The Pennsylvania State University Workforce Education and Development Competency-Based Teacher Education

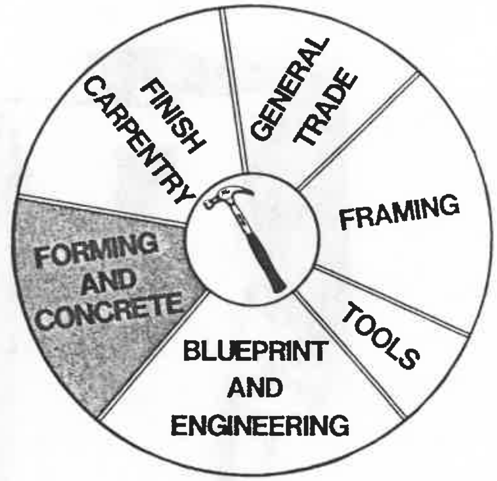
Lesson Plan Template

Name of Instructor: Jeff Weyer
Program Title: Construction Trades
Course Title: 600 Concrete
Unit Title: Water proofing foundation
Lesson Title: FID Lesson 4 Damp and water proofing
Lesson Performance Objective: Learn materials nd differences in damp proofing
Time (length of lesson): 90 Minutes
Equipment and Materials needed: Packet and work sheet in handout
Academic Standard(s) and Anchor(s) and/or Common Core Standard addressed by this lesson:

Technical Standard(s) or Competencies taught in this lesson: CC.3.5.9-10.A Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions CC.2.1.HS.F.2Apply properties of rational and irrational numbers to solve real-world or mathematical Problems.
Introduction There will be a short introduction lesson covering what is expected when this packet is passed out covering the basics of concrete and form building
Body: Students will have to read Task module 10508 Water and damp proofing Then complete assigned questions on worksheet. **There will be an Email sent out with a link to a zoom meeting on the morning of the FID day where I will have online class with a Power point presentation and will cover the packet with the students.**
Summary: We will review the material the day the students return to school with a question and answer session.

Student Assessment (attach a copy of the assessment instrument that will be used to assess students for this lesson): (UDL- Multiple Means of Expression) **Formative Assessment(s) A ten question quiz will be given the next day** **Summative Assessment: Completed work sheet.**
Universal Design for Learning (UDL **Multiple Means of Engagement: Paper Packet and zoom meeting** **Multiple Means of Representation: Module and power point** **Multiple Means of Expression:**

Task Module 10508



WATER AND DAMP PROOFING

Objectives

Upon completion of this task module, the student should be able to identify the following characteristics of successfully controlling moisture in a structure:

1. The areas of construction that require the use of a waterstop.

2. Characteristics of water vapor.

3. How water vapor passes through a structure and when and where to use a vapor barrier.

4. Reaction of building materials to moisture.

5. Types of vapor barriers and their use.

6. Ventilating a structure.

7. The importance and functions of proper ventilation.

8. The importance of quality construction and quality control.

INTRODUCTION

Three important areas of building a successful structure are the control of moisture, the control of and provisions for ventilation and the control of infiltration. This module will examine these areas and present procedures that the craftsperson can apply on the job to insure that effective moisture control is evident.

CONDENSATION

The term condensation means the conversion of moisture in air to water, as on the warm-room side of a cold wall; the forming of water on a surface can usually be prevented by insulating the inner wall so that its surface is kept warmer.

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FIGURE 1

Beads of water on the outside of this tumbler of ice water are caused by condensation of water vapor in the air as it comes in contact with the cold surface.

Four characteristics of water and water vapor should be understood before attacking the problem of condensation control.

1. Water vapor is held in the air depending on the temperature of the air. Warm air is capable of holding more than cold air.

2. Water vapor (like heat) tends to move from a place where it is in concentration to a place where there is less concentration.

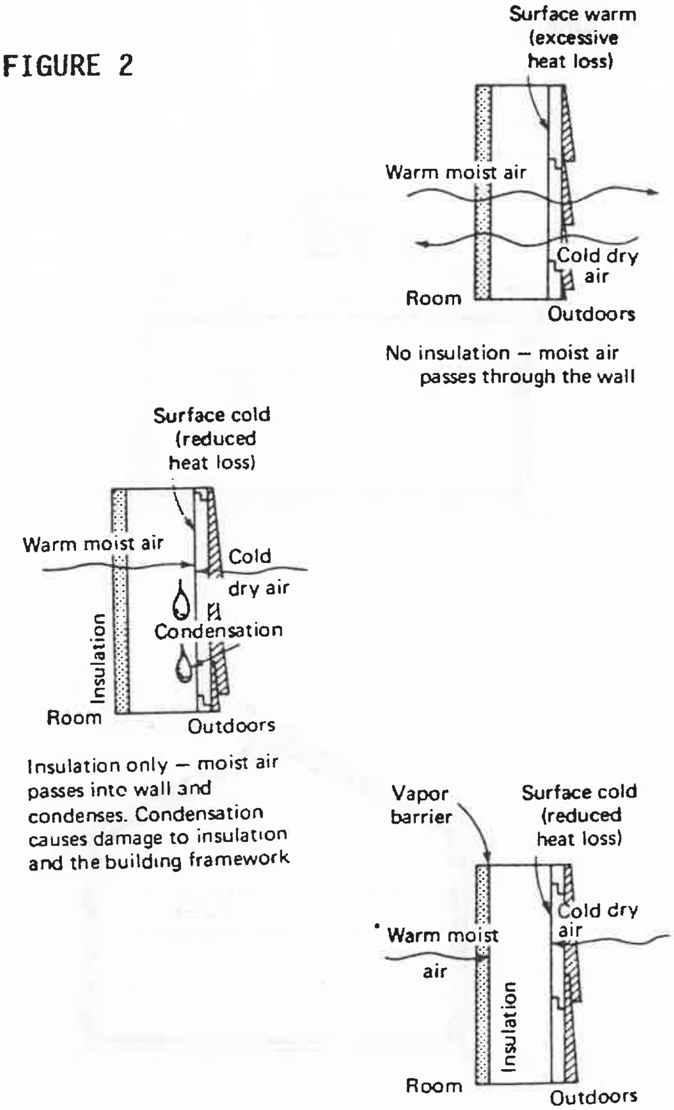
3. Water vapor condenses (turns into visible droplets of water) when it comes in contact with a cold surface. The temperature at which this occurs is known as the dew point. The air surrounding a cool surface has less ability to hold water vapor thus the vapor condenses into droplets.

4. Water is highly corrosive, and to a greater or lesser degree will decompose most natural substances (including wood) sooner or later.

Because there is more moisture inside the structure (being held by the heated air) than there is outside, a relative vapor pressure builds up inside, forcing the vapor outward. In its path outward, through the walls of the structure, the vapor reaches a cold point where it condenses into visible droplets.

In older, uninsulated structures, the difference in temperature between the inside surface and the outside is not so great. The vapor has a chance to escape the wall completely before it reaches the dew point. Usually, it turns to water at just the point between the outside siding and the exterior paint, causing the paint to peel. In well insulated structures without vapor barriers or with insufficient vapor protection, condensation problems are crucial. The thermal insulation inhibits the flow of heat but does not stop the flow of water through the opposite sides of the insulation. When the vapor mo' out through the insulation it encounte., cold air and cold surfaces somewhere in the middle of the wall (usually in the middle of the insulation). The vapor becomes water and stays trapped inside the wall, sometimes forming ice crystals. The water will quickly decompose most insulation materials and even if it doesn't, the weight of the water and ice causes the batts of insulation to become detached from the wall and fall to the bottom of the cavity. Condensation control in well insulated structures is a problem that deserves a great deal of consideration. The best insurance to help prevent condensation is top notch, quality construction.

FIGURE 2



No insulation – moist air passes through the wall

Insulation only – moist air passes into wall and condenses. Condensation causes damage to insulation and the building framework

Insulation with vapor barrier – moisture cannot enter wall space

CONTROLLING MOISTURE

Water vapor contained in air can readily pass through most building materials used for wall construction. This vapor caused no problem when walls were porous because it could pass from the warm wall to the outside of the building. When builders started to install insulation in the walls to cut down on heat loss, moisture in the air passed through the insulation until it reached a point cold enough to cause it to condense. The condensed moisture froze in very cold weather and reduced the efficiency of the insulation. The ice contained within the wall thawed as the weather warmed, and the resulting water in the wall caused studs and sills to decay over a period of time. See Fig. 2.

Moisture is capable of causing structural damage by decomposing wood. It is, therefore, of utmost importance to keep cellars, basements, crawl spaces, and attics dry (moisture in the crawl space and basement encourages wood-chewing insects such as termites). In the case of crawl spaces, moisture often rises from the ground into the crawl space during periods of heavy rain. To prevent the concentration of this damaging moisture, some precautions must be taken in the original design of the structure.

