UNIT 10
ANTI-TERMITE, DAMP PROOFING AND WATER PROOFING

Structure

10.0 INTRODUCTION

Anti-termite treatment and damp proofing are the essential requirements to ensure safety of buildings against termite and dampness. All possible measures and techniques to achieve these two basic requirements will be discussed in this unit. We shall deal with types of termite, anti-termite treatment, damp proofing, sources or causes of dampness and its effects, methods of damp proofing and damp proof treatments of buildings.

10.1 OBJECTIVES

After studying this unit, you should be able to

- conceptualize problem of termites and their effects,
- explain different types of anti-termite treatment commonly used to prevent damages due to termites,
- discuss damp proofing and water proofing, their causes and effects in buildings, and
- describe various materials and methods used for damp proofing treatments in the buildings.

10.2 ANTI-TERMITE

Insects have been in existence for millions of years and they are capable of survival under most adverse conditions and environments. Termites, also types of insects, cause maximum damage to the buildings. Termites, popularly known as white ants, cause considerable damage to wood work, furnishings etc. of buildings. In some countries, the loss caused due to termites is estimated to be as high as 10% of the capital outlay of the buildings. Anti-termite treatment is, therefore, necessary so that damages due to termites are either reduced or stopped all together.

10.3 TYPES OF TERMITE

Termites are divided mainly into following two types. These are:

a. dry wood termites, and
b. subterranean termites.

Dry Wood Termite: Dry wood termites live in wood and do not maintain contact with the ground. They normally build nests within the dry timber members like door window frames, wooden furniture etc. and destroy them gradually. They are, however, not as common as subterranean termites and they cause lesser damage to the buildings.

Subterranean Termites: Subterranean termites on the other hand live in soil and require moisture for their existence. They are mainly responsible for causing damage to the buildings and its contents. They build underground nests or colonies and form mud-wall tunnels or runways (tubes), which serve as safe shelter for their movements. Sometimes they build nests near ground in stumps of dead trees or create colonies in the form of dome shaped mounds on the ground. It is through these mud wall tubes that they maintain direct contact with the soil for meeting their moisture requirements. These mud walls also create conditions of darkness, which is essentially needed for their survival. The termites enter the building through foundations or from ground adjacent to buildings and advance upward through floors destroying everything that comes within their reach. They may also enter the building through cracks in masonry and joints or cracks in floors in contact with ground. Termites eat celluloses materials like wood, grass, etc. and also attack materials like leather, plastics, rubber, furniture, furnishings; clothing, stationery etc.

10.4 ESSENTIALS OF TERMITE-PROOFING

A careful examination of untreated building can show that damage by termites and evidence of their activity is not difficult to find. Often such damage or termite activity can be found on the upper floors as well. Even if termite damage on the lower floors is not clearly visible, this should not lead to the conclusion that they have not established a colony on the upper floors.

The termite-proofing treatment should invariably be given to all types of buildings during the construction stage. It is because of the fact that during the post-construction period, it is extremely difficult and costly to control the termite growth. Care should be taken to ensure that no bridge is formed between any part of building and untreated soil. In order to reclaim land by utilizing debris or filling material, great care should be exercised to ensure that debris is termitefree. As far as possible metal strain or suitable joint fillers may be used to make the floor joints free from termite attack. To check termite movements from ground, the foundations should be either made of concrete or any other solid material. Also, care should be taken to ensure that building site is free from dead wood, old tree stumps, etc. The superstructure should be treated with suitable preservatives to make it termite-proof. All the wooden members like door frames, stair-cases, etc. should be set on flooring. They should not be through flooring to prevent ground soil contact.

3.5 TYPES OF ANTI-TERMITE TREATMENT

The anti-termite treatment in buildings may be divided into two categories:

a. Pre-construction treatment, and
b. Post-construction treatment

10.5.1 Pre-construction Treatment

Pre-construction treatment is the kind of anti-termite treatment carried out right from the stage of initiating the construction activities for the building. The various stages involved in this treatment are described below.

