Home Inspection – The Basics Continuing Education (5-Hour Classroom CE Course)

CILB: Gen - Architects: - (H/S/W) ECLB: (B), Inspectors: Reciprocity (Gen) - Miami-Dade: Engineers: Provider #0003342 - (AOP) - Home Inspectors: (Gen)

Home Inspection – The Basics Part 1 - Introduction to Building Systems and Components (2hrs) Part 1 of a 3-part 5-Hour CE Package

Objective

 The objective for this 2-hour section of the course is to increase understanding of building systems and their components as they relate to the home inspection industry.

Organizing the Report by System

 A building, as a lay person views it, is just that... a building.

 As inspectors your ability to break down the building into its' different systems and components will allow you to inspect, document and report on the building in an organized, concise and accurate manner.



Overview

 This session will attempt to make the inspector aware of the different building systems and their related components.

 Buildings are dynamic by nature. We hope that they are static structurally, but even this concept can be debated when inspecting the Structural System.

Dynamics of Systems

 Building Systems provide dynamic functions for the building in that they:

- Provide structural stability,
- Keep the building dry and ventilated,
- Bring in potable water and remove waste water,
- Condition air by removing heat and humidity,
- Distribute electrical energy for use by the occupants, and

Ensure that the site the structure occupies has proper drainage.

Identifying the Building Systems

The Building Systems include:
Structural
Roofing
Electrical
Mechanical
Plumbing

- Insulation & Ventilation
- Exterior
- Interior



1. Structural System

 In this section, the following topics will be discussed:

- Foundation
- Walls and ColumnsHorizontal Beams



Structural System (cont'd)

 The Structural System is charged with keeping the building stable.

 The structural system is comprised of a foundation, floors, walls, beams, roof rafters or trusses and sheathing or decking.

 The architect and engineer of record during their design phase have calculated all of the various loading conditions that might affect the structure during its lifespan, including soil bearing capacity for foundation design and uplift calculations for wind loads.

a. Foundation

 The foundation of a building, although not visually accessible, plays an important part in ensuring that the weight of the building will be supported by the soil it is placed on.

• This is accomplished by eliminating differential settlement.



Foundation (cont'd.)

 All buildings will settle. The expectation is that buildings will settle uniformly.

 When a building experiences differential settlement (one side settling more than the other) vertical or diagonal cracks may be observed on the interior or exterior walls of the building.



Foundation Types

• There are various designs and types of foundation systems: Continuous footings, Isolated footings, Monolithic footings, • End bearing, • Auger or pin piles.



b. Walls & Columns

 The walls and columns make up part of the exterior envelope of the structural system.

 They are charged with preventing the building from vertical racking in addition to resisting lateral wind loads.



Walls & Columns (cont'd.)

 The walls may be comprised of masonry or wood members.

 Masonry walls may be comprised of concrete blocks, brick or stone.

 Wood walls are comprised of vertical wood members called studs with an exterior sheet of plywood followed by metal lathe and plaster over the exterior.

Walls & Columns (cont'd.)

- Construction in south Florida is usually concrete block with a stucco veneer on the exterior.
- These walls can either be free standing between concrete columns or reinforced masonry in which block cells include vertical steel reinforcement filled with grout.
- Freestanding columns may be wood, concrete, steel or brick.





c. Horizontal Beams

 Horizontal Beams are charged with preventing horizontal racking of a structure and carrying the roof load as it transfers the load through the columns/walls to the foundation.

- In a wood frame system the beams are built into the wall as the double top plate.
- In a masonry system the beams rest on the concrete block as the tie beam.





Horizontal Beams (cont'd.)

 Beams that span over an opening with no support are to be structural in nature and must be designed to carry the loading condition imposed on them.

 These beams may be wood, laminated wood, glue-lam wood, concrete or steel.



2. Roofing System

 In this section, the following topics will be discussed:

Roof Structure Sheathing and Decking Deck Attachment Roof Shape Roof Types Roof Slope Shingles & Tiles



Roofing System (cont'd.)

- The roofing system is charged with keeping the interior of the structure free from moisture.
- This is also accomplished by providing a vented attic space. However, in recent years we have seen the introduction of non vented attics.



a. Roof Structure

 The roof structure is charged with spanning between the walls and/or beams and supporting the roof structural loads in addition to an attachment to the wall or beam system to resist uplift forces.

 The roof system may be comprised of individual wood members referred to as rafters in conventional framing or engineered roof truss system. In isolated cases structural steel is also used, but rarely on residential construction.

Roof Structure (cont'd.)

