**Chapter 7: Building Construction**

**Chief Concepts**

* It is vital for fire fighters to understand the basic types of building construction and to recognize how building construction affects fire growth and spread.
* Based on a structure’s occupancy classification, a fire fighter can predict who is likely to be inside the building; for example, a bank is unlikely to have occupants at 3 a.m.
* Building contents are usually related to the occupancy of the structure; for example, a warehouse is likely to store goods or chemicals, whereas an apartment building is likely to be filled with human occupants and furniture.
* The most commonly used building materials are wood, engineered wood products, masonry, concrete, steel, aluminum, glass, gypsum board, and plastics. The key factors that affect the behaviour of each of these materials under fire conditions are combustibility, thermal conductivity, decrease in strength at elevated temperatures, and thermal expansion when heated.
* Masonry includes stone, concrete blocks, and brick. These types of components are usually bonded together with mortar. Masonry is fire resistive and a poor conductor of heat. Even so, a masonry structure can collapse under fire conditions if the roof or floor assembly collapses.
* Concrete is a fire-resistive material that does not conduct heat well. It is often used to insulate other building materials from fire. Concrete does not lose strength when exposed to high temperatures. Steel reinforcing rods are often embedded within this material to strengthen it. The high heat from a fire may convert trapped moisture in the concrete to steam and cause spalling; severe spalling can, in turn, expose steel reinforcing rods to heat.
* Steel is often used in the structural framework of buildings. It is strong and resistant to aging but can rust. Steel is not fire resistive and conducts heat. Steel both expands and loses strength when heated. The risk of failure of a steel structure depends on the mass of the steel components, the loads placed on them, and the methods used to connect the components. Any sign of bending, sagging, or stretching of steel structural members should be viewed as a warning of imminent collapse.
* Glass is noncombustible but not fire resistive. Ordinary glass will usually break when exposed to fire. Tempered glass is stronger and more difficult to break. Laminated glass is likely to crack and remain in place when exposed to fire. Glass blocks have limited strength and are not intended to be used as part of a load-bearing wall. Wired glass incorporates wires that hold the glass together and prevent it from breaking when exposed to heat.
* Gypsum board is commonly used to cover the interior walls and ceilings of residences. It is manufactured in large sheets consisting of a layer of compacted gypsum sandwiched between two layers of specially produced paper. Gypsum board has limited combustibility and does not conduct or release heat to contribute to fire spread. It may fail if exposed to fire for extended periods. Rated drywall is a major component in many rated fire separations.
* Engineered wood products are also called manufactured board, manmade wood, or composite wood. These products are manufactured from small pieces of wood that are held together with glue or adhesives (e.g., urea-formaldehyde resins, phenolformaldehyde resins, melamine-formaldehyde resins, and polyurethane resins). Engineered wood products may warp under high humidity and release toxic fumes during a fire.
* The most important characteristic of wood and engineered wood products is their high combustibility. The rate at which wood ignites, burns, and decomposes depends on several factors: ignition, moisture, density, preheating, and its size and form.
* Wood cannot be treated to make it completely noncombustible, but it can be made to be more difficult to ignite and burn through the application of a fire-retardant treatment.
* Plastics are rarely used for structural support but may be found throughout a building. The combustibility of plastics varies greatly. Many plastics produce quantities of heavy, dense, dark smoke and release high concentrations of toxic gases.
* There are five types of building construction:
	+ Type I construction: fire resistive—Can withstand and contain a fire for a specified period of time. All of the structural members and components used in this construction must be made of noncombustible materials and constructed so that they provides at least 2 hours of fire resistance. Under extreme fire conditions, a Type I building can collapse.
	+ Type II construction: noncombustible—Includes structural components made of noncombustible materials. The fire severity is determined by the contents of the building.
	+ Type III construction: ordinary—Used in a wide variety of buildings—from strip malls to small apartment buildings. These buildings have masonry exterior walls and interior structural members constructed of wood. The resulting structure may have void spaces that can allow fire spread.
	+ Type IV construction: heavy timber—Marked by masonry construction and interior walls, columns, beams, floor assemblies, and a roof structure made of heavy wood. It has no concealed spaces or voids. The columns, support beams, floor assemblies, and roof assemblies will withstand a fire much longer than the smaller wood members used in ordinary construction.
	+ Type V construction: wood frame—All of the major components are constructed of wood or other combustible materials. Type V is the most common type of construction used today. Many of these structures do not have any fire-resistive components. Fire detection devices and automatic sprinklers are the most effective way of protecting lives in these buildings.
* In a balloon-frame building, an open channel that extends from the foundation to the attic can enable hidden fire to spread throughout the structure.
* Platform-frame construction is used in most modern construction. In this building technique, each level is constructed as a separate platform. At each level, the floor platform blocks the path of any fire rising within the void spaces.
* Every building contains the following major components:
	+ Foundation—Usually constructed of concrete or masonry and designed to transfer the weight of the building and its contents to the ground.
	+ Floors and ceilings—Might be designed to resist fires or might have no fire-resistant capabilities. In a fire-resistive building, the floor is designed to prevent a fire from spreading vertically and to prevent a collapse when a fire occurs in the space below the floor–ceiling assembly. Wood floor structures are common in non-fire-resistive construction. The ceiling is considered to be part of the floor assembly.
	+ Roof—Designed to protect the inside of the building from the weather. Roofs are constructed in three primary designs: pitched, curved, and flat. The major components of a roof assembly are the supporting structure, the roof deck, and the roof covering.
	+ Trusses—A structural component composed of smaller pieces joined to form a triangular configuration or a system of triangles. Trusses are used as support systems for both floors and roofs. The strength of a truss depends on its members as well as the connections between them. The types of trusses include parallel chord truss, pitched chord truss, and bowstring truss. Depending on their construction, trusses may fail when exposed to heat and fire.
	+ Walls—Either load bearing or non-bearing. Loadbearing walls provide structural support. Non-bearing walls support only their own weight.
	+ Doors—Typically constructed of either wood or metal. Hollow-core wood doors are often used inside buildings and can be easily opened. Metal doors are more durable and fire resistant.
	+ Windows—Used frequently by fire fighters as entry points to attack a fire and as emergency exits.
	+ Interior finishes and floor coverings—The exposed interior surfaces of a building. Different interior finish materials contribute in various ways to a structure fire; for example, plastics emit toxic gases when they burn.
* Buildings under construction or demolition often lack fire protection features and present additional hazards to fire fighters.
* The preincident plan should contain information on the type of building construction present in a given structure.