Site Preparation: This consists in removing stumps, roots, logs, waste-wood etc. from the site where the building is to be constructed. In case the termites mound is discovered within the plinth area of the building they should be destroyed by use of insecticide solution. For this treatment, holes should be made into the mound at several places by use of crow-bar and the insecticides taken in the form of water suspension or emulsion should be poured into the holes. The quantity of insecticides solution to be used depends on the size of mound. For a mound having volume of about 1 cu. m., 4 liters of an emulsion in water of one of the following chemicals may be used:

DDT 5%,
BHC 0.5%,
Aldrin 0.25%
Heptachlor 0.2%
Chlordane 0.5%
(Here, chemical concentration is expressed by weight.)

Soil Treatment: The most reliable method to protect building against termites is to apply a chemical treatment to the soil at the time of construction of the building. This treatment consists in poisoning the soil underneath the building and around the foundations of the buildings with insecticide solution. This should be done in such a way that a complete chemical barrier is created between the ground from where the termites come and damage wood work in the building. An insecticide solution consists of anyone of the following chemicals in water emulsion:

Aldrin 0.5%
Heptachlor 0.5%
Chlordane 1% (whereas chemical concentration is expressed by weight).

In order that the soil treatment may be fully effective, the chemical water emulsion should be applied in required quantity on entire area of ground covered by the building. To ensure uniform distribution of the chemical emulsion, a watering can or hand operated compressed air sprayer can be used. The soil treatment should be applied in the following stages:

Wall Trenches, Column Pits and Basements: The bottom surface and the sides of the foundation trenches, column pits and basements should be treated by applying chemical water emulsion at the rate of 5 liters per square meter of the surface area. After the foundation for the walls, columns, piers and retaining walls of the basement come up, treat the back fill earth in immediate, contact with each side of the foundation with the chemical emulsion at the rate of 7.5 liters per square meter of the vertical surface of the foundation masonry. This treatment is essentially to be given to masonry foundation with a view to ensure that the termites do not gain entry into the building through the voids in the joints in the masonry.

In case of RCC columns or RCC basement walls, there is no possibility of voids, which can permit entry of termites, and hence it is not necessary to start anti-termite treatment right from the bottom of excavation. In such cases, the treatment should start at depth of 500 mm below ground level. The back fill around RCC columns, beams and entire basement walls from a depth of 500 mm up to ground level should be treated with chemical emulsion at the rate of 7.5 Liters per square meter of vertical surface.

Top Surface of Plinth Filling: Prior to laying the sand bed or sub grade for the ground floor of the building, top surface of the consolidated earth filling within the plinth walls should be levelled and treated with chemical emulsion to 5 liters per square meter of the surface.

Junctions of the Wall and Floor: The junctions of walls and the floors require special attention to ensure effective soil treatment. It is important to establish vertical continuity of the poisoned soil barrier on inner wall surface up to top of consolidated earth filling in plinth. This is achieved by making 30 mm wide and 30 mm deep channels at the junction of walls and columns with the earth filling in plinth. Holes are thereafter made in the channel at 150 mm apart up to ground level and then chemical emulsion is poured in the channel at the rate of 7.5 liters per square meter of the vertical wall or column surface. After the treatment the earth should be immediately tamped back into the holes and channel.

Soil along External Periphery of Building: Despite the treatments given above, termites are liable to gain excess in the building from ground surface around the external periphery of the building. In order to check this, 300 mm deep holes at 150 mm center are dug all along the external perimeter of the building (parallel to the external wall) and filled with chemical emulsion at the rate of 2.25 liters per linear meter. After the treatment, the earth should be tamped back in the holes.

Expansion Joints: The expansion joints are given additional treatment by applying chemical emulsion at the rate of 2 liters per linear meter after the sub grade for floor on either side of expansion joints has been laid. This treatment is in addition to the treatment, which is necessarily provided to the structure up to top of consolidated earth fill within plinth.

Structural Barriers: Impenetrable physical structural barriers may be provided continuously at plinth level to prevent entry to termites through walls. These barriers may be in the form of concrete layer or metal layer. Cement concrete layers should be 5 to 7.5 cm thick and should preferably be kept at projecting about 5 to 7.5 cm internally and externally. Metal barrier may consist of non-corrodible sheets of copper or galvanized iron of 0.8 mm thick. These sheets are likely to be damaged; in that case, they become ineffective against termites' movement.

