# 2010 Architectural Technology

# Higher

# Finalised Marking Instructions

**Attempt all questions in this Section (total 40 Marks)**

**Marks**

1. Identify **four** *functional requirements* of a domestic building.

   The substance of **four** of the following is required:

   - Must withstand the forces of nature, construction and occupancy.
   - Must provide shelter and protection from the elements.
   - Must provide physical comfort.
   - Must provide security and safety.
   - Must provide space for social, domestic and business activities.
   - Should be in harmony with the natural environment and site conditions.    **4**

2. Briefly explain the term *Buildability*.

   Buildability means consideration should be given to the following:

   - Ease of construction.
   - Safety.
   - Standardisation.
   - Modular co-ordination.
   - Prefabrication.    **4**

3. For **each** of the following *performance requirements* of a building, identify **two** associated *design factors*.

   - Architectural
   - Comfort
   - Economics

   **Two** design factors for **each** as follows:

   - Architectural: creativity, spatial, form/scale relationships, harmony, fire protection.
   - Comfort: water exclusion, thermal, light, air quality, sound and acoustics, ergonomics.
   - Economics: client's budget, contract completion requirements, concept of required standard at lowest cost, whole life costs, investment potential.    **6**

4. Identify and briefly explain **three** *technical constraints* that a designer may have to consider in the development of a site for housing.

   The substance of **three** of the following is required:

   Technical constraints:
   - Ability of the structure to transfer safely the loads to the subsoil.
   - Ability of the subsoil to carry the loads of the structure.
   - Possibility of excessive settlement due to landfill, contaminated land, old mine workings.
   - Effects of aspect and location on the internal environment of buildings – wind currents, sunlight, obstruction of daylight.
   - Local Building Control.
   - Availability of services.
   - Site access.    **6**

**5.** Briefly explain the terms *Eastings* and *Northings* with reference to the Ordnance Survey National Grid.

The substance of the following is required:

The Ordnance Survey National Grid is based on the $49°$ North line of latitude and the $2°$ West line of longitude. In order to keep all east/west co-ordinates positive and all north co-ordinates less than 1000 kilometres, the origin of the National Grid was moved North by 100km and West by 400km to a point Southwest of the Scilly Isles. This is called the point of False Origin. Any position in Great Britain is therefore known by its Easting followed by its Northing. Together these make one two-dimensional point that is known as a grid co-ordinate. This co-ordinate gives, respectively, the distances East and North of the False Origin.    **4**

**6.** State the scale to which Ordnance Survey Superplans are normally produced?

Normally produced at a scale of **1:1250**    **2**

**7.** In surveying, what is meant by the term *Ordnance Datum*?

Ordnance Datum is the point of reference to which all bench marks, spot levels and contours are referred, usually Above Ordnance Datum (AOD) and is the mean sea level (MSL) of the sea as recorded over many years at Newlyn Harbour, Cornwall.    **2**

**8.** (a) A survey line, AB, has been measured by step taping with step lengths of 11·86, 12·42, 16·21 and 7·67m. Calculate the horizontal plan length of line AB.

   Horizontal length = 48·16m    **2**

   (b) If the vertical difference between A and B is 8·712m, determine the average gradient between A and B.

   Gradient is 1:5·5 or 18·1%    **4**

**9.** With reference to linear measurement surveying, briefly explain the meaning of **each** of the following terms.

- Trilateration
- Base line
- Offsetting

The substance of **each** of the following is required:

- Trilateration: is the name given to a network survey of triangles in which all the side lengths are measured and not the angles. It is the basis of linear survey techniques.
- Base line: refers to a straight line of known length extending through the area of a survey. All survey triangles are based on or tied back to the base line.
- Offsetting: is the method of picking up detail from a survey line by short measurements at right angles to the line.    **6**

   **(40)**

**Attempt any TWO questions in this Section (total 60 Marks)**

Marks

**10.** (a) When using steel tapes for surveying, errors in measurement can arise from many sources.

(i) Explain how you would ensure that measurement error due to incorrect tape tension is kept within acceptable limits when using a steel tape.