1. The earth must slope down and away, about 20 feet from the structure, carrying surface water away.

2. The crawl space should be protected from moisture by a vapor barrier on the ground.

3. The foundation walls should be penetrated with vents so that moisture will not be trapped in the crawl space.

4. A vapor barrier should be installed under the floor above the crawl space, between the insulation and the sub floor.

Basements usually have the most trouble with condensation in summer during muggy weather. The earth under the concrete basement floor is comparatively cool, causing the floor of the basement to be a cold surface. The hot air is saturated with moisture and condenses when it comes in contact with the cooler surfaces of the floor and walls. This problem is difficult to control. If the surface of the concrete is rough and porous, the moisture will sink in and not cause a wetness problem. If, however, the floor is dense and smoothly finished, the tightly knit grains of concrete form a vapor barrier of sorts, and the water collects on the slab. When installing polyethylene film as an underslab vapor barrier, precaution must be taken not to tear, puncture, or damage the film in any way. Any passage ways for moisture will defeat the purpose of the vapor barrier. Prior to pouring the concrete slab, make sure the polyethylene film is place properly and is free of punctures. Keep all construction debris away from the vapor barrier.

To keep moisture from rising up into the basement, 6" of coarse gravel should be placed over the compacted earth before the slab is poured. A polyethylene film should be placed on top of the gravel to keep the concrete from penetrating into the gravel and possibly weakening the slab. Water will not penetrate through the gravel unless under pressure.

In summary the four characteristics of water and water vapor are:

1. Water vapor is held in the air depending on the temperature of the air.

2. Water vapor tends to move from a place where it is in concentration to a place where there is less concentration.

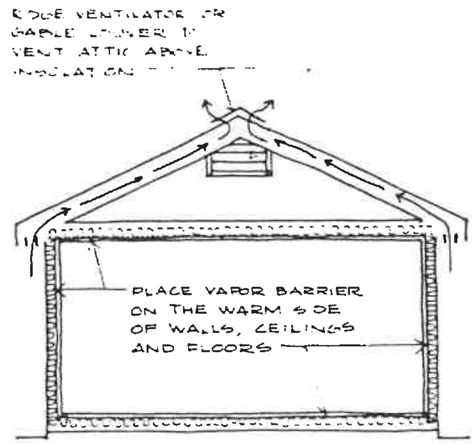
3. Water vapor condenses when it comes in contact with a cold surface.

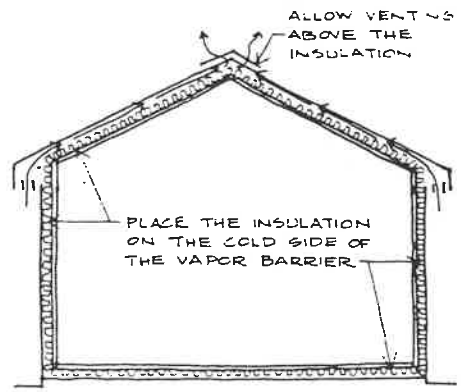
4. Water is highly corrosive.

Interior Ventilation

One of the best ways to reduce or eliminate the chances of water damage in attics or in the space between the rafters and the finished roof is by the proper ventilation of this space. The ventilation, in essence, provides a stream of outside air to remove trapped moisture before it is allowed to do any damage. In insulated attics, baffles (blocking strips) are used to keep the insulation material from getting into the vented areas. With the increased use of blown-in type insulation in attics, baffles are being required by code in some areas.

FIGURE 3

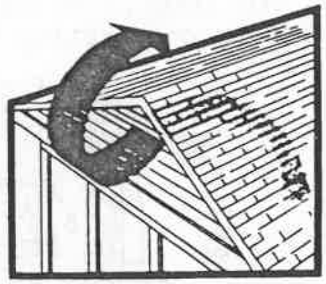




The amount of ventilation required varies with different climates and different building codes. Attics or gable and hip roofs may be ventilated with a variety of louvers and vents. Flat roofs are ventilated with a combination of eave vents and roof stacks. See Figures 3 & 4.

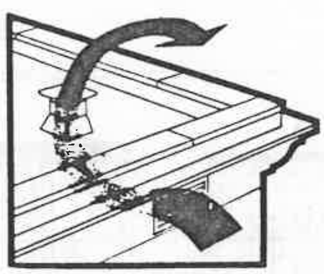
Miniature louver vents also referred to as silver dollar vents can be installed in the exterior wall to provide adequate ventilation. They range in size from 1 to 4 inches. They are installed by pressing them into a hole bored through the siding and sheathing in each stud space. For best results, install one at the top

FIGURE 4

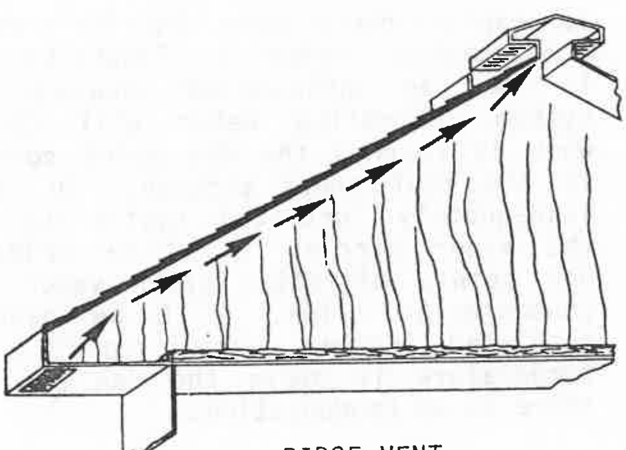


GABLE LOUVER VENT

SOFFIT VENT



EAVE VENT ROOF STACK



RIDGE VENT

Ice dams can be avoided in most cases by installing plenty of cap insulation, providing ample ventilation in the attic, and properly flashing the eave edge of the roof See Figure 5.

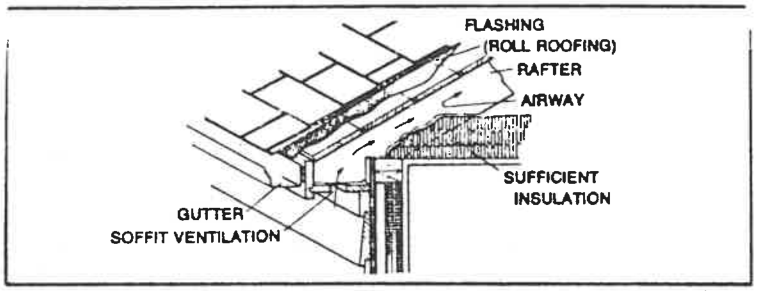
Properly designed subroof ventilation is the most certain technique for preventing water vapor infiltration into a built up roof. But for low sloped roofs, it poses the most difficult set of design conditions to meet. Because natural convection decreases with diminishing roof height, ventilation is far less effective for low sloped roofs than for steeply sloped roofs. Moisture dissipation is done through diffusion and wind-induced ventilation.

VAPOR BARRIERS

Selection

A vapor barrier is any material or substance that will not permit the passage of water vapor or will do so only at an extremely slow rate. The permeability of a material is a measure of its capacity to allow the passage of liquids or gases. Water vapor permeability is the property of a substance to permit the passage of water vapor and is equal to the permeance of the substance when 1 inch thick. The measure of water vapor permeability is the perm. This equals the number of grains, squared, or water vapor passing through a material or substance 1 foot square, per hour, per inch of mercury difference in vapor pressure. About all you really have to remember is that any material that has a perm rating of 1.0 or less is considered a vapor barrier. It will not allow the passage of any appreciable or harmful amounts of water vapor. Any material with a rating higher than 1.0 is a "breather" or breathable material that will permit the passage of water vapor in whatever degree its perm rating indicates. The higher the perm number, the greater the amount of water vapor will pass through the material in a given time; 0.0 is totally impermeable. Refer to Figure 6 for Perm ratings of some vapor barrier materials.

FIGURE 5



Ice dams can be avoided in most cases by installing plenty of cap insulation, providing ample ventilation in the attic, and properly flashing the eave edge of the roof.

FIGURE 6

PERM RATINGS OF SOME VAPOR-BARRIER MATERIALS*

(Based on table provided by The American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc.)

Material	Permeance	
	Dry cup	Wet cup
Aluminum foil, 1 mil	0†	
Aluminum foil, 0.35 mil	0.05†	
Polyethylene, 4 mil	0.08†	
Polyethylene, 6 mil	0.06†	
Polyester, 1 mil	0.07†	
Saturated and coated roll roofing	0.05‡	0.24‡
Reinforced kraft and asphalt-laminated paper	0.3‡	1.8‡
Asphalt-saturated and coated vapor-barrier paper	0.2–0.3†	0.6‡
15-lb tarred felt	4.0‡	18.2‡
15-lb asphalt felt	1.0‡	5.6‡
Asphalt (12.5 lb/sq)	0.5‡	
Asphalt (22 lb/sq)	0.1‡	
Built-up membrane (hot-mopped)	0 ‡	

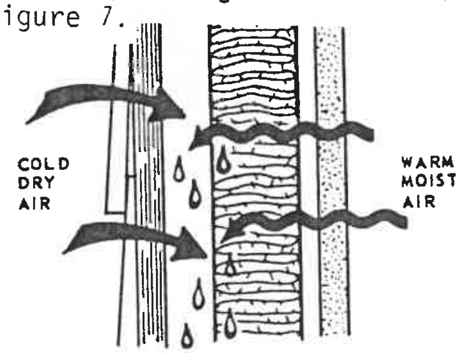
* Values are from ASHRAE "Handbook of Fundamentals," 1967 ed., chap. 19, table 1.

