to be fitted as scaffolding is being erected to keep structure rigid //
- structure must be adequately tied to the building //
- protective clothing to be worn by all workers erecting the scaffolding // etc.

** Accept any other appropriate answer(s).



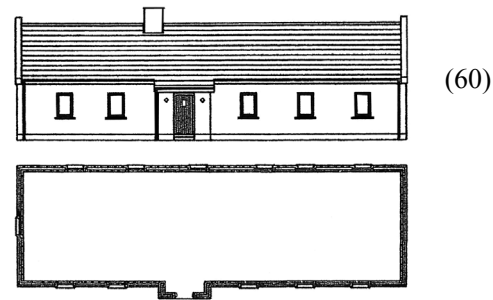
- (c) Discuss **three** guidelines, which are commonly referred to in the Health and Safety Statement of a construction company, as required by the Health and Safety Authority.

Any 3: (3 × 6m)

- hazard identification and control //
- emergency plans //
- accident planning //
- safe procedures in using machines and plant //
- maintenance and inspection of equipment //
- training procedures // etc.

** Accept any other appropriate answer(s).

3. The drawing shows the elevation and plan outline of the external wall of a new dwelling designed for an elderly couple, of which, one is wheel chair bound.



- (a) Discuss **three** areas of the new house design that require specific consideration for this couple.

Any 3: (3 × 6m)

Entrance / Hallways

Any 3: (3 × 2m)

- main entrance to be accessible for wheelchair user //
- doorways to have clear opening of 800 mm //
- avoid door saddle boards //
- door handles and light switches should be 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 // *etc.*

** Accept any other appropriate answer(s).

Kitchen

Any 3: (3 × 2m)

- must have adequate space for a wheelchair to turn, *i.e.* 1500 diameter //
- light switches and electric sockets at correct heights for wheelchair user //
- 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 goods //
- non-slip floor surfaces //
- no changes in floor levels //
- circular table for ease of movement //
- dishwashers, washing machines to be built under work surfaces // *etc.*

** Accept any other appropriate answer(s).

Bathroom

Any 3: (3 × 2m)

- wall-mounted sink //
- use of lever-style taps //
- wheelchair access to window //
- vertical and horizontal grab rails fitted at required positions //
- flush finished shower tray or wet room design //
- fabric shower curtain for ease of use //
- flip-up shower seat //
- non-slip floor surfaces //
- push button flushing on WC // *etc.*

** Accept any other appropriate answer(s).

Bedrooms

Any 3: (3 × 2m)

- 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 //
- wheelchair access to window // *etc.*

** Accept any other appropriate answer(s).

- (b) Select **one** of the areas identified at 3(a) above and show, using notes and freehand sketches, **three** specific design considerations that would make it suitable for a wheelchair user. Indicate on your design sketches typical dimensions as appropriate.

Specific design considerations

Notes (3 × 8m)

Sketches (3 × 6m)

** Accept any appropriate design considerations.