Whether the tape is fully supported or suspended, the application of a tension 50N or 70N will ensure that errors are within acceptable limits. This may be achieved by using a tape tension handle incorporating a spring balance.

**4**

(ii) Identify **two** other possible sources of error that may occur, apart from that mentioned in part (i), when determining horizontal lengths by means of a steel tape.

**Two** of the following or similar are required:

The tape could be affected by temperature, stretched, kinked, misread or mis-recorded.

**2**

(iii) A line is measured with a 50m steel tape and is found to be 328·296m long. A *standardisation* check on the tape shows it to be actually 50·029m long. Calculate the error in the measured line and the correct length of the line.

Error = 0·190m
True length of line = 328·296 + 0·190 = 328·486m

**4**

(b) Briefly describe, the use of ranging poles and survey arrows when measuring lines in a linear survey.

The substance of the following is required:

The length of lines in a linear survey framework can exceed the maximum length of the measuring tape, therefore, a means of ensuring the line is straight is needed when the line is measured. Ranging poles are used to achieve this by placing a ranging pole at both ends of the line to be measured. The follower standing at one end of the line will line in the leader by sighting between these two stations. The follower should give clear and concise directions to the leader to bring the intermediate ranging pole into line. When all points are in a straight line it can then be measured. A survey arrow replaces the intermediate ranging pole. The process may be repeated with the intermediate ranging pole and more survey arrows, depending upon the length of the line. The number of arrows collected between the two end points of the line is the number of complete tape lengths used in measuring the line.

**4**

(c)   For each material listed below, briefly describe **two advantageous properties** of the materials which make them suitable for their location and **one disadvantageous property** which may compromise their use.

(i)      Facing brick to outer leaf of cavity wall
(ii)     Timber frame inner leaf to cavity wall
(iii)    Foamed polyurethane insulation to cavity wall
(iv)    Mass concrete in foundations

The response should, in essence, highlight **two** advantageous properties and **one** disadvantageous property from the following list for each material.

(i)      Facing brick to outer leaf of cavity wall.

Advantageous properties:
- Compressive strength, durability, appearance, fire resistance and water resistance.

Disadvantageous properties:
- Thermal resistance.                                                                          **3**

(ii)     Timber frame inner leaf to cavity wall.

Advantageous properties:
- Strength/weight ratio, thermal resistance, renewable resource and easily shaped.

Disadvantageous properties:
- Durability if untreated.                                                                  **3**

(iii)    Foamed polyurethane insulation to cavity walls.

Advantageous properties:
- Low density, thermal resistance, durability if protected.

Disadvantageous properties:
- Fire resistance.
- Not environmentally friendly.                                                       **3**

(iv)    Mass concrete in foundations.

Advantageous properties:
- Compressive strength, durability, density and fire resistance.

Disadvantageous properties:
- Tensile strength and bending strength.                                         **3**

(d) Briefly explain **two** procedures to ensure quality that could help reduce defects and improve building performance.

The substance of the following is required:

Planning control is concerned with the suitability and architectural quality of development and Building Control requirements ensure that minimum standards of construction and health and safety are achieved.

In housing, approval by the National House Building Council (NHBC) with its Buildmark scheme applies a self-regulating procedure on development.

Most construction, design and building companies have tailored quality assurance procedures which cover such areas as:

- Control of design process, purchasing, product certification, drawing issue, building process control and defect identification and correction.

At site level, site management, site operation, materials management and testing and waste management will all contribute to the quality process.

The combination of statutory control, advice, self regulation and QA procedures is serving to improve the quality of construction. **4**

**(30)**

11. (a) Briefly describe the set up procedure for a *three-screw automatic level and tripod* prior to taking readings for a levelling survey.

