

# FLOOR JOIST & DECK SYSTEMS Specification Guide





## BILLINGS CLINIC BED EXPANSION BILLINGS, MT

Architect: A&E Architects  
Structural Engineer: Whitten & Borges, P.C.  
Steel Fabricator: TrueNorth Steel  
General Contractor: Langlas & Associates  
Photographer: Zakara Photography



A four-story addition expanded the Family Birth Center at Billings Clinic, along with two additional floors and a new roof for increased in-patient care. Composite Joists, spaced at 8'-4", clear-spanned 81 feet above the existing clinic roof.

## PORT SAN ANTONIO (TECH BUILDING 2)



Completion Date: March 2022  
Owner: Port Authority  
Architect: Beaty Palmer Architects  
Steel Fabricator: Myrex Industries  
General Contractor: Joeris

A five-story, 173,000 SF office building featuring Vulcraft Composite Joists.

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# PURPOSE OF SPEC GUIDE

Designing an effective floor system requires balancing multiple factors, including load requirements, fire ratings, serviceability, and cost efficiency. This guide is intended to help Specifying Professionals make informed decisions when selecting Vulcraft steel joists and deck for floor applications. It provides valuable tools and insights to navigate the key variables of floor system design while optimizing for cost, performance, and fire resistance.

## WHAT'S INSIDE?

- **ADVANTAGES OF VULCRAFT STEEL JOIST AND DECK SYSTEMS** Benefits such as customization, open floor plans, vibration control, and reduced cost and weight savings.
- **COMPARATIVE CASE STUDIES** Examples of performance and cost savings.
- **TYPICAL DETAILS** Standardized design configurations and best practices.
- **DIVISION OF RESPONSIBILITIES** Clarifying roles in the design and construction process.
- **DESIGN EXAMPLE** An illustration of floor system design.
- **SYSTEM OPTIMIZATION** A key feature of this guide is its comprehensive floor system tables, which highlight the most economical options for various fire ratings, spans, and loads. These tables demonstrate how previously unfeasible or cost-prohibitive spans and loadings are now achievable and economical. They serve as an economic system guide, presenting a small sample of the numerous combinations of fire ratings, loadings, and spans based on estimated relative costs.
- **FIRE RESISTANCE** Fire resistance tables cover assemblies meeting 1- to 4-hour requirements and include guidance from the UL Fire Directory on substituting joists for tested structural members.
- **SPECIAL TOPICS** A description of the basics of composite steel joists, application of composite joists for framing of storm shelters, and an extensive discussion on the benefits, details, and specification of Flush Framed Connections.

This guide provides an overview of Vulcraft systems and products rather than a comprehensive catalog. For more information, feel free to connect with a local Vulcraft engineer, view the complete catalogs at [Vulcraft.com](https://www.vulcraft.com), or access Steel Joist Institute resources at [steeljoist.org](https://www.steeljoist.org).



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## OVERVIEW & HISTORY OF VULCRAFT FLOOR JOIST AND DECK SYSTEMS

For decades, K- and LH-series joists, standardized by the Steel Joist Institute, have been a staple in roof applications. However, their adoption in floor systems was traditionally limited due to outdated misconceptions regarding capacity and serviceability. Multistory buildings commonly use other steel products, such as wide flange beams, or other materials, such as concrete or mass timber. These material types limited the clear span possibilities due to cost. The perceived reasons for using these products included concerns about load capacity, vibration, limited deck span capabilities, or increased floor-to-floor heights caused by joist depths. Due to a confluence of several developments, these obsolete concerns should no longer hinder specifying a floor joist & deck system. These developments include additional research, new material testing, advanced design methods, connection details, and powerful design tools. As a result, steel joists and deck systems now stand as a viable and efficient choice for modern floor applications, offering enhanced performance and flexibility..

