

CONSTRUCTION TECHNOLOGY 1: HOUSE CONSTRUCTION 2nd edition

OUTLINE ANSWERS TO REVIEW TASKS

Chapter/ Section	Page	Answer
1.1	8	<p>Thermally light buildings are physically light in weight and have a fabric which has little capacity to absorb heat. Such buildings respond quickly to changes in external temperatures.</p> <p>By contrast thermally heavy often have a heavy dense fabric which reflects some heat and absorbs much of the rest. They insulate the interior by reacting slowly to variations in external temperature.</p>
1.1	13	<p>List of performance requirements may include:</p> <ul style="list-style-type: none">structural stabilitydurabilitythermal insulation exclusion of moisture and protection from the weatheracoustic insulationflexibility (changing user needs)aesthetics
1.2	17	<p>Tensile – forces resulting from a tendency to stretch</p> <p>Torsional – resistance to forces tending to twist</p> <p>Shear – forces resisting a tendency for one part of a loaded member to slide passed another and fracture</p>
1.3	22	<p>The function of foundation is to transfer loads to the ground with safety, efficiency and economy, but fundamentally the aim is to spread the load from the wall (in this case) over sufficient area to ensure that the ground can cope with the load, leaving the wall stable.</p>
1.3	26	<p>Steel beams are generally of I profile. We know that when a beam bends under load (smile fashion) that the maximum compression force is experienced in the very top of the beam, and here we have a major part of the steel beam's material in the form of a flange.</p> <p>Similarly, the maximum tensile force in a bending beam occurs in the lowest region of its material, and here we have the other flange.</p> <p>Clearly, the I profile suits the way that a beam is expected to bend, as it places the material in the flanges where it is needed to resist load.</p>

2.2 35 Five from:

Nature of the soil (possible justification – we need to know many characteristics of the soil; particle size and shape, tendency to be dimensionally unstable during changes of moisture content, chemical pollutants).

The thickness of the layers of soil (possible justification – once we know the characteristics of the soil, the thickness of layers will help the decision of the form of foundation that is to be selected as we know the depth to which the ground feels the impression of load through different foundation forms).

The strength of the soil (possible justification – this correlates directly with two other factors, the load from the building and the area over which the load needs to be spread by using a foundation).

Contaminants in the soil (possible justification – these need to be viewed from the standpoint of possible injury to the health of construction workers or to the later building occupants, and also in respect of potential damage to the materials used in the ground).

The degree of moisture present (possible justification – this may influence the water used when mixing materials used in the soil, such as concrete; it may also have a deteriorating effect on certain materials and an effect may be expected as a result on specification selection).

The existence of a water table (possible justification – this may influence the need to temporarily lower the water level using dewatering techniques; it is also likely to influence the water content of mixed concrete; there will usually be other readings of the water table as the work commences to see if there has been any change).

Location of existing services (possible justification – it is important that these are not damaged during the works from a safety and a present user point of view, the location may be important to the design of possible connections to existing).

2.3 40 Planning permission and Building Regulation approval.

Construction Design and Management regulations general application tends to be where the job is likely to last more than 30 days or where there are five or more workers on the site at any one time.

The CDM regulations concern health and safety and involve the assembly of a health and safety plan.

- 2.4 48 Gas – yellow, cold water – mid blue
- Foul drains carry discharges from all sanitary appliances.
- Surface water drains carry rainwater.
- 2.5 54 Part C: Preparation of site and resistance to ground moisture.
- Strip level – reached after removal of topsoil
- Formation level – the level at which we start to form the ground floor, reached after the exercise of reduced level excavation
- 3.1 61 A method of building based on prefabricated components to be assembled on site. This has two variants – *open systems*, which could accept modular sized prefabricated components from other manufacturers, and *closed systems*, which are self-contained with no ability to accept the components manufactured elsewhere.
- 3.2 64 The use of MMC will affect the design of houses by employing greater levels of pre-manufacture and pre-assembly of components and sub-assemblies. The nature of the design will be affected by the level of MMC to be employed and the degree to which standard modules or assemblies are utilised. Clearly the greater the degree of standardisation the lesser the level of individuality in properties. The designer must understand the construction technology associated with MMC at the outset as there may be less flexibility for subsequent variation than there is with ‘traditional’ building. The effect on production will be that there will be a shift in the location of production and assembly to a factory environment. This relies on sufficient numbers to ensure economies of scale. The cost implication of MMC should be that enhanced quality is achievable at lower cost due to the reduction in labour intensity of the process.
- 3.3 75 The RIBA Plan of Work aimed to divide the construction process into a series of phases to represent recognisable groups of activities.
- Inception – the first idea of the need for a building Feasibility – examination of the financial viability of the proposal.
- Outline proposals – working up some sketches and ideas for the design
- 3.4 79 An *S curve* graph plots expenditure against time showing the outlay to date.
- The steeper the graph, the greater the expenditure over time.