The substance of the following is required:

Set the tripod on the ground so that the legs are spread equal distances apart, (equilateral triangle shape) and the head of the tripod, when the instrument is mounted is as close as possible to eye level. If the tripod is set up on soil, set the legs firmly into the ground by applying body weight to the tripod leg footplate. Adjust the tripod head back to level if necessary by adjusting the required leg(s). When the tripod is firmly fixed and level, place the instrument on the tripod head and secure.

Rotate the level over two of the tribrach footscrews and adjust the pillbox level as necessary. To adjust the pillbox level, move both screws in opposite directions with the same amount of adjustment for each. The pillbox bubble will move on the direction of the left thumb. Keep adjusting until the bubble is central in the axis you are moving it. Rotate the instrument through $90^{o}$ and with the left thumb, adjust the bubble as described until it is central to the axis you are adjusting. However, the bubble may not be fully centred yet, and the refining process of adjusting over two, then one foot screw is repeated until it is fully centred. The pillbox bubble should be checked in each quadrant to ensure it remains centred throughout. The instrument is now ready to use. **6**

(b) **Worksheet Q11(b)** shows the booking and notes taken during a levelling survey along the line of a proposed sewer. On the **Worksheet** carry out the following tasks:

    (i)    Reduce the levels (Using Collimation or Rise and Fall method). **8**

    (ii)    Perform an arithmetical check and state the closing error. **2**

(c) The Construction Industry is increasingly aware of the interaction between the *built and natural environments.*

Identify **four** examples of how the Construction Industry impacts on the natural environment and briefly explain what steps are being taken to reduce the damage.

The substance of **four** of the following is required:

- Extraction of raw materials.
- Production processes for materials and components.
- Construction processes.
- Building use.
- Demolitions.
- Disposal of wastes.
- Transportation of materials, components and wastes.

Steps being taken as follows:

- Reduction in the extraction of raw materials through changes in construction methods and greater use of local and recycled materials.
- Reduction in landfill through greater use of recycled materials.
- More use of materials from economic, renewable sources.
- Reduction in energy consumption of occupied buildings through increased levels of thermal insulation, greater use of solar gain and the use of local combined heat and power schemes.
- Observation of the Environmental Protection Act 1990.
- Completion of Environmental Site Investigations (ESI).
- Use of BREEAM to allow environmental assessment of premises to be carried out. **8**

(d)    For **each** of the following structural elements, identify **two** main performance requirements and **one** associated design principle.

     (i)    Foundations
     (ii)   External Walls

    The substance of the following is required:

     (i)    Foundations: Performance requirements are; must provide strength and stability; must provide a level base for the substructure. Associated design principles are: designed to transmit all dead, imposed and wind loads to the ground and to restrict total and differential settlement; soil strength must be considered.    **3**

     (ii)   External walls: Performance requirements are; provide strength and stability; provide satisfactory enclosure to the building and control the internal environment; prevent passage of moisture; prevent heat loss; provide fire protection; provide quality through durability; provide architectural character through appearance. Associated design principles are; designed to support floors and roof and to transfer dead, imposed and wind loads to foundation; cavity provision and DPCs prevent moisture penetration; designed to provide adequate thermal insulation; condensation must also be considered.    **3**

                                                           **(30)**

**12.**    Refer to the enclosed Ordnance Survey Sitemap and answer the following questions.

   (a)    Identify the building that has the 10m grid reference 78140157.

      Cathedral Nurseries    **2**

   (b)    State the 1m grid reference of the war memorial on the Haugh.

      7803601401    **2**

   (c)    State the meaning of **four** symbols contained in grid square 779016.

      Four of the following are required:

      •   Electricity Transmission Line
      •   River
      •   Deciduous Trees
      •   Grassland
      •   Cutting
      •   Railway    **4**

(d) Determine the average gradient of Perth Road (B8033) from its junction with Beech Road at grid reference 7825700970 to the point at grid reference 7855501261.

Gradient is 1:29.4 or 3·5%     **4**

(e) Briefly identify **four** items of detail in grid square 781012.

