AN ROINN OIDEACHAIS AGUS EOLAÍOCHTA

DEPARTMENT OF EDUCATION AND SCIENCE

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Marking Schemes *Leaving Certificate Examinations, 1999*

Construction Studies *Higher Level*

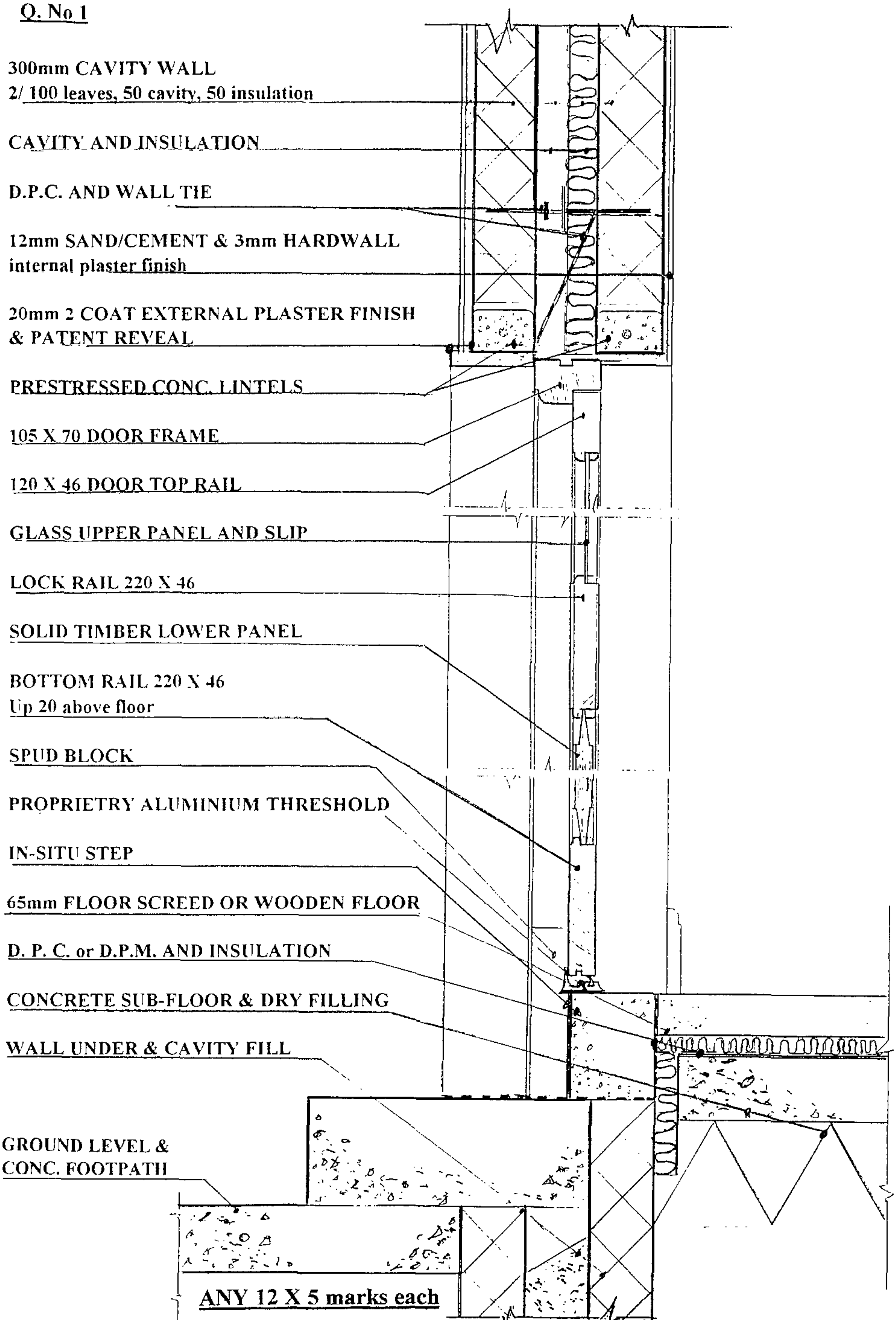
LEAVING CERTIFICATE

CONSTRUCTION STUDIES

HIGHER LEVEL

1999

Q. No 1



ANY 12 X 5 marks each

Q 2(a)

Component	k	1/k ×	Th.(m) =	R.	
Internal Surface				0.123	3
Lt. wt. Plaster	0.160	$\frac{1}{0.160}$	0.015	0.094	3
Aerated Conc. Block	0.220	$\frac{1}{0.220}$	0.100	0.455	3
Urethane Foam	0.033	$\frac{1}{0.033}$	0.035	1.061	3
Cavity				0.176	3
Facing Brick	1.400	$\frac{1}{1.400}$	0.100	0.071	3
External Surface.				0.053	3

Total Resistance of wall = 2.033 m² °C/W 3

$$U = \frac{1}{R}$$ 3

$$= \frac{1}{2.033}$$

$$U = 0.492 \ W/m^2 °C$$ 3

(b)

R of Wall		2.033	3
Deduct R of Cavity	0.176		
Deduct R of Urethane	1.061	1.237	3
New Resistance of Wall =		0.796	3
Add R of blown fibre		+	3

	k	1/k	Th (m)	R	
Blown Fibre		35.714	0.100	3.571	3
			New R =	4.367	3

$$U = \frac{1}{R} = \frac{1}{4.367}$$ 3

$$U = 0.229 \ W/m^2 °C$$ 3

The effect will be to reduce the U value to 0.229 W/m² °C. 3

Q3(a).
Damp Penetration.

