LESSON 1: TYPES OF FRAMES AND FLOOR FRAMING

INTRODUCTION

As a home remodeler, you must have a solid understanding of home framing systems. After all, your work will often involve some type of modification to an existing frame, and there are several frame types. Approximately 85 percent of the homes in North America are of lightwood construction, as opposed to heavy timber or solid masonry. The two most common lightwood framing systems are balloon and platform frames. Since these two frames represent quite different styles and finishes, you must use different methods to modify each type. You'll probably encounter situations in which old and new lumber must be integrated, so it's important to understand the changes that affected framing lumber over time.

SECTION 1.1: STRUCTURAL SYSTEMS

Read the following section. Then read Chapter 14 in your Carpentry textbook.

> ***Objective***
>
> When you complete this section, you'll be able to explain the differences between structural systems in regards to framing.

This section outlines basic structural considerations of wood framing. You'll also learn some history about wood framing and how the industry got to the point it is today.

Early carpenters in the United States used a technique to build houses called *balloon framing*. The first balloon-style houses appeared in the 1830s and remained standard until the early 1920s. Back then, lumber was abundant and inexpensive. To meet the swiftly growing demand for housing, rough cut lumber was often transported immediately from mills temporarily set up in forests to construction sites in towns and cities. Soon, however, indiscriminate logging thinned the forests nearly to the point of extinction. Builders, too, began to realize that framing members of uniform size were easier to use than members of unpredictable dimensions that had simply been cut from the tallest trees available.

Innovators in the lumber industry began to explore options for standardizing the dimensions of framing members.

Although the typical *lath-and-plaster type finish* (sometimes called *wetwall*) was able to make up for many deviations in the surface of rough studs, less flexible types of exterior siding required painstaking shimming and planing. In addition, to install a level floor, every joist would need to be planed.

Eventually, carpenters came to see that it was more efficient to plane the edges of lumber in the mills.

The switch from planing lumber on jobsites to mills is why we still call 2×4s, 2×4s and not 1.5×3.5s. Originally, 2×4s were milled to be 2" thick and 4" wide—although they suffered minor variations from rough cutting. As the need to plane the 2×4s became clearer, the lumber industry agreed to keep the rough dimensions and surface each piece on two edges only. This new product, called an edge-planed 2×4, spared the lumber companies from the expensive task of having to replace all their equipment. However, after the planing process, the 2×4s were now 1.5×3.5s. This is what we now call nominal dimensions and net dimensions. Nominal dimensions are commonly used to describe a lumber product, such as 2×4 or 2×8. The net dimensions are the actual measurements of the pieces. Today's framing lumber is surfaced on all four sides (S4S) to make handling and cutting even easier.

Balloon frames are distinguished from modern platform frames by long studs, which run continuously from the sill to the second- or third-story plate. Floors and internal walls were added only after the entire shell had been framed. A girder held up by posts and piers typically supported the joists near the center of the house. External wall joists were nailed to the studs. In most balloon frame houses, the joists were supported by a structure known as a let-in ribbon.

Some of the earliest frames, however, either didn't let the ribbons in or omitted them entirely. Joists were simply nailed to the studs, so the entire floor and all of the internal walls bearing on it were supported by a handful of nails.

> This practice resulted in poor structural strength and to this day makes firefighters' jobs even more dangerous when a balloon frame catches on fire. Read Fighting Fires in Balloon-Frame Construction.

In many older balloon-frame houses, the floor joists were over-spanned; in other words, they used structurally insufficient joists. As a result, floors began to sag in the center or pull away from exterior wall supports. In older houses, it's common to see floor joists framed with 2×10s or even 2×8s, compared with 2×12s in most modern houses.

On balloon frame houses, carpenters typically decided the size, spacing, and connections between the framing members on site. If the carpenter decided that a certain section of wall required six supports, workers would simply space all six evenly with no concern about the actual distance between them. Such distinctive frames may have been compatible with lathe and plaster, but they don't work well with drywall panels.

If you're building an addition to a balloon frame house, you must be sure to examine the structure carefully. Before going ahead with a project like this, you'll also need to consult with city planners and likely hire a structural engineer. The engineer will determine how much you need to strengthen the frame.

When forests began to thin out and the trees needed for balloon framing members were no longer available, the contemporary platform frame was developed. *Platform frames* are characterized by shorter, cheaper studs but also have structural advantages. Over time, platform frame's lower costs, better performance, and more flexible application helped make them a standard practice.

Self-Check 1.1

At the end of each section of *Floor, Wall, and Stair Framing*, you'll be asked to pause and check your understanding of what you've just read by completing a Self-Check exercise. Answering these questions will help you review what you've studied so far. Please complete "Self-Check 1.1" now.

Fill in the blanks.