Cash flow is important because the developer needs to fund ongoing construction without exposing themselves to excessive levels of borrowing or high levels of capital commitment. The use of cash income to fund ongoing development minimises the cost of borrowing and reduces the level of financial exposure of the developer. Generally, cash-flow is more important than absolute profit.

- 4.1 98 The need to select foundations solutions to effectively increase the spread of load to the ground may arise from two sources: higher levels of building load or poorer ground bearing capacities.

The depth of the foundation may need to vary to suit the level in the ground where suitable strength exists for load transfer.

This may mean that deep foundation solutions, such as end bearing piles, may be the only economic option.

- 4.1 92 (answers personalised)

- 4.1 98 High proportion of voids – cohesive such as silts and clays; voids in larger particle cohesionless soils tend sometimes to be large

Compressible – cohesive silts and clays at shallow depths
High permeability – cohesionless Low permeability – cohesive
Variable volume with moisture content – certain cohesive
Able to support self – cohesive

- 4.3 104 (answer personalised)

- 4.3 107 By shear – the unreinforced strip footing is tied to the recommendations of the Building Regulations Part A, s.E, which suggests that the thickness of the concrete strip should not be less than the dimension of the projection from the face of the foundations wall and not less than 150 mm, whichever is the greatest.

Failure by bending is also a possibility if the above Building Regulation dimensions were ignored.

The loads that will transfer to the foundation accumulate as we move down the property structure. As we know the dead and live loads from the roof will pass down the inner leaf of the wall, as will those from the upper floors. In addition the self weight of the building fabrics (walls) will need to be catered for.

- 4.3 109 Excavation of oversite
Setting out

Excavation of trench
Trimming of trench sides
Timbering of trench sides
Levelling and trimming trench bottoms
Placement of concrete

- 4.3 109 It is a feature of this foundation form that the trench is mechanically excavated, the trench base consolidated by the excavator bucket, and the concrete poured into the trench from ground level. As no earthwork support is used, the ground must be self-supporting, and this restricts the application of this foundation type to cohesive soils.
- 4.3 112 Although these answers are generalisations, subject to other factors, a possible list is:
- Situation 1: raft or strip
 - Situation 2: deep strip
 - Situation 3: wide strip
 - Situation 4: raft

- 4.3 125 (answers may be subject to other factors)
- 1 (a) displacement piles
 (b) replacement piles
 (c) lined replacement piles or displacement
 (d) replacement piles
 (e) replacement piles
- 2 Key issues are speed and low disturbance. Economy generally relates to the numbers of piles being placed.
- 3 A main feature of driven piles is that ground consolidation occurs by vibration. Economy generally relates to the numbers of piles being placed.
- 5.1 131 A main factor is ground moisture, and this tends to influence the porosity of the materials chosen for use below ground.
- Contaminants in the ground or ground moisture may also be influential; sulphates, for example, will affect any cement-containing materials.
- Pressures from the soil or the building can also affect the condition of the walls.
- Tanking involves the application of impervious membranes to the structure to resist moisture penetration. These may be applied to horizontal or vertical surfaces, but are often particularly associated with application to vertical surfaces of walls.
- 5.2 137 To resist pressures from the ground or buildings.
- To intercept cavity moisture which might penetrate the outer skin of the cavity wall and to encourage it to leave the wall at ground level.
- Foundation block – savings in time and labour, creation of a solid wall in one operation negating the need to fill the cavity from concrete strip level.
- Deep strip – speed with far less labour involvement when compared with ordinary strip footings (uses more concrete than the ordinary strip, but the labour savings outweigh this).
- 5.3 143 From – water, gas, electricity, telecommunications, drainage.
- Large diameter pipes (e.g. drainage)
 Small diameter pipes (e.g. water or gas)
 Cables (e.g. electricity or telecommunications)