 In a conventionally framed (rafter) system the components of the roof structural system are:

- Ridge Beam
- Rafter
- Collar Ties
- Ceiling Joists



Ceiling joists are not an integral part of the roof structure, but merely support the ceiling in the interior of the rooms.

Roof Structure (cont'd.)

 In a pre engineered truss system the components of the roof structural system are:

- Top Chord
- Bottom Chord
- Web Members
- Gusset Plates or Gang Nails



 A defining characteristic of a truss system is the triangulation of the members. Since the wood members are smaller they depend on this relationship for structural stability.

b. Sheathing or Decking

- The sheathing or decking of a structural system is the component which acts as a diaphragm or exterior skin of the structure at the roof level. It is also designed to support the weight of the roof material which will be attached to it.
- The term "sheathing" is used to describe this layer when sheet material is applied.
- The term "decking" is used when individual wood members are applied.

Sheathing or Decking Materials

- The are different types of materials that may be observable on the sheathing or decking layers.
- The inspector must be able to identify the following:
 - Plywood Sheathing
 - O.S.B. Oriented Strand Board
 - Gypsum Decking
 - Tongue and Groove Decking
 - Wood Planks
 - Wood Battens
 - Structural Concrete







c. Deck Attachment

 All roofing materials require attachment to the structural sheathing system. The "sheathing" in roofing jargon is referred to as the decking.

There are two types of decking types in the roofing industry:

- Nailable decking
- Non-Nailable decking



The particular combination of deck the systems
 The particular combination of deck the systems
 and geographic location will determine the type and spacing of the fasteners in the nailable deck type roof as well as the type of adhesive used in non-nailable deck systems

d. Roof Shape

- When referring to a roof the inspector must be able to speak to the architectural appearance
- roof configuration and the type of roof covering material utilized.
 Architectural appearance includes:
 - ✤ Hip

or

- Gable
- Flat
- Mansard



e. Roof Types

- When referring to a roof the inspector must also be able to speak to the roof covering material utilized. The choice of the material will depend greatly on whether the roof is a low slope or a steep slope roof.
- There two major roof types which have particular characteristics:
 - Low Slope roofing and
 - Steep Slope roofing



f. Roof Slope

- Low slope roofs are defined as those roofs which have a slope or pitch of 2:12 or less.
- Steep slope roofs are defined as those roofs which have a slope or pitch of 2:12 or greater.
 - Slope is a ratio of rise to run. A slope of 2:12 is a rise of 2 inches in a 12 inch run.



Low Slope Roofs

 Low slope roofs (2:12 or less) have waterproof roof systems and the membranes usually come in rolls. This is referred to as a built up roof.

Some types of low slope roofs are as follows:

- ♦ 3 Ply Fiberglass
- Aggregate Surface
- ♦ 90# Cap Sheet
- Modified Bitumen



Steep Slope Roofs

 Steep slope roofs (2:12 or greater) are water resistant roof systems and the materials usually come in bundles. Some types of steep slope roofs are as follows:

Shingles
Tile
Metal
Wood Shakes
Slate



Shingle Materials

 Shingles are manufactured from different materials including: Asphalt Composition □ 3 Tab Dimensional Asphalt Dimensional □ Shakes Wood □ Shingle 3 Tab □ Shakes Metal Metal Shingle □ Shingle Wood Shake

Tile Shapes

 Tiles are manufactured from either concrete or clay and come in different shapes including:

* Flat

Spanish-SMission-S

- ✤ Villa
- Barrel







Metal Roofs

• Metal roof systems include:







3. Electrical System

 In this section, the following topics will be discussed:

- Service Entrance
- Electric Meter
- System Ground
- Main Disconnect
- Main Distribution Panel
- Branch Circuits
- Equipment Disconnects



Electrical System (cont'd.)

The electrical system is charged with the safe distribution of electrical energy throughout the building for use by its occupants and equipment and delivering the unused energy back to the utility

company.



a. Service Entrance

 The electrical system originates at the electrical service entrance. The service entrance may be either overhead or underground.

- If an overhead electrical service is present, no portion of the service drop may be below 10' above the ground, nor 12' above the driveway, nor less than 8' above any accessory building on the site.
- In no case can the electrical service drop pass over an aluminum roof nor over a swimming pool.
b. Electric Meter

In an overhead electrical service there shall be a weather head with a drip loop and a tension line supporting the conductors to the structure as they enter the weather head. Most weather heads are fitted to a mast which is a metallic conduit that provides the conductors a path to the electric meter.