1. Balloon style houses first appeared in the year _____.
2. The switch from planing lumber _____ to _____ is why we still use nominal and net dimensions when describing lumber.
3. Before renovating a balloon style house, you'll likely need to consult a/an _____.

Respond to the following based on your reading:

4. Why were such tall studs used to frame houses?
5. Why is modern framing lumber typically surfaced on all four sides (S4S)?

(Continued)

Self-Check 1.1

6. What are the two common problems with the floors in a balloon frame house?

7. Why is it challenging during a renovation to install drywall on a balloon frame house?

8. What change led to the adoption of platform frame houses?

Check your answers with those in the back of this study guide.

SECTION 1.2: FLOOR FRAMING

Read the following section. Then read Chapter 15 in your Carpentry textbook.

> ***Objective***
>
> When you complete this section, you'll be able to describe the differences in floor framing systems.

After the foundation, the floor frame is usually the first major component of a building to be assembled. The exception to this rule is slab-on-grade construction, which is used in warmer climates that don't require below-grade basements and don't require a subfloor. In this chapter, you'll learn how to estimate, lay out, and assemble a floor frame using the platform method of framing, which is the most widely used framing method today. You'll learn about joists and girders. *Joists* are the main framing members that make up the floor and girders are used for extra support on larger spans.

Foundation sills are often called mud sills because in older homes they were often set on the foundation wall in a bed of mortar. Sill wood is selected to be structurally sound and resistant to both decay and insect infestation. Douglas fir and yellow pine are two commonly used wood types.

In older buildings, sills often vary in size but most are 2″ by 6″ or 3″ by 6″. Basement windows are typically fitted with heavier 4″ by 6″ sills, sometimes made up of two parts connected with staggered joints. The upper part is nailed to the lower part, with the sills overlapping at the corners. In cases where the sill is comprised of a single member, adjoining pieces are toenailed or spliced together. In modern construction, the sill is usually a 2×4 or 2×6 and is often pressure-treated to counter the effects of contact with moisture. In many cases, acoustical caulking or moisture barriers are installed between the sill and the foundation.

For many years now, joist-framing techniques have remained the same. Lumber for joists is chosen to meet the load requirements. One of the most important considerations is stiffness, which will limit vibrations caused by moving loads. A floor can be structurally sound but a lack of stiffness causes sound, a source of annoyance to occupants. An appropriate degree of stiffness will also minimize cracking in both plaster and drywall finishes.

The nominal dimensions of wooden floor joists are usually 2″ in thickness and either 6, 8, 10, or 12″ in depth. The size depends on the load, length of span, spacing between joists, and species and grade of lumber used.

Joists are normally installed at distances of 16″, calculated from center to center. In general, 2×6 joists are too small for any application but ceilings. However, to save materials, advanced framing techniques are being used on some projects that don't follow a typical placement pattern. In many of these cases, the floors are built off-site or used in premanufactured homes. The general principle takes advantage of the fact that different parts of the floor require more strength than others to achieve the same performance. Advantages of using less material for framing include lower cost, lower weight of the structure, and better insulating properties.

Lumber selection and proper usage is a key factor when building floors. It's important to place joists crown side up. A bow will normally straighten under the weight of the subfloor and floor loads. From a structural load perspective, the bottom side of the joist carries most of the load, therefore knots should also be laid facing upwards. To overcome any variation in the depths of the joists, and to bring the tops of the joists to the same level, you may need to size or notch the joists where they rest on the sill. To keep the lumber from splitting, avoid cutting any notches that are deeper than one-sixth of the depth of the actual joist.

In addition to overcoming the force of gravity, frames need to resist other forces like wind. This is one the reasons that sill plates should be bolted to the foundation. In general, ½″ bolts are used, spaced approximately 4′ OC, with the threaded ends projecting above the foundation. You may encounter situations in which the top of the foundation isn't exactly level, in which case you may need to use shims to adjust the sill. After leveling the sill, you can fill the space between the bottom of the sill and the top of the foundation wall, with pieces of slate set in mortar. Make sure that the spaces are filled, so that the sill bears on the wall at all points. If the top of the sill is a fraction of an inch too high, you may need to trim the bottom. In any case, the upper surface of the sill must be level and true before you can install the upper framework.

Self-Check 1.2

Fill in the blanks.

1. Joists are the _____ framing members and girders are used for _____ over longer spans.

2. Sill plates should be _____ to the foundation to help resist _____ forces.

Respond to the following based on your reading.

3. What's a slab-on-grade floor?

4. Why is pressure-treated lumber used for sill plates?

5. Why are joists sometimes used that are structurally stronger than required to carry expected floor loads?

6. What are the main advantages of advanced framing techniques?

7. Why should joist's crowns be placed up?

8. Why do sill plates need to be set level?

Check your answers with those in the back of this study guide.