10.5.2 Post-construction Treatment

Though it is always advisable to go for pre-construction treatment but in case when pre-construction treatment has not been properly carried out and termites affect building then post-construction treatment becomes essential. This treatment is applied to existing buildings, which have already been attacked by termites. It is observed that even after their entry in the building, the termites maintain regular contact with their nest in the ground. This important symptom is well utilized in eradicating termites from the buildings. Regular inspection and suitable control measures are necessary to prevent damage to buildings from termites.

At times when the termite's attack is of minor nature it may only be necessary to break off the shelter tubes to check the damage from termites. In situations where the attack is of mild nature the effected materials may also be removed along with shelter tubes. In case of severe attack it is necessary to poison the soil around and beneath the building besides resorting to the above steps. The type of treatment to be given to eradicate termites from the existing building largely depend upon the extent of attack and the magnitude of cellulosic and other materials available in the building. The various operations involved in eradicating termites from an existing building can be summarized as follows:

Inspection: Inspection is essentially carried out to estimate the magnitude of spread of the termite's infestation in the building and also to detect the root of the entry of termites and the zones in the building, which are attacked. The portion of the building in contact with or adjacent to the earth should be inspected first. This includes basements, ground floor, steps leading from ground, walls, columns, areas having damp or humid conditions like bathrooms, lavatories, leaking pipes or drains etc. and the places where wood work is embedded in the floor or wall. The ceilings, wooden paneling, battens for wiring conduits, switch boards are other locations which serve as hide-out for the termites and need careful inspection.

In case of multi-storied buildings, lift wells, casings covering electrical wiring, telephone cable, water supply and soil pipes which serve is convenient and well protected zones for termite's infestation should also be inspected carefully.

Wherever the mud walled shelter tubes or the termite's runways are detected, they should be removed. Wherever possible, oil or kerosene based chemical emulsion should be injected over the attacked areas of wood work and masonry. At times, structural additions may become necessary to ensure elimination of all direct contacts between the soil and the affected portion of the structures.

Soil Treatment for Foundations: This treatment consists in treating the soil under the building and around the chemical emulsion, which can kill or repel termites. In this treatment, about 500 mm deep trenches are made along the external periphery of the wall of the building and 15 mm diameter holes at 150 mm centers are then made in the trenches close to the wall face. The holes should preferably extend up to the top of footing of foundations or to a depth of at least 500 mm whichever is lesser. These holes are then filled with chemical emulsion in water and the back fill earth is also sprayed with the chemical emulsion as it is returned to the trench thereby creating a barrier of poisoned soil along the external periphery of the building. The total quantity of the chemical to be used in this treatment should be at the rate of 7.5 liters per square meter of the vertical surface of the masonry in foundation.

In case of RCC frame structure, the chemical treatment shall be applied to the soil in contact with column side and plinth beams along external periphery of the building for a depth of 500 mm below ground level. In case the building has masonry or concrete apron, about 12 m diameter holes at 300 mm center to center should be drilled close to the plinth wall along the apron. The holes should be deep enough to reach the soil below. Chemical emulsion should thereafter be pumped into these holes at the rate of 2.5 liters per linear meter of the length of the apron.

Soil Treatment under Floor: Cracks in floors are the weak spots, which permit entry of termites from soil below the floor. The cracks usually occur at the junction of the floor and walls, expansion joints in floor and at construction joints in a concrete floor. Cracks in floors may also develop due to use of unsound materials or on account of defective workmanship. In such cases, eradication of termites is achieved by poisoning the soil underneath the floors wherever such cracks are noticed. Drilling 12 mm diameter holes at 300 mm center to center all along the cracks in the floors in different areas and then injecting chemical emulsion into the holes till the soil below gets fully saturated generally carry out this operation. The maximum quantity of chemical emulsion may, however, not exceed one liter per hole. The holes in floors are sealed after treatment.

