



Design Guide for Mid-Rise Cold-Formed Steel Structures

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Introduction

We are pleased you are interested in mid-rise cold formed steel structures from ElevenTen Systems. This design guide is based upon years of experience constructing multi-family and hospitality structures and will provide general guidance to design a building that fulfills all of the owner's requirements.

Cold-formed steel construction offers a uniquely flexible and efficient structural solution for mid-rise buildings where people live in density. At the core of the ElevenTen Systems approach are cold-formed steel bearing walls, which provide a repeatable, non-combustible gravity load path while allowing designers the freedom to select and optimize the most appropriate floor system for a given project. This flexibility distinguishes cold-formed steel from traditional structural steel and concrete frame construction, particularly in **multifamily, student housing, hospitality, and senior living** facilities, where unit repetition, acoustic performance, fire resistance, and speed of construction are critical. While cold-formed steel structures can be engineered beyond twelve residential stories, the most economical and constructible applications typically fall at twelve stories or fewer—generally within the practical limits of a **Type IB** building—before fire-resistance requirements, structural complexity, and cost escalation begin to outweigh the benefits. In this range, cold-formed steel provides a clear advantage: rapid construction, non-combustibility, and a viable path forward when wood framing is no longer permitted or appropriate, yet full concrete or structural steel framing is unnecessary or inefficient.

Cold-Formed Steel Bearing Walls

Cold-formed steel bearing walls are the structural backbone of the ElevenTen Systems approach. Rather than introducing a separate primary structure—such as a concrete frame or structural steel skeleton—the ElevenTen system leverages building elements that already exist in dense residential construction: **interior and exterior partition walls** that occur at regular, repeatable intervals throughout the building.

By engineering these partitions as load-bearing walls, gravity loads are efficiently transferred through a distributed, redundant system that aligns naturally with residential unit layouts. This approach results in a highly economical and constructible structural solution, particularly for buildings where people live in density.

Bearing Wall Strategy and Layout

The placement of bearing walls is driven primarily by two factors:

1. The selected floor system, and
2. The architectural layout of the dwelling units or program spaces

Bearing walls are most commonly aligned with:

- Unit demising walls
- Party walls between adjacent units
- Select corridor walls where required

Because these walls already exist for architectural planning, acoustic separation, and fire-resistance requirements, converting them into load-bearing elements minimizes redundant framing and maximizes structural efficiency.

ElevenTen Systems works directly with the design team to recommend bearing wall layouts tailored to the project's unit mix, span strategy, and overall program, ensuring the structural system supports—rather than dictates—the building layout.

Bearing Wall Strategy and Primary Load Path

ElevenTen's preferred structural approach is to **carry gravity loads through interior bearing walls that run perpendicular to the exterior wall**. This configuration establishes a clear, repeatable load path from floor to floor and distributes gravity loads across multiple interior bearing lines rather than concentrating them at the building perimeter.

This load path strategy offers several key advantages:

- Improved distribution of gravity loads
- Reduced reliance on perimeter slab edge bearing
- Simplified slab and connection detailing
- Increased flexibility in exterior wall and façade design

In this configuration, the majority of exterior walls function as a **semi-load-bearing or non-load-bearing enclosure**, rather than as a primary structural element.

Alternate Bearing Wall Approach and Limitations

In some layouts, it is possible to omit bearing walls perpendicular to the exterior wall and instead rely on:

- The corridor wall, and
- The exterior wall

as the primary gravity load-bearing walls of the building.

While this approach may be viable in select low-rise or special-use conditions, it becomes increasingly problematic as building height increases. In buildings **taller than approximately seven stories**, concentrating gravity loads at the slab edge introduces significant structural and constructability challenges.

Specifically:

- The slab edge must carry and transfer cumulative gravity loads from multiple stories above
- Concrete edge confinement becomes critical to prevent localized crushing, spalling, or failure
- Additional reinforcing, slab thickening, or special confinement detailing is often required
- Reduced flexibility in exterior wall and façade design
 - Glazed curtain walls, window walls, or transparent facades become increasingly difficult

For these reasons, relying on the exterior wall as a primary gravity load-bearing element is generally discouraged for mid-rise cold-formed steel buildings.

Façade Flexibility Advantage

One of the key benefits of utilizing interior bearing walls perpendicular to the exterior wall is that the building does not structurally depend on the exterior wall to remain standing.

This opens the door to significant façade flexibility, including:

- Full-height storefront systems
- Curtain wall or window wall assemblies
- Highly transparent or non-traditional exterior enclosures

By decoupling the gravity load path from the exterior wall, the enclosure can be designed primarily for aesthetics, performance, and constructability—rather than structural necessity.

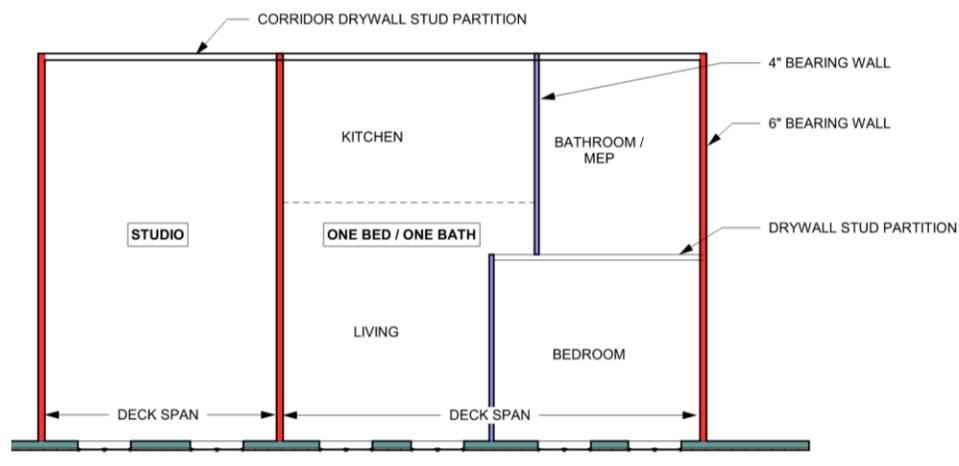


Figure 1 - Schematic Layout of Studio & 1 Bed / 1 Bath

Stud Sizes and Typical Construction

Most load-bearing walls within the ElevenTen system are constructed using:

- **6-inch cold-formed steel studs** – the most common and versatile bearing stud size

- **4-inch cold-formed steel studs** – used where loads and wall heights permit

In select conditions, **8-inch studs** may be utilized, typically where:

- Wall heights exceed approximately **15–16 feet**, or
- Higher axial loads demand additional section capacity

As a General Rule

- Walls should be kept to approximately 10'-0" in height for optimal structural efficiency, constructability, and economy.
- Load-bearing wall heights up to 15 feet are well suited for cold-formed steel framing and can typically be achieved using standard stud sizes without excessive material escalation.
- Wall heights approaching 20 feet require careful structural evaluation and often drive increased stud depth, tighter spacing, or heavier gauge members.
- Wall heights beyond 20 feet are generally outside the practical limits of cold-formed steel bearing wall construction and should be considered only with project-specific engineering, often prompting evaluation of alternate structural strategies.

While **3-5/8" cold-formed steel studs** are commonly used in commercial construction, their application as **load-bearing structural members is not economical** for mid-rise buildings. Due to limitations in section capacity, bearing performance, and compatibility with floor system interfaces, 3-5/8" studs are inefficient for carrying gravity loads in multi-story construction.

For this reason, **ElevenTen Systems does not recommend 3-5/8" studs for load-bearing applications**. Where architectural or coordination constraints would otherwise call for a 3-5/8" stud, ElevenTen Systems will instead provide a **true 4-inch cold-formed steel stud** to ensure adequate structural performance and constructability.

Coordination Note:

Because a true 4-inch stud differs from a nominal 3-5/8" stud, **door and frame suppliers must be made aware of this condition early in design**. The increased stud

depth directly affects **door frame throat depth**, and failure to coordinate this dimension can result in fabrication conflicts or field modifications.

Stud Spacing Strategy

Stud spacing is a critical variable in the performance, constructability, and economy of cold-formed steel bearing walls. ElevenTen Systems typically strives to utilize the **maximum stud spacing permitted**, both to reduce material quantities and to align with common UL-listed fire-resistance assemblies.

Standard Spacing Approach

As a baseline:

- 24 inches on center is the preferred stud spacing and is compatible with the majority of UL fire-rated wall assemblies.
- This spacing provides an efficient balance between structural capacity, fire-resistance compliance, acoustic performance, and material efficiency.

Infinitely Variable Stud Spacing

As building height increases and axial loads accumulate, stud spacing often needs to be reduced to maintain structural capacity. Rather than defaulting to prescriptive spacings such as 16" or 12" on center, ElevenTen Systems utilizes **proprietary software** that evaluates **infinitely variable stud spacing**.

This process works by:

- Evaluating the total wall length, and
- Dividing that length into equalized stud spacing optimized for the applied loads

Resulting stud spacings may be non-standard values such as **10.425 "**, **12.875 "**, or **13.625 " on center**, rather than fixed modular increments.