1. Water introduced during construction.
   In building a traditional house several tonnes of water are introduced into the walls during bricklaying and plastering. The walls often remain damp until a summer season has passed. A porous wall with an impervious coating on one surface will cause drying out on the other surface. Typical moisture contents of some of the more common building materials are plaster: 0.2 to 1.0 per cent; lightweight concrete: up to 5 per cent; and timber: 10 to 20 per cent.

2. Penetration through roofs, parapets and chimneys.
   Tiled roofs may admit fine blown snow and fine rain, particularly in exposed situations. Both tiles and slates must be laid to an adequate pitch and be securely fixed. It is wise to provide a generous overhang at eaves. Parapets and chimneys can collect and deliver water to parts of the building below roof level, unless they have adequate damp-proof courses and flashings. Leakage through flat roofs is more difficult to trace and needs to be distinguished from condensation.

3. Penetration through walls.
   Penetration occurs most commonly through walls exposed to the prevailing wet wind or where evaporation is retarded, e.g. in wall recesses. On occasions the fault stems from excessive wetting from a leaking gutter or downpipe.
   The greatest penetration is likely to occur through the capillaries (shrinkage cracks) between the mortar joints and the walling units. The more impervious the mortar and the denser the bricks or blocks, the more serious is the penetration likely to be. Dense renderings can prevent moisture drying out more effectively than preventing its entry, and this tendency is accentuated in cracked renderings with moisture penetrating the cracks by capillary action, becoming trapped behind the rendering and subsequently drying out on the inner face of the wall.
   Rain penetration normally occurs in localised patches, with well-defined edges, but not in any particular position. The patches will increase in wet weather, especially after driving rain, and fade away in prolonged dry spells. Cavity walls when properly detailed and soundly constructed will not permit penetration of rain. Penetration when it occurs is usually the direct result of faulty detailing at openings or mortar droppings on wall ties. Finally, disintegration of brickwork may be caused by the action of sulphates or frost when the bricks are saturated.

4. Rising damp.
   In older buildings damp may rise up walls because of the lack of dampproof courses. In newer buildings rising damp may occur through a defective dampproof course, the bridging of the damp-proof course by a floor screed internally, or by an external rendering, path or earth outside the building, or mortar droppings in the cavity. Damp may also penetrate a solid floor in the absence of a damp-proof membrane. It usually results in a horizontal tidemark about 600 to 900 mm above ground level on external walls.

5. Other causes.
   Dampness may result from leaks in a plumbing system, although this must not be confused with condensation on cold pipes.

Q3

When warm, damp weather follows a period of cold, the fabric of a building which has not been fully centrally heated may remain cold for some time. The warm, moist air will tend to condense on the cold wall and floor surfaces. Furthermore, the humidity inside a building is usually higher than outside. The occupants and many of their activities, such as cooking and washing, produce moisture vapour. Changing living habits and constructional methods, such as hard plasters and solid floors, accentuate the condensation problem. Water vapour from a kitchen or bathroom may circulate through a house and condense on colder surfaces of stairwells and unheated bedrooms. Remedial measures include the provision of background heating, thermal insulation and adequate ventilation.

Any 3 x 5 Marks each = 15 Marks

Damage to a building.

1. Brick and stonework if porous is vulnerable to frost damage due to the absorbed moisture expanding when frozen and causing spalling to of the face of the masonry. Likewise, external rendering may spall off, if moisture gets behind it through cracks and defective joints.

2. If moisture penetrates the roof covering due to faulty materials, workmanship or detailing, flat roof decking and ceilings may collapse because of the low resistance of chipboard (if used) and plasterboard to moisture. Also damp insulation is no longer effective as a heat barrier.

3. Timbers if wetted above 20% moisture content is subject to wet rot and dry rot. Also wet timber will swell and cause jamming of doors and sashes, the lifting of floorboards and the distortion of thin panelling.

4. As the moisture dries out from inner and outer surfaces it is liable to leave deposits of soluble salts or translucent crystals (efflorescence).

5. Damage to finishings will occur by the spoiling of painted or wallpapered surfaces, wetting of carpets etc.

6. Apart from causing deterioration of the structure and finishings, dampness can also result in damage to the building contents and can in severe cases adversely affect the health of occupants.

7. If the dampness accesses the internal fabric of the building (e.g. rising dampness), internal humidity levels will increase, giving rise to condensation problems. This will affect the finishings, leading to increased maintenance costs.

8. The conductivity of building materials is affected by moisture content. Therefore penetrating dampness will increase the U value of the building elements, leading to greater heat losses.

Any 3 x 5 Marks each = 15 Marks

Q3

Q3(b)

Sketches should refer to methods normally employed to control moisture in buildings. E.g. either a barrier of impervious material or an air gap (cavity) is placed to intercept the movement. Flashings (capillary movement only), damp proof courses, damp proof membranes (capillary and vapour diffusion) and vapour barriers (vapour only) are examples of impervious materials being used as barriers. Cavities, provided that they are not bridged by moisture transmitting features, are a very effective means of arresting capillary movement. They are not necessarily effective against vapour diffusion since, unless well ventilated, it will be possible for the vapour to pass across the cavity. Suspended ground floors are a good example of a cavity formed to prevent capillary and vapour movement, which to be effective in preventing vapour reaching the other side has to be adequately ventilated.