### **JOIST FLOOR SYSTEM VIBRATION PERFORMANCE**

One significant improvement was introducing the [Flush Frame Connection](#), which resolved long-standing vibration and structural integration issues. Unlike traditional joist seats that separate the deck/slab from the top of the girder, Flush Frame Connections align the top of the joist with the top of the girder, eliminating gaps and allowing the deck to bear on and be attached directly to the girder. The bolted connections of Flush Frames further simplify installation, offering customization options while reducing reliance on field welding.



**VULCRAFT**  
FLUSH FRAME  
CONNECTION



Increasing the joist's Moment of Inertia will stiffen the floor structure and improve vibration performance by increasing natural frequency. This can be done economically by deepening the joist or increasing the angle sizes used in the top and bottom chords. Vulcraft can easily design joists to achieve a minimum Moment of Inertia if needed on a project. To simplify this analysis, Vulcraft offers several online calculator tools at no cost, such as the [Vibration Analysis Tool](#), which evaluates a floor structure for walking vibration, and the [Joist Wizard](#) and [Girder Wizard](#) tools, which output the most economical depths and corresponding estimated Moments of Inertia for your unique loading condition. See the section on Flush Frame Connections for more discussion on vibration.



## DECK SPAN CAPABILITIES

Until the late 2010s, Vulcraft's published load capacity tables of composite deck-slabs were determined using the shear-bond method, which calculated the bending force at which the concrete separates from the steel deck. Unfortunately, the underlying testing that generated these capacities did not fully capture the realities of composite deck-slab usage, using a single-span panel with roller supports with no additional restraints normally provided by adjacent spans.

The Steel Deck Institute (SDI) generally supported the shear-bond method but recognized its dependency on roller-supported specimens. In the early 1980s, the SDI initiated research at West Virginia University to study "real world" effects on composite deck-slab behavior. This led to the ANSI/SDI C-2017 Standard for Composite Steel Floor Deck-Slabs, which provides procedures to develop load tables without needing full-scale testing while accounting for "real world" effects. This standard has been adopted by the International Building Code, and subsequent updates have developed superimposed load capacities that exceed those from the lower bound shear-bond method.

## COMPOSITE JOISTS

Vulcraft Composite (VC series) joists were developed in the 1980s and 1990s and adopted by the Steel Joist Institute in 2006. The designation was changed to CJ. Many tests conducted by Vulcraft have refined the design process, confirmed design assumptions, and enabled the performance of CJ joists to be confidently predictable. CJ joists are available in depths from 10 to 120 inches and lengths up to 120 feet and longer. When joists and concrete are used in composite construction, the compressive force due to superimposed loading is transferred from the top chord of the joist into the concrete slab, creating a composite section that resists the superimposed loads.



DESIGN CONSIDERATIONS

Composite joists utilize welded shear studs, while non-composite joists do not utilize studs. The studs require field labor to install but typically result in significant overall weight and cost savings due to the more efficient design. At specific spans and loading, a non-composite joist can be the more economical option.

To provide more insight into the capabilities of floor joists and the most economical design, Vulcraft offers the online [Floor Wizard](#) tool. This tool analyzes your project’s allowable floor system depth, span, loading, and required hourly fire rating and generates the most economical joist depth, type, spacing, and resulting deck-slab. Then, you can confidently specify the most economical configuration for your floor structure.

PREVIEW OF THE FLOOR WIZARD TOOL:

COST RATIO	TOTAL WEIGHT (PSF)	JOIST WEIGHT (PSF)	SPACING (FT)	MIN TOTAL SLAB DEPTH (IN)*	JOIST	JOIST MOMENT OF INERTIA (IN^4)	MAX ROUND DUCT DIAMETER (IN)	DECK**
1.078	5.07	3.47	5.00	6.00	30LH	699	17.00	1.5VL (22)
1.065	4.43	2.83	5.50	6.00	40CJ	1044	26.00	1.5VL (22)
1.026	4.26	2.66	6.00	6.00	40CJ	1081	26.00	1.5VL (22)
1.023	4.90	3.30	6.50	6.50	36LH	1226	24.00	2VLI (22)
1.000	4.81	3.21	7.00	6.50	36LH	1226	24.00	2VLI (22)
1.027	5.07	3.17	7.50	6.50	36LH	1392	24.00	2VLI (20)

EXPANDED CAPABILITIES

The maximum allowable load per foot for either K or LH series joists has been increased to 2,400 plf (ASD). CJ joists can resist higher loads, and all types can be provided with either standard joist bearings or flush-framed connections. Vibration concerns have been resolved. Much larger clear spans are now economical. Engineers can support owners and architects who wish to eliminate columns to create large, clear spans. This allows for more flexibility and unobstructed space without costly structural modifications or renovations.