† Per ASTM E96-66 ("Water Vapor Transmission of Materials in Sheet Form").

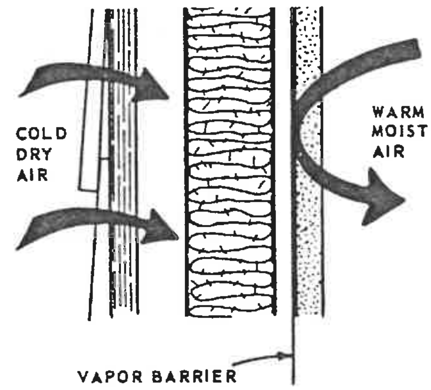
‡ Per ASTM C355-64 ("Water Vapor Transmission of Thick Material").

A properly installed vapor barrier will protect ceilings, walls, and floors from moisture originating within a heated space. See Figure 7.

FIGURE 7

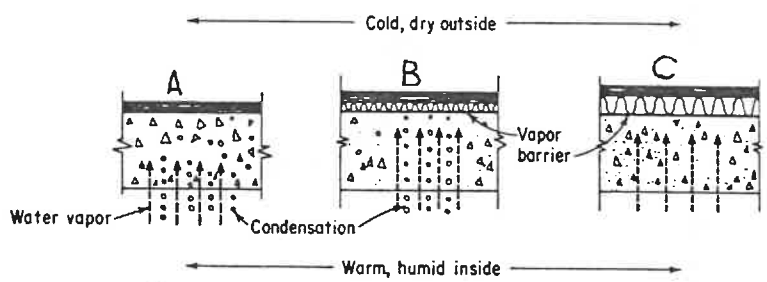


WALL WITH NO VAPOR BARRIER



WALL WITH VAPOR BARRIER

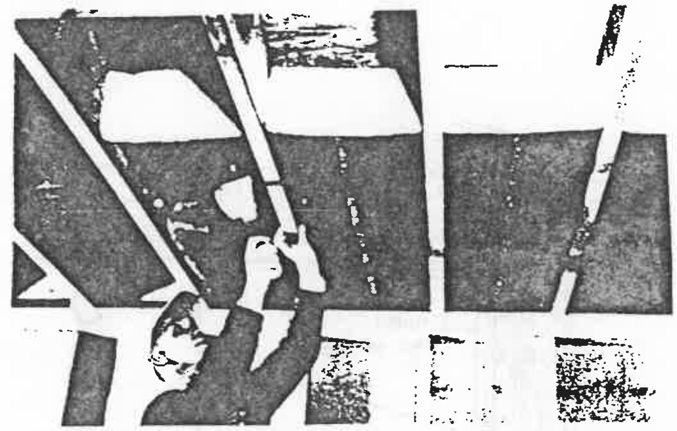
FIGURE 8



To explain how a vapor barrier prevents condensation refer to Figure No. 8. In A, an uninsulated concrete roof system, migrating water will condense when it reaches the dew point somewhere in the roof cross section. In B, an inadequately insulated system in which the vapor barrier is at or below the dew point, migrating water vapor again condenses and drips. In C, an adequately insulated system, the vapor barrier temperature is above the dew point and there is no condensation.

An insulated wall will divide two temperature gradients. The area on the inside of the structure will normally be warmer than the air on the outside. The vapor barrier must be located on the warm side to prevent moisture from moving through the insulation to the cool side and condensing. Many of the insulation materials produced today have a vapor barrier applied to the inside surface. Also, many interior wall surface materials are backed with vapor barriers. When these materials are properly installed, they usually provide satisfactory resistance to moisture penetration. If the insulating materials do not include a vapor barrier, then one should be installed as a separate element.

FIGURE 9



Installing insulation batts between ceiling joists, with vapor barrier down.

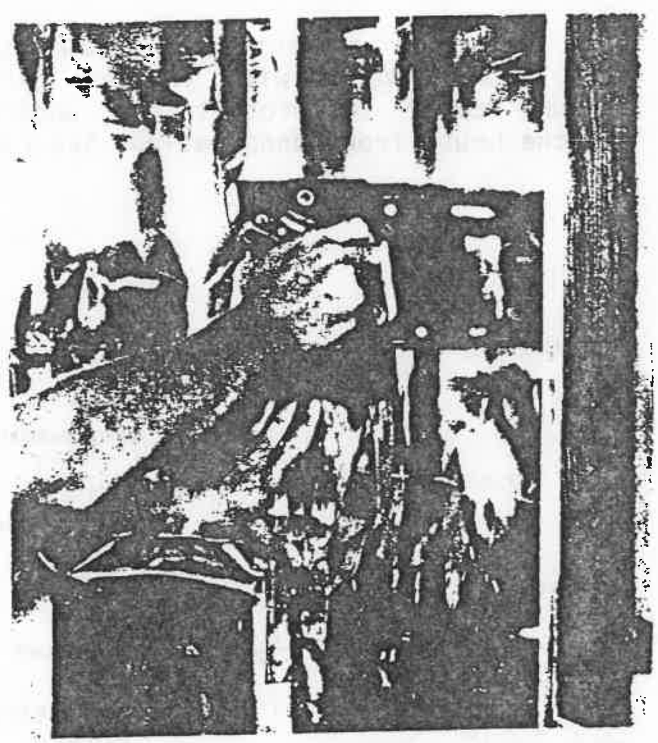
Materials

Commonly used vapor barrier materials are asphalted kraft paper, aluminum foil, and polyethylene film.

Asphalted kraft paper is usually incorporated with blanket or batt-type insulation. It serves as a means for attaching the insulation to the building framework and as a vapor barrier when installed on the warm side of the wall. See Figure 9.

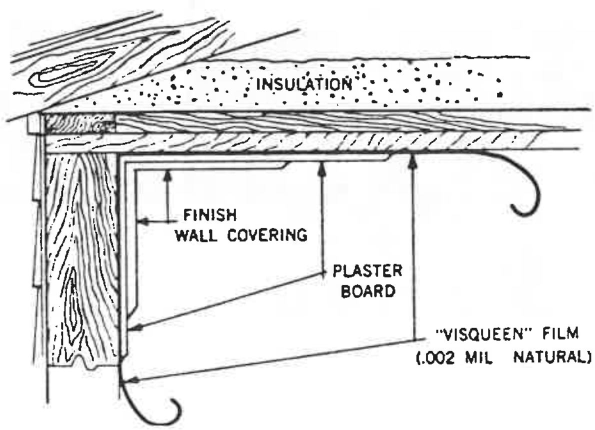
Aluminum foil may be incorporated with blanket or batt-type insulation in the same manner as kraft paper. It is also applied to the back of gypsum lath and gypsum wallboard where it works as an effective vapor barrier. See Figure 10.

FIGURE 10



Polyethylene film is applied over the studs and ceiling joists after the insulation is installed. When polyethylene film or foil backing on wallboards are used, the insulation will be plain batts or blankets which are held in place by friction. Polyethylene film, as a vapor barrier, is stapled over the studs and also covers the window frames. This helps in keeping the window frames and sashes clean during application and finishing of the gypsum wallboard. See Figure 11

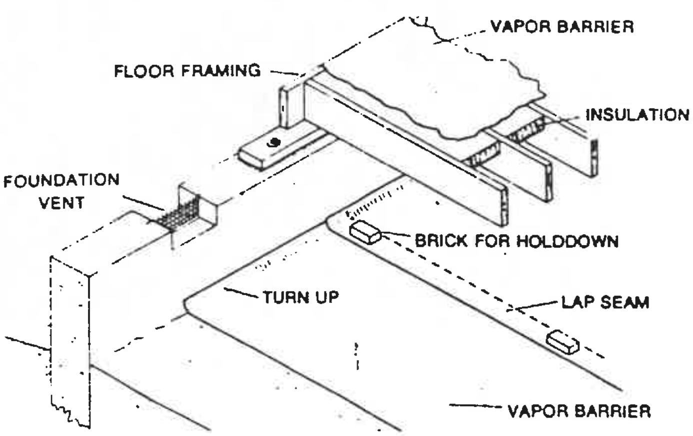
FIGURE 11



Installation: Crawl Spaces

The floor of a ventilated crawl space should be covered with a vapor barrier ground cover to protect the underside of the house from condensation. See Figure 12.

FIGURE 12



Installation: Slabs

When allowed to proceed unchecked, moisture will migrate from the ground upward through concrete and into the building where it can cause moisture problems, damage and higher energy costs. Even though the water table may be several feet below the slab, moisture vapor will migrate up to and through concrete slabs.

Up to 80% of moisture entering a structure does so by migrating from the ground beneath the structure. Moisture vapor passes through concrete more readily than liquid moisture.

Moisture in a building can manifest itself in deterioration of interior finishes, especially floors and equipment. Moisture can also add to energy costs by raising humidity and taxing coding systems and require dehumidification. Moistop is a product designed by the Fortifiber Corp. (one of many companies in water and damp proofing) to provide maximum moisture protection (two layers of extruded polyethylene) while adding strength against job site damage (reinforced kraft) assuring a membrane application with minimal moisture penetration. Moistop will provide a barrier against the major source of moisture entering a structure. It will also hold moisture and fine aggregate in newly poured concrete, preventing moisture from escaping into the ground and drying out a slab prematurely.

