Costs to Build with Cold-Formed Steel Versus a Wood-Framed Building

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Abstract

SFIA has conducted studies of construction costs in two different locations using two identical buildings – one designed with wood and the other with CFS framing. The Chicago case, where we examined only hard construction costs, shows a cost increase of 2.61% for CFS over wood. When the cost of insurance during the construction phase was included in the New Jersey building, the cost difference dropped to less than 1%.

Combustible Construction in Buildings/Project Purpose

Light Wood Frame $6,401,779

CFS Frame $6,460,696

Difference: 0.92%

In the early to mid-1990s, the cold-formed steel (CFS) industry pushed aggressively to bring steel framing into the mainstream single-family housing market. Despite some small inroads into home construction, as we neared the middle of the 2000s, CFS was experiencing more sustained growth as a cost-effective material for load-bearing frames in mid-rise buildings. The four to seven story market, especially in residential occupancies, was suddenly viewed as a market opportunity for CFS as the main structural and partition framing material.

Other material interests also viewed mid-rise buildings as an opportunity. The concrete industry is of course interested in maintaining its relatively strong position in the four-story and taller buildings market, not too different than the position of steel product manufacturers. The wood industry viewed mid-rise buildings as a potential growth market, but their growth was limited by allowable building height and area restrictions in most building codes. That began to change in the late 1990s and early 2000s as the older legacy code publishers throughout the country merged into a single code organization and the International Building Code (IBC) came on the scene.

Without getting into a detailed explanation of a long but effective campaign to relax historic code requirements, the IBC no longer has strict prohibitions on combustible construction in buildings above three stories in height. It now allows combustible wood-based framing in buildings that cover most of the typical range of the 4 to 7 story mid-rise market.

Further, an argument has surfaced and resurfaced during nearly every code development process in the past decade over the cost of a building with different materials. The wood industry claims a wide cost advantage over other materials, even in taller buildings. Concrete industry representatives disagree agree that a large cost difference exists and have produced stud-

Figure 1. Our comparative cost study of framing a 5-story, 49,900 SF mixed-use apartment building includes the cost of construction insurance.

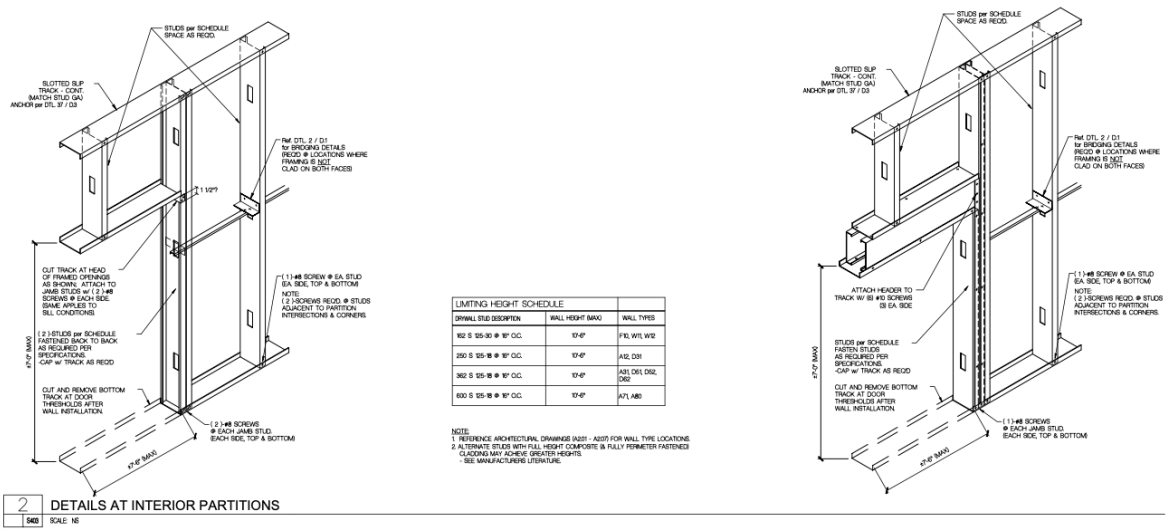

Figure 2.
Details at interior partitions

ies that show some types of concrete buildings cost less than a comparable wood building.