Examples of Vulcraft composite joist systems include clear spans of 100 feet and longer used to support gymnasiums over swimming pools, heavily loaded warehouse floors, hospital floors, robotic mezzanines, structural floors for retail buildings, data centers, gymnasiums, gymnasiums doubling as storm shelters, and a tennis court above a hockey rink. These examples demonstrate composite joists’ expanded capabilities, economy, and serviceability. Many projects with more typical spans of 30 to 80 feet are also examples of the successful use of steel joists to provide economical floors with excellent serviceability characteristics.

TOOLS AND RESOURCES

Specific and unique project requirements can be checked using the Vulcraft Design Tools at [Vulcraft.com](#) or discussed with your [local Vulcraft engineering contact](#).

# ADVANTAGES OF J-D FLOOR SYSTEMS

Steel joists and decks are engineered to achieve cost-effective floor systems for both short and long clear spans.

## PRIMARY ADVANTAGES

**TAILORED PERFORMANCE:** Steel joist systems can be tailored for specific depths, spans, loading, camber, deflection, stiffness, web layout, and end connections, ensuring precise performance to optimize your project.

**OPEN FLOOR PLANS:** Composite joists are ideal for long-span applications, especially with heavy loading. This eliminates the perceived need for intermediate columns and girders, creating expansive, column-free, and open floor plans.

**FLEXIBLE ERECTION METHODS:** Flexible erection methods and connections using standard end-bearing joist seats or flush-framed connections can be provided for all joist types (K, LH, CJ).

**VIBRATION CONTROL:** With flush-framed connections, the cost of vibration control can be reduced, as the joists are connected to the girder web, and the top flange of the girder is directly connected to the slab, resulting in full composite behavior. Joists and girders with the same effective stiffness will provide the same vibration behaviors as wide flange beams. Providing more stiffness can be done economically by incrementally increasing the joist depth. See the section on Flush Framed Connections for more information about vibration control.

**REDUCED FLOOR-TO-FLOOR HEIGHT:** Floor-to-floor height can often be decreased as mechanical systems can be routed through the open webs. This can eliminate the need for mechanical plenum requirements, bulkheads to conceal ductwork, and expensive web penetrations. Flush frame connections also reduce floor heights by aligning the tops of joists with the girders, eliminating joist seat depths.

**OVERALL WEIGHT SAVINGS:** Due to their efficient design, joist systems offer weight savings compared to concrete or structural steel shapes. This reduces the overall building weight, translating into foundation design savings and seismic-resisting lateral systems.

**REDUCED GREENHOUSE GAS EMISSIONS:** The weight savings directly reduce Greenhouse gas emissions and embodied carbon compared to other heavier structural steel or concrete options.

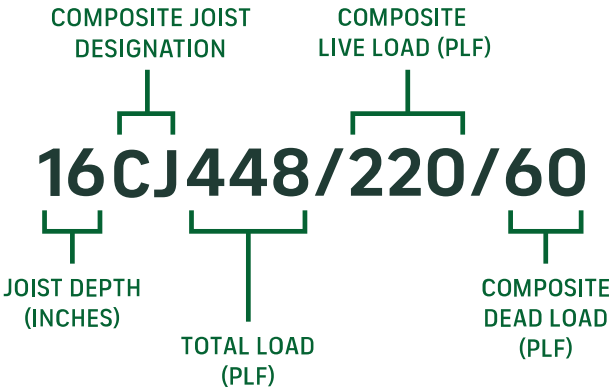
**SIGNIFICANTLY REDUCED LIVE LOAD DEFLECTIONS:** The resulting composite behavior provides a reliably stiffer floor system with the overlying concrete slab locked to the steel joist.