Although plain polyethylene film does just about the same job as Moistop, Moistop resists job site rips and tears and has a better perm rating.

Vapor barriers should be continuous under the slab great care must be taken; not to tear or puncture the barrier. Keep all construction debris away from the barrier location. Vapor barrier installation must be done by qualified contractors.

Relative to thickened-edge slab construction, as shown in Figure 13, a vapor barrier is placed between the gravel cushion and the poured concrete. The same arrangement is used for other types of slab-on-grade construction.

FIGURE 13

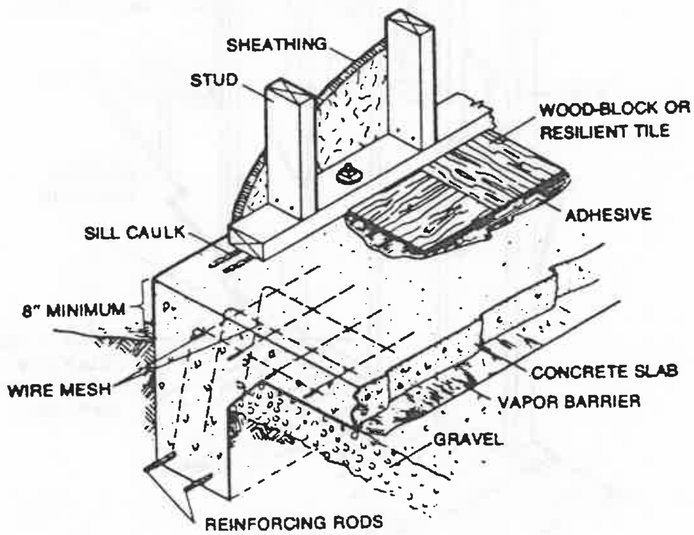


Figure 14 shows various typical methods of installing perimeter insulation in a slab floor. The vapor barrier must be continuous under the entire floor and only the perimeter needs to be insulated. Heat loss for a concrete slab floor is usually concentrated along the perimeter and not the center of the floor. The insulation can be installed horizontally under the floor or vertically along the foundation walls as shown in Figure 14.

FIGURE 14

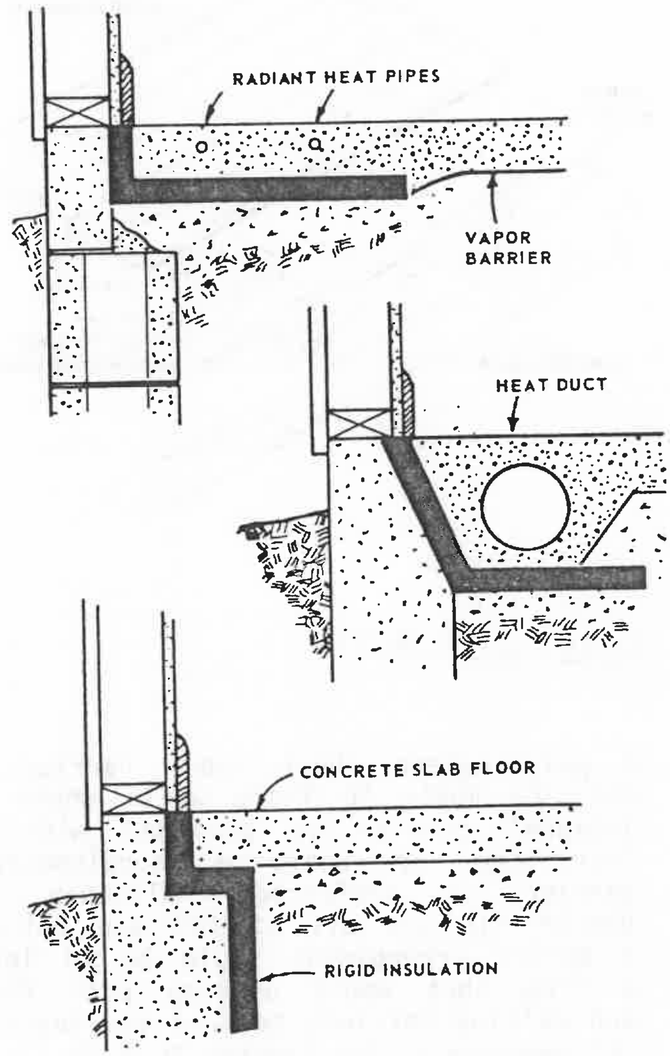


Figure 15 shows a method of constructing a finish floor over a concrete slab which affords double protection against moisture. It is a sealer or water-proofer on the slab itself and a vapor barrier suspended above.

FIGURE 15

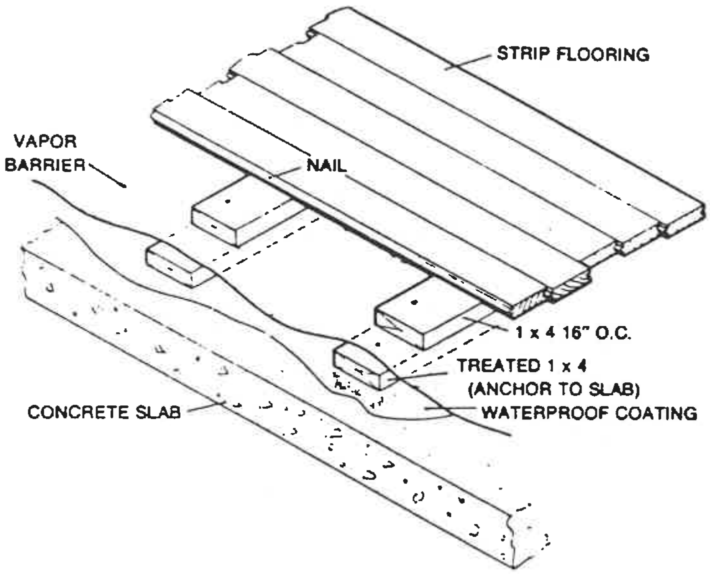
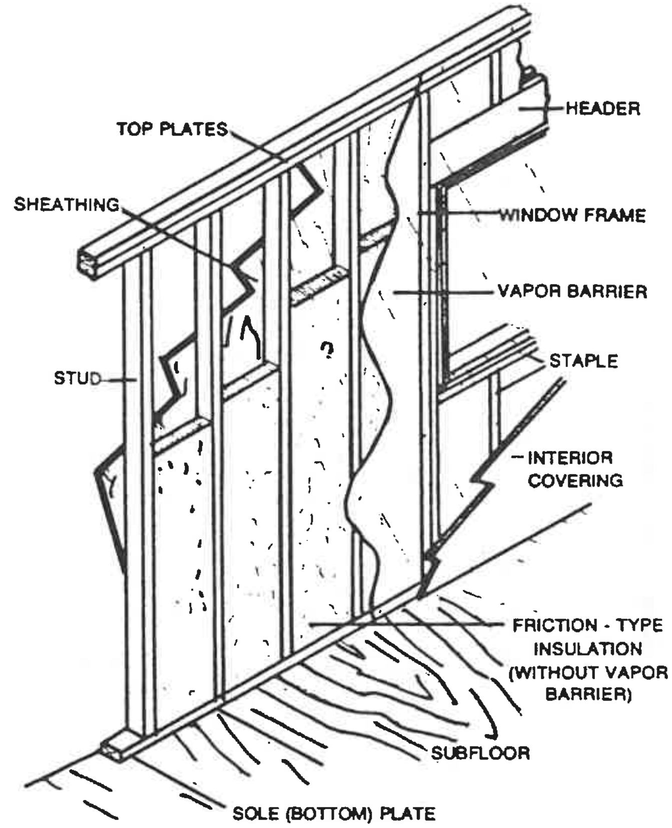


FIGURE 16

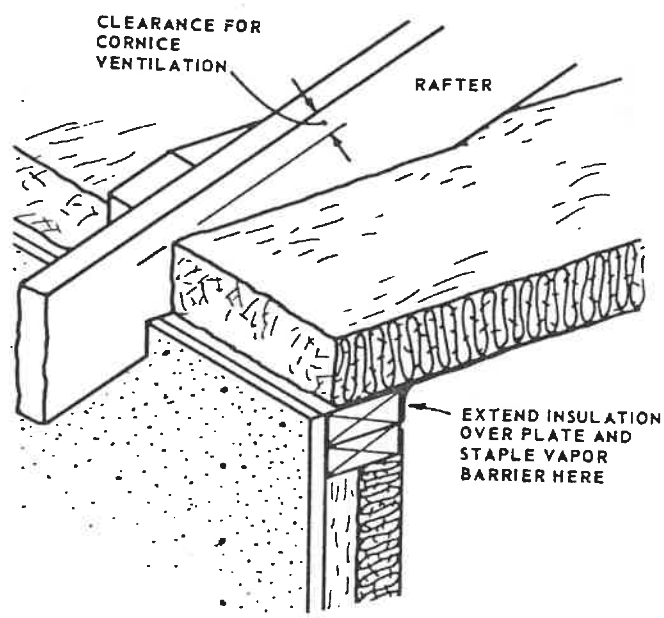


Installation: Walls

A polyethylene sheet vapor barrier is easy to apply to frame walls where no integral barrier is provided with no insulation or where a supplementary barrier is preferred. Although the barrier is cut off at top and bottom, a better arrangement would be to leave a flap that would overlap both floor and ceiling barriers to seal the interior off completely. See Figures 16 & 17.