Clarity and Presentation	**6 Marks**
Sketches – Any 4 x 6 Marks each =	**24 Marks**
	30 Marks

Q4

Q4(a).
Airborne Sound.

Note:- Noise Generated within or outside the building are equally acceptable

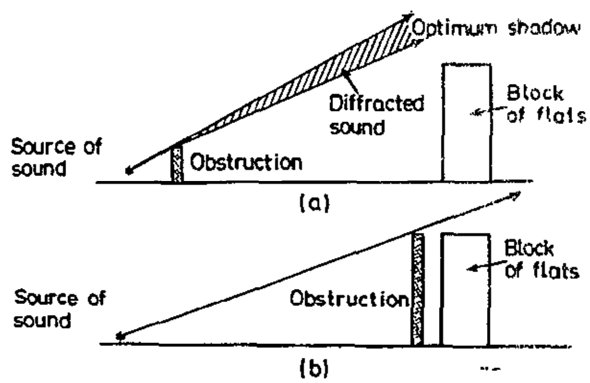
Noise from Outside

There are two main points to note.

1. The propagation of noise follows an inverse square law (i.e. doubling the distance from the source reduces the intensity four times). Therefore, in the design stages for any project, it is important to keep the sources of noise as far away from people as possible.

2. Noise (apart from diffracted noise) can be stopped by putting an obstruction in the way of the noise. The more solid the obstruction the better is the sound reduction.

There are two optimum positions for placing the obstruction, (see sketches).



Obstruction placed (a) as near to source as possible; (b) as near to the hearer as possible

If an obstruction is not an option, or to insulate aircraft noise, insulation must be placed on the face of the building itself. There are three main points to note:

1. The material used must have as large a mass per unit area as possible.

2. The insulation value of any barrier is only as good as its weakest point. The weak points may be cracks around windows and doors, etc., and it is important that all cracks are adequately sealed.

3. The other weak point to be considered is the window itself. It is possible to try to improve the insulation value by increasing the thickness of the glass, but this is inefficient compared to the use of double glazed windows. To obtain the best results, the gap between the sheets of glass should be about 200 mm.

Noise From The Same Room

The same considerations apply to the control of noise inside a room as to the control of noise from outside. The source of the noise may be screened or moved further away and as much absorbent material placed in the room as possible, to prevent the reflection of noise around the room.

15 Marks

Structure Borne Sound.

Structure borne sound or impact noise is caused by objects impacting on the structure, the resulting vibrations being carried by the structure itself. The most common forms of impact noise are footsteps and other bangings on the floor, and the slamming of doors and windows. The latter causes may be prevented by some form of cushioning device to prevent the actual slam occurring. Impact noise on the floor is prevented by the use of 'floating' floors.

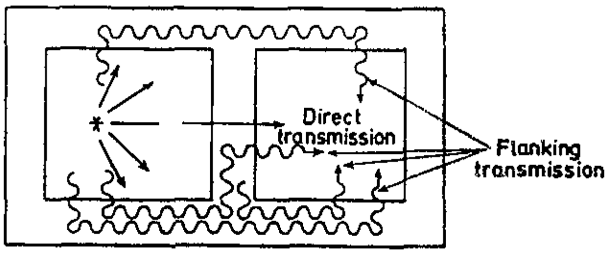
Noise Transmitted From One Room To Another

This noise may be divided into two different types: directly transmitted noise and noise carried by flanking transmission.

Q4

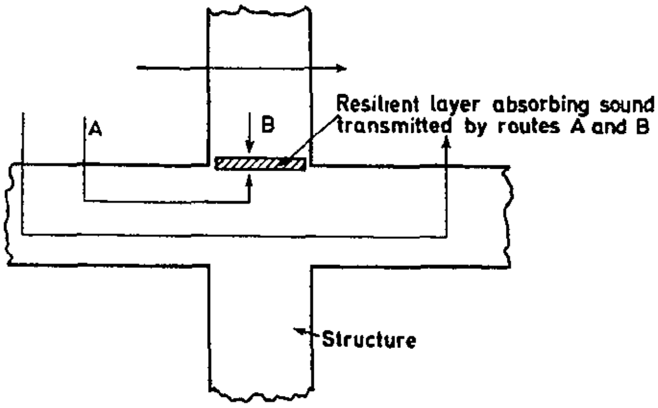
Directly transmitted noise.
This can only be prevented by making the dividing wall as dense as possible, remembering that it is the weakest link in the structure that will determine the insulation value. This means that doors and windows between rooms must be given special consideration and care should be taken to see that they fit correctly.
If the insulation of a floor has to be improved, the mass per unit area can be increased by 'pugging', i.e. filling the gaps between the joists with sand.

Noise carried by flanking transmission.
In this case the noise by- passes the partition by travelling through the flanking walls, floors or ceilings. The importance of flanking transmission depends on the efficiency of the direct partition. It would be pointless to take a great deal of trouble over this if direct transmission was not reduced accordingly.



Showing the paths by which sound is transmitted

Indirect transmission may be reduced by using a resilient layer between the joints of the structure, which may reduce the flanking transmission by reflecting or absorbing a large amount of the sound energy that would normally pass through that part of the structure.