Treatment of Voids in Masonry: It has been seen that termites enter into masonry foundations from soil adjacent, beneath the building and work their way up through voids in the masonry joints and gain entry into the interior of the buildings. To prevent the entry of the termites through voids in masonry, 12 mm diameter holes at 300 mm center to center are drilled at downward angle of about 45° from both sides of walls at plinth level and then chemical emulsion is pumped into the holes until masonry gets fully saturated with the chemical emulsion. The holes are then sealed. This treatment is carried out for all walls (both internal as well as external) having foundation in soil. Treatment of drilling hole and pumping chemical emulsion should also be carried out at critical locations like wall corners and at places where door and window frames are embedded in masonry in ground floor.

Treatment of Wood Work: Wood work which is badly damaged by termites should be replaced by new timber which is adequately brushed or dipped in oil or kerosene based chemical emulsion. The infected wood work for door and window frames, etc. should be given protective treatment by drilling 6 mm diameter holes at 150 mm center to center at a downward angle of 45° to cover the entire framework and thereafter pumping oil based chemical emulsion into the holes. The wood work which is not attacked by termites should be sprayed over with chemical emulsion to prevent possible attack.

10.6 DAMP PROOFING AND WATER PROOFING

A building should remain dry or free from moisture traveling through walls, roofs or floors. If this condition is not satisfied, the building may become damp. Dampness is the presence of hygroscopic or gravitational moisture. Dampness in building gives rise to unhygienic conditions apart from reduction in strength of structural components of the building. Prevention of dampness is, therefore, one of the important items of building design. Every building should be damp proof. The provisions made to prevent the entry of damp into a building are known as the damp proof courses (DPC). These are provided at various levels of entry of damp into a building. Thus provision of damp-proofing courses prevents the entry of moisture from walls, floors and basement of a building. The treatment given to the roofs of a building for the same purpose is known as the waterproofing.

10.6.1 Causes of Dampness

Dampness in buildings is generally due to faulty design and construction, poor workmanship or due to use of poor quality material in construction. These causes give rise to an easy access to moisture to the building from different points, such as rising of moisture from ground, rain penetration through walls, roofs and floors, etc. The moisture, entering the buildings from foundation and roofs, travels in different directions further under the effects of capillary action and gravity, respectively. The entry of water and its movements, in different parts of the building, are due to one or more of the causes listed above. The various sources that create dampness in buildings can be categorized as follows:

Moisture Rising from the Ground: The sub-soil or ground on which the building is constructed may be made of soils, which easily give an access to water to create dampness in buildings, through the foundations. Generally, the foundation dampness is caused when the building structures are constructed on low-lying waterlogged areas, where a sub-soil of clay or peat is commonly found, through which dampness will easily rise under capillary action unless properly treated. This dampness further finds its way to the floors, walls, etc. through the plinth.

Rain Beating against External Wall: Heavy showers of rain may beat against the external faces of walls and if the walls are not properly treated, moisture will enter the wall, causing dampness in the interior. If balconies and chajja projections do not have proper outward slope, water will accumulate on these and could ultimately enter the walls through their junction. This moisture travel would completely deface interior decoration of the wall.

Rain Penetration from Tops of Walls: All parapet walls and compound walls of the building which have not been protected from rain penetration by using damp proof course or by such measures on their exposed tops are subjected to dampness. This dampness in buildings is of serious nature and may result in unhealthy living conditions or even in structurally unsafe conditions.

Condensation: Whenever the warm air in the atmosphere is cooled, it gives rise to the process of condensation. On account of the condensation, the moisture is deposited on the whole area of walls, floors and ceilings. However, this source of dampness is prevalent only in certain places in India where very cold climates exist.

Miscellaneous Sources or Causes: The various other sources or causes which may be responsible for dampness in buildings are mentioned below:

> ***Poor Drainage of the Site:*** The structure, if located on low-lying site, causes waterlogged conditions where impervious soil is present underneath the foundations. So, such structures, which are not well drained, cause dampness in buildings through the foundations.
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> ***Imperfect Orientation:*** Whenever the orientation of the buildings is not proper or geographical conditions are such that the walls of building get less of direct sunrays and more of heavy showers of rains, then such walls become prone to dampness.