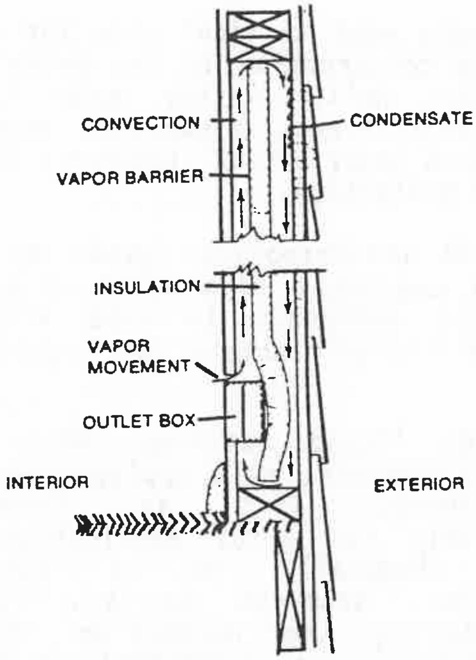
When vapor barriers are applied to walls, particular attention should be paid to fitting the material around electrical outlet boxes, exhaust fans, light fixtures, registers, plumbing or whatever. The problem is that considerable water vapor can escape through the cracks around the equipment, travel from the warm side of the wall to the cold side and condense on the sheathing or siding. This is especially true if the insulation is poorly fitted at the top and bottom. See Figure 18.

FIGURE 17



Placement of ceiling insulation at outside wall.

FIGURE 18



The reader is also referred to Figures 19 & 20 for additional illustrations of vapor barrier installations.

FIGURE 19

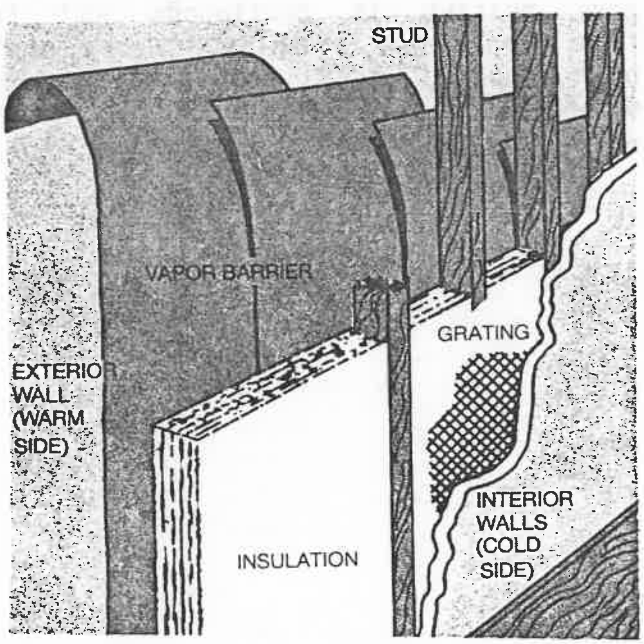
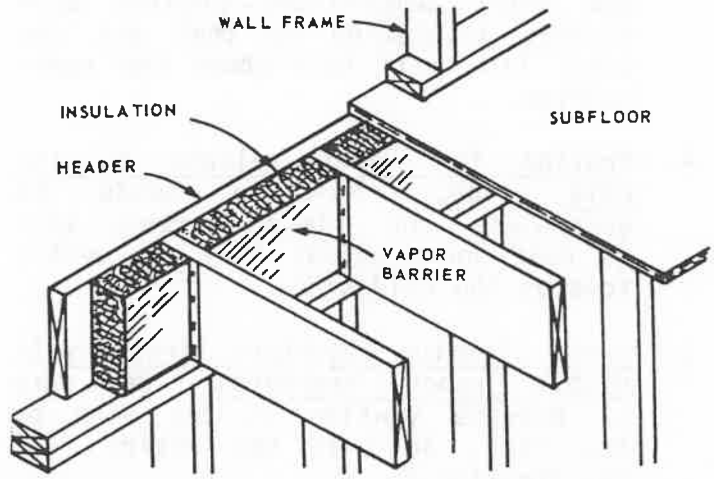


FIGURE 20



Installation: Roofs

A major cause of failure in built-up roofs is condensation of moisture vapor which rises from inside the building and penetrates the roof deck insulation. When this vapor reaches its dew point, which can be located inside the insulation or at the cool outer surface it condenses. This results in reduction or total loss of the thermal efficiency of the insulation, dripping, and damage. And this means expensive call backs for the roofer.

Five steps to a vapor-proof roof.

1. Eliminate excessive water vapor whenever possible. Use ground covers, enclose sources of steam or water, etc., and provide a sufficient venting capacity to rid the building of excess moisture (in showers, kitchens, etc.).

2. Use a vapor barrier. Select a vapor barrier that is both easy to apply and resistant to job site abuse. Install on the warm side of the roof deck insulation.

3. Use enough insulation. To keep critical surfaces warmer than the dew point temperature, provide sufficient insulation so that the dew point line will fall above the vapor barrier.

4. Provide for vapor release on the cold side. Moisture tends to accumulate in closed areas such as roof decks unless they are vented towards the cold side.

5. Avoid forming moisture traps with double vapor barriers. Be sure to provide venting at the edge of the roof, so that the entire roof can "breathe."

Summary

Within an insulated wall or structure, the vapor barrier **must** be located on the **warm side** to prevent water vapor from moving through the insulation to the cool side and condensing. The most commonly used vapor barrier materials are polyethylene film, asphalted kraft paper and aluminum foil.

Vapor barrier selection is determined by the permeability of the material. The permeability of a material is a measure of its capacity to allow the passage of liquids or gases.

The vapor barrier shall have a permeance of not more than .01 perms. The barrier should be lapped 3 to 6 inches. All laps should be tapped or sealed with an approved vapor resistant tape or mastic. Make tight applications around electrical outlets, doors and windows and equipment. Refer to Figures 21 and 22 for a review of vapor barriers.

WATERPROOFING

The single most critical area for waterproofing construction is the below grade foundation wall. Rising water tables, hydrostatic heads, structural movement, and ground water attack require a special type of protection.

A liquid waterproofing system by spray methods ensures a high build up of film thickness necessary to cope with the above mentioned problems. See Figure 23.

Hydrocide liquid membrane (HML) is a single component, cold applied, modified polyurethene, that is formulated exclusively for spray application. It cures chemically to a flexible, rubberlike, seamless barrier. It is self-adhering and becomes an integral part of the structure and will not crack.

Hydrocide mastic can be trowelled or brushed on as well as sprayed. It is good for below grade and above grade application.

For all below grade applications of waterproofing, make sure to fill all cracks, crevices and grooves. Make sure coating is continuous and free from breaks and pinholes. Carry mastic over exposed tops and outside edges of footing, forming a cove at junction of the wall & footing. See Figures 24 & 25.

