




## Cold-Formed Steel Trusses: Design, Performance, and Advantages

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# Table of Contents

**INTRODUCTION** **1**

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**Cold-formed steel trusses at a glance** **2**

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**Why multi-family and mid-rise projects benefit from CFS trusses** **3**

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**How CFS trusses help solve complex challenges and support design flexibility** **5**

---

**How CFS truss systems deliver on performance and lifecycle savings** **7**

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**Streamlined projects for success, safety, and savings** **9**



Cold-formed steel (CFS) trusses are among the most efficient systems in mid-rise and multi-family construction. Through the lifecycle of a project, they provide architects, developers, and contractors with many advantages over other framing systems. And, in a highly competitive marketplace, CFS trusses provide property owners cost-effective ways to differentiate their projects, deliver value, and meet market demand.

The key to successful project outcomes is in the specification, design, and sourcing of CFS trusses to align with project goals and stakeholder expectations.



In this eBook, we will explore:

1. Why multi-family and mid-rise projects benefit from CFS trusses
2. How CFS trusses help solve complex challenges and support design flexibility
3. How CFS truss systems deliver on performance and lifecycle savings

## Cold-formed steel trusses at a glance

**CFS trusses, including those made of proprietary shapes and C-studs, are made of light-gauge steel forms.** They are pre-engineered with the help of software programs, and can be customized into roof shapes and layouts for a variety of applications. They can also be prefabricated, which can reduce on-site labor and construction timelines.

The process is streamlined through proprietary estimating, design, and detailing software that is developed by CFS truss engineering and manufacturing companies. In turn, the programs are leased to truss manufacturers, who then design and manufacture the final truss product.

Compared to conventional framing systems, CFS trusses offer significant advantages for architects, developers, and contractors/builders.

### ARCHITECTS AND DEVELOPERS

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- Savings in design costs and better project control
- Faster shell completion time, enabling faster interior buildout
- Smaller-dimension trusses in lieu of beams and columns
- Flexibility in spatial layout and location of infrastructure elements
- Increased durability and resiliency because CFS is noncombustible

### CONTRACTORS AND BUILDERS

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- Pre-designed, pre-engineered truss system
- Reduced installation time due to fewer pieces and lighter weight
- Easier, streamlined installation with reduced waste
- Resilient to termite damage and dry rot
- Components are customized and exact, without inconsistencies such as knots





# 1. CFS trusses provide benefits and savings for mid-rise and multi-family projects

**Mid-rise and multi-family structures come with unique challenges and considerations.** They are high-traffic, high-usage, and often, high-turnover environments. They are more prone to wear and tear, so they need to be durable, comfortable, and visually appealing to attract and retain tenants while remaining profitable for owners.

**Designed to meet strict codes and standards, CFS trusses address these considerations, outperforming alternative materials on many critical fronts. CFS trusses are:**

-  **LIGHTWEIGHT**
-  **CAPABLE OF LONG-SPANS**
-  **UNLIMITED IN CONFIGURATION**
-  **NONCOMBUSTIBLE**
-  **DIMENSIONALLY STABLE**
-  **ROT-PROOF AND MOISTURE-RESISTANT**
-  **IMPERVIOUS TO INFESTATION**

The weight of the framing is a key factor in the construction of multi-story buildings. CFS trusses and framing impart a lighter dead load on buildings than other traditional construction materials. CFS trusses can also contribute to larger floor areas and taller buildings because of the material's light weight, which puts less stress on the overall structure and its foundation.

Project time can be further reduced with prefabrication. CFS trusses can be manufactured in plants or fabricated on site to help reduce shipping costs. The installation team can then simply install the trusses on the structure. Prefabrication, in turn, reduces on-site labor costs and material waste. Trusses are made to order rather than templated. They are designed and fabricated specifically for the application. What you get at the job site is what you use.

CFS truss roof or floor systems can also be assembled on the ground and lifted onto the structure (called "rafting"), which saves time for the installer and can lead to reduced workers' compensation insurance rates. Installation is completed with typical carpentry skills using widely available standard screw guns, levels, cutting, and other tools, which helps keep labor costs down. With the precision of design and fabrication and the quality of CFS truss material, call backs are received very infrequently, if at all.<sup>1</sup>

Altogether, these labor savings contribute to more efficient construction, resulting in faster completion and occupancy than with alternative framing materials. With faster occupancy comes expedited revenue generation from rent, sales, or business transactions.

