

Technical Bulletin #160614

Building Settlement and Wood Frame Construction

An Appealing Cost Effective Alternative?

Despite the growing number of wood-frame buildings, some people in the industry are still surprised to learn that wood can be used to build anything higher than a four-story structure.

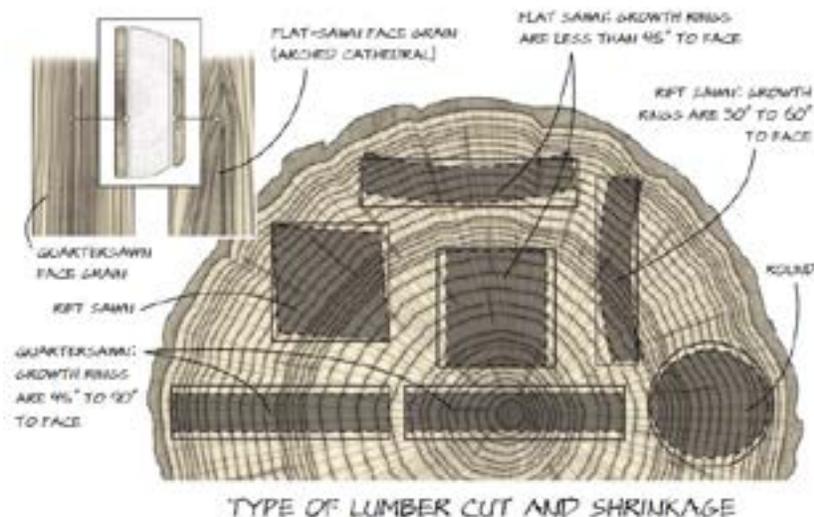
The International Building Code (IBC) allows wood-frame construction for five stories and more by meeting Type III-A construction requirements; Type V-A construction can be used in the Pacific Northwest. Type IV construction, also known as heavy timber construction, can also be used.

The most appealing feature of wood-frame construction is cost. Wood works well for multi-story projects because it offers a high percentage of rentable square footage at a relatively low cost. However, there are many variables that the designers and builders acknowledge are a challenge. Of these challenges, none are more discussed than the settling of the wood frame through shrinkage and differential movement. Because wood is a natural material, considerations for shrinkage are crucial, especially in a multi-story application. But before you can account for shrinkage, you must first understand it.

Shrinkage and Differential Movement: A Growing Problem

The dimensional changes that accompany the shrinking and swelling of wood are major sources of both visual and structural problems in wood frame construction. Shrinking occurs as the moisture content in the wood responds to daily as well as seasonal changes in the relative humidity of the atmosphere, i.e., when the air is humid, wood adsorbs moisture and swells; when the air is dry, wood loses moisture and shrinks.

Differential movement, on the other hand, occurs in different parts of the structure as a result of different cross grain wood elements. The image below illustrates this complexity.



**image courtesy of popularwoodworking.com*

How Does This Affect Plumbing Systems?

When the weight of a wood frame building settles, this weight is often transferred to plastic fittings and horizontal plastic pipe. Damage to the piping system may result.

With an escalation in the construction of multi-level wood frame construction, Charlotte Pipe has seen damaged fittings due to settling of these structures through shrinkage and differential movement.

The pipe and fittings depicted in figures 1-3 are not examples of product defects, but rather the effects of building settlement and/or shrinkage of multi-story wood frame construction and the forces that are being applied to the plastic plumbing systems.

Note:

With the movement of the structure, it is also possible for fire stop materials to be pushed out of the annular space in a fire rated separation. The result of this effect compromises the integrity of the fire rated separation and is a life safety hazard for building occupants.

The Changing Landscape of Construction

This is of concern to designers and builders across the country and is the topic of many publications. The prevailing code bodies have worked to address this issue. The International Building Code now addresses shrinkage:

IBC 2303.3.3

“Shrinkage Wood walls and bearing partitions shall not support more than two floors and a roof unless an analysis satisfactory to the building official shows that shrinkage of the wood framing will not have adverse effects in the structure or any plumbing, electrical or mechanical systems, or other equipment installed therein due to excessive shrinkage or differential movements caused by shrinkage.”

Still Considering Wood Framing?

Design for structural shrinkage must be addressed in the system design by the engineer of record or the installing contractor. Design considerations are similar, but not identical to, compensation for thermal expansion and contraction of piping systems. Compensation for expansion, contraction or building settling is often accommodated by the use of offsets or expansion joints.

See the Charlotte Pipe and Foundry Plastics Technical and Installation Manual available at www.charlottepipe.com for additional information.



Figure 1



Figure 2



Figure 3

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