Benefits of Infinitely Variable Spacing

This approach provides several advantages:

- Structural efficiency - Stud spacing is tuned to nearly maximize the structural capacity of each stud rather than overbuilding the wall.
- Material economy - Optimized spacing often eliminates the need for heavier stud gauges or deeper sections.
- Reduced bridging and anchorage requirements - By avoiding excessive axial demand on individual studs, bridging spacing and anchorage forces within the wall panel can often be reduced, resulting in lower field labor.
- Avoidance of built-up stud conditions - In taller buildings, prescriptive spacing often forces the use of back-to-back or toe-to-toe studs. Infinitely variable spacing frequently eliminates the need for these built-up members.

In particular, **toe-to-toe studs severely restrict or prohibit the installation of batt insulation** within the stud cavity. Avoiding this condition improves acoustic and constructability outcomes.

Tradeoffs and Coordination Considerations

There are some downstream impacts that must be acknowledged:

- Batt insulation waste factor - Non-standard stud spacing can increase insulation waste due to cut-down requirements.
- Gypsum board layout - On walls exceeding approximately 12 feet in length, non-modular spacing can result in irregular (“bastard”) gypsum board layouts.

In practice, this is often mitigated by:

- Installing gypsum board in horizontal orientation, and/or
- Specifying resilient channel on one or both sides of the wall, which both decouples board layout from stud spacing and improves acoustic performance.

Building Lateral Systems – Approach and Philosophy

The selection of the building lateral force–resisting system is a foundational structural decision that directly impacts constructability, cost, coordination, and long-term performance. ElevenTen Systems’ preferred approach is to **utilize building cores and shafts as the primary lateral system** whenever possible.

This strategy leverages elements that are already required within the building—such as elevator shafts, stairwells, and mechanical risers—to resist wind and seismic forces, minimizing the need for additional lateral elements distributed throughout the floor plate.

The appropriate shaft or core system is evaluated based on:

- Overall floor plate size and geometry
- Shaft location within the building
- Total building height
- Seismic design category and wind demands

CMU Shear Walls

Concrete masonry unit (CMU) shear wall are a **common and cost-effective lateral system** for mid-rise cold-formed steel buildings.

Typical characteristics include:

- Commonly used up to approximately eight stories, depending on building geometry and lateral demand
- CMU thickness typically increases with height:
 - Smaller buildings may utilize **8-inch CMU** at lower heights
 - Buildings exceeding approximately four stories often require **10-inch or 12-inch CMU**
- Walls are typically fully reinforced in every cell and fully grouted

CMU shear walls provide robust lateral capacity and are well understood by most design teams. However, the primary drawbacks are related to **field execution**, including:

- Coordination challenges between concrete and masonry trades
- Missed or mislocated embeds and reinforcing steel
- Inconsistent detailing or workmanship in the field

Despite these challenges, CMU shear walls remain a viable and economical solution when properly detailed and coordinated.

Cast-in-Place Concrete Shear Walls

As building height increases—typically **beyond eight stories**—cast-in-place concrete shear walls often become the preferred or required solution.

Key advantages include:

- Extremely high lateral capacity
- Excellent stiffness and drift control
- Broad applicability across seismic and wind design conditions

Cast-in-place concrete cores provide a reliable solution for taller buildings; however, they introduce additional trade coordination, formwork requirements, and schedule considerations.

ElevenTen Speed Shaft System

To address the execution challenges associated with traditional cast-in-place concrete cores, ElevenTen Systems has developed a **proprietary Speed Shaft wall system**.

The Speed Shaft system:

- Is a panelized wall system with reinforcing steel pre-installed

- Utilizes metal deck on both faces of the wall as permanent, stay-in-place formwork
- Eliminates the need for a conventional formwork contractor
- Designers should plan on an overall wall thickness of ~14”.

Construction advantages include:

- Speed Shaft panels are erected by the wall panel crew
- Concrete placement occurs simultaneously with horizontal slab pours
- Significant reduction in trade coordination and schedule risk

The Speed Shaft system is well suited for buildings **up to approximately 12 stories in height**, providing a streamlined and repeatable approach to core construction while maintaining robust lateral capacity.

Cold-Formed Steel Shear Walls

Cold-formed steel shear walls represent the final lateral system option and are generally treated as a **last resort** within the ElevenTen approach.

These systems typically consist of:

- X-braced flat strap shear walls with holdowns, or
- Steel sheet shear walls with holdowns

Limitations include:

- Lateral capacity typically maxes out around five stories
- Increased erection complexity for the framing contractor
- Significant MEP coordination conflicts
- Reduced flexibility for penetrations and routing in shear wall locations

Using a metal roof deck instead of extending concrete diaphragms to the roof can necessitate the addition of CFS shear walls beyond the existing concrete or CMU

shafts. Metal deck diaphragms typically have shorter effective spans than the concrete floor diaphragms below, requiring lateral support at closer intervals than those provided by the building's typical shaft layout.

Summary

ElevenTen Systems prioritizes **shaft- and core-based lateral systems** as the most efficient, constructible, and scalable solution for mid-rise cold-formed steel buildings. Concrete shear walls—particularly when executed through the ElevenTen Speed Shaft system—provide robust lateral resistance while minimizing impacts to unit layouts and MEP coordination.

Distributed cold-formed steel shear walls are used only when necessary and are not the preferred lateral strategy for mid-rise construction.

Floor Systems – Overview

A key advantage of cold-formed steel bearing walls is their **compatibility with multiple floor systems**. Because the gravity load path is distributed through walls rather than concentrated into columns or frames, the system allows flexibility in floor system selection—including composite decks, CLT, joists, trusses, or other assemblies—based on span, acoustics, fire rating, and constructability.

This flexibility allows ElevenTen Systems to adapt the structural solution to the building program rather than forcing the program to adapt to the structure.

ElevenTen Systems supports multiple floor system approaches for mid-rise construction. No single floor system is universally “best”; the optimal solution depends on project-specific drivers including building height, structural spans, fire-resistance requirements, acoustics, MEP coordination, floor-to-floor height constraints, construction schedule, and cost.

Based on our experience across multi-family, hospitality, student housing, and mixed-use projects, the following **five primary floor systems** are most commonly evaluated and delivered. Each system carries distinct advantages and limitations that must be understood early in design to avoid downstream impacts to structure, enclosure, and MEP systems.

The five floor systems addressed in this guide are:

1. Composite Deck with Concrete Topping

A steel deck acting compositely with a concrete slab. This is the most commonly utilized system in cold-formed steel mid-rise construction due to its predictable fire ratings, structural efficiency, diaphragm performance, and compatibility with bearing wall layouts.

2. Cross-Laminated Timber (CLT) with Gypsum or Lightweight Concrete Topping

A mass-timber floor system utilizing CLT panels with a topping slab for acoustics and fire performance. This system is often driven by architectural expression or sustainability goals and introduces unique considerations related to fire rating, acoustics, shrinkage, and bearing conditions.

3. Cold-Formed Steel (CFS) Joist Floor Systems

Floor framing using cold-formed steel joists, which may be panelized or supplied as proprietary composite joists spaced at wider intervals (e.g., 4 feet on center). These systems can offer speed of installation but require careful coordination for fire ratings, acoustics, and MEP integration.

4. Cold-Formed Steel Trusses or Structural Steel Bar Joists

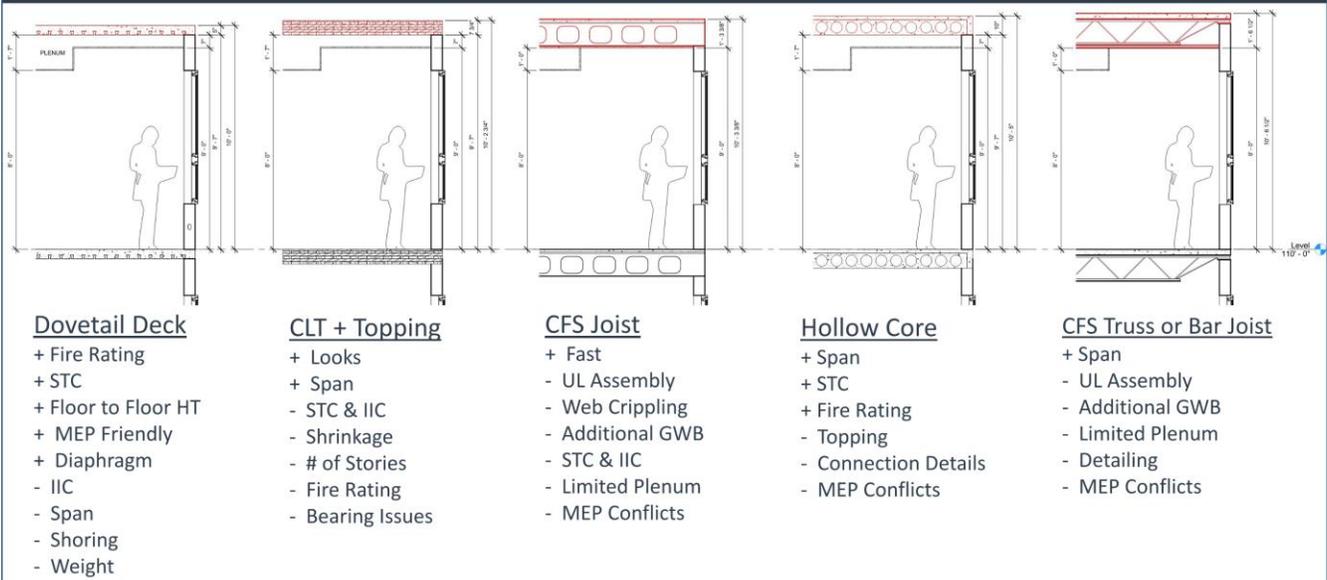
Open-web framing systems used where long spans or structural constraints dictate. While structurally efficient, these systems often require additional fire protection, gypsum board assemblies, and careful detailing to address acoustics and MEP conflicts.