## Misconceptions vs. realities of CFS truss systems

Some professionals in the building industries may still have some questions about the suitability of CFS trusses due to limited knowledge of the material. Despite some lingering myths, CFS trusses outperform wood trusses on many fronts:

### MYTH #1: THEY REQUIRE A SPECIALIZED LABOR FORCE

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As with wood trusses, installing CFS trusses requires only general carpentry skills. You don't need ironworkers unless connections call for welding. But if you're welding for connection, then there's a lot of force, so wood would likely not be up to the task.

### MYTH #2: THEY ARE TOO NOISY

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In sound transmission ratings tests, CFS trusses "pass with flying colors." Transmission is more likely through the building's cladding than through the truss itself.

### MYTH #3: THEY SHIFT AND MOVE TOO MUCH

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The coefficient of expansion for steel is very small — approximately  $6.5 \times 10^{-6}$  in/inF°. For example, expansion is only half an inch for a 50-foot truss with temperature range of 120 degrees Fahrenheit. So, any fluctuations are small and are readily accounted for in a building's design.

### MYTH #4: THEY ARE TOO COSTLY AND COMPLICATED

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CFS engineers mitigate complexity for project architects and engineers, enabling a streamlined and straightforward process from bid to delivery. CFS engineers use state of the art software to design efficient, cost-effective truss systems for the most complex roof geometries, resulting in precise systems that are easy to assemble with little to no waste. This allows for reduced construction cycle time, faster building occupancy, and lower overall cost. CFS trusses are noncombustible and have been tested for two-hour fire protection, which protects property and lowers insurance premiums.



## 2. CFS trusses solve complex challenges while supporting creative design

**When architects specify roof framing for a project, they have an array of options to choose from.**

However, for multi-story and multi-family construction, particularly in cases of sloped roofs and challenging conditions, choices become limited. And while there is market demand for sloped roofs, there's also demand for architects to do more economically.

CFS trusses have advantages over alternative framing materials in addressing complicated roof architecture where there are angles, ridges, multiple roof planes, cantilevers and overhangs, and much more.

**They can create an unlimited variety of roof profiles, from the more familiar to the exotic:**

- Pitched roofs
- Flat roofs
- Hip roofs
- Gables and gambrels
- Cantilevers and overhangs
- Vaulted ceilings
- Curved roofs and barrel vaults

**Shown here are just a couple of truss configurations that can be achieved with CFS.**



Photos courtesy of Steel Framing Industry Association and Super Stud Building Products, Inc.



**Trusses are versatile and efficient framing components** – available in an almost infinite combination of profiles, depths, and internal web patterns, depending upon the required building geometry and loads.

Mid-rise and multi-story structures may look simple, but there are bearing issues and rooflines that get complicated. CFS systems help resolve these complexities because the geometry can be modelled and the trusses designed with software and then the components can be prefabricated to precision.

Trusses are versatile and efficient framing components. They are available in an almost infinite combination of profiles, depths, and internal web patterns, depending upon the required building geometry and loads. The great efficiency of trusses comes as the result of the custom design of every truss for its location, loading, bearing conditions, and application.

CFS trusses are prefabricated in a facility or on-site using quality control procedures, so the final product is more precise than “stick framing.” This translates to all like trusses being the same in length, slope, web placement, and other truss details.

CFS truss systems also enable “hybrid” construction (for example, where trusses intersect support systems constructed of other materials) to address a broad range of cost issues and project conditions. Every project presents a combination of materials, and CFS trusses interact with other materials through connections. Truss engineers provide help with those connections to make sure the truss systems integrate seamlessly with other products.

The design flexibility afforded by CFS trusses means that multi-family and mid-rise commercial buildings can have roof lines that respond to and complement the surrounding residential community or retail district. Also, steep pitches and complex roofscapes enabled by CFS trusses have an added benefit: They result in extra spaces within the roof cavity for utility and mechanical functions versus putting those functions in prime areas or on top of the roof. The saved prime areas are a premium for building owners seeking to maximize leasable or accessible space.