Constructional Dampness: If more water has been introduced during construction or due to poor workmanship, the walls are observed to remain in damp condition for sufficient time

Dampness Due to Defective Construction: The dampness in building is also caused due to poor workmanship or methods of construction, viz. inadequate roof slopes, defective rain water pipe connections, defective joints in the roofs, improper connections of walls, etc.

10.6.2 Effects of Dampness

The various effects caused due to dampness in buildings are mentioned below. All these effects mainly result in poor functional performance, ugly appearance and structural weakness of the buildings.

a. Dampness gives rise to breeding of mosquitoes and creates unhealthy living conditions for occupants.
b. Travel of moisture through walls and ceiling may cause bleaching and flaking of the paint, which results in formation of colored patches on the wall surfaces and ceilings.
c. Presence of damp conditions causes efflorescence on building surfaces, which ultimately may result in the disintegration of bricks, stones, tiles etc. and hence in the reduction of strength.
d. It may result in softening and crumbling of plaster. The wall decoration (i.e. painting etc.) is damaged, which is very difficult and costly to repair.
e. The flooring gets loosened because of reduction in the adhesion when moisture enters through the floor.
f. Floor coverings are damaged; on damp floors one cannot use floor coverings.
g. Timber fittings, such as doors, windows, almirahs, wardrobes, when come in contact with damp walls, damp floors, get deteriorated because of warping, buckling, dry rotting of timber.
h. Dampness promotes and accelerates growth of termites.
i. Electrical fittings get deteriorated, giving rise to leakage of electricity and consequent danger of short-circuiting.
j. Moisture causes rusting and corrosion of metal fittings attached to walls, floors and ceilings.
k. Dampness, when accompanied by the warmth and darkness, breeds the germs of tuberculosis, neuralgia, acute and chronic rheumatism etc., which, sometimes, result in fatal diseases. Occupants may even be asthmatics.

10.6.3 Precautions to Prevent Dampness

The following precautions should be taken to prevent the dampness in buildings, before applying the various techniques and methods described later:

a. The site should be located on a high ground and well-drained soil to safeguard against foundation dampness. It should be ensured that the water level is at least 3 meters below the surface of ground or lowest point even in the wet season. For better drainage, the ground surface surrounding the building should also slope away from the house or structure.
b. All the exposed walls should be of sufficient thickness to safeguard against rain penetration. If walls are of bricks, they should be made of at least 30 cm thickness.

c. Bricks of superior quality, which are free from defects such as cracks, flaws, lump of lime stones, etc. should be used. They should not absorb water more than 1/8 of their own weight when soaked in water for 24 hours.
d. Good quality cement mortar (1 cement : 3 sand) should be used to produce a definite pattern and perfect bond in building units throughout the construction work. This is essential to prevent the formation of cavities and occurrence of differential settlement, due to inadequate bonding of units.
e. Cornices and string courses should be provided. Window sills, coping of plinth and string courses should be sloped on top and throated on the underside to throw the rain water away from the walls.
f. All the exposed surfaces like tops of walls, compound walls, etc. should be covered with waterproofing cement plaster (i.e. 1 cement : 3 sand + water proofing compound).
g. Hollow walls (i.e. cavity walls) are more reliable than solid walls in preventing dampness and hence the cavity wall construction should be adopted wherever possible.

10.6.4 Materials Used for Damp Proofing Course

An ideal damp proofing material should have the following characteristics:

a. The material should be perfectly impervious and it should not permit any moisture penetration to travel through it.
b. The material should be durable and should have the same life as that of the building.
c. The material should be strong, capable of resisting superimposed loads/pressure on it.
d. Material should be flexible, so that it can accommodate the structural movements without any fracture.
e. The material should not be costly.
f. The material should be such that leak-proof jointing is possible.
g. The material should remain steady in its position when once applied. It should not allow any movement in itself.

Following materials are commonly used for damp-proofing course:

Hot Bitumen: It is highly flexible material, which can be applied with a minimum thickness of 3 mm. It is placed on the bedding of concrete or mortar in hot condition.