Use of a resilient layer

Sound transmitted by routes A and B is greatly reduced and even the. direct sound transmission may be affected.
In modern lightweight construction, the linkages between party walls in housing must be kept to a minimum.

Basic Rules For Sound-Level Reduction

1. Keep the source of the noise as far away from the buildings, or quiet areas, as possible.
2. Use materials with as large a mass per unit area as possible, when trying to block the path of the noise.
3. Remember it is the weakest part of any structure that determines its sound reduction value; open windows or ill-fitting or flimsy doors allow practically all the sound to pass through.

Q4

4. Plan buildings with the quiet areas or rooms together as far from the noisy areas as possible.
5. Isolate heavy machinery and other sources of large noise value as low down in the basement as possible, so that some of the vibrations can be absorbed by the ground.

15 Marks

Q4(b)(i)

RESONANCE.

Resonance is where a vibrating object will cause a nearby object to also begin vibrating at the same frequency. Consider a tuning fork set in vibration and note the intensity of the sound produced. If, while still vibrating the fork is placed on a table top the loudness of the sound will immediately increase. This is because the table top is now vibrating in sympathy with the tuning fork and acting as a sounding board for the fork. It is possible for doors and thin panels to vibrate in this way, and it should, at all costs, be eliminated in any construction.

Q4(b)(ii)

REVERBERATION

When a sound wave meets a solid object, part of the sound energy is absorbed, part is reflected, and part is transmitted through the object.
The portion of sound reflected depends largely on the surface porosity and texture.
Sound generated in a room will bounce from surface to surface many times, each time reducing in intensity until it finally fades away. This effect is known as REVERBERATION and the time taken for the sound to fade away by 60 dB or one millionth of its original intensity is called the reverberation period. If the reverberation period is too long echoes will result and audibility will be affected. Conversely, reverberation reinforces sound produced in the room and may be desirable in auditoria and music rooms etc. Reflected sound gives useful reinforcement provided the reflected sound path is not more than 20 m longer than the direct sound path.

Q4(b)(iii)

SOUND WAVES

Sound is a sensation produced in the ear, caused by pressure fluctuations in the air which originate room some vibrating energy source, such as a loud speaker or a tuning fork. The vibrations compress and decompress the air and these pressure fluctuations or vibrations are detected by the air as sound.

The frequency (or rate) at which the molecules of air vibrate are important as the human ear can only detect frequencies within certain limits, typically 20 20000 Hz (Herth or cycles per second) but this can vary with each individual and with age.

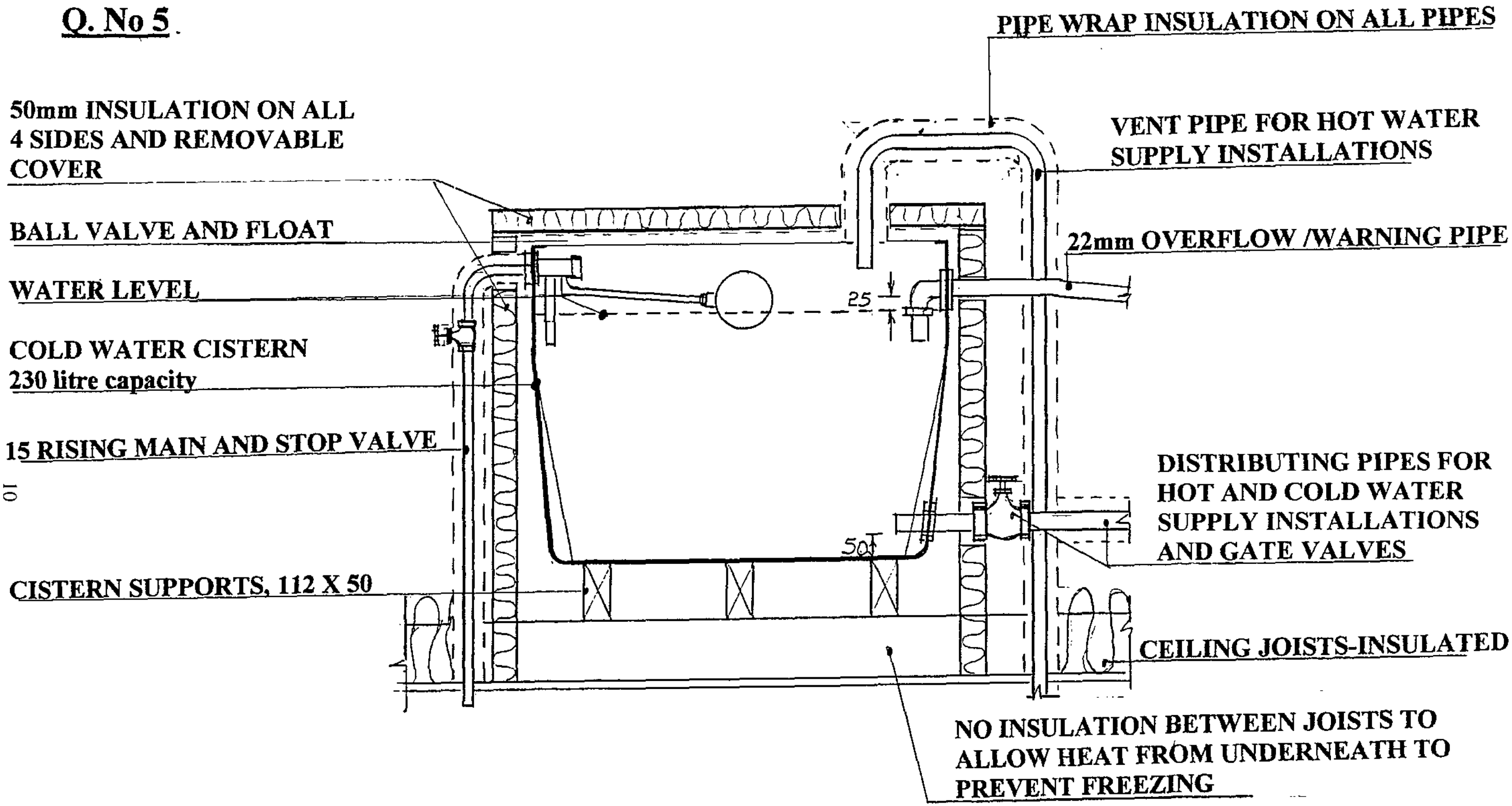
The pitch of the sound heard is frequency dependant, i.e. low frequencies produce low pitched sounds and high frequencies produce what we hear as high pitched sounds.