5. Precast Hollow Core with Topping Slab

A precast concrete plank system with a field-applied topping. Hollow core floors offer long spans, inherent fire resistance, and strong acoustic performance, but introduce coordination challenges related to connections, penetrations, and MEP routing.

The following sections expand on each system individually, outlining typical applications, advantages, limitations, and key coordination considerations to assist the design team in selecting the most appropriate floor system for a given project.

→ FLOOR CEILING ASSEMBLIES



Composite Metal Deck

Composite metal deck floor systems consist of a steel deck acting compositely with a concrete topping slab to form a structural floor diaphragm. These systems are widely used across many building types; however, their suitability in cold-formed steel (CFS) construction depends heavily on deck geometry, bearing behavior, and load path continuity.

ElevenTen Systems differentiates between **traditional composite decks** and **specialty composite decks**, as their performance and compatibility with CFS bearing wall construction differ significantly.

Traditional Composite Metal Deck

Traditional composite metal decks are **open-flute profiles**, typically ranging from **1 inch to 3 inches in deck depth**, with a normal-weight or lightweight concrete topping. Composite action is achieved through mechanical embossments in the deck flutes that bond with the concrete slab.

These systems are commonly used in structural steel and concrete frame buildings and can be effective in **low-rise construction** where gravity loads, cumulative wall forces, and bearing demands are relatively modest.

Key characteristics:

- Open flute geometry
- Composite action via mechanical embossments
- Concrete topping provides strength, stiffness, and fire resistance
- Familiar means and methods for many contractors

Limitations in CFS construction:

- Open flutes bear discontinuously on cold-formed steel walls
- Concentrated bearing creates load path challenges at wall heads
- Requires additional detailing to distribute slab loads into thin-gauge steel
- Fire-stopping of deck flutes at walls is often required
- Becomes increasingly inefficient as building height increases

Typical use cases:

- One- to four-story buildings
- Podium or hybrid structures where floors bear on structural steel or concrete
- Projects where CFS walls are not the primary vertical load-bearing system

While traditional composite decks can be used with cold-formed steel, they require careful engineering, additional headers or distribution elements, and increased coordination. As building height and cumulative gravity loads increase, these challenges compound.

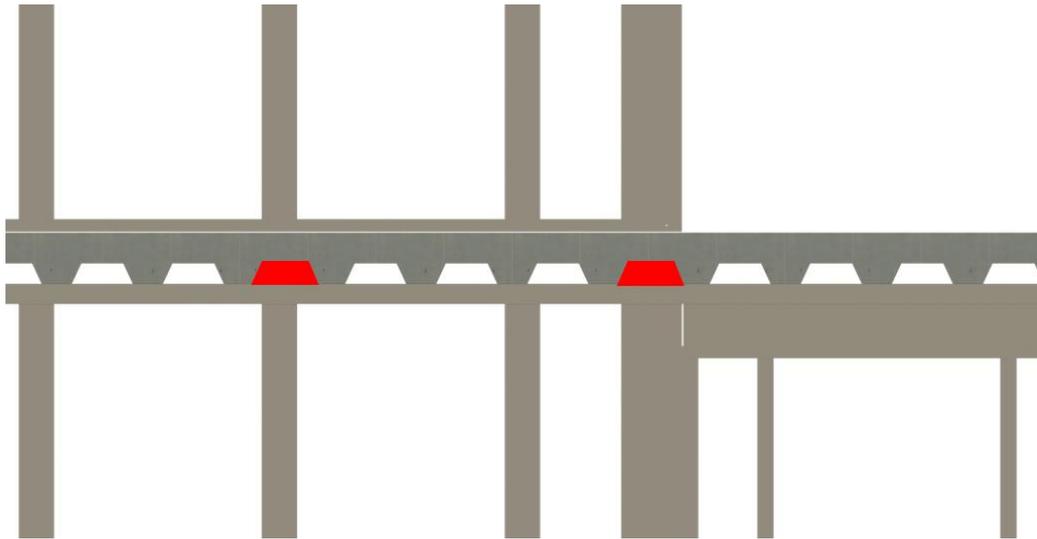


Figure 2 – Traditional composite decks introduce load path challenges. The red area denotes the discontinuous load path interrupted by the open deck flute.

Specialty Composite Decks (Dovetail Decks)

Specialty composite decks—most commonly **dovetail-shaped decks**—were developed specifically to address the shortcomings of open-flute decks in wall-bearing applications. In these systems, the deck geometry mechanically keys the concrete into the steel profile, creating superior composite behavior and a more uniform bearing condition.

Dovetail decks are particularly well suited for **mid-rise cold-formed steel structures** where continuous load paths, predictable fire ratings, and constructability are critical.

Key advantages:

- Dovetail profile uniformly distributes slab loads into CFS bearing walls
- Eliminates concentrated bearing at thin steel wall flanges
- Excellent compatibility with prefabricated cold-formed steel wall panels

- Shallow overall slab depths for given fire ratings
- UL-listed floor and head-of-wall fire assemblies – sometimes eliminating the need for fire-stopping
- Strong diaphragm performance
- MEP-friendly underside geometry, including engineered hanger systems

Typical characteristics:

- 2-inch to 3-1/2-inch deck profiles
- Normal-weight, semi-lightweight, or lightweight concrete toppings
- One- to three-hour fire-resistance ratings achievable with minimal slab thickness
- Proven performance in multi-story residential and hospitality construction

Specialty composite decks are the **preferred and recommended composite floor system** for mid-rise CFS buildings, particularly beyond five stories, where gravity load accumulation and wall bearing behavior govern design decisions.

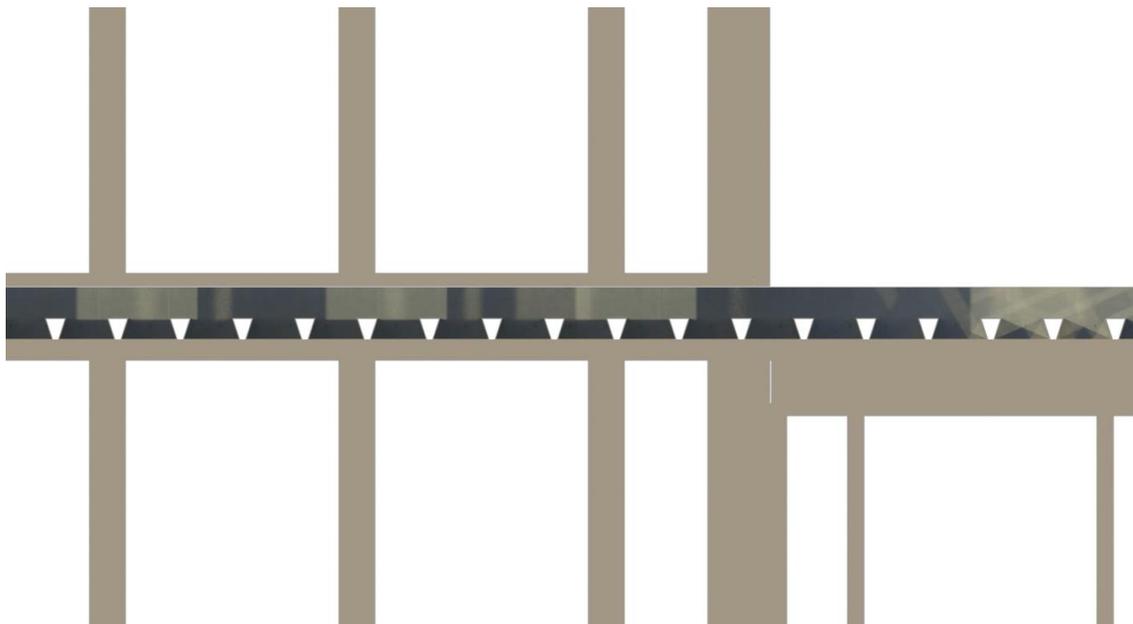


Figure 3 – Specialty dovetail decks are well suited for Cold-Formed Steel construction. Laboratory testing validates the structural capacity of the bearing condition.