The common services trench is used to avoid unnecessary and costly repetition of excavation for different utilities providers. It facilitates the coordination of installation and allows services to be clustered in a structured manner to ensure easy location and management.

One potential issue with the use of a common trench is the potential for confusion in identifying the various services. This is dealt with by careful location of the services according to established protocols together with appropriate colour coding of the various pipes and cables.

- 6.1 151 The total area of floors being laid will be influential on cost/m² of each solution, but as a generalisation the cheapest is likely to be the concrete solid floor, then the concrete suspended floor; the timber will be most expensive.

Labour content is a key issue, but the basic materials need consideration also.

Voids below ground floor will provide useful routes for central heating pipes and cable services.

- 6.2 156 Power float or screed.

Sand blinding is used to fill the gaps between the stone or broken brick of the hardcore layer in order to provide a flat surface to receive the damp-proof membrane.

Without the blinding, concrete poured onto the dpm would probably cause a puncture on the sharp edges of the hardcore base.

Cold bridging points will occur where the floor interfaces with solid parts of the structure that are exposed externally. Of particular concern in ground floors are the perimeter edges of the floor. The use of insulation upstands between the floor and external walls eradicates the risk to some extent.

- 6.3 163 By applying rigid insulation boarding below the floor boarding supported on battens attached to the joists or by metal lathing running between the joists.

To support the floor joists, eliminating the need to build the joists into external walls, where they would be vulnerable to moisture absorption.

To help create a void below the floor which can be used to ventilate the floor timbers preventing possible rot conditions.

A cement based screed is usually applied to the surface.

Speed of completion, less labour intensity, not as vulnerable to moisture-related problems as timber.

- 7.1 170 Three from:
- strength and stability
 - exclusion of moisture/weather
 - thermal insulation
 - durability
 - acoustic insulation
 - aesthetics
- Personalised selection of important criterion to be justified by comments.
- 7.1 172 It may allow dampness caused by rainfall to penetrate to the interior of the wall.
- It tends to have poorer thermal insulation properties than other insulated wall solutions.
- 7.1 176 SAP stands for Standard Assessment Procedure and is a figure (1–100) based on the cost of annual energy costs for space heating and generation of hot water. The higher ratings tend to reflect better efficiency.
- Cold bridging is caused by construction detailing which allows concentrated heat flow from inside to outside the property. The effect is often to create condensation on interior surfaces.
- 7.2 186 Traditional cavity walls have exterior skins of clay brickwork and interior skins of insulated blockwork. It is important that the sizes of these components are coordinated in order that courses of bricks and blocks allow mortar joints to occur at the same level as we wish to build-in wall ties between the skins.
- A standard course of bricks is 75 mm (65 mm high brick with 10 mm mortar joint), and a standard course of blocks 225 mm (215 mm high block and 10 mm mortar joint). This means that every three brick courses the mortar joints of the bricks and blocks will be at the same level.
- Wall ties tend to be built-in every two block courses (450 mm vertically) or, if you prefer, every six brick courses.
- Various options exist in terms of thermal insulation. The main alternatives are; internal, external or cavity positioned insulation, which may be full or partial filling of the cavity. The use of external insulation means that the

external enclosure is on the warm side of the insulation. This reduces risk of interstitial condensation and prevents extreme variance in the temperature of the fabric. However, the technical details associated with external insulation can result in a non-traditional appearance for the building and treatment at door and window openings can be complex. Internal insulation reduces the usable space within the building but prevents the external fabric from acting as a heat sink for the property, thus increasing responsiveness to heat inputs.