The amplitude of the sound is a measure of the increase and decrease in pressure and determines the intensity or loudness of the sound.

It should be noted that the air is moving backwards and forwards in the direction of travel of the sound wave and is therefore called a longitudinal wave. (If the vibrations are at right angles to the direction of travel of the wave it is called a transverse wave motion, e.g. light waves).

Any 2 x 15 Marks each = 30 Marks

Q. No 5.



ANY 10 X 6 marks each

Where tank stand/trestle is offered marks should be awarded!

Q.No 6

The functional requirements of stud partitions:

Any 3 x 5 marks each

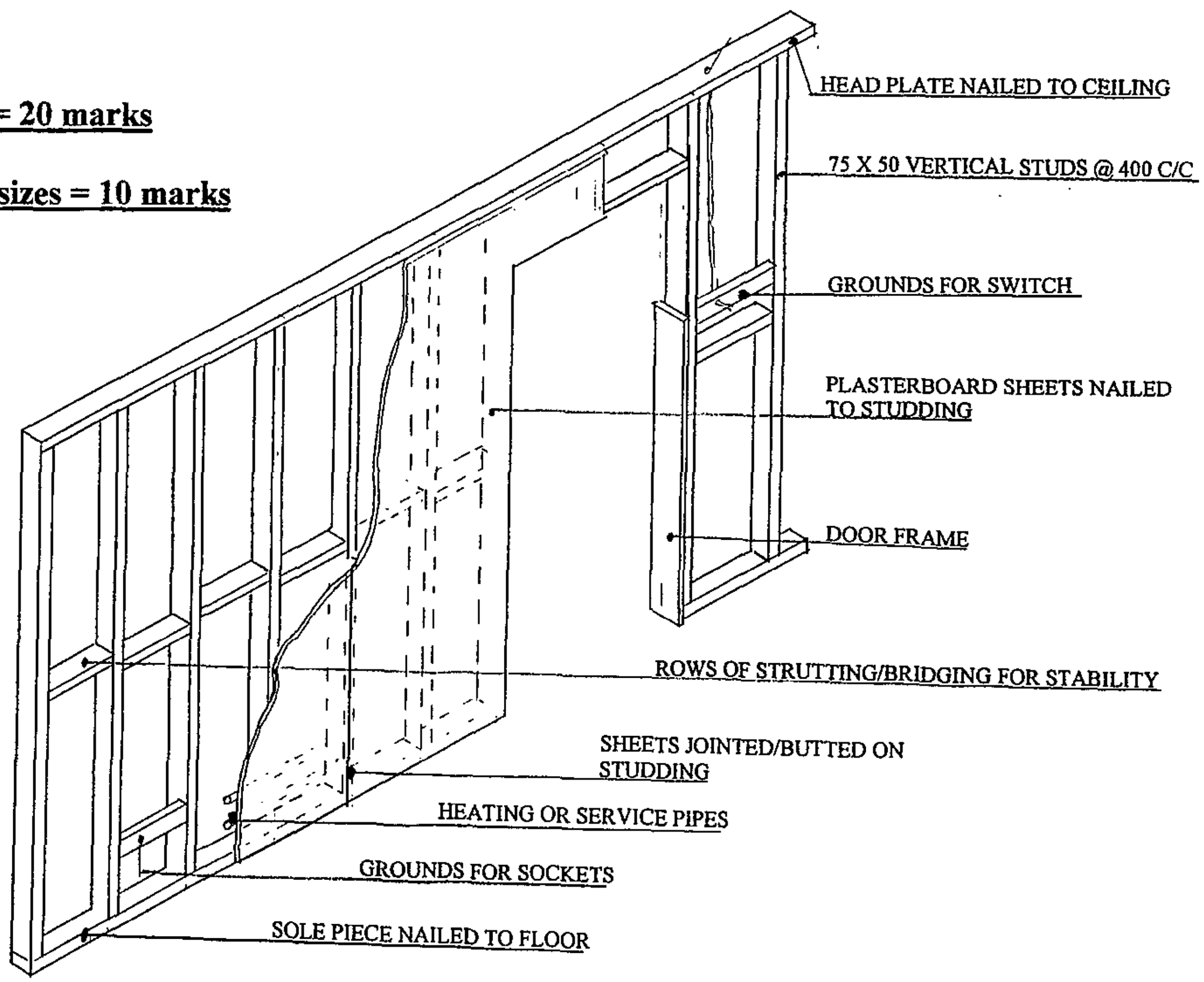
- To divide up space, creating rooms especially upstairs.
- They may be used to make corridors, closets, closing-off under stairs and such.
- They can be constructed to act as load-bearing or non-load-bearing walls.
- Stud partitions with plasterslabs and hardwall finish appear like a normal plastered block wall.