Closing Guidance – Traditional vs. Specialty Composite Decks

Traditional composite metal decks remain a viable structural system in many building types; however, in **cold-formed steel mid-rise construction**, their application is inherently limited by the open-flute geometry and the discontinuous load transfer it creates at bearing walls.

In low-rise buildings—generally **one to four stories**—traditional composite decks can be successfully used with proper detailing and engineering oversight. Beyond that height, the cumulative gravity loads imposed on thin-gauge bearing walls, combined with localized bearing and fire-stopping requirements, introduce unnecessary complexity and risk.

For buildings **five stories and greater**, specialty composite decks—specifically dovetail deck systems—provide a far more robust solution. They establish a continuous and predictable load path, reduce structural workarounds, simplify fire-resistance detailing, and integrate efficiently with prefabricated cold-formed steel wall systems.

Pro Tip – Composite Metal Deck Design Guidance

Optimal Span Range

For the majority of mid-rise residential applications, the most economical composite metal deck spans fall in the **16 to 18 foot range**. In this span range, deck gauge, concrete thickness, shoring requirements, vibration performance, and overall material cost tend to balance most efficiently. Shorter spans typically underutilize the system, while longer spans often drive increased slab thickness, heavier deck profiles, additional steel reinforcing, or shoring—reducing cost efficiency.

Composite Deck as a Transfer Structure

Composite metal deck systems can be engineered to act as a **transfer structure** where bearing walls do not stack from floor to floor. In these conditions, the slab transfers gravity loads laterally to adjacent bearing walls, eliminating the need for a separate structural steel transfer system.

This approach generally requires:

- Increased concrete slab thickness
- Additional reinforcing steel within the slab
- Careful coordination of slab reinforcement detailing and construction sequencing
- Additional shoring and re-shoring

When designed intentionally, this strategy can simplify the overall structure and reduce the need for steel beams or transfer girders.

Three-Hour Horizontal Separation

Where a **three-hour horizontal fire-resistance rating** is required for code or occupancy separation, composite metal deck systems provide a straightforward solution. In most cases, this rating can be achieved by increasing the **overall slab thickness to approximately 7 inches**, without introducing complex assemblies or supplemental fireproofing.

In short:

Traditional composite decks *can* work in CFS construction.

Specialty composite decks are *the right tool* for mid-rise CFS buildings.

Cross Laminated Timber Floors & Roofs

Cross-laminated timber (CLT) floor and roof systems are increasingly used in mid-rise construction due to their prefabrication potential, span capabilities, and architectural appeal. When paired with cold-formed steel (CFS) bearing walls, CLT can be successfully integrated into hybrid structural systems; however, this approach introduces additional structural and code-related complexity that must be addressed early in design.

Code Considerations and Combustibility

Unlike cold-formed steel, CLT is a **combustible structural material**. As a result, its use introduces a more complex code path compared to non-combustible floor systems.

Whether CLT members may remain exposed or must be protected with additional fire-resistive materials is highly dependent on:

- Building type and construction classification
- Allowable height and area provisions
- Encapsulation requirements for mass timber
- Fire-resistance ratings required by code
- Engineering analysis of CLT burn characteristics and charring behavior

Determining the required level of protection for CLT floors and roofs typically requires close coordination between the Architect, Structural Engineer, and Code Consultant. In many cases, additional gypsum protection or encapsulation is required to satisfy fire-resistance and combustibility limits.

Gravity Load Accumulation and Bearing Wall Interaction

One of the primary structural challenges when using CLT floors with cold-formed steel bearing walls is the **accumulation of gravity loads** as the building increases in height. While CLT performs well in bending and diaphragm action, wood has **relatively low compressive strength**, particularly perpendicular to the grain.

As gravity loads accumulate from multiple stories above, localized bearing stresses can exceed the compressive capacity of the CLT panels at bearing wall locations. Without careful detailing, this can result in:

- Compression-perpendicular-to-grain failures
- Excessive creep and long-term deformation
- Differential vertical movement between floors
- Load concentration and uneven load distribution

These issues become increasingly pronounced as building height increases and must be explicitly addressed in the structural design.

Required Detailing Strategies at Bearing Walls

To mitigate gravity load accumulation and long-term deformation issues, CLT floor systems in CFS buildings typically require one of the following strategies:

- **Discontinuous CLT floor panels at bearing walls**, allowing CFS walls to stack directly over one another so gravity loads bypass the CLT panels entirely
- **Integration of steel elements within the bearing wall zone** to redistribute and transfer loads through steel rather than through the wood floor panels
- **Hybrid bearing details** that isolate CLT shrinkage and compression effects while maintaining a continuous load path through the steel wall system

These approaches prevent cumulative loading of the CLT panels and allow gravity loads to be carried efficiently through the cold-formed steel bearing walls instead.

CLT/CFS Hybrid System Performance

When properly detailed, CLT floor and roof systems can be effectively paired with cold-formed steel bearing walls in a **platform-type hybrid system**. In this configuration:

- CLT panels act primarily as spanning floor elements and diaphragms
- Cold-formed steel walls provide a stable, non-combustible gravity load path
- Vertical loads are transferred directly through stacked CFS walls rather than accumulating in the CLT panels
- Differential shrinkage, creep, and compression effects in the CLT are isolated at each floor level

Research and applied engineering studies have demonstrated that this hybrid CLT/CFS approach can be structurally efficient and code-compliant when detailed correctly, particularly in the mid-rise range.

Summary

Cross-laminated timber floors and roofs offer compelling architectural and prefabrication advantages, but they introduce additional complexity in both **code**

compliance and structural detailing due to their combustible nature and limited compressive capacity.

Cold-formed steel bearing walls provide the flexibility needed to successfully integrate CLT floor systems by enabling clear gravity load paths, accommodating differential movement, and allowing CLT to perform in its most effective role—as a spanning floor element rather than a cumulative gravity load carrier.

When CLT is considered early in design and paired with appropriate detailing at bearing walls, it can be a strong and viable floor system option within cold-formed steel mid-rise structures.

Cold-Formed Steel Joist Floor Systems

Cold-formed steel (CFS) joist floor systems provide a lightweight and highly adaptable solution for mid-rise construction. These systems can be configured using conventional CFS joists, proprietary joist products, or specialty composite joist members, depending on span, loading, and coordination requirements.

Panelization and Constructability

One of the primary advantages of CFS joist floor systems is the **ability to panelize the floor assemblies**. Floor panels can be prefabricated with:

- Cold-formed steel joists
- Shop-installed metal deck
- Pre-coordinated openings and edge conditions

These panels can be delivered to the site ready to receive a concrete topping slab, significantly improving construction speed and reducing field labor. Panelization also improves quality control and allows parallel fabrication of floors while wall framing progresses on site.

From a scheduling and constructability standpoint, this is one of the most efficient floor systems available.

Span Limitations and Vibration Performance

While CFS joist systems are efficient, **span length is a critical design driver**. As spans increase, the system becomes increasingly sensitive to:

- Floor vibration and occupant comfort
- Serviceability deflection limits
- Dynamic response under walking loads

In practice, CFS joist floor systems perform best at **shorter spans**, generally **less than 20 feet**. Beyond this range, vibration mitigation often requires deeper joists, tighter spacing, added mass, or proprietary solutions, all of which can reduce the cost effectiveness of the system.

For projects with longer spans or strict vibration criteria, alternative floor systems should be evaluated early.

MEP Coordination

MEP coordination is one of the more challenging aspects of CFS joist floor systems. The joist depth defines the available plenum space, and services must pass either:

- Through the joist webs
- Below the joists within the ceiling cavity
- Through framed openings coordinated with joist layout

Standard CFS joists have limited web opening capacity. However, specialty joist members are available with large pre-engineered web openings, allowing ducts, piping, and conduit to pass through the joist depth. These products can significantly improve coordination but require early commitment and precise layout.

Without early MEP coordination, CFS joist systems can quickly become congested and inefficient.

Fire Resistance and Floor-Ceiling Assemblies

Fire-resistance ratings are a major consideration for CFS joist floor systems. In most cases, the **entire floor-ceiling assembly**—from the underside gypsum board to the concrete topping—is relied upon to achieve the required fire rating.

Key implications include:

- Gypsum board protection at the underside of the joists is typically required
- Fire rating continuity must be maintained at all penetrations
- Any MEP element entering or exiting the floor-ceiling assembly requires proper fire-stopping detailing
- Field modifications after fire-rated assemblies are installed are costly and disruptive

Because the joists are part of the rated assembly, penetrations and openings must be tightly controlled and well documented.

Composite and Specialty Joist Systems

In addition to conventional CFS joists, **specialty joist systems** are available that can:

- Act compositely with a metal deck and concrete topping
- Improve stiffness and vibration performance
- Extend viable span ranges compared to conventional CFS joists

These systems can be effective where moderate spans and enhanced performance are required, but they typically carry higher material costs and require manufacturer-specific engineering and detailing.

Summary

Cold-formed steel joist floor systems offer excellent speed and constructability, particularly when panelized with shop-installed metal deck. They are best suited for **shorter spans**, where vibration performance, fire resistance detailing, and MEP coordination can be managed efficiently.

