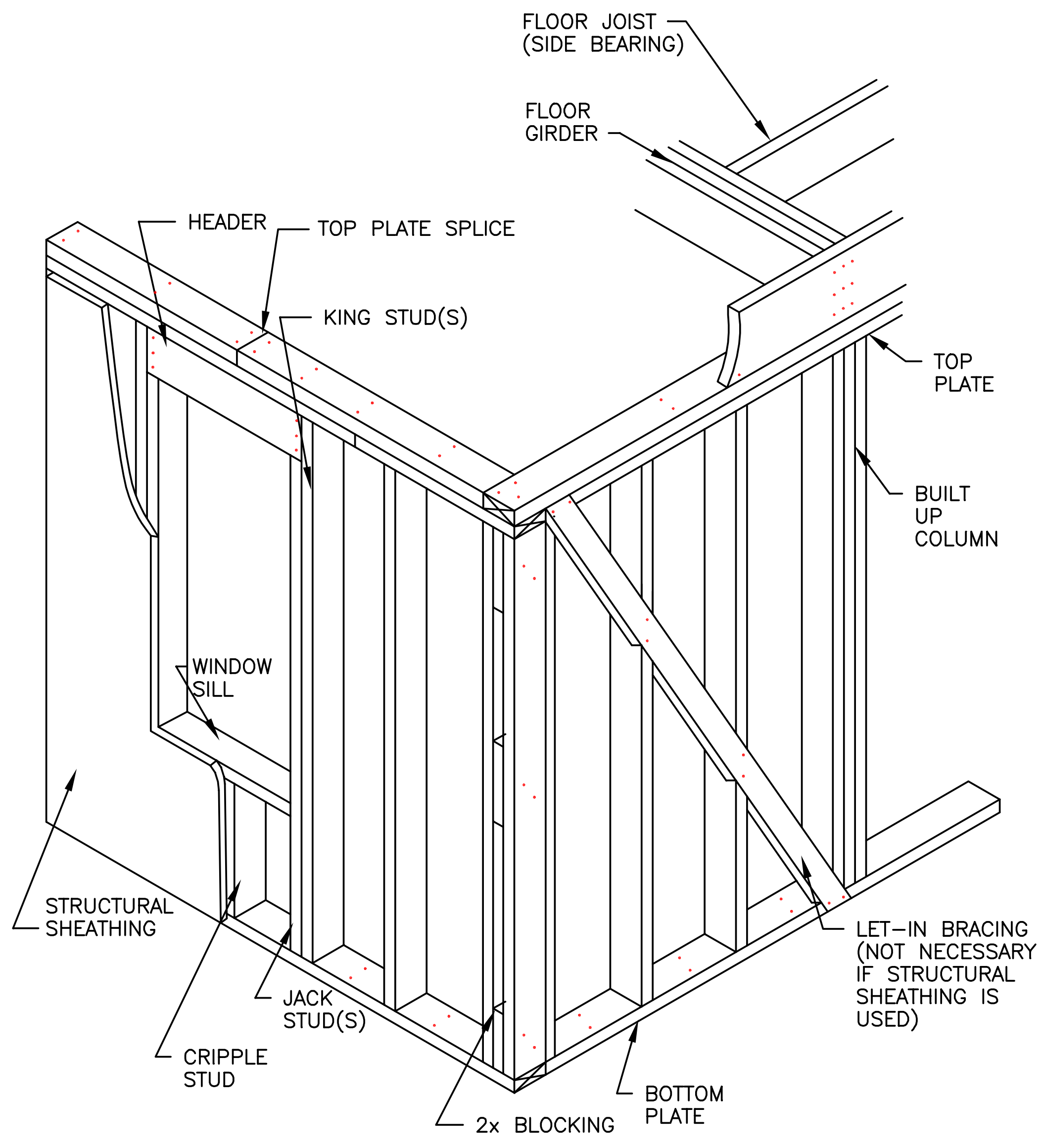
FIGURE 5.5 ***Structural Elements of the Wall System***



Structural wall sheathing, such as plywood or oriented strand board, distributes lateral loads to the wall framing and provides lateral support to both the wall studs (i.e., buckling resistance) and the entire building (i.e., racking resistance). Interior wall finishes also provide significant support to the wall studs and the structure. In low-wind and low-hazard seismic areas, metal 'T' braces or wood let-in braces may be used in place of wall sheathing to provide resistance to lateral (i.e., racking) loads. About 50 percent of new homes constructed each year now use wood structural panel braces, and many of those homes are fully-sheathed with wood structural panels. These bracing methods are substantially stronger than the let-in brace approach; refer to Chapter 6 for greater detail on the design of wall bracing. Wood let-in braces are typically 1x4 wood members that are "let-in" or notched into the studs and nailed diagonally across wall sections at corners and specified intervals. Their use is generally through application of conventional construction provisions found in most building codes for residential construction in combination with interior and exterior claddings.

The design procedure discussed herein addresses dimension lumber wall systems according to the *National Design Specification for Wood Construction* (NDS). Where appropriate, modifications to the NDS have been incorporated and are noted. Standard design equations and design checks for the NDS procedure were presented earlier in this chapter. The detailed design examples in this section illustrate the application of the equations by tailoring them to the design of the elements that make up residential wall systems.

Wall systems are designed to withstand dead and live gravity loads acting parallel to the wall stud length, as well as lateral loads–primarily wind and earthquake loads–acting perpendicular to the face of the wall. Wind also induces uplift loads on the roof; when the wind load is sufficient to offset dead loads, walls and internal connections must be designed to resist tension or uplift forces. The outcome of the design of wall elements depends on the degree to which the designer uses the "system strength" inherent in the construction. To the extent possible, guidance on system design in this section uses the NDS and the recommendations in Sections 5.2 and 5.3.

When designing wall elements, the designer needs to consider the load combinations discussed in Chapter 3, particularly the following ASD combinations of dead, live, snow, and wind loads:

- $D + L + 0.3 (L_r \text{ or } S)$
- $D + (L_r \text{ or } S) + 0.3 L$
- $D + W$
- $D + 0.7E + 0.5L + 0.2S$

A wall system may support a roof only or a roof and one or more stories above. The roof may or may not include an attic storage live load. A 10 psf attic live load used for the design of ceiling joists is intended primarily to provide safe access to the attic, not storage. The controlling load combination for a wall that supports only a roof is the second load combination listed above. If the attic is not intended for storage, the value for L should be 0. The controlling load combination for a wall that supports a floor, wall, and a roof should be either the first or second load combination depending on the relative magnitude of floor and roof snow loads.

The third load combination provides a check for the out-of-plane bending condition due to lateral wind loads on the wall. For tall wood-frame walls that support heavy claddings such as brick veneer, the designer should also consider out-of-plane bending loads resulting from an earthquake load combination, although the other load combinations above usually control the design. The third