FIGURE 21

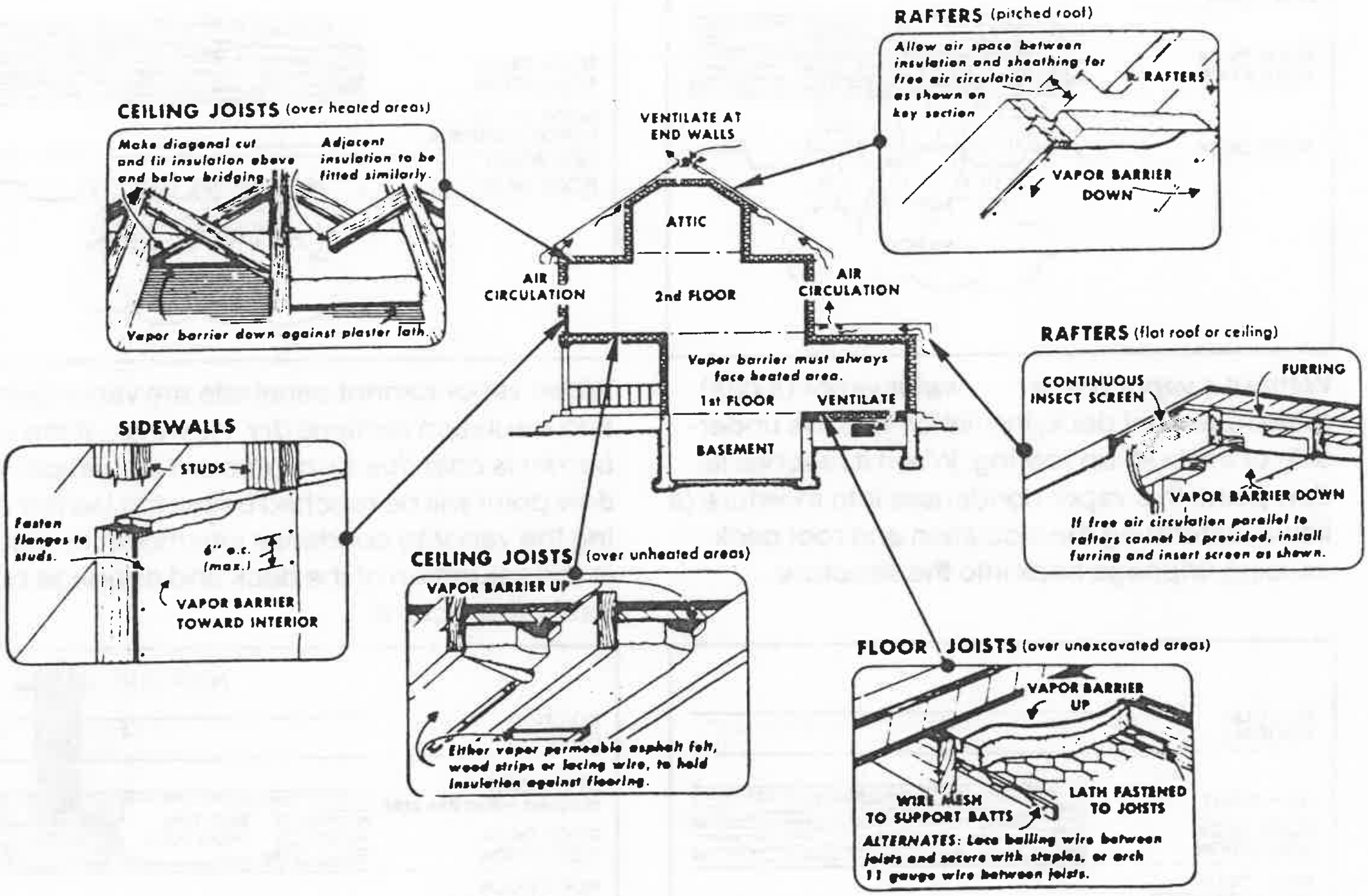
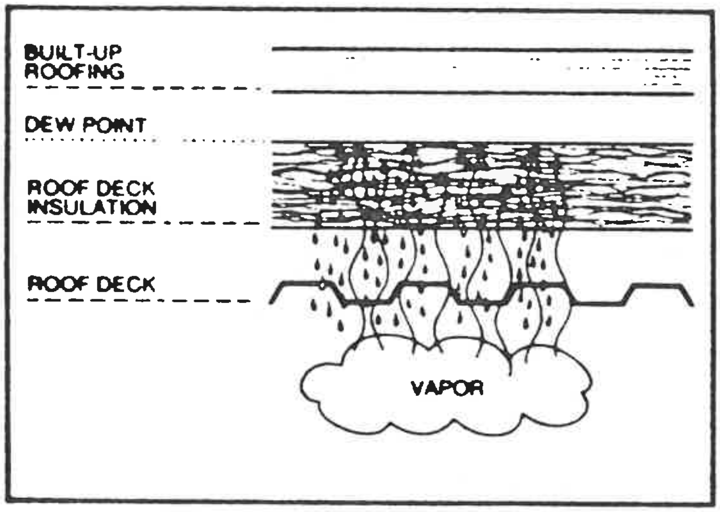
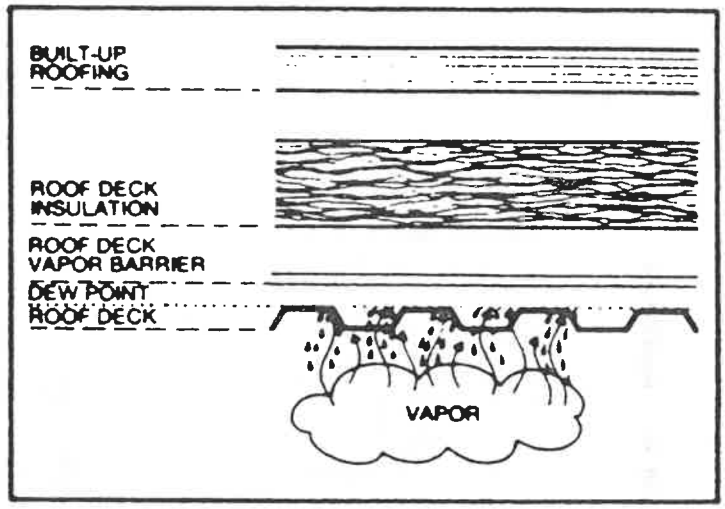

CEILING JOISTS (over heated areas)
Make diagonal cut and fit insulation above and below bridging.
Adjacent insulation to be fitted similarly.
Vapor barrier down against plaster lath.
VENTILATE AT END WALLS
ATTIC
AIR CIRCULATION
2nd FLOOR
AIR CIRCULATION
RAFTERS (pitched roof)
Allow air space between insulation and sheathing for free air circulation as shown on key section
RAFTERS
VAPOR BARRIER DOWN
Vapor barrier must always face heated area.
1st FLOOR
VENTILATE
BASEMENT
RAFTERS (flat roof or ceiling)
CONTINUOUS INSECT SCREEN
FURRING
VAPOR BARRIER DOWN
If free air circulation parallel to rafters cannot be provided, install furring and insert screen as shown.
SIDEWALLS
STUDS
Fasten flanges to studs.
6" o.c. (max.)
VAPOR BARRIER TOWARD INTERIOR
CEILING JOISTS (over unheated areas)
VAPOR BARRIER UP
Either vapor permeable asphalt felt, wood strips or lacing wire, to hold insulation against flooring.
FLOOR JOISTS (over unexcavated areas)
VAPOR BARRIER UP
WIRE MESH TO SUPPORT BATTS
LATH FASTENED TO JOISTS
ALTERNATES: Lace bailing wire between joists and secure with staples, or arch 11 gauge wire between joists.

FIGURE 22

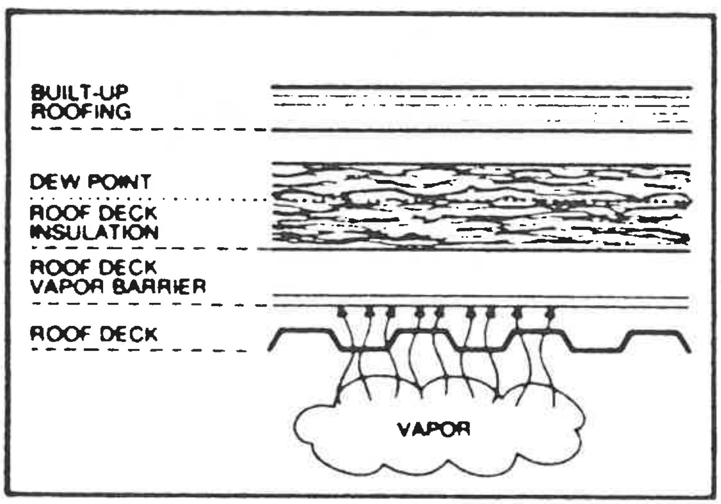
Here's why you need BOTH sufficient insulation AND a vapor barrier.



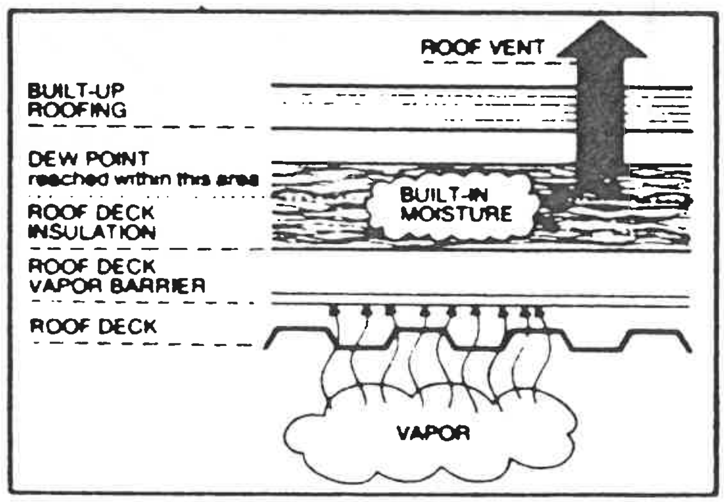
Without *a vapor barrier* . . . water vapor (a gas) penetrates roof deck, insulation and the underside of the built-up roofing. When it reaches its dew point, this vapor condenses into moisture (a liquid) saturating the insulation and roof deck causing drippage back into the structure.



Water vapor cannot penetrate the vapor barrier, and insulation remains dry. However, *if the vapor barrier is cold due to insufficient insulation*, the dew point will be reached below the barrier causing the vapor to condense into moisture result in the saturation of the deck and drippage back into the structure.



Water vapor cannot penetrate the vapor barrier, and insulation remains dry. *If enough insulation is employed to keep vapor barrier warm* (above the dew point temperature of air space below) *no condensation of vapor into moisture will occur.*



Double vapor barriers are to be avoided. *A roof vent can provide an exit for built-in moisture within the insulation.* Built-in moisture can be due to various factors, one prime factor is job site abuse during construction.