**STRUCTURAL ANALYSIS TOOLS** New tools have incorporated composite joist design. For example, RISAFloor added a composite joist design beginning with Version 15.0.





## FLOOR JOIST DESIGNATIONS



Non-composite joist designations are the same standard designation (e.g. 40LH20) or a Load/Load designation (e.g. 40LH1950/1200) as joists for any other application. Composite joists are designated: depth CJ TL/LL/CDL where TL is the total of the superimposed live and dead loads plus the non-composite loads including concrete slab, deck, joist & bridging. LL is the superimposed live load and CDL is composite dead load including ceiling, ductwork fireproofing, etc. For example, the above Load/Load example might be designated 40CJ1950/1200/120. Designation loads can be given at either service or factored level. In either case, composite joists will be designed with the LRFD design method.

## LOAD COMBINATIONS

Building codes and standards specify the minimum combinations of loads to ensure safety and performance under various conditions. Vulcraft will use the appropriate combinations shown in the applicable IBC code along with any other combinations specified. For most applications, floor joists will have limited combinations. If lateral forces are specified, or the joists will be used in a storm shelter application (see the section on storm shelters), then additional load combinations will be checked. Combinations to determine deflections from specific loads can also be specified.

## JOIST DEPTH AND SPAN (MINIMUM & MAXIMUM)

The maximum span for K or LH joists is 24x joist depth. The minimum joist span for CJ joists is 12x joist depth. The maximum joist span is 30x joist depth.

## BRIDGING AND BRIDGING ANCHORS

Bridging is required for erection and is designed and provided by Vulcraft. The requirements of OSHA also apply to composite steel joists. Vulcraft will design and provide the bridging needed to properly brace the joists during erection and meet OSHA safety regulations. Anchorage of the bridging is designed and provided by others at the ends of each bridging row at both the top and bottom chords. Contact Vulcraft for forces.

## BEARING DEPTHS

Bearing depths are similar to standard joists. K joists are furnished with a minimum bearing depth of 2½ inches. LH and CJ joists bearing depths are typically 5 to 10+ inches depending on material sizes and the needed working point locations. Any joist can be furnished with flush-framed connections instead of standard-type bearings. Square ends (bottom chord bearing) can also be provided; however, allow for standard tolerance in depth.



## EXTENDED ENDS

All steel joists can be provided with extended ends or top chord extensions. Extensions can have different loading than the base portion of the joist. Extension depths may need to be adjusted to resist the loading or meet other criteria efficiently. Consult with Vulcraft to determine the best depth to accommodate length and load.

## CEILING EXTENSIONS

Ceiling extensions are extended bottom chord elements that support ceilings directly attached to the bottom chord of the joists, such as gypsum board. They are not intended to support suspended ceilings, typically attached to top chords.

## DUCTILITY

The fundamental concept in proportioning the components of a composite steel joist is that no element (including the shear connectors) reaches its design strength prior to bottom chord yielding.



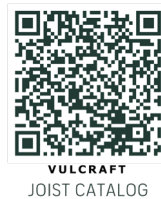
## SHEAR CONNECTORS

Vulcraft designs the shear connectors and their layout to transfer the compression force from the joist top chord into the slab. Shear connector size, quantity, and spacing are designed to develop the yield force of the bottom chord. Welded shear studs are installed onto the joists in the same manner as beams. Vulcraft provides top chord members with sufficient thickness and leg size for the shear stud diameter provided. Vulcraft does not provide the shear studs.



## CAMBER

Standard camber is often adequate for non-composite joists, as shown in Table 4.6-1 of the SJI specification (see page 127 of the [Vulcraft Joist catalog](#)). Loads that create a deflection of  $L/360$  are shown in the load tables. These loads can be prorated to show the deflection from any uniform load, such as construction dead load to check camber. Vulcraft can vary the camber if specified clearly on the structural drawing.