Any 3 x 5 marks each

- In order to provide sound and thermal insulation in a stud wall, fibreglass insulation is fixed in the spaces between the studs.
- To make studs walls even more soundproof a double row of studding is erected, not in contact with each other and fibreglass rolls are hung vertically between them.
- Where there is a likelihood of abuse to a stud wall a second layer of plaster slab is nailed or screwed on.
- Metal studs are now being used in place of timber in some places. It is lighter in weight and fireresistant.

Sketches = 20 marks

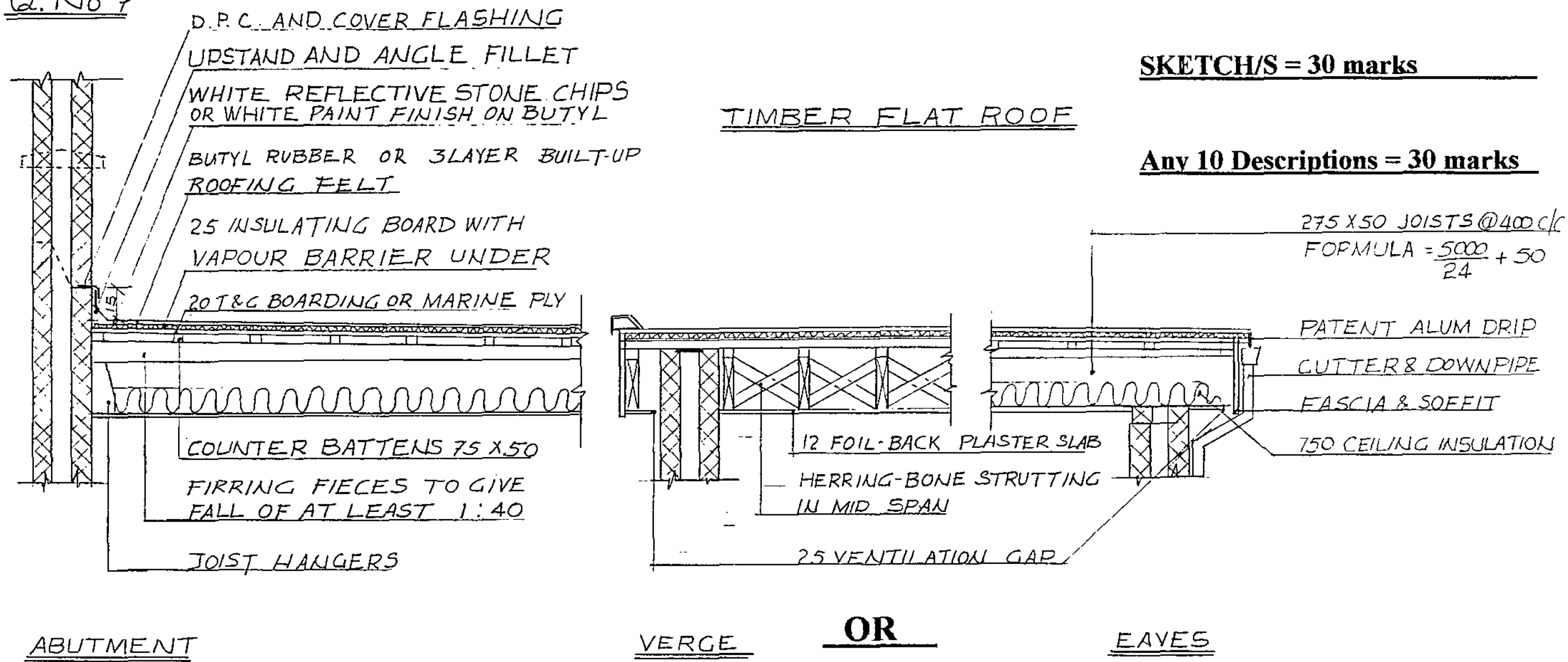
Terms & sizes = 10 marks



Q. No 7

SKETCH/S = 30 marks

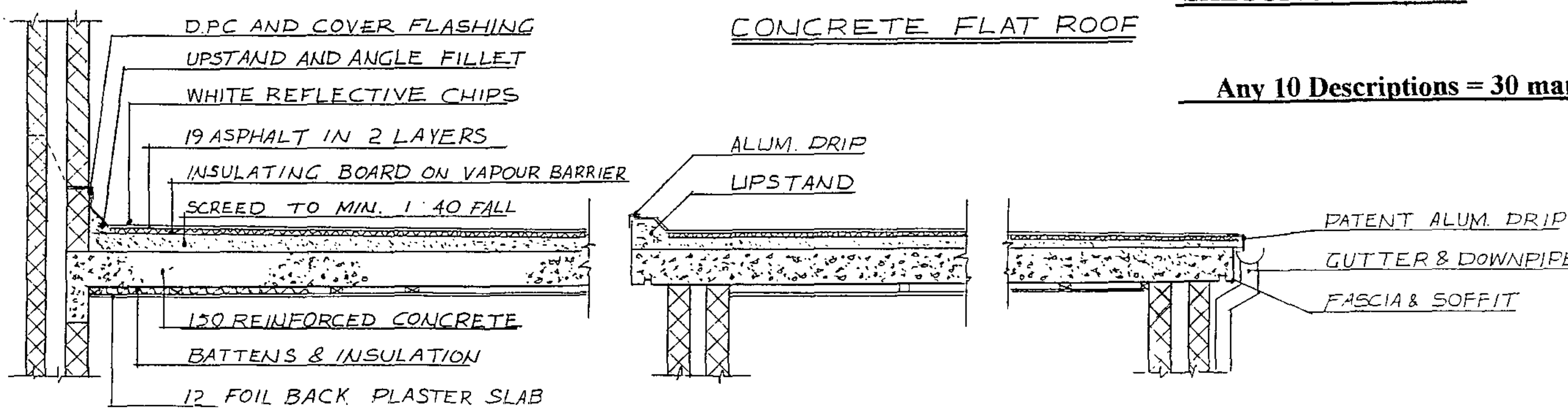
Any 10 Descriptions = 30 marks



OR

SKETCH/S = 30 marks

Any 10 Descriptions = 30 marks



Q8

Q8(a).

Condensation - Problems

Condensation arises from the variations with temperature of the capacity of the air to hold moisture in the form of water vapour, as temperature increases this capacity also increases. For each temperature there is a saturation level (dew point), where the air cannot absorb any more moisture. When air containing moisture is cooled to such a temperature that the moisture content exceeds the saturation or dew point temperature the excess moisture will be deposited as water, i.e. condensation.

10Marks

Causes.

The causes of condensation are mainly:

1. Poor ventilation.
2. Low surface temperatures.
3. High humidities.

In buildings, the air from outside is taken in and warmed and moisture is added from occupants and processes such as washing and cooking. Cold surfaces such as windows or badly insulated walls can cool the air immediately adjacent to them so that moisture is deposited on the surface in the form of condensation.

In recent years, condensation particularly in dwellings appears to be increasingly troublesome. A number of factors can account for this:

1. Changing to open fires from other forms of heating is one, as the open fire promoted high rates of ventilation via the chimney, which disposed of the water vapour in the air.