As spans increase or coordination becomes more complex, the system requires careful engineering and early multidisciplinary coordination to remain viable. When used in the right application, CFS joist floors can be a highly effective and economical solution within mid-rise cold-formed steel construction.

Cold-Formed Steel Trusses and Steel Bar Joists

Cold-formed steel trusses and structural steel bar joists are primarily selected for **long-span conditions** and layouts requiring large, open spaces. These systems are structurally efficient and non-combustible, but they introduce added coordination, detailing, and serviceability considerations compared to other floor systems commonly used with cold-formed steel bearing walls.

Span Capability and Applications

The primary advantage of truss-based floor systems is **span capability**. Both cold-formed steel trusses and bar joists can economically achieve spans approaching or exceeding **30 feet**, depending on loading, depth, and spacing.

These systems are well suited for:

- Large open rooms or amenity spaces
- Areas where intermediate bearing walls are undesirable
- Pitched roof framing where non-combustible construction is required

When long spans or open layouts drive the structural design, trusses are often the most practical framing option.

Structural Depth and Building Height Impacts

Truss systems achieve long spans by increasing member depth. As a result, they typically:

- Increase overall floor system depth
- Reduce clear ceiling heights within units

- Increase floor-to-floor heights or total building height

These impacts must be evaluated early, particularly in residential projects where ceiling height is a critical design parameter.

MEP Coordination

Although trusses provide open web geometry, **MEP coordination remains complex**. Truss members are repetitive and tightly spaced, and while services can pass through the truss depth, routing must be carefully planned to avoid conflicts with web members, bracing, and strongbacks.

Without early coordination, MEP routing can become inefficient or force field modifications that compromise both performance and fire-rating integrity.

Fire Resistance and Rated Assemblies

Fire resistance requirements for truss floor systems are similar to those for cold-formed steel joist floors. In most cases, the **entire floor-ceiling assembly**—from the underside gypsum board to the concrete or subfloor topping—is relied upon to achieve the required fire-resistance rating.

Key considerations include:

- Continuous gypsum protection at the underside of the trusses
- Careful detailing at bearing points and penetrations
- Fire-stopping of all services entering or exiting the assembly
- Limited tolerance for post-installation modifications

Fire-rated truss assemblies are achievable but require disciplined detailing and coordination.

Vibration and Serviceability

As span lengths increase, **floor vibration becomes a governing design criterion**. Truss systems with long spans must be carefully evaluated for:

- Walking-induced vibration

- Dynamic response under live loads
- Serviceability deflection limits

Mitigating vibration may require increased truss depth, reduced spacing, added mass, or supplemental stiffening elements, all of which can impact cost and floor-to-floor height.

Cost and Detailing Complexity

Compared to shorter-span floor systems, truss framing introduces:

- Higher material and fabrication costs
- More complex shop and erection detailing
- Increased coordination between structural, architectural, and MEP systems

These factors do not disqualify truss systems, but they make them best suited for **specific conditions** rather than as a default floor solution.

Pro Tip – Cold-Formed Steel Truss Depth and Span Optimization

Economical Depth-to-Span Guidance

For cold-formed steel floor trusses, overall system economy is strongly influenced by truss depth. Based on typical loading, deflection limits, vibration performance, and fabrication efficiency, the following depth ranges are generally the most cost-effective:

- Spans up to 20 feet → 18-inch truss depth
- Spans up to 24 feet → 20-inch truss depth
- Spans up to 26 feet → 22-inch truss depth
- Spans up to 30 feet → 24-inch truss depth

These depth ranges tend to balance material usage, fabrication complexity, and serviceability performance. Reducing the truss depth is often preferred than maintaining the optimal depth for performance. A slight increase in cost will be realized as the truss depth decreases. For example at a 20' span, 12"

deep truss members are available, but it may carry approximately 50% more than the 18" deep truss.

Flat Roof Trusses

Flat roof trusses may follow the same depth-to-span guidance outlined above, provided snow, drift, and mechanical loading conditions are consistent with typical floor loading assumptions.

Longer Span Considerations

Spans **beyond 30 feet** should be approached cautiously. At these lengths, truss systems must be carefully evaluated for:

- Floor vibration and occupant comfort
- Serviceability deflection limits
- Overall feasibility and cost effectiveness

As spans increase, truss depth, chord sizes, bracing requirements, and fire-rating complexity can escalate rapidly, often making alternative structural systems more appropriate.

Summary

Cold-formed steel trusses and structural steel bar joists are excellent framing solutions when **long spans, open layouts, or pitched roofs** are required and non-combustible construction is desired. They are particularly effective in applications where intermediate bearing walls are impractical.

However, these systems come with tradeoffs—most notably increased depth, vibration sensitivity at longer spans, fire-rating complexity, and heightened coordination demands. When used deliberately and in the right locations, truss systems are a powerful tool within the mid-rise cold-formed steel design toolkit.

Precast Hollow Core Floor Systems

Precast hollow core floor systems consist of prestressed concrete planks manufactured off-site and erected rapidly in the field. These systems are widely used in concrete and structural steel construction but are **less commonly utilized in cold-formed steel bearing wall buildings**.

Advantages

The primary advantages of hollow core floor systems are related to **span capability and speed of construction**:

- Long clear spans with minimal structural depth
- Factory-controlled production with consistent quality
- Rapid erection once panels are delivered to site
- Inherent fire resistance due to concrete mass

These characteristics can be attractive for projects with aggressive schedules or where long spans are required.

Challenges in Cold-Formed Steel Construction

Despite their benefits, hollow core systems introduce several challenges when paired with cold-formed steel bearing walls.

Bearing and Connection Detailing

Hollow core planks impose concentrated bearing loads that are not naturally compatible with thin-gauge steel walls. Specialized bearing details are typically required, often involving:

- Steel ledgers or bearing angles
- Embedded plates or grouted pockets
- Additional framing or distribution elements at wall heads

These details add cost, complexity, and coordination effort compared to other floor systems commonly used with CFS.

Grouting Requirements

Open cells at plank ends and at bearing locations typically require grouting to:

- Transfer loads properly
- Achieve fire-resistance continuity

- Address acoustic and durability concerns

Grouting adds labor and sequencing requirements and must be carefully coordinated during erection.

MEP Coordination

MEP routing through hollow core slabs requires early and precise coordination. Penetrations are limited by the internal void geometry, and field coring is restricted and often undesirable. Misaligned penetrations can lead to costly rework or compromised structural performance.

Summary

While hollow core floor systems offer excellent span capability and rapid installation, they are **not a natural fit for cold-formed steel bearing wall construction**.

Connection detailing, grouting requirements, and MEP coordination challenges typically outweigh the benefits when compared to alternative floor systems better aligned with CFS framing.

For these reasons, hollow core systems are generally considered only in **project-specific conditions** where span requirements or schedule constraints clearly justify their use.

Roof Systems and Roof Diaphragms

Selection of the roof system is a critical early design decision, as it directly affects fire-resistance compliance, diaphragm behavior, lateral system efficiency, acoustic performance, and long-term functionality of rooftop elements.

While a roof system may initially appear to be a cost-driven decision, the implications on structural performance and code compliance often outweigh first-cost considerations.

Metal Deck–Only Roof Systems

Metal deck–only roof systems can be attractive from a material and installation standpoint; however, they introduce several challenges that must be carefully evaluated.

From a structural perspective, a metal deck–only roof functions as a **flexible diaphragm**. Depending on the shear wall layout and lateral system configuration, this may require:

- Additional shear walls
- Supplemental lateral bracing
- Increased collector and drag strut demands

These measures can quickly erode any perceived cost savings.

From a fire-resistance standpoint, metal deck–only roof systems are also limited. While they can be viable in **Type II-B construction**, challenges arise as soon as a **1-hour roof rating** is required. There are limited, and often impractical, UL-listed assemblies for metal deck–only roof systems with a 1-hour fire-resistance rating.

As a result, deck-only roof systems are generally not recommended for mid-rise residential buildings where fire-resistance and diaphragm performance are governing design criteria.

Concrete and Composite Roof Deck Systems

When a **rigid diaphragm** is required, or when fire-resistance and lateral efficiency are priorities, ElevenTen Systems recommends utilizing:

- A concrete roof deck, or
- A composite metal deck with concrete topping

This approach provides several key advantages:

- Straightforward fire-resistance ratings, including 1-hour and higher as required
- Rigid diaphragm behavior, which can significantly reduce the demand on the building's lateral force-resisting system
- Improved acoustic performance, particularly beneficial for rooftop mechanical equipment

- High connection capacity, allowing for robust attachment of:
 - Roof screens and enclosures
 - Davits and maintenance equipment
 - Rooftop mechanical units
 - Signage and architectural features

In many cases, the use of a rigid concrete roof diaphragm can reduce the overall cost of the lateral system enough to offset the increased cost of the roof construction itself.

Joist and Truss Roof Systems

Cold-formed steel joist or truss roof systems may also be used, particularly where long spans or pitched roof geometries are required. However, when used **without a concrete topping**, these systems behave as **flexible diaphragms**.