The use of cavity located insulation provides an easily constructed and effective solution but the potential for bridging of the cavity must be considered. This has resulted in the use of partially filled cavity forms.

- 7.3 192 Moisture barriers to the outside of the frame are used to keep out rainfall until the exterior finish of the wall is constructed (perhaps an outer facing brick skin).
- Vapour checks are applied to the inside face of the framed walls before application of the plasterboard finish. Their aim is to prevent moisture vapour in the air of the property penetrating the wall and potentially forming condensation in the wall body, which could create rot.
- 7.3 202 Movement gaps at the top of exterior skins of brickwork to allow the roof which bears onto the frame to move up and down without stressing the top of the brickwork.
- Flexible corrugated wall ties which allow the timber-framed wall to move without stressing the brickwork, but at the same time maintain the connection between brick and timber-framed skins.
- 7.4 208 Stick build forms utilise individual components to assemble panels on site. Panelised forms utilised pre-assembled panels which are brought to site as complete frame units, whilst volumetric or modular forms utilise complete sections of the building that are pre-assembled as three dimensional modules.
- Criteria that may be used include inter alia:
Cost
Speed in terms of site assembly and production lead-in time
Quality of finished product
Potential for flexibility in design
Access restrictions on a given site
Scale of the project
- Individualised answer

Compressible movement strips are also incorporated below windows which traverse the two skins, allowing movement in just the same way as the gaps left at the top of outer brick skins.

Minimum 30 minutes.

Cavity barriers and fire stops are the main way of assisting compliance with the Building Regulations. These tend to have a 60 minutes performance rating.

7.5 229 By using insulated lintels.

By using insulated vertical dpcs at cavity closures around window and door openings.

By using vertical insulation at the edges of ground floors against the external wall.

By sketches to show:

the sides of a window opening in a wall

the part of the lintel that sits on the wall

a horizontal and inclined dpc designed to encourage water to leave the cavity wall, usually through weep holes

8.1 240 Sketch to indicate the trimmed joists, the trimming joists, and the trimmer joist.

8.2 245 The landing (e.g. quarter turn and half turn stairs)

From, for example:

the guardrailing

the rise of the step

the going of the step

the pitch or angle of the flight of steps

- 9.1 252 Stability – the ability to withstand fire without collapse.
Integrity – the ability to resist fire penetration.
- Sound reduction is measured in terms of airborne sound and flanking sound generally using the dBA scale. This is a range of frequencies that broadly matches the human hearing range. It is important that sound reduction is not measured using only one frequency.
- Individualised answers
- 9.2 256 The two main classes are loadbearing and non-loadbearing
- Class 0-4 relates to the characteristics of the surface material of the partition to allow the spread of flame across it's surface.
- Potential locations include the dividing wall between a garage and the dwelling. This would be to ensure fire protection. Alternatively a solid partition may be needed at a point that supports significant loads from above such as floors and first floor partitions. This will depend on the extent and nature of the load.
- This is the classification for surface spread of flame as defined by BS476.
- 9.2 258 Layered or laminated.
- Noggins are largely found in studded timber partitions. They brace the vertical studs, preventing distortion, and are also sometimes used to provide a background material on which to fix partition coverings.
- 10.1 265 As warm air rises a large proportion of the heat generated inside the property may be lost through the roof.
- At present, the roof has to provide almost twice the insulation qualities of the external wall.
- The shape, which is basically determined by the pitch or slope of the roof surfaces.
- 10.2 277 Jack rafters are shorter than common rafters as they have to be cut to meet the hip rafter at the hipped end of a roof.
- Typically a purlin would be found at the mid-span of the rafter, providing support for both the rafter and the roof covering.
- If more than one purlin is used to each side of the roof slope, these tend to equally divide the length of the rafter (two purlins per slope divide rafters into thirds)

Ties (running to the apex).

Struts (propping the rafter section).

Diagonal bracing is found attached to the underside of rafters on trussed rafter roof structures. The bracing runs upwards from both eaves towards the apex of the roof at both ends of the building.

- 10.3 285 Interlocking tiles may be laid straight up the slope of the roof without the need to stagger between courses.