Mastic Asphalt: Mastic asphalt is semi-rigid material, which is quite durable and completely impervious. It is obtained by heating asphalt with sand and mineral fillers. However, experienced persons should lay it very carefully.

Bituminous or Asphaltic Felts: This is a flexible material, which is available in rolls of various thicknesses. It is laid on a leveled flat layer of cement mortar. An overlap of 10 cm is provided at joints and full width overlap is provided at angles, junctions and crossings. The laps should be sealed with bitumen. Bituminous felts cannot withstand heavy loads, though they can accommodate slight movements.

Plastic Sheets: Plastic sheets made of black polythene are also being used as a type of DPC material. These sheets are 0.5 to 1 mm thick in the usual walling width and roll lengths of 30 m.

Metal Sheets: Sheets of lead, copper, aluminum can be used as DPC. These sheets are of flexible type. Lead sheets are quite flexible. They are laid similar to the bituminous felt. Lead sheets have the advantages of being completely impervious to moisture, resistant to ordinary atmospheric corrosion, capability of taking complex shapes without fracture and resistant to sliding action. It does not squeeze out under ordinary pressure. However, it may be corroded when in contact with lime or cement. A coating of bitumen should, therefore, protect it. Copper sheets of minimum 3 mm thicknesses, are embedded in lime or cement mortar. It has high durability, high resistance to dampness, high resistance to sliding and reasonable resistance to ordinary pressure. Aluminum sheets, if used, should be protected with a layer of bitumen. It is not as good as lead or copper sheets.

Combination of Sheets and Bituminous Felts: Lead foil sandwiched between asphaltic or bituminous felts can be effectively used as DPC. The combination, known as lead core, possesses characteristics of easy laying, durability, efficiency, economy and resistance to cracking.

Bricks: Special bricks, having water absorption not less than 4.5 % of their weight may be used as DPC in locations where damp is not excessive. These bricks are laid in two to four courses in cement mortar. The joints of bricks are kept open.

Stones: Dense and sound stones, such as granite, trap, slates, etc. are laid in cement mortar (1 : 3) in two courses or layers to form effective DPC. The stones should extend to the full width of the wall.

Mortar: Cement mortar (1 : 3) is used as bedding layer for housing other DPC materials. A small quantity of lime may be added to increase workability of the mortar. This mortar may also be used for plasterwork on external walls.

Cement Concrete: Cement concrete of 1 : 2 : 4 mix or 1 : 1.5 : 3 mix is generally provided at plinth level to work as DPC. The thickness may vary from 4 cm to 15 cm. Such a layer can effectively check the water rise due to capillary action. Where dampness is more, two coats of hot bitumen paint may be applied

10.7 METHODS OF DAMP PROOFING

Following methods are adopted to make a building damp proof:

a. Use of damp proofing course (DPC) or membrane damp proofing,
b. Integral damp proofing,
c. Surface treatment,
d. Cavity wall or hollow wall construction,
e. Guniting or shot concrete, or shotcrete, and
f. Pressure grouting or cementation.

Use of Damp-Proofing Courses (or DPC): These are the layers or membranes of water repellent materials such as bituminous felts, mastic asphalt, plastic sheets, cement concrete, mortar, metal sheet, slates, stones, etc., which are interposed in the building structures at all locations wherever water entry is anticipated or suspected. These damp proof courses of suitable materials should be provided at appropriate locations for their effective use. Basically, DPC is provided to prevent the water rising from the sub-soil or ground and getting into the different parts of the building. The best location or position for DPC in case of buildings without basements, lies at the plinth level or in case of structures without plinth it should be laid at least 15 cm above the ground level (Figure 3.1). These damp-proof courses may be provided horizontally or vertically in floors, walls etc.

Integral Damp Proofing: This consists of adding certain water proofing compounds of materials to the concrete mix, so that it becomes impermeable. These water proofing compounds may be in various forms like compounds made from chalk, talc etc., which may fill the voids of concrete. Compounds like alkaline silicates, aluminum sulphate, calcium chlorides etc., react chemically with concrete to produce water proof concrete. Compounds, like soap, petroleum, oils, fatty acid compounds such as stearates of calcium, sodium, ammonia etc. work on water repulsion principle. When these are mixed with concrete, the concrete becomes water repellent. Some commercially available compounds used for this purpose are Publo, Permo and Silka.