The CFS industry position is that the costs are not that different in mid-rise buildings between steel and wood when all costs for an entire building are considered. When wood industry advocates isolate costs comparing just materials, it tends to exaggerate the impact of the material selection. In reality, costs of specific materials may not be significant in terms of what an owner pays for the entire completed building.

This study examines the cost of two otherwise identical buildings with the exception being one was designed with wood and the other with CFS framing. It represents a first step to address all initial and long-term costs that go into a building versus just the initial material costs often debated. It specifically addresses the impact of insurance costs during the construction phase. It does not address the merits of taller wood buildings from a fire safety perspective.

Methodology

Cost comparisons between building materials are always a challenge. Supply and demand are constantly changing, labor shortages come and go and don't always affect all materials equally, costs vary geographically, and the economy is never static. A comparison today may not be accurate six months down the road. Readers should not use a cost study such as this one to bid or make any commitments on a specific job. However, one can find a general range of costs that gives insight into relative costs of building with various methods or materials, assuming there are no extreme economic changes that impact either material vastly different than the others.

In addition to the variable nature of costs, there is no one universally recognized method for comparing costs of materials, sometimes leading to vastly different results. For example, a manufacturer may be interested in material price differences only while the total cost of the building may be more important to an owner or general contractor. A building owner may also be interested in the costs over a life cycle that includes cash flow and operating costs. We initially looked at the hard costs of a building as the first step in this study. We then expanded on that to include the cost of insurance that the general contractor and/or owner would need to secure during construction. In the future, we plan to address operational long-term costs and cash flow due to different construction cycles associated with various materials.

This study is limited to a comparison of the costs between two buildings that only differed in their structural framing material. The structural and nonstructural framing in the floors, walls, and roof were designed using CFS in one building and with wood in the other. The general contractor's costs were the basis for the comparison (i.e., cost to the owner and not the sales price). The building was eventually built in Chicago although costs will be examined in different locations around the country where the same building could be constructed with little or no design changes.

Building Description

The mixed-use building is representative of many residential buildings constructed in the mid-rise

market today and includes:

· A first floor with parking and retail space
· Residential dwellings on levels 2-5
· Roof-top/penthouse space atop level 5 housing building services.

The whole building square footage floor area is approximately 49,900. The building was originally designed with wood framing over a first story non-combustible (concrete) podium. Podium construction allows for taller buildings with combustible construction under relatively new allowances in the IBC. The building was then redesigned with CFS framing. The designs were by Antunovich Associates of Chicago and Matsen Ford Design (Now RA Smith) for the structures.

2017 Chicago Cost Comparisons

In-place construction costs were determined separately for the total building and the framing for both wood and CFS for the Chicago location See Table 1. Cost were reflective of the end of 2017. The costs are based on pricing from All-Steel Midrise of Richfield, OH for the CFS version, and TK Architectural Design Services, LLC of Milwaukee for the wood framing.

The whole building costs were $6,420,000 for the CFS package and $6,257,000 for the wood package. In terms of whole building composite unit costs, this equates to about $128.65/sq.ft. for the CFS version, and $125.40/sf.ft. for the wood version. Both numbers are exclusive of land costs, insurance differences, or costs to the community.

When considering the framing only, the wood and CFS costs were $21.90/sq.ft and $26.50/sq.ft, respectively. The framing thus represents about 20% of the total building cost in each case. The framing included all bearing wall, floor and roof framing members above the podium (2nd through 5th story); 0.6C metal decking with 1-1/2" LWGC at floors 3 through 5, and 1-1/2" B roof deck for the CFS option; ¾" plywood deck for the wood option, with ¾" gypcrete at the upper floors; and all 5/8" exterior sheathing and all interior non-bearing partition framing for both buildings. Interior drywall, ceiling, and finish work were not included in the framing-only costs.

2019 New Jersey Comparison With Insurance Impacts

A theoretical location in Morristown, New Jersey was selected for the initial insurance cost impact study. This location was selected in response to a need for cost information related to ongoing legislative deliberations in New Jersey. The Chicago building numbers were adjusted to account for geographical differences and to bring them to mid-2019 equivalent costs, using RS Means location factors and the US Consumer Price Index. These adjustments turned out to be insignificant in terms of their overall impact but may be more important if the study is expanded to other locations in the future.