### 3. CFS trusses deliver on performance and lifecycle savings

**A building's enclosure — including its roof system — has a big impact on its energy use and expenses, overall safety, and environmental footprint.** Over time, CFS has proven to be more durable, energy efficient, and eco-friendly than alternative materials. This is borne out by a University of Waterloo study that investigated CFS enclosures in commercial buildings compared to alternative enclosure types. After 50 years of monitoring a building in Toronto, Canada, researchers found that CFS enclosures are very competitive compared to other enclosure types in terms of total energy use and greenhouse gas emissions.<sup>2</sup>

There are, of course, more costs involved in a building than just the framing material. Often, if there's a choice between wood and CFS trusses for mid-rise construction, most owners will likely opt for the cheaper alternative. However, they should consider not just the initial cost of the trusses, but also other factors such as fire ratings and insurance, which can offset material costs down the road.

For example, wood trusses might seem cheaper initially, but can actually be costlier because they run a greater risk of being damaged by fire. In fact, *Multi-Housing News* reports that "...the loss history for wood construction has been poor, and carriers are very restrictive of the amount of risk they will take. This drives up the cost to the builder, and weakens the pro-wood argument that it is less expensive than other materials."<sup>3</sup>

Overall, framing and trusses represent approximately 20 percent of the total cost of construction, so any incremental additional initial cost from using CFS trusses is a minimal increase to owners. However, when you factor in the costs resulting from wood shrinkage, rot, infestation, creep deflection, and other maintenance issues, CFS trusses and framing prove beneficial to an owner's bottom line through the entire lifecycle of a building.

CFS trusses reduce callbacks on projects because they start straighter and remain straighter than many other types of trusses. The dimensional stability of steel also reduces drywall fastener pops, which means that interiors need far less maintenance and repairs. This adds up to big savings in multi-family and mid-rise commercial structures, where too frequent repairs become highly disruptive for occupants.

After 50 years of monitoring a building in Toronto, Canada, researchers found that **CFS enclosures are very competitive compared to other enclosure types** in terms of total energy use and greenhouse gas emissions.<sup>2</sup>

## How to source CFS trusses

**One question often arises from the building owner's perspective:  
How do I buy CFS trusses?**

When a project goes out for bid, the contractor may already have a relationship with truss fabricators who manufacture the trusses using proprietary software and CFS engineering support provided by companies including Aegis Metal Framing, TrusSteel, and others.

### SPECIFY

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CFS trusses should be specified as “pre-engineered” and “prefabricated.” Pre-engineered trusses have been fully analyzed and engineered to meet all specified load conditions. Individual truss designs should be sealed by a Professional Engineer who is registered in the state where the project is located. Prefabricated CFS trusses may be fabricated in a shop environment or on the job site with experienced fabrication personnel.

When specifying trusses, you must ensure you're referencing all applicable industry standards within the project specification. You also need to ensure that the specifications and project design drawings clearly define all applicable loads and load conditions, as well as all other performance criteria; applicable codes, building use, geometry, and so forth.

In commercial and multi-story residential construction, CFS roof trusses require engineered truss design drawings stamped and signed by a professional engineer and truss layout plans for building code approval. Panel and truss manufacturers have the resources to provide engineered designs, based on the architectural drawings, along with the manufactured components and jobsite delivery. Some manufacturers further offer builders one-stop solutions that include product installation by trained crews.



Also, some truss fabricators have earned the Truss Fabricator certification by the SFIA which requires companies to demonstrate knowledge and expertise in truss design and fabrication. Visit [SFIAcert.org](https://SFIAcert.org) for more information.

### ORDER

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**The process for ordering CFS truss materials vary depending on the type of construction method you use.**

- Find CFS pre-fab truss manufacturers using the directory in the “Find-A-Member” Section of the Steel Framing Industry Association Web site: [CFSteel.org](https://CFSteel.org).





## Streamlined projects for success, safety, and savings

Mid-rise and multi-family projects are an intricate weave of many parts. It can get complicated and even overwhelming.

The CFS industry has addressed this complexity, making it easy to incorporate these truss systems into complex, multi-tenant, and commercial environments. The industry provides architects, builders, and engineers with resources and support, taking them from bid to punch list and beyond. Owners, in turn, can expect high performance and lower operating and maintenance costs.