 The electric meter is utilized by the utility company to monitor the consumption of energy utilized measured in kilowatts.



c. System Ground

 In addition to providing a source for monitoring consumption, the electrical system ground originates from the electric meter. The grounding wire is usually a #8 copper wire and would be grounded to a cold water pipe, two grounding rods separated by a distance of 10' and the building foundation steel. Grounding clamps should be observed on the grounding rods and the cold water pipe.



d. Main Disconnect

 In newer construction the electrical main disconnect or main breaker is found on the exterior of the building adjacent to the meter or in what is referred to as a combo meter/disconnect box.

 It is important to determine the size of the main service conductors, their material and their condition

 The type of Main Disconnect protection should be noted, breakers, cartridge fuses.



e. Main Distribution Panel

 The Main Distribution Panel (MDP) distributes the electrical power from the meter to the branch circuits (rooms) throughout the building.

- The type of branch circuit protection should be noted (breakers, plug type, fuses).
- The conductor material serving the branch circuits should also be noted (copper, aluminum).



f. Branch Circuits

 Branch circuits: a representative number of outlets should be observed. All GFCI locations should be observed: 4' from a source of water, exterior, garage outlets. All bedrooms should be checked for Arc Fault Circuit Interrupters (AFCI) outlets.





g. Equipment Disconnects

- Each 240 volt piece of equipment which is hard wired into the electrical system and is not in plain view of the electrical panel, must be equipped with an independent disconnect switch which is under the control of the technician installing the device (i.e. A/C compressors and air handler units).
- This requirement is in place to protect the technician working on the device.



4. Mechanical System

 In this section, the following topics will be discussed:

Types of Systems
Split Systems
Package Units
Heat Strip
Heat Pump
Ductwork
Condensate Lines



Mechanical System (cont'd.)

 The Mechanical system or Air Conditioning system is charged with the conditioning of the interior environment by the removal of heat and moisture from the air in the interior environment or conditioned space.

 Although not very prevalent in South Florida many elaborate heating systems exist in other parts of the State and the U.S. steam generators, boilers, coal and wood fired furnaces. These would also be included in the Mechanical System.

a. Types of Systems

 The Air conditioning system is usually identified by how heat is produced in the unit (i.e. Heat Strip or Heat Pump).

- Air Conditioning systems can be either ducted or non-ducted. This depends on the area that the unit is servicing.
- In Central A/C systems (ducted systems) there are both Split Systems or Package Units.





Split Systems

 In a split system the condensing unit is usually on the exterior of the building while the air handler is in the interior of the building.

 The condensing unit contains the compressor and a condensing coil used to dissipate heat from the compressor via a fan drawing cool air from the exterior environment across the coil.

• The compressor condenses gas to a liquid refrigerant for use in the air handler unit.

Split Systems (cont'd.)

• The air handler unit contains the evaporator and a evaporator coil used to remove heat from the interior environment via a blower, drawing warm air from the interior environment across the coil and distributing the cooled air via ductwork to

the various rooms.

 The evaporator converts liquid refrigerant to a gas for use in the condensing unit.



Adequate Cooling

 Since what we are trying to achieve is the reduction of heat in the air, measuring the difference of temperature across the evaporator coil is the most effective way of determining adequate cooling.

 We should observe a temperature difference between 12 and 20 degrees in determining adequate cooling.



Package Units

Package Units perform exactly the same as split systems, however all of the components of the A/C system are contained in one unit. Both condensing unit and air handling unit are located in one box, usually located on the exterior or rooftop of a building.



Heat Strips

 In an electrical Heat Strip system there is a small heating element requiring 240 volt power located inside the air handling unit. When the system is placed in heating mode the Heat strip is energized and the refrigerant cycle is disabled. The blower is activated and cool air is heated by convection when blown passed the heated unit.



Heat Pumps

- In a Heat Pump system heating is achieved by reversing the refrigerant cycle. This is accomplished by a reversing valve in the condensing unit.
- As the roles of both coils become reversed through this process the interior coil now heats up and the blower of the air handler draws cool interior air across the coil and distributes the air via the ductwork to the rooms.
- No 240 volt power is required at the air handler unit.



A heat pump heats your home in the winter...



and cools your home in the summer.

b. Ductwork

- Air distribution in central air systems is accomplished via ductwork usually concealed in the attic or soffits in the rooms. The material of the ductwork where accessible must be determined.
- Insulated metal, rigid fiberglass, or flexible fiberglass are usually found in these systems.





c. Condensate Lines

 Condensate lines are required on all systems where an evaporator coil is utilized.

 The condensate lines are usually PVC and must discharge to the exterior of the building 12" away from exterior walls.