At the lap position there is a double thickness of material, whereas plain tile and slate coverings have a triple thickness of material at the lap position.

Sarking felt is the secondary line of defence against water penetration of the roof and is found below the roof covering, draped over the rafter sections of the roof. Any water that penetrates the covering is carried by the sarking felt down the roof slope and into the rainwater gutter.

Centre nailed slates are usually found in situations of severe exposure where wind pressures may disturb the roof covering. Coastal locations are typically places where these types of coverings may be contemplated.

- 10.4 289 Sprockets are used to extend a flat roof structure over the external walls of a property in the direction perpendicular to the main span direction of the roof joists.

Firrings are timbers of diminishing sectional size used to provide a slope to the *flat* roof to help shed rainwater.

Wall plates tend to act as distributors of load and in the flat roof situation take point loads from individual joists and spread them across the loadbearing interior skin of the cavity wall.

In the cold deck solution the insulation is below the deck, and in the warm deck solution the insulation is above the deck.

- 10.5 291 A timber tilting fillet to break the angle to prevent the felt from fracturing as a result of a too severe a change in direction.

Sketch to show the upturned edge of the felt above the rainwater gutter.

- 10.6 297 Rainwater *goods*.

Gutter – two from: stop end, nozzle outlet, corner, or stop end with nozzle outlet

Downpipe: offset (from gutter to wall), shoe

A roof outlet is generally used as a fitting to carry rainwater through the roof covering and structure to connect to an internally located rainwater pipe.

- 10.7 301 The brickwork provides the fire-resistant qualities required by the Building Regulations. Clearly it is important to extend the fire-resistant barrier some distance above the roof covering in case of chimney fires (largely caused by accumulations of soot catching fire).
- 200 mm of quilt is typically used to achieve the U value.
- 11.1 306 The U value of single glazing would be around $5.7 \text{ W/m}^2 \text{ }^\circ\text{C}$. Compared with 0.45 for walls, this means that the glass will lose approximately 12 times the quantity of heat.
- Ventilation through an openable area of window equivalent to one twentieth of the room floor area is to be provided.
- 11.2 311 Tapers to the frame allow better light penetration into the room.
- PVCu, steel, aluminium.
- A casement window has opening parts which are supported by hinges; a sash has opening parts supported on something other than hinges: pivots, rope cords or springs.
- 11.3 315 Orientation relates to the way that the building or component faces relative to the path of the Sun.
- Typical U value = $5.7 \text{ W/m}^2 \text{ }^\circ\text{C}$ for single glazing and $2.8 \text{ W/m}^2 \text{ }^\circ\text{C}$ for double glazing.
- Translucent glass allows light through but distorts image; patterned glasses are a good example.
- 11.4 317 Three from:
- security
aesthetics
preserve heat
maintain sound insulation
durability
size to allow household objects to pass
- Hygroscopicity is a characteristic of some building materials (particularly timber) to be able to absorb and lose moisture.

- 11.4 321 From: skeleton, cellular, solid (laminated or boarded)
- Lever furniture refers to the handles used to work the latch mechanism.
- 11.4 323 Door frames are typically used for external doors, while door linings tend to be for internal doors (the name lining implies to lining the width of the opening formed in the partition).
- To create a rebate into which the door can close, with the door closing against the stop.
- 12.2 329 Calcium sulphate.
- Two layers to a total of 13 mm thick
- 12.3 336 9.5, 12.5, and 19 mm thicknesses of basic plasterboard
- A metal angle bead
- Scrim reinforcement is used to cover and reinforce the joints between plasterboard prior to the application of plaster. It is used fundamentally to resist cracking at this location, which would otherwise follow the edge of the plasterboard sheet.
- 12.4 338 Nails with little if any heads hammered through the tongue of tongue and grooved joints between timbers to hide the fixing from view.
- Herringbone and basket weave patterns.
- Parquet is made of thin veneers of timber applied to a material backing. The backing fixed to the floor structure. Wood blocks are of significantly greater thickness (perhaps four times the thickness) and these are laid to the floor as individual blocks, not attached to a sheet of fixing material.