As with deck-only roof systems, flexible diaphragms typically require:

- Additional lateral restraint
- Increased shear wall density
- Supplemental diaphragm bracing

These systems can be effective when intentionally designed and restrained, but they do not provide the same diaphragm stiffness, fire-resistance simplicity, or connection capacity as concrete-based roof systems.

Roof Slope and Drainage Strategy

Roof drainage strategy is an important consideration when selecting the roof system. While it is possible to slope the **structural roof deck itself**, doing so typically requires sloping the **bearing walls at the uppermost level**, which introduces additional detailing and a modest cost premium. When structural sloping is employed, the practical slope that can be accommodated is generally limited to **1/4 inch per foot**.

More commonly, the roof structure is designed to remain **structurally flat**, with a consistent concrete thickness, and **tapered insulation** is installed above the roof deck to achieve the required drainage. This approach provides greater flexibility, simplifies structural detailing, and allows drainage patterns to be adjusted late in design without affecting the structure.

ElevenTen Systems can evaluate sloping the bearing walls at the top story to introduce slope into the concrete roof deck where it is advantageous—typically to reduce the volume of tapered insulation. However, it should be noted that **tapered insulation is never fully eliminated**, as it is still required at valleys, transitions, and low points to direct water toward roof drains and scuppers.

Pro Tip – Use a Concrete Roof Deck When:

- A 1-hour roof rating is required
- Rooftop mechanical units are concentrated (condensing unit farm)
- Davits or heavy attachments are planned

Building Type and Fire Resistance Ratings

IBC Chapter 5 – General Building Heights and Areas

ElevenTen Systems' cold-formed steel structural approach is optimized for mid-rise residential and residential-adjacent occupancies where efficiency, repetition, and constructability govern overall project cost. While cold-formed steel structures can be engineered beyond twelve stories, the most economical and repeatable applications generally occur at twelve residential stories or fewer.

IBC Chapter 5 establishes allowable building heights and areas based on construction type and occupancy. Within these limits, cold-formed steel bearing wall construction provides a clear advantage over traditional concrete and structural steel frames by distributing gravity loads through repetitive wall elements rather than concentrating them into columns or transfer structures.

For residential occupancies—including multifamily, student housing, hospitality, and senior living—ElevenTen Systems typically operates within the height and area limits associated with Type I-B construction, where cold-formed steel bearing walls can be efficiently integrated with a variety of floor systems. This approach balances density, code compliance, and structural economy while avoiding the escalation in cost and complexity associated with taller high-rise construction.

Projects that approach or exceed these limits should be evaluated holistically with respect to fire resistance, structural system transitions, and constructability, as discussed further in the following sections.

IBC Chapter 6 – Types of Construction and Fire-Resistance Requirements

IBC Chapter 6 establishes the required fire-resistance ratings for building elements based on construction type. For cold-formed steel mid-rise buildings, the most relevant construction types are **Type I-B, Type II-A, and Type II-B**. While each classification carries different height and area allowances, the fundamental distinction between them lies in the **required fire-resistance rating of the primary structural elements**.

For the ElevenTen Systems approach, the elements of interest are limited to:

- Interior bearing walls
- Exterior bearing walls
- Floor construction
- Roof construction

Non-bearing partitions, secondary framing, and finish materials are addressed separately and are not the focus of this section.

Type II-B Construction

Type II-B is the least restrictive construction type from a fire-resistance standpoint.

Under this classification:

- Interior bearing walls: No fire-resistance rating required
- Exterior bearing walls: No fire-resistance rating required
- Floor construction: No fire-resistance rating required
- Roof construction: No fire-resistance rating required

While Type II-B construction can be economical for low-rise applications, it is generally **not suitable for mid-rise buildings** due to height, area, and separation limitations.

Type II-A Construction

Type II-A construction introduces **baseline fire-resistance requirements** for structural elements while remaining noncombustible.

Typical requirements include:

- Interior bearing walls: 1-hour fire-resistance rating
- Exterior bearing walls: 1-hour fire-resistance rating
- Floor construction: 1-hour fire-resistance rating
- Roof construction: 1-hour fire-resistance rating

Type II-A represents a practical and efficient construction type for mid-rise cold-formed steel buildings where height and area limits are satisfied. These one-hour assemblies align well with standard cold-formed steel wall and floor assemblies and can often be achieved without excessive material or labor.

However, Type II-A construction provides **less flexibility** than Type I-B when increased height, density, or mixed occupancies are desired.

Type I-B Construction

Type I-B construction is the most common baseline classification for ElevenTen Systems mid-rise residential projects. It provides increased allowable height and area while requiring higher fire-resistance ratings for certain structural elements.

Typical requirements include:

- Interior bearing walls: 2-hour fire-resistance rating
- Exterior bearing walls: 2-hour fire-resistance rating
- Floor construction: 2-hour fire-resistance rating
- Roof construction: 1-hour fire-resistance rating

These requirements establish Type I-B as a robust, noncombustible construction type suitable for higher-density residential buildings. Cold-formed steel bearing walls are well suited to meet these ratings through gypsum-based assemblies, making Type I-B a natural fit for the ElevenTen system from a constructability standpoint.

The tradeoff is that higher fire-resistance ratings generally increase wall thickness, gypsum layers, and overall cost—unless strategic code allowances are applied.

IBC Chapter 4 – Special Detailed Requirements for High-Rise Buildings

Type I-B Fire-Resistance Rating Reduction Strategy

IBC Chapter 4 permits fire-resistance rating reductions for certain building elements in sprinklered high-rise buildings under IBC Section 403.2.1. When the required conditions are met—including supervised sprinkler systems with water-flow initiating devices—Type I-B buildings may take advantage of a significant reduction in required fire-resistance ratings.

Under this provision:

- The fire-resistance ratings of building elements in Type I-B construction may be reduced to those permitted for Type II-A construction

- This reduction does not affect allowable building height or area
- Columns supporting floors are excluded from this reduction and must maintain their required rating

For ElevenTen Systems, this code allowance is particularly impactful. Cold-formed steel bearing walls—already noncombustible and distributed throughout the building—can often be detailed to meet Type II-A fire-resistance ratings while the building remains classified as Type I-B. This strategy reduces:

- Gypsum layers and assembly thickness in select conditions
- Labor and material cost associated with higher fire-resistance assemblies
- Overall construction complexity

When applied appropriately, this reduction creates a highly efficient “sweet spot” for mid-rise residential construction: Type I-B height and area allowances with Type II-A-level fire-resistance assemblies, except where prohibited by code.

UL Ratings for Partitions and Floors

UL Fire-Resistance Ratings for Partitions and Floors

UL-listed assemblies form the basis for achieving required fire-resistance ratings in cold-formed steel mid-rise construction. These assemblies provide a tested and prescriptive path to compliance for both bearing partitions and horizontal floor systems. Because UL assemblies are periodically revised, designers should always verify the most current listing during design.

Interior Load-Bearing Partitions – UL U423

UL U423 is the primary and most commonly used assembly for **interior load-bearing partitions**. This assembly is suitable for the majority of bearing wall conditions encountered in mid-rise residential construction and performs well in typical unit demising, corridor, and shaft-adjacent applications.

Key characteristics:

- Applicable to approximately 95% of interior load-bearing wall conditions
- Compatible with standard cold-formed steel stud framing
- Supports both 1-hour and 2-hour fire-resistance ratings
- Provisions available for STC improvements and shaft wall configurations

For **2-hour-rated partitions**, UL U423 requires **mineral wool insulation within the stud cavity** in order to utilize **100% of the stud's available structural capacity**. If mineral wool is omitted, the allowable structural capacity of the studs is typically reduced to approximately **80%**.

This mineral wool requirement must be clearly identified on the construction documents to avoid omission during bidding or construction, as it directly affects both fire performance and structural capacity.

Exterior Load-Bearing Walls – UL U425

UL U425 is commonly used for **exterior load-bearing walls** requiring a fire-resistance rating. This assembly provides a flexible starting point for integrating exterior sheathing, continuous insulation, and façade systems while maintaining compliance with fire-resistance requirements.

Key characteristics:

- Suitable for exterior bearing wall conditions
- Compatible with a wide range of gypsum board manufacturers
- Allows multiple continuous insulation and façade configurations
- Also applicable to 1-hour-rated interior bearing walls in certain conditions

UL U425 is frequently used where exterior wall performance, enclosure detailing, and fire resistance must be carefully balanced.

Fire-Resistant Floor Assemblies – Dovetail Deck Systems

UL assemblies D904, D917, D928, and D961 apply to **dovetail steel deck floor systems with concrete topping slabs**. Among these, UL D904 is the most commonly used and serves as the baseline assembly for many mid-rise floor conditions.

General guidance includes:

- 1-hour floor ratings typically require a minimum total slab thickness of approximately 4 inches
- 2-hour floor ratings typically require a minimum total slab thickness of approximately 5-1/4 inches
- Assembly selection should consider span, loading, deck profile, and acoustic requirements

Each assembly carries specific detailing requirements and limitations that must be reviewed during design. Longer spans, heavier loads, or specialty conditions may warrant evaluation of alternate UL listings.