FIGURE 23

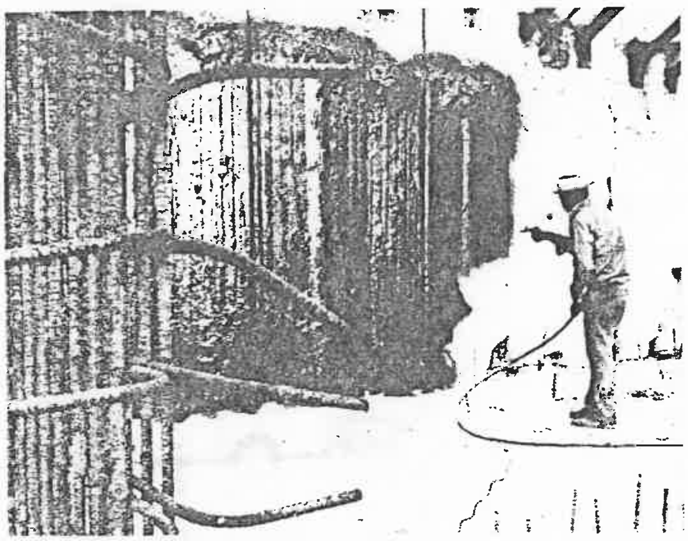


FIGURE 24

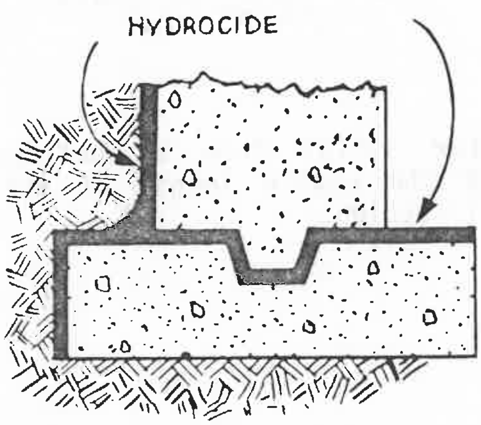
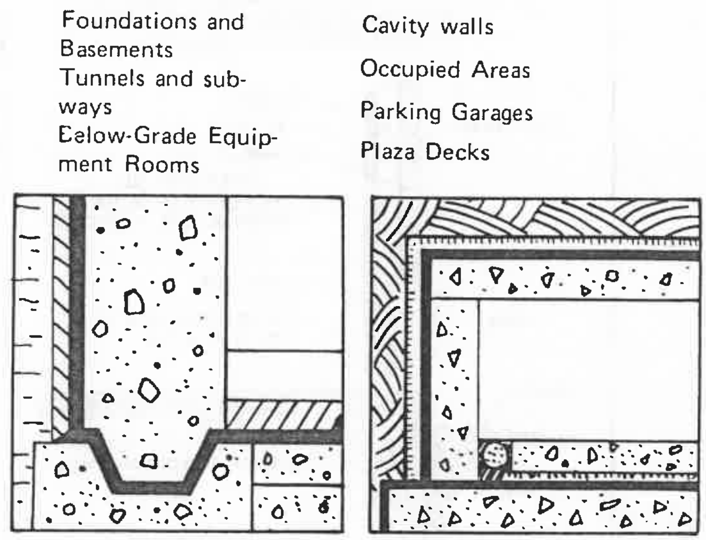


FIGURE 25



Spread around all joints, grooves and slots and into all chases, corners, reveals and soffits. Bring the coating to finished grade. See Figure 26.

Do not place backfill for at least 24 to 48 hours after application. It is suggested, where possible, backfill be placed within approximately 7 days to avoid any unnecessary damage due to construction activities. Care should be taken so the backfill is placed in a manner that will not rupture or damage the film or cause the coating or membranes to be displaced on the coated surface.

Above grade application on interior surfaces makes an excellent vapor barrier. See Figure 26 and 27.

WATER STOPS

Water stops are thin sheets of rubber, plastic (PVC) or other material inserted in a construction joint to obstruct the seepage of water through the joint.

FIGURE 26

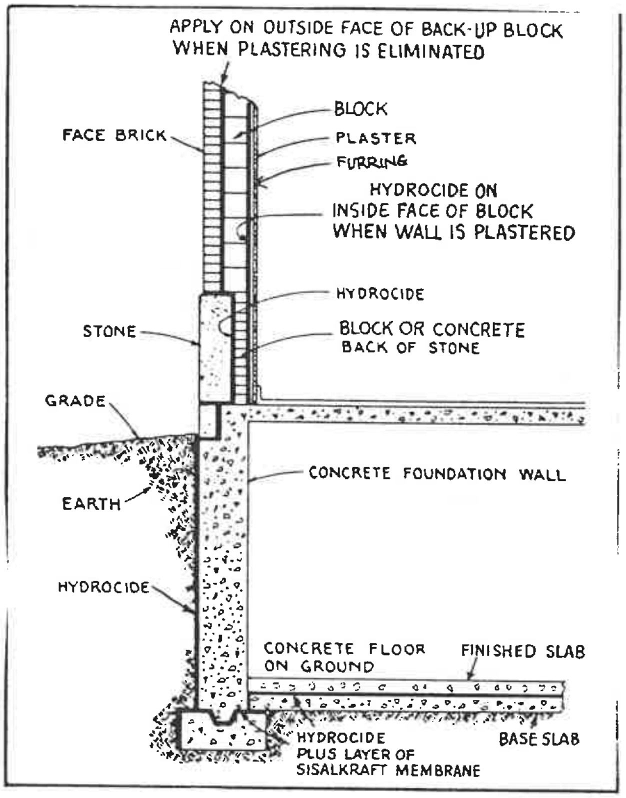
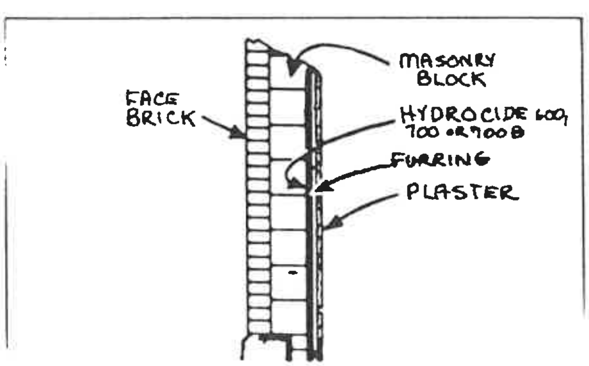
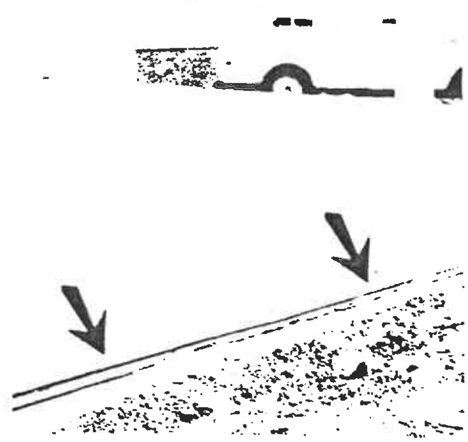


FIGURE 27

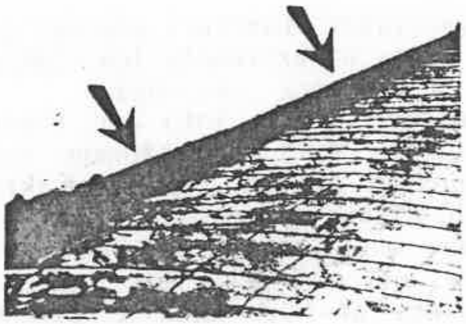


The application of PVC waterstops is multiple and may be used for installations in underpasses, tunnels, tanks, locks, walls, swimming pools, siphons, sewage disposal plants, reservoirs, culverts, sewage treatment plants, channels, drums, filtration plants, foundations, bridges, basements, abutments and decks, mineshafts, aqueducts, retaining walls, and roofs. Refer to Figures 28, 29 & 30 for various applications of the water stop.

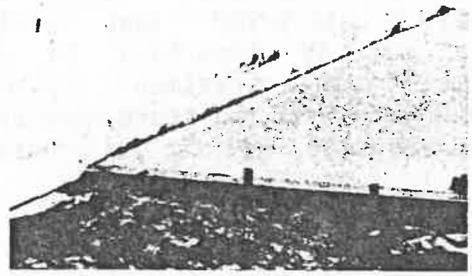
FIGURE 28



Rubber strips from a continuous water stop the entire length of the basement wall section.



Basement floor slab in place and in direct contact with the rubber water stop.



A water stop installed at the stopping of a pour. When the concrete has set, the forms are stripped and the water stop is folded together before pouring the rest of the wall.