Surface Treatment: The surface treatment consists of application of layer of water repellent substances or compounds on these surfaces through which moisture enter. The use of water repellent metallic soaps such as calcium and aluminium oletes and stearates are much effective against rain water penetration. Pointing and plastering of the exposed surfaces must be done carefully using water proofing agents like sodium or potassium silicates, aluminium or zinc sulphates, barium hydroxide and magnesium sulphates etc. It should be noted that surface treatment is effective only when the moisture is superficial and is not under pressure. Sometimes, exposed stone or brick wall face may be sprayed with water repellent solutions.

Cavity Wall Construction: This is an effective method of damp prevention, in which an outer skin wall, leaving a cavity between the two, shields the main wall of a building. For details about cavity wall construction learner may refer other standard text.

Guniting or Shot Concrete or Shotcrete: This consists of depositing under pressure, an impervious layer of rich cement mortar over the exposed surfaces for water proofing or over pipes, cisterns etc. for resisting the water pressure. Cement mortar consists of 1: 3 cement sand mix, which is shot on the cleaned surface with the help of a cement gun, under a pressure of 2 to 3 kg/sq. cm. The nozzle of the machine is kept at a distance about 75 to 90 cm from the surface to be gunited. The mortar mix of desired consistency and thickness can be deposited to get an impervious layer. The layer should be properly cured at least for 10 days.

Pressure Grouting or Cementation: This consists of forcing cement grout, under pressure, into cracks, voids, fissures etc. present in the structural components of the building, or in the ground. Thus the structural components and the foundations, which are liable to moisture penetration, are consolidated and are thus made water penetration resistant. This method is quite effective in checking the seepage of raised ground water through foundations and sub-structure of a building.

10.8 DAMP PROOFING TREATMENT IN BUILDINGS

Damp-proofing treatment in buildings is carried out for its different components like treatment to foundations, floors, walls, roofs and parapet walls etc. Following section presets damp proof treatment given to these components.

Treatment to Foundation: Before dealing with the problem of damp proofing treatment to be given to foundations, it is essential to have an idea about the ground water level. When it rains, the rain water seeps through the ground until it is stopped by an impervious layer in the sub-soil strata. The strata of ground above the water table attract water by capillary action. The height of capillary rise depends on the size of voids in the soil. It is noticed that in case of fine grained soils like clay, silty clay etc., ground water can rise more than 6 m by capillary action. In case of granular soils, gravel, coarse sand etc. the capillary rise of water is almost negligible. Depending upon the depth of the ground level, the treatment to be given to foundations depends upon condition of soils. Building foundations on ordinary soil where the sub-soil water table is not high are also liable to get damp. Bricks being porous, brick masonry below ground level can absorb moisture from adjacent ground. This moisture travels up from one course to another by capillary action and can make the wall damp for a considerable height. Providing DPC at appropriate place can check this. In case of building constructed on damp soil in wet areas, both the walls as well as the ground floor are liable to become damp due to capillary rise of moisture from ground. In such cases, the DPC. is laid over the entire area of ground floor including wall thickness. Bitumen felts can be used for damp-proofing treatment. Immediately after laying the DPC is protected with a course of bricks laid flat on a cushion of fine sand.

Foundation rain water may also receive water percolating from adjacent ground and this moisture may rise in the wall. This can be checked by providing air drain parallel to external wall. The width of air drain may be about 20 to 30 cm. The outer wall of the drain is kept above the ground to check the entry of surface water. A concrete slab is provided at the top of the drain. Opening and gratings are provided at regular interval, for the passage of the air. Usually, DPC is also provided horizontally and vertically as shown in Figure 3.2. Figure 3.2 : Air Drain

Where the foundations of basements are not properly drained (in dry or peat soil) and hence subjected to great hydrostatic pressure, then in such cases the structure should be disconnected from the face of the ground excavation and a trench made all round for width of about 30 cm taken down to a point as low as underside of the concrete footing (Figure 3.3). This becomes essential, because the mere provision of continuous DPC may not give satisfactory results. The bed of the trench should be provided with a good slope at each end and the trench filled with coke, gravel or stone, graded with fines to fill the voids. Moreover, in such cases the basement is relieved of hydrostatic pressure by suitably draining the sub-soil water. Providing open jointed land drain at the bottom of trench may drain sub-soil water and also drainage pipes below the concrete base.