2. The heat output from an open fire is partly radiant heat which helped to keep internal surfaces warm and above dew point temperature.

3. Another factor is the improved sealing of buildings, e.g. weather stripping, the elimination of air bricks and flues, which also contributed to reduced rates of ventilation.

4. Modern work practices often mean that dwellings are left unoccupied during the day and the resulting intermittent use of the heating system means that the fabric of the building is often at a temperature below dew point, particularly with modern lightweight construction techniques.

5. Some gas and oil fired room heaters (e.g. Super Sers and paraffin heaters), do not have flues and their products of combustion can contribute significant amounts of water vapour to the atmosphere of the room.

10 Marks

Cures.

1. Condensation can be minimised by increasing ventilation rates. This is however, not feasible with naturally ventilated buildings in winter.
2. A more effective technique is to ensure that the surface temperatures are kept above dew point, by installing effective insulation materials.
3. High humidity can be reduced by limiting the escape of steam from cooking, washing etc. by for e.g. extraction at source.

10 Marks

8(b)

Design considerations.

It is not satisfactory to design a building without regard to condensation and then apply remedial measures as a result of unsatisfactory performance. The problem muse be addressed during the design stage.

Measures that can be taken at the design stage to reduce the risk of condensation are:

1. Provision of adequate ventilation rates.
2. Insulation of the various building elements.
3. An effective vapour barrier, correctly located and installed.
4. Double glazing of glazed external areas.
5. Provision of a Utility Room for washing, food preparation etc. to reduce humidity levels in other rooms.
6. Elimination of cold bridges at lintels, sills, reveals, external floor edges etc.
7. Selection of the correct method of construction, e.g. heavy, massive construction is not suitable for intermittent heating.