FIGURE 29

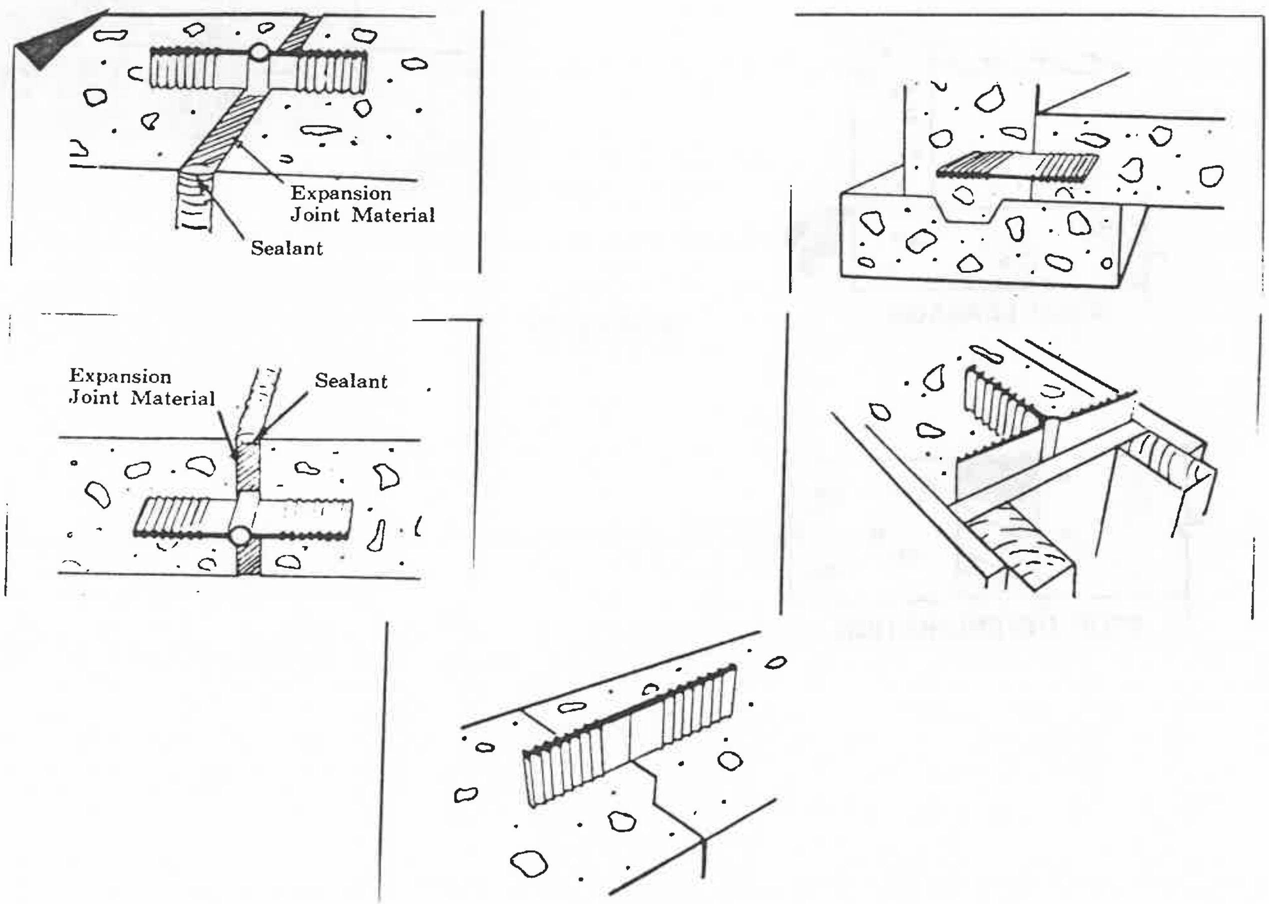
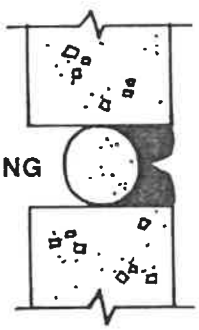


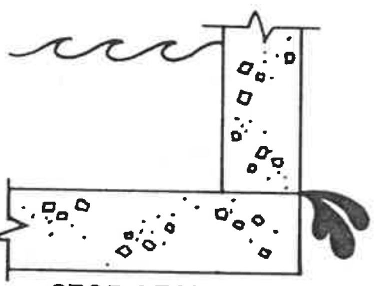
FIGURE 30

JOINT TREATMENT

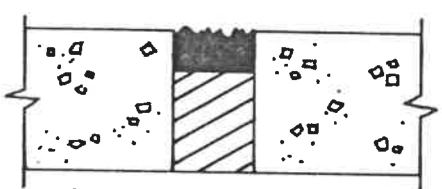
Joints in structures are critical. They are expected to maintain integrity during movement and attack, yet remain permanently waterproof and airtight. Therefore, it is important to select the proper joint treatment system to **avoid** problems with moisture penetration at the construction joints. See Figure 31.



STOP CRACKING



STOP LEAKAGE



STOP DETERIORATION

VAPOR BARRIER FOR COLD STORAGE AND OTHER LOW TEMPERATURE FACILITIES

Cold storage vapor barriers are designed for use in areas of extremely low temperatures to halt the migration of damaging moisture vapor into and through the insulation. Most cold storage vapor barriers consist of two layers of kraft paper, each extrusion coated with black polyethylene, a layer of aluminum foil, two layers of non-asphaltic adhesive and two layers of high tensile strength reinforcing fibers which are embedded in the adhesive.

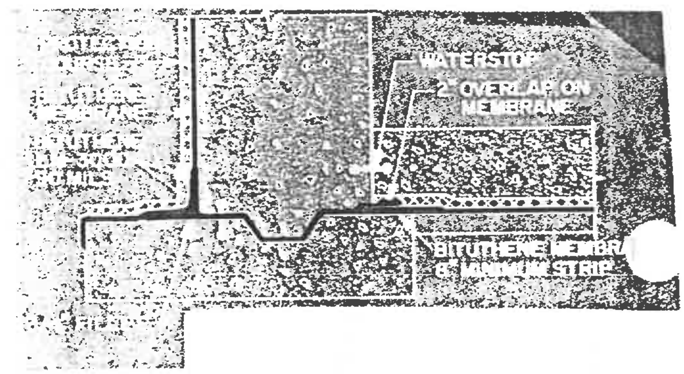


FIGURE 31

DEFINITIONS

Condensation - The conversion of moisture in air to water.

Dew Point - The temperature at which air becomes over-saturated with moisture and the moisture condenses.

Permeance - The water vapor permeance of a sheet of any thickness is the ratio of water vapor flow to the vapor pressure difference between the surfaces.

Permeable - Porous

Perm - The measure of water vapor permeability. This equals the number of grains squared of water vapor passing through a material or substance 1 foot square per hour, per inch of mercury difference in vapor pressure.

Permeability of a Material - Is a measure of its capacity to allow the passage of liquids or gases.

Water Vapor - A gas. Water in a vaporous form especially when below the boiling point, and diffused in the atmosphere.

Convection - The transfer of warm air from the earth's surface.

Diffusion - The movement, often contrary to gravity, of the molecules of gases in all directions causing them to intermingle.

Chimney Effect - The tendency of air or gas in a duct or vertical passage to rise when heated due to its lower density compared with that of the surrounding air or gas.

Vapor Barrier - Material used to retard the flow of vapor or moisture into walls and thus prevent condensation within them. The vapor barrier must be a part of the warm side of the wall.

Waterstop - Thin sheets of rubber, plastic or other material inserted in a construction joint to obstruct the seepage of water through the joint.

Name________________________________ Date__________

FID Worksheet 4

1. The conversion of moisture in air to water is:

   a. water vapor b. condensation c. dew point
   d. convection __________

2. Warm air is capable of holding more water than cold air. True or False __________

3. The temperature at which air becomes over saturated with moisture, and the moisture condenses is__________. __________

4. By insulating the inner wall of a structure, you can help prevent condensation through the wall. True or False __________

5. In a wall with no insulation the moist air will be able to pass through it. True or False __________

6. Should a vapor barrier be installed in a crawl space? Yes or No __________

7. __________in essence, provides a stream of outside air to remove trapped moisture before it is allowed to do any damage. __________

8. List two types of ventilating vents.

   a.__________ b.__________ __________ __________

9. The transfer of warm air from the earth's surface. Choose one:

   a. condensation b. diffusion c. convection
   d. ventilation __________

10. Material used to retard the flow of vapor or moisture into walls, floors, or ceilings is known as:

    a. vapor barrier b. insulation c. vents
    d. sheathing __________

11. The vapor barrier must be a part of the cold side of the wall. True or False __________

12. List three types of vapor barriers.

    a.__________ b.__________ c.__________ __________ __________ __________

13. Is water vapor a gas or a liquid? __________

14. The measure of water vapor permeability is the__________. __________

15. Any material that has a perm rating of 1.0 or more is considered a vapor barrier. True or False __________

16. A 0.0 rating is totally impermeable. True or False ________

17. Permeable means the same as ________. ________

18. What is a major cause of failure in built up roofs? One word answer ________. ________

19. There are five important steps to a vapor proof roof. List 3 of them. ________ ________ ________

a.________ b.________ c.________

20. Up to 80% of moisture entering a structure does so by migrating from the ground beneath the structure. True or False ________

21. Of the two, which passes through concrete more readily?

a. moisture vapor b. liquid moisture ________

22. Before installing a vapor barrier the ground must be ________ and________. ________ ________

23. Vapor barriers should be________under the entire floor. ________

24. Vapor barriers are used to protect from moisture in:

a. ceilings b. slabs c. walls
d. all of the above ________

25. Vapor barriers are also used for cold storage facilities. True or False ________