Photo courtesy of Steel Framing Industry Association

### SFIA CASE STUDY: TRUSSES IN PARADISE

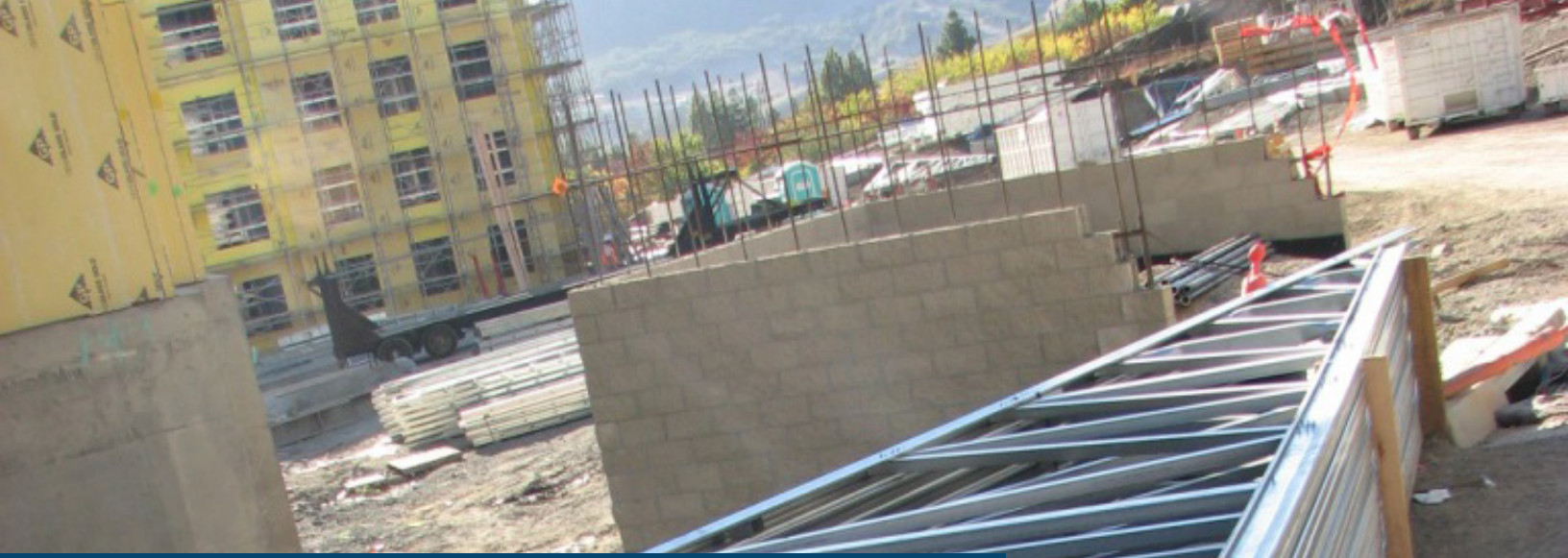
The \$175 million Margaritaville Hollywood Beach Resort is a prime example of how CFS trusses help solve complex problems while supporting design flexibility. This 349-room, 17-story oceanfront resort incorporates trusses creatively to create two signature roofscapes.

The resort bar's unique tiki-style roof design created structural challenges. The solution was found in the CFS U-shaped profile and use of double-shear fasteners, which transferred loads efficiently and reduced the need to install lateral restraints and bracing.

Another truss design — this one evoking a sailboat — is located at the rear the resort's main hotel and cantilevers to partially cover an outdoor poolside dining area. "This was the most difficult truss job I've had in 18 years of business," said Robert Brannon, president and owner of Brannon Specialties, Inc., the Miami-based company that installed the trusses.

Despite the various challenges, the project was a success, with both the truss fabricator and installer meeting their construction deadlines.

Read the [full case study](#) by Steel Framing Industry Association.



If you have an upcoming CFS framed project and need help during the design or planning process, request complimentary assistance from the BuildSteel team of experts. [Request assistance now.](#)

## RESOURCES

[A Life-cycle Assessment of Cold-formed Steel Enclosures Verses Alternative Enclosures in Commercial Buildings](#)

[How Steel Trusses Perform](#)

[A Builder's Guide to Steel Framing](#)

## REFERENCES

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## CREDITS


Bill Babich, TrusSteel director of engineering  
Mike Pellock, P.E. executive vice president, Aegis Metal Framing, a division of MiTek

## About BuildSteel

BuildSteel provides valuable resources, education, and complimentary project assistance related to the use of cold-formed steel framing in low and mid-rise and multi-family construction projects.

As a centralized source for information, BuildSteel offers resources to help move your next cold-formed steel framing project forward efficiently and effectively.

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