It is standard practice to design and fabricate composite joists with sufficient camber to offset the calculated deflection from a minimum of 100 percent of the non-composite dead loads. With the composite joist cambered for 100% of the non-composite dead load and the floor slab placed to a uniform thickness, the floor will be approximately level after the concrete has been placed.

If additional camber is desired for a portion of the superimposed dead and live loads, the Specifying Professional shall provide the percentages of those loads (if any) on the structural drawings. Joists of any type can also be cambered to meet the requirements of a specific application. For example, a joist at the perimeter can be cambered so that the camber is removed with the application of the dead load from the floor system plus the dead load of the building cladding. This will provide an approximately level floor for simpler installation of the exterior windows.

## JOIST LOCATION NEAR STRUCTURAL "HARD POINTS"

When sidewalls, beams, columns, etc., that support the deck/slab are adjacent and parallel to floor joists, a cambered joist placed too close can cause fit-up issues. To reduce construction issues due to camber, it is recommended that the first steel joist be placed one full space from these members. Camber and deflections can be adjusted and coordinated.

## LATERAL FORCE RESISTING SYSTEMS

Composite steel joists can be used as diaphragm components such as chords, collectors, and other transfer elements in the same way non-composite joists are used. Composite steel joists can also be used within a moment frame system designated as a System Not Specifically Detailed for Seismic Resistance in Seismic Design Category A applications to resist the effects of wind load combinations. Please see SJI Technical Digests 11 & 13 for limitations and other guidance.

## **CONSTRUCTION PHASE CONSIDERATIONS**

The same basic construction practices used for conventional non-composite steel joists can be employed for composite joists.

### **ERECTION & BRIDGING**

Bridging must be installed after the joists are placed and before the deck is attached. This stabilizes the top chord and keeps the joists plumb during deck installation. Before construction loads are placed on the joists, all bridging and bridging anchors must be installed entirely. Vulcraft will design and provide the necessary bridging for safe installation.

### **STAGED CONCRETE POUR**

When joists are long enough to require a staged concrete pour, the first pour should occur at the middle section of the joist. This allows a larger portion of the camber to come out of the joist and significantly reduces the force from construction dead loads to the studs near the ends of the joists.

## **SERVICEABILITY**

### **DEFLECTION**

The superimposed live load limitation is assumed to be  $L/360$ . However, other limitations and the associated load case can be specified.

### **MECHANICAL ACCOMMODATIONS**

One significant advantage of specifying Vulcraft CJ composite joists is the ability to pass mechanical ducts, piping, conduit, etc., through the web system. For additional information, refer to the Approximate Duct Opening Sizes table on page 66 of this guide or contact the local Vulcraft engineering contact.



Vierendeel openings are an option to accommodate larger mechanical ducts to utilize ducts that would otherwise be too large to fit a typical web layout. Generally, the horizontal width of the opening should be no more than 2 times the joist depth. Any Vierendeel openings should be within the middle 1/3 of the joist span. Contact Vulcraft before specifying Vierendeel openings.



## FIRE RESISTANCE

Steel joists and deck are often used in buildings that require fire resistance assemblies. K, LH, and CJ joists are easily incorporated into many published fire resistance designs. K and LH joist fire resistance tables are published in the Vulcraft Joist Catalog. CJ composite steel joists are designed to meet the minimum requirements of UL Beam Designs N789, N736, and N825 and can be substituted for the structural member in the specified UL fire resistance assembly. See Fire Resistance Ratings later in this guide for additional information on using K, LH, and CJ joists in fire-rated assemblies.

Fire protection costs can be a significant portion of the overall system cost. When spray-applied fire protection is specified, it is economical to minimize the number of joists and bridging pieces by spacing them as far apart as feasible. Under certain circumstances, bridging for composite steel joists can be removed after the concrete has cured, which may further reduce the cost of fire protection. Contact Vulcraft before removing any bridging.