 Where air handler units are located in attic spaces drip pans must be utilized and be equipped with float switches to shut off the machine to prevent overflow.



Condensate Lines (cont'd.)

 Where condensate lines are located in closets and no viable path is available in the floor or through a crawl space, the condensate must be discharged into a pump also fitted with a float switch. The pump must discharge over the attic space to the exterior through the soffit.

 In no case can a condensate line discharge directly into a crawl space.

5. Plumbing System

 In this section, the following topics will be discussed:

- Potable Water
- Supply Lines
- Distribution
- Water Heaters
- Plumbing Fixtures
- Waste Lines
- Waste Discharge



Plumbing System (cont'd.)

 The plumbing system is charged with bringing potable water to the building and removing waste water from the building and site.

- The plumbing system consists of three parts:
 - Septic: waste lines
 - A-Septic: supply lines
 - Mechanical: fixtures and valves



a. Potable Water

 The providing of potable water to the site is accomplished by either providing a private drinking water well or subscribing to a municipal water service.

 In either case it is required to identify the source of the potable water.

 In the event of a private well being used a chlorinator and a coliform test for bacteria is required.



b. Supply Lines

 The supply lines which bring the water into the building and distribute the water throughout the building are typically made of the following materials:

- Copper
- Galvanized Pipe
- ✤ P.V.C.
- ✤ C.P.V.C.



c. Distribution

 The supply lines typically provide cold water throughout the interior fixtures and exterior hose bibs of the building.

• The supply lines also provide water service to the water heater.

 Additional supply lines run from the water heater to all of the fixtures and locations where hot water is required.

Plumbing System Water Heaters

 The water heater can be either a conventional storage tank or a tankless system.

 Conventional storage tank water heaters are considered pressure vessels and require to be fitted with a temperature and pressure relief (TPR) valve.

 The TPR valve must be located on the top of the tank or on the side no more than 6" from the top of the tank.



Temperature Pressure Relief (TPR) Valve

- The TPR must have a discharge tube attached to it. The discharge tube must discharge no more than 6" above the floor, or to the exterior, and may not be reduced in size.
- Conventional storage tank water heaters can be either electric or gas fueled.
- Gas fueled tanks are required to be vented to the exterior and cannot be installed in an enclosed closet unless the closet is properly vented.



e. Plumbing Fixtures

- Plumbing Fixtures include sinks, bathtubs, toilets, showers and laundry tubs.
- All plumbing fixtures must be vented.
- All plumbing fixtures require a P-trap except toilets since they contain their own water seal.
- P-traps prevent sewer gasses from entering the building and are part of the waste system.



f. Waste Lines

 The waste lines which remove the waste and grey waters from the building and lead to a waste disposal system are typically made of the following materials:

P.V.C.
Cast Iron Pipe
Vitrified Clay Pipe



Vent Stacks

 The waste lines are typically sized based on their fixture unit count.

• At a minimum, residential units are required to provide one 3" diameter vent stack.

• At a minimum, the waste line to the septic or sewer system is required to be 4" in diameter.

g. Waste Discharge

 The waste system may discharge to one of two locations:

- Municipal sewer system
- On site sewage facility (septic tank)



Septic Tanks

 Septic tanks are usually 1000 gallon minimum an consist of a two chamber tank which separates the solid from the liquid waste.

- The septic tank usually is tied into a drain field which is sized according to the flow rate and tank size.
- The effluent is then discharged into the ground via perforated pipe in the drain field.



6. Insulation & Ventilation

 In this section, the following topics will be discussed:

Types of Insulation
Methods of Application
Required Locations



Insulation & Ventilation (cont'd.)

- The Insulation and Ventilation system is charged with keeping the building ventilated and providing insulation where required to ensure compliance with the Florida Model Energy Code between conditioned and non-conditioned spaces.
- The use of insulation contributes to the reduction of heat gain and heat loss between spaces.

a. Types of Insulation





b. Methods of Application







c. Required Locations

 Insulation is required wherever you have conditioned air space areas abutting non condition areas.

- Attics
- Exterior Walls
- Garage walls
- 2nd Floor Overhangs



7. Exterior

- This section discusses exterior components.
- The exterior system is comprised of all of the exterior components of the building including:
 - Stucco or siding
 - Exterior slabs and terraces
 - Windows
 - Doors
 - Site conditions including terrain


8. Interior

- This section discusses interior components.
- The interior system is comprised of all of the inside components of the building including:
 - Ceilings
 - ♦ Walls
 - Floors
 - Cabinets
 - Vanities