Coordination and Verification

UL assemblies are subject to ongoing updates and revisions. Designers are responsible for confirming that the selected assembly remains current and appropriate for the project conditions.

Current UL listings and detailed assembly requirements are available at:

<https://iq.ulprospector.com/en>

STC and fire-resistance reference manuals should be consulted in parallel with UL listings to ensure assemblies meet both fire and acoustic performance requirements.



ESTIMATED STC & IIC RATINGS of VERSA-DEK® COMPOSITE FLOOR ASSEMBLIES (NOTES 1, 2 & 3)

STC	IIC		
+0	+40		ADD 44 oz. WOVEN CARPET & 3/8" FOAM RUBBER PAD
+0	+25		ADD 20 oz. COMMERCIAL CARPET (GLUE DOWN)
+0	+21		ADD LAMINATE FLOORING (HARD WOOD FLOORING SIM. EXCEPT STC +2) & 6mm RUBBER SOUND MATT
+2	+1		ADD PER INCH OF CONCRETE TOPPING
51	24		BASE SYSTEM: 3-1/4" NWT CONCRETE OVER 2" VERSA-DEK COMPOSITE TOTAL DEPTH: 5-1/4"
			BASE SYSTEM: 2-1/4" NWT CONCRETE OVER 3-1/2" VERSA-DEK COMPOSITE TOTAL DEPTH: 5-3/4"
+1	+4		GYPSUM BOARD CEILING NOT RESILIENTLY SUSPENDED
+10 to 12	+8		GYPSUM BOARD CEILING RESILIENTLY SUSPENDED
+13 to 15	+13		GYPSUM BOARD CEILING RESILIENTLY SUSPENDED W/ SOUND ABSORBING MATERIAL IN AIRSPACE

Notes:

1. Consult component manufacturers for information regarding sizes, types, spacings and/or installation requirements for all collateral flooring and ceiling materials.
2. STC values for base systems (bare slabs) were calculated as $STC = 0.1304 * W + 43.48$ in accordance with Section 9.2 of PCI Design Handbook, 6th Edition.
3. IIC values for base systems (bare slabs) were calculated as $IIC = (19.4 + 0.5 * h) + (0.02 + 0.0036 * h) * W$. The formula was derived from the data published in Section 9.2 of PCI Design Handbook, 6th Edition.
4. Reference *Architectural Acoustics* handbook by David Egan for acoustical enhancements provided by floors and ceiling materials.

NMBS v092017

Materials, Constructability & Coordination

Sheathing and Weather Barrier

ElevenTen Systems can tailor exterior wall sheathing and weather barrier assemblies to meet the specific performance, budget, and code requirements of each project. Because exterior wall systems are installed early in the construction process and may

remain exposed for extended durations, particular attention is given to weather barrier selection, detailing, and durability.

Weather Barrier Performance and Exposure Duration

Mid-rise projects often experience extended construction schedules, during which exterior wall assemblies may be exposed to the elements for months before final façade installation. For this reason, ElevenTen Systems only recommends and provides weather barrier products that carry a minimum 12-month exposure warranty.

This requirement ensures that the weather barrier can:

- Withstand prolonged UV exposure
- Maintain water-resistive performance during construction
- Avoid degradation or warranty conflicts prior to enclosure

Where necessary, ElevenTen Systems will incorporate **additional detailing measures**—including transitions, sealants, and accessory components—to maintain weather barrier continuity and performance throughout the construction duration.

Recommended Weather Barrier Products

When ElevenTen Systems is furnishing panels with an integrated weather barrier, commonly recommended products include:

- USG ExoAir® 430
- Georgia-Pacific DensElement® Barrier System

Both systems provide integrated air- and water-resistive barriers with **12-month exposure warranties** and are well suited for panelized cold-formed steel construction. These products allow enclosure work to progress efficiently while maintaining durability during extended exposure periods.

Final product selection is coordinated with the design team to ensure compatibility with the specified façade system and performance requirements.

Nail-Base and Specialty Sheathing

Where a nail-base sheathing is required—such as for attachment of exterior finishes—ElevenTen Systems commonly evaluates products such as:

- Dow™ ArmorWall™
- Rok-On® magnesium oxide panels

These products combine structural sheathing and insulation into a single panelized component. Exposure limitations vary by product:

- ArmorWall typically carries a 6-month exposure limitation and may require omission of the factory-applied weather barrier in favor of a field- or shop-applied system for longer schedules.
- Rok-On panels do not include an integrated weather barrier and provide greater flexibility in selecting the weather-resistive barrier system.

Each option is evaluated based on exposure duration, façade attachment requirements, and overall enclosure strategy.

Combustible and Noncombustible Sheathing Options

ElevenTen Systems is not limited to a single sheathing type. Depending on the building's construction classification and performance requirements, we can provide:

- Noncombustible sheathing systems
- Plywood or wood-based sheathing for combustible construction

In practice, **most sheathing products available in the United States can be integrated into ElevenTen exterior wall systems**, provided they are compatible with the project's code requirements, weather exposure duration, and enclosure detailing.

Factory Installed Windows

ElevenTen Systems can provide **factory-installed windows** as part of the panelized exterior wall system. Factory installation improves quality control, accelerates field

installation, and reduces coordination risk between framing, window installation, and weather barrier detailing.

Window Type and Compatibility

Factory-installed windows are typically **residential-style, nail-flange window systems** constructed from composite, vinyl, aluminum-clad, or similar materials appropriate for panelized installation. Window selection must be coordinated early to ensure compatibility with off-site installation and transportation requirements.

A critical requirement is that the **window manufacturer must explicitly allow horizontal installation and shipment** of the windows. Written confirmation from the manufacturer is required, as not all window systems are designed to tolerate horizontal handling without risk of distortion or damage.

Shipping and Panel Height Constraints

Panel height is one of the most important constraints when factory-installed windows are incorporated into exterior wall panels.

As a general guideline:

- Floor-to-floor heights up to approximately 10 feet are well suited for horizontal panelization and shipping.
- Floor-to-floor heights exceeding 10 feet begin to significantly impact shipping efficiency and cost.

While vertical transport of panels using specialty skids is technically possible, this approach introduces substantial challenges:

- Reduced shipping efficiency and increased number of truckloads
- Higher handling risk during loading, transport, and erection
- Increased cost due to specialized rigging and transport methods
- Constraints imposed by legal shipping limits related to overall height, width, and length of the load

As panel height increases, these factors quickly render vertical shipping **cost-prohibitive** for most projects.

Practical Guidance

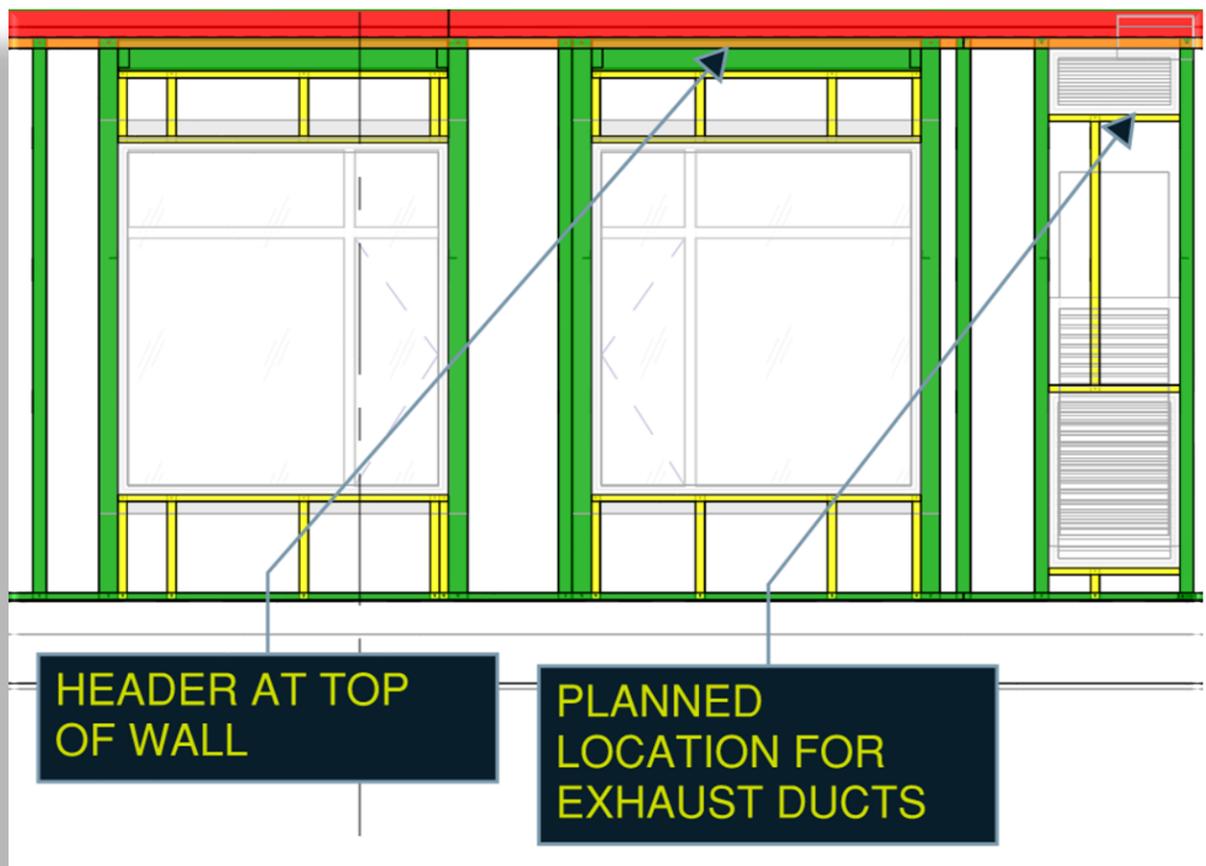
For projects where factory-installed windows are desired, ElevenTen Systems strongly recommends:

- Maintaining floor-to-floor heights at or below 10 feet where possible
- Selecting window systems approved for horizontal installation and transport
- Coordinating window selection, panel height, and shipping strategy early in design

When taller floor-to-floor heights are unavoidable, alternative strategies—such as field-installed windows or modified panelization approaches—should be evaluated collaboratively with the design team.

Exhaust Duct Coordination

Keeping code required distances from intake, exhaust, and operable openings is a challenge. Typically, we cannot allow the installation of an exhaust duct over a window due to a structural header being installed at the top of the wall over the opening. This leaves minimal space to install these ducts between openings all the while missing studs. We will coordinate our stud locations with exhaust ducts and allow larger openings for these ducts, but the locations usually need to be carefully planned out.



For structural reasons and constructability, typically we need to utilize a 2" deep top track on the bottom side of the deck. This should be the height pinch point for how high ducts can be installed in the units. So, a 4" duct will have a bottom elevation of 6" below the bottom of the deck.

Headers and Beams

Floor systems frequently require localized framing elements to transfer loads around openings, corridors, shafts, or non-stacking wall conditions. Within the ElevenTen system, four primary header or beam strategies are commonly employed. Two of these approaches are **agnostic to floor system selection**, while the remaining two are **specific to composite metal deck with concrete topping**.

The four header and beam types are:

1. Cold-Formed Steel Box Headers
2. Structural Steel Members
3. Slab Beams (Composite Deck Only)
4. Deck Beams (Composite Deck Only)

Each option carries different implications for span capability, fire protection, constructability, and ceiling plenum space.

Type 1 – Cold-Formed Steel Box Headers

(Floor-System Agnostic)

Cold-formed steel box headers are the most commonly used header solution within the ElevenTen system. These members are fabricated from cold-formed steel components assembled into a closed box section.

Typical characteristics include:

- Depths ranging from approximately 6 inches to 16 inches
- Typical spans of up to 12 feet, with spans approaching 16 feet possible in select conditions depending on loading
- Depth increases as span and load increase, which correspondingly reduces available ceiling plenum
- Fire-resistance ratings are typically achieved by gypsum board encapsulation
- Limited large punch-outs can be provided to allow MEP elements to pass through the header
- Installed using mechanical fasteners, making them well suited for rapid field installation without specialized trades

Cold-formed steel box headers are generally the preferred solution where spans and loading permit, due to their compatibility with cold-formed steel construction methods and ease of installation.

Type 2 – Structural Steel Members

(Floor-System Agnostic)

Structural steel members may also be used to header off floor systems where loads, spans, or architectural constraints exceed the practical limits of cold-formed steel headers.

These members may include:

- Wide-flange beams
- Hollow Structural Sections (HSS)
- WT members
- Steel members may be configured as:
 - Uprturned (dropped below the slab), or
 - Upset (embedded into the slab depth)

They may also be designed as **composite members**, utilizing shear studs—typically shop-installed by ElevenTen Systems—to increase load-carrying capacity.

Key considerations include:

- Steel members are commonly subject to fireproofing requirements as determined by the Authority Having Jurisdiction (AHJ)
- Field installation frequently requires welding, which introduces additional coordination and may require certified welders
- Welding may be one of the few site-welded elements in an otherwise mechanically fastened cold-formed steel structure

While structurally efficient, steel members are generally used selectively due to added cost, fireproofing requirements, and erection complexity.

Type 3 – Slab Beams

(Composite Metal Deck Only)

Slab beams are a preferred solution when utilizing composite metal deck with concrete topping and when maintaining clear ceiling plenum space is a priority.

A slab beam is formed by thickening the concrete slab and introducing **two-way reinforcing steel**, allowing the slab to act as a reinforced concrete beam.

Key characteristics include:

- Slab beam depth is typically equal to the overall composite slab thickness
 - For example, a 5-inch composite slab typically results in a 5-inch slab beam
- Additional capacity can be achieved by:
 - Increasing slab beam depth, and
 - Adding reinforcing steel
- No structural elements project into the ceiling plenum
- No fireproofing is required, unlike exposed steel members

Tradeoffs include:

- Requires full shoring, including shoring frames and plywood formwork
- Involves a relatively high amount of reinforcing steel
- Increased coordination during concrete placement

Slab beams are often selected where MEP congestion is high and plenum space must be preserved.

Type 4 – Deck Beams

(Composite Metal Deck Only)

Deck beams are a specialized solution that leverages the composite deck itself to act as a localized beam within the slab system.

A deck beam is created by:

- Installing additional reinforcing steel within the concrete topping, and
- Utilizing the deck in a multi-span condition (typically two or three spans)
- Key limitations and requirements include:
 - Maximum effective width is typically limited to approximately 4 feet
 - Deck beams must be located within the interior spans of the deck
 - They cannot occur at deck end-bearing conditions
- Minimal shoring is required, often achieved with:
 - A single post shore and timber member, or
 - A cold-formed steel member temporarily fastened to the walls

Deck beams provide a cost-effective alternative to slab beams where spans and loading permit, with significantly reduced shoring requirements.

Summary

ElevenTen Systems evaluates header and beam strategies on a project-specific basis, balancing span requirements, fire resistance, constructability, and ceiling plenum constraints. Cold-formed steel box headers and structural steel members provide flexibility across multiple floor systems, while slab beams and deck beams offer efficient solutions uniquely suited to composite metal deck construction.

Selecting the appropriate header or beam type early in design can significantly reduce downstream coordination issues and overall project cost.

There are a couple of ways to header off the floor system. These will consist of either a beam or a special slab design (slab beam). The beam approach will limit the available plenum space for MEP elements. We would recommend planning on a beam depth of 6", but 8" or larger may be needed for heavier loads or longer spans. We always strive to design these beams out of cold-formed steel and try and avoid structural steel. Using structural steel beams runs the risk of the AHJ requiring the steel element to be fire proofed. If MEP elements need to be installed tight to the bottom of the deck, then a slab beam needs to be utilized. The downside to slab beams is added cost due to shoring. Below are pictures of each approach.

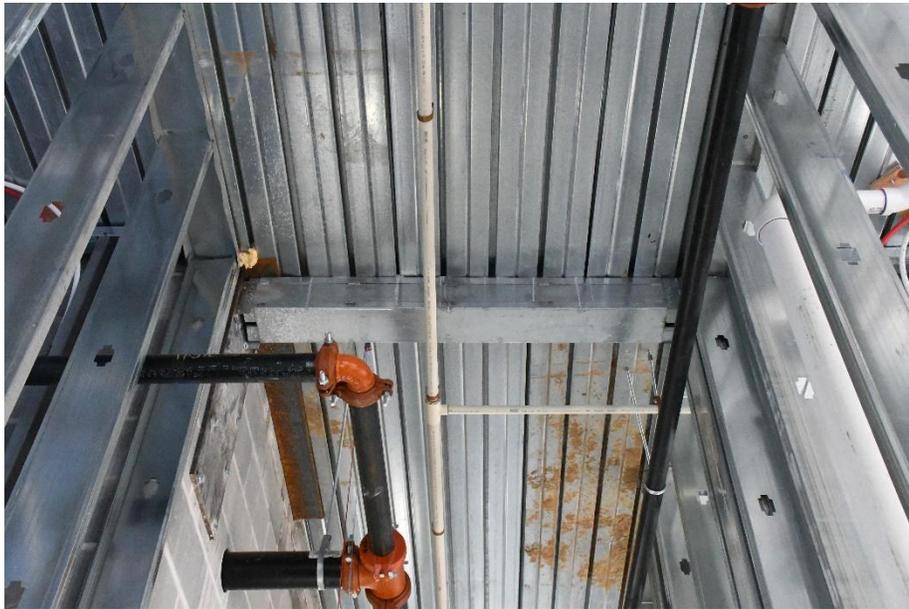


Figure 1 - CFS Box Header connecting into a CMU shaft and the end of a load bearing wall



Figure 2 - The Slab Beam Approach will result in more space for MEP elements.