Treatment of Basements: To ensure the dryness, the whole of the structure below ground level should be provided with a continuous membrane of asphalt (i.e. DPC) either mastic asphalt or bituminous felt supported on the inside. This is achieved by spreading a layer of an impervious material (i.e. DPC) over the whole area of the floor and continuing the same through the horizontal walls extending vertically up, forming a sort of water proof tank as shown in Figure 3.4.

Treatment to Floors: In places where the soil water table is low and rainfall is not much, a 75 to 100 mm thick layer of coarse sand is first spread over the entire area of flooring on the prepared bed of rammed earth. Alternatively, this layer can comprise stone soling with voids filled with smaller stones. This layer is known as base course and its material is well rammed. A 75 to 100 mm thick layer of lean cement concrete (1 : 3 : 6 or 1 : 4 : 8) mix or lime concrete is thereafter laid over the base course. This follows the base for the floor topping, which may comprise tiles, stone or cement concrete etc. In places where the sub soil water table is high, or in damp or humid areas, where there is possibility of moisture rising up in the floors, it is necessary to provide membrane DPC of flexible material like bitumen felt etc. over the entire area of flooring (Figure 3.5).

Treatment to Walls: Wall can get damp due to penetration of moisture from its external face to internal one, due to porosity of bricks and mortar joints. Various treatments given to exposed surface of walls to prevent dampness include pointing, plastering, painting etc. It is observed that plaster made out of cement, lime and sand mixed in proportion of 1 : 1 : 6 serves as protection of walls against dampness in weather conditions. In areas of heavy rainfall, cement plaster 1 : 4 (1 cement : 4 sand) mixed with water proofing compounds like Pudlo, Permo etc. serves the purpose effectively. In exposed brick work, dampness can be prevented by painting the surface with water proof cement paint. The provision of DPC for internal wall is shown in Figure 3.6.

Treatment to Roofs: Flat roofs require relatively heavier and costlier water-proofing treatment as compared with pitched or sloped roofs. The specification of material used for the purpose should be such that it performs the function of water-proofing as well as provides adequate thermal insulation. Stagnation of water on the roof is considered to be the root cause of leakage and dampness in flat roofs. This can be avoided by providing adequate roof slope and rainwater pipes. In case of RCC or RBC slab roofing with proper grading above, a slope of 1 in 40 to 1 in 60 is desirable. In addition to the slope, the size and the spacing of the rain water pipes or the outlets require due consideration for the proper drainage of the roof. In general practice, one 10 cm diameter pipe is considered suitable for every 30 square meter of the roof area to be drained. The water proofing of flat roofs is shown in Figure 3.7 and Figure 3.8.

The water proofing treatment for the roof may consist in laying bitumen felt directly over the surface of roof slab after painting the rooftop with hot bitumen. The bitumen felt may be hessian based or fiber based. Depending upon the type of building, climate and atmospheric conditions of the site, the treatment with felts may be with four courses, six courses or eight courses. The four-course treatment is recommended for moderate conditions, whereas the six and eight course treatments are recommended for severe and very severe conditions respectively. Learner can refer standard text for details about four or six course treatment and treatment of sloping roof.

10.9 SUMMARY

In this unit, we have studied about termites and their effects, types of anti-termite treatment required for various components of buildings before as well as post construction.

Dampness is the presence of hygroscopic or gravitational moisture. Dampness in building gives rise to unhygienic conditions apart from reduction in strength of structural components of the building. We have understood about damp proofing and water proofing, sources and effects of dampness and precautions to be taken to prevent dampness in the buildings. Methods and materials used for damp proofing along with the damp proofing treatment essential for different components of a building have also been discussed. Details pertaining to lintels, arches and scaffolding form the subject matter of next unit.