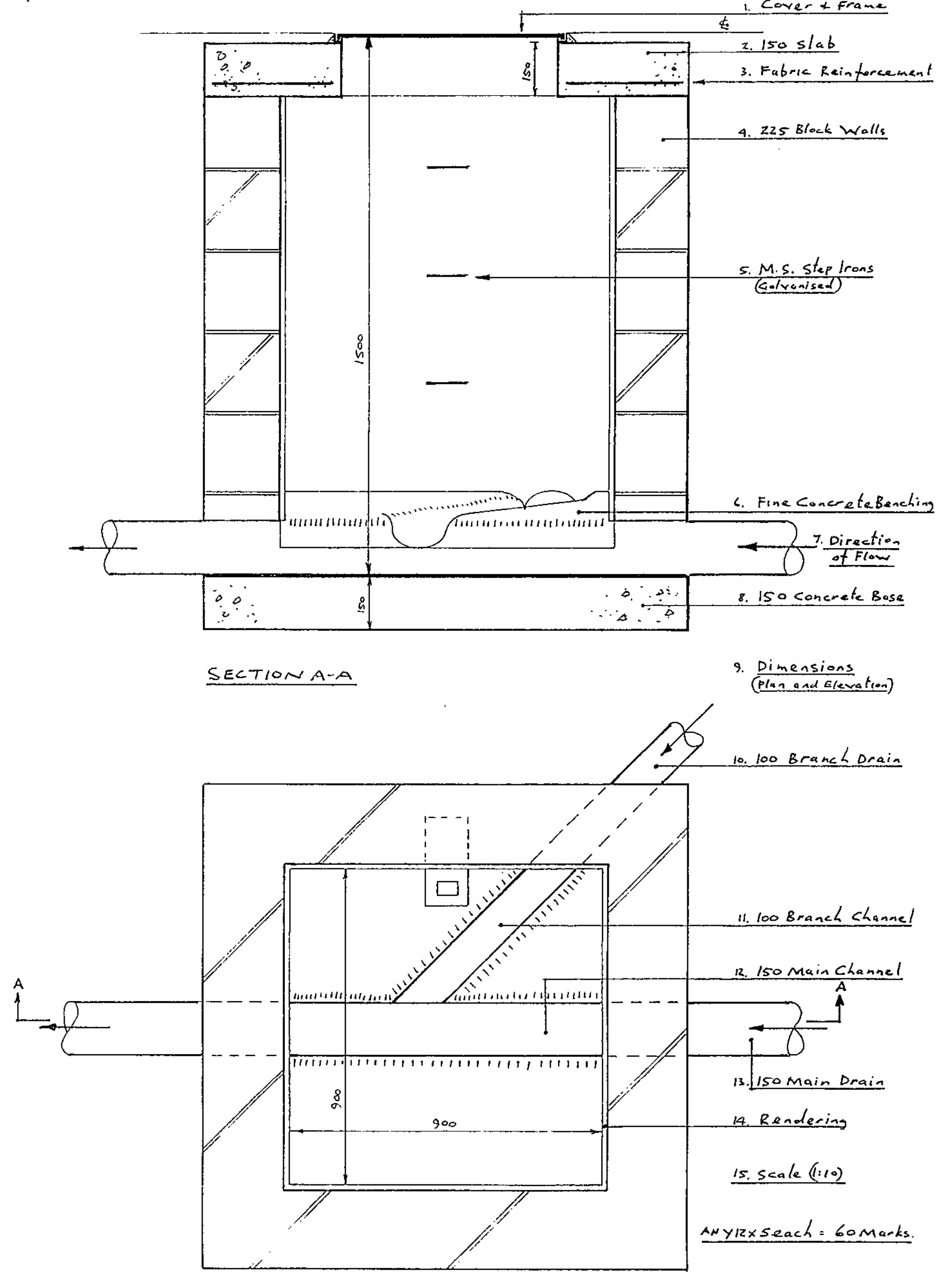
Any 5 x 5 Marks = 25 Marks

It is possible for water vapour to diffuse through building materials so that condensation can take place within the construction itself. The problem is likely to be particularly acute where a very permeable inner layer such as insulation board also provides a large part of the internal insulation. This results in a high moisture content combined with low temperatures at points within the structure. In these instances a vapour barrier (polythene sheet, aluminium foil etc.) to govern the movement of moisture must be provided and places on the warm side of the insulation.

Troublesome condensation can also occur on cold water pipes, particularly where hot water pipes run alongside them and on windows. Pipes should be lagged and the lagging provided with a vapour barrier to keep the insulation dry. Where condensation on windows must be avoided (e.g., shop and display windows), it is possible to increase the surface temperature by using double glazing or by a heater at the base of the window or by increasing ventilation rates by using a fan to blow air across the glass.

5 Marks

Q9



MANHOLE DETAILS

SCALE 1:10

Q 10

Form:

Domestic Buildings generally smaller in size, One fireplace, and one fire to heat the house, Labour intensive construction, notion of privacy, two rooms, kitchen and bedroom, Small roof spans, 2/ 1/2 trees.

Materials:

Traditional & gathered locally, slate, stone, wood, thatch local colour, harmony with the locality

Methods of Construction:

Traditional stonework - local craft, mud, clay and wattle, lime mortars lime as colouring materials.

Ecological Adaptations:

Simplicity of material, stones, thatch, easy material resources, settle bed beside fireplace.

Rural Society:

Houses dispersed around the countryside, farm-houses divided up, built on to, built in clusters.

Rapid Change

Increased mechanisation, car & air travel, change from rural to urban in the 1960's, towns and cities increase in building .Modern housing estates & developments.

Larger spans, bigger windows, larger houses, materials from all over the world, Spanish slates, Italian tiles, Travel influencing styles, imported ideas, flat roofs, Spanish arches..

Lack Of Regional Distinction: Use of Pattern books- Plans, 'Internationalisation of designs'. Mass production of building components, doors, windows, stairs etc. Primacy of the straight line, wall, roads. Acceptance of fences and walls.

5 x 12 Marks

OR

Destruction of structures/buildings;

Nature :	Effects of natural currents.
Time:	General deterioration.
Incompetence:	Lack of care/maintenance, ineffective design/construction.
Human folly:	Lack of understanding of need for preservation.
Greed:	Sub standard quality of building, materials, workmanship for profit.

5 x 12 Marks