When considering Insurance, it is important to note that building material selection not only affects the cost of premiums but also can determine maximum coverage limits or whether a building is insurable at all. According to Constructive Risks, a California-based Insurance risk consulting firm, underwriters may consider certain types of buildings or even contractors with a poor loss history as undesirable risks and thus push the contractor to a an expensive secondary market (often called E&S or Extras and Surplus) for their insurance. In other cases, an upper limit on the coverage for certain building types with combustible construction may force the owner or contractor to purchase multiple policies to have adequate coverage. The risk and thus costs of premiums are generally lower with non-combustible construction. The same applies for a contractor and/or owner with a good loss history.

For the New Jersey location, the impact of the general contractor's General Liability (GL) and Builders Risk (BR) policies was considered. The costs were provided by major insurance companies active in New Jersey. The impact of premium costs was determined by first adjusting the Chicago building costs for geographical location and the time lapse between the end of 2017 when the Chicago location costs were obtained and

Table 1. Chicago Construction Costs.

	Chicago Total Building Cost Summary
Total building cost w/wood framing	$6,257,000
Total building cost w/ CFS framing	$6,420,000
Difference in $ (CFS over wood)	$163,000
Difference in $ (CFS over wood)	2.61%
Difference in $/sq.ft. (CFS over wood)	$3.27
Source: R.A. Smith	

	New Jeresey Total Building Cost Summary	Total Building Cost with lower BR and GL Premiums for CFS
Wood framing	$6,401,779	6,401,779
CFS framing	$6,568,551	$6,460,696
Difference in $ (CFS over wood	$166,772	$58,917
Difference in $ (CFS over wood)	2.61%	0.92%
Source: R.A. Smith		

Table 2. New Jersey Cost Comparison Costs in New Jersey for a Wood Versus CFS building, Including the Impact of Construction-Phase Insurance Premiums.

the July-August 2019 timeframe when the insurance costs in New jersey were obtained. The insurance costs were then converted to a cost per square foot and evaluated in terms of their impact on the overall building costs.

Note that the location in New Jersey shares the same basic seismic, wind, and climate zone design criteria as Chicago. This location selection was intentional so that it would be reasonable to expect the same building designs would be acceptable in either location. If in the future the study is expanded to other locations, it may be necessary to redesign the building if there are significant differences in the design criteria.

Conclusions/Discussion

It is important to understand what any cost numbers represent. What seems like a significant difference in the cost between two materials when looking at just the framing doesn't necessarily translate into a significant difference when the total cost of a building is considered. For example, the framing-only costs difference between CFS and wood of $4.60/sq.ft. or 21% may seem significant in isolation. However, this method can be misleading if the real question is how much the general contractor, owner, or tenants will be affected. Further, from a public policy perspective relative to affordability of housing, the cost impact on the total building is most important. The Chicago case where we examined only hard construction costs shows a cost increase of 2.61% for CFS over wood. When the cost of insurance during the construction phase was included in the New Jersey building, the cost difference dropped to less than 1%.

One could argue that a 1% difference is noise given the variability of wood framing costs over time. Other decisions such as the choice of exterior or interior finishes could have a greater impact than the choice between these two framing materials. Further, there are some mitigating costs not included in this study that could lead to the CFS building dropping to a cost less than the wood building, especially over the long-term. These include the cost of insurance products such as property and general liability necessary during the operation of a building, as well as lower call back and maintenance costs. Costs for wood also tend to increase with major disruptions in supply, such as after a hurricane. Steel prices, on the other hand, have been historically more stable.

We should also point out that this study was reliant on finding a willing general contractor who already had a representative building in the pipeline. The CFS building could have been constructed without the concrete podium (100% CFS for all stories) since it is a noncombustible material, further reducing the cost of the CFS option. However, we chose to include a podium in both buildings for several reasons, including to keep the buildings as identical as possible and the financial limitations on asking the contractor and owner to redesign their building.

In addition, insurance estimates obtained for this study assume the general contractor is a good risk and the building itself is not considered high risk. If a standard insurer won't write a policy, E&S or Extra and Surplus underwriters are the only option. E&S is like a secondary market for high risk projects or contractors. Most E&S providers are not familiar with construction types and design or material impacts

Last there are safety benefits to combustible construction that are not part of this study. Owners, contractors, designers, and those who develop public policy should consider fire safety both during and after construction in their decision-making.

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