## VIBRATION ANALYSIS

Significant advancements have improved vibration characteristics. The [Vibration Analysis Design Tool](#) can be used to investigate vibration characteristics. This tool is based on AISC Steel Design Guide 11, Floor Vibrations Due to Human Activity, along with [white papers and case studies](#) prepared for Vulcraft by Brad Davis, Ph.D., S.E., and Thomas Murray, Ph.D., P.E.



Flush frame connections to the girder can provide vibration characteristics similar to those of steel beams. For more information about the vibrations of steel joists, see the section on Flush Frame Connections.

In general, a system's vibration performance can be improved by:

- Using Flush Frame joist end connections instead of standard bearings
- Adding damping elements
- Increasing the joists' stiffness with a specified minimum Moment of Inertia
- Adding additional weight, such as a heavier slab or flooring

Vulcraft engineers are available to assist the Specifying Professional to address vibration concerns.

# DIVISION OF DESIGN RESPONSIBILITIES

## RESPONSIBILITY OF VULCRAFT

Vulcraft's responsibility as the manufacturer of the engineered product:

- Design the joists to safely and efficiently carry all specified loads and load cases. This includes cambering each joist per SJI standards or as specified.
- If Flush Frame Connections are specified, design and furnish the end connection plate. Coordinate the end reaction location with the connection designer. For more information, see the section on Flush Frame Connections.
- Provide joist and deck drawings for coordination and approval. Provide final layout drawings for joist and deck erection.
- If Composite Joists are specified:
  - Shear stud design, spacing, and quantity calculation is by Vulcraft, and communicated via Vulcraft placement drawings. (Shear studs area supplied by others)
  - Design joists for the specified loading.





## **RESPONSIBILITY OF SPECIFYING PROFESSIONAL**

The project engineer of record (EOR) is responsible for the structure's design, including specifying the joists and designing appropriate connections between the joists and wide-flange girders or other supporting members.

To expedite composite steel joist design, the Specifying Professional should provide the following:

### **1. JOIST DEPTH**

This depth only includes the steel joist portion, not the deck & slab. For composite joists, only parallel top and bottom chords are allowed at this time.

### **2. FINISH**

Composite Joists are typically unprimed because shear studs require a bare top chord, and spray-applied fireproofing adheres better to uncoated steel, especially on larger members. If primer is needed, the top chords and upper portion of the webs will be left uncoated.

### **3. JOIST SPACING**

The distance (feet-inches) to the adjacent members (or to the edge of the slab for an exterior joist)

### **4. JOIST DESIGN**

The loads required to design composite joists are as follows:

- Non-composite DL
  - Concrete, joists, deck, bridging, and any other non-composite dead loads. Vulcraft will assume joist weight is included in loadings unless specified otherwise. Alternatively, Vulcraft can add for joist self-weight if directed. Example note: "Joist self-weight is not included in loading given for joist design. Joist manufacturer shall add self-weight of the joists to the specified loading for design".
- Construction LL
  - Typically, 20 to 50 psf or as recommended by the contractor or others. Guidance on Construction Live Loads can be found in ASCE/SEI 37-14, Section 4.8.1.1
- Superimposed (Composite) DL
  - Partitions, mechanical, electrical, fireproofing, floor covering, ceilings, and other composite dead loads.
- Composite LL
  - Reduced design live loads can be used to specify the joist loading if applicable.

# DIVISION OF DESIGN RESPONSIBILITIES

- Camber
  - Standard camber for non-composite joists is shown in the camber tables in the Vulcraft joist catalog and varies by span length. Increased stiffness or a non-standard camber can provide a flat floor under any loading. Vulcraft engineers can help determine the best solution.
  - The standard camber for composite joists is for 100% of non-composite dead loads. After placing the concrete, the goal is for the composite joist to provide a flat floor. Camber can also be calculated and provided for any additional loads.

## 5. IN THE CASE OF FLUSH FRAME CONNECTIONS