**Four** items from the following are required:

- Memorial
- Allanbank House
- Playground
- Footpaths
- Electricity Sub Station
- Bank
- Manse
- Library
- Spot level     **4**

(f) State **four** *functions/performance requirements* of the roof to a domestic building.
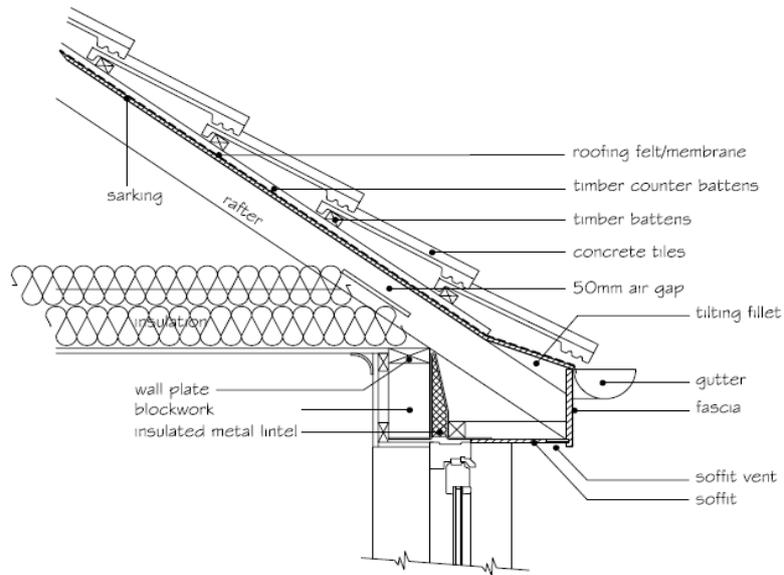
**Four** of the following are required:

- Provide strength and stability.
- Provide satisfactory enclosure to the building and control the internal environment.
- Prevent the passage of water.
- Prevent spread of fire from other properties.
- Prevent heat loss.
- Provide quality through durability.
- Provide architectural character through appearance.     **4**

(g)   Describe, with the aid of an annotated sketch, a domestic pitched **cold roof** showing each of the following in its appropriate location:

- insulation
- ventilation
- ceiling finish
- roof structure
- roof covering.



roofing felt/membrane
timber counter battens
timber battens
concrete tiles
50mm air gap
tilting fillet
gutter
fascia
soffit vent
soffit

sarking
rafter
insulation
wall plate
blockwork
insulated metal lintel

DETAIL AD/1

**10**

**(30)**

**WORKSHEET Q11 (b)**

**(i)     Reduction**

**All entries in metres**

| Back Sight | Inter sight | Fore Sight | Ht of Collimation (or) Rise & Fall | Reduced Level | Remarks |
|---|---|---|---|---|---|
| 0.970 | | | 46.185 | 45.125 | **TBM 45.215** |
| | 1.355 | | | 44.830 | **Point A**<br>Chainage 0m |
| | 1.827 | | | 44.358 | Chainage 30m |
| | 1.486 | | | 44.699 | Chainage 60m |
| 1.655 | | 2.280 | 45.560 | 43.905 | **Change point B**<br>Chainage 90m |
| 2.790 | | 0.375 | 47.975 | 45.185 | **Change point C**<br>Chainage 120m |
| 1.860 | | 1.075 | 48.760 | 46.900 | **Change point D**<br>Chainage 150m |
| | 0.505 | | | 48.255 | Chainage 180m |
| | 0.946 | | | 47.814 | Chainage 210m |
| 0.830 | | 2.135 | 47.455 | 46.625 | **Change Point E**<br>Chainage 240m |
| | | 2.230 | | 45.225 | **TBM 45.215** |

**(ii)     Arithmetic check and closing error**

Arithmetic check
Backsights = 8.105
Foresights = 8.095
Difference = 0.010

Closing error = 45.225 – 45.215 = 0.010

[END OF MARKING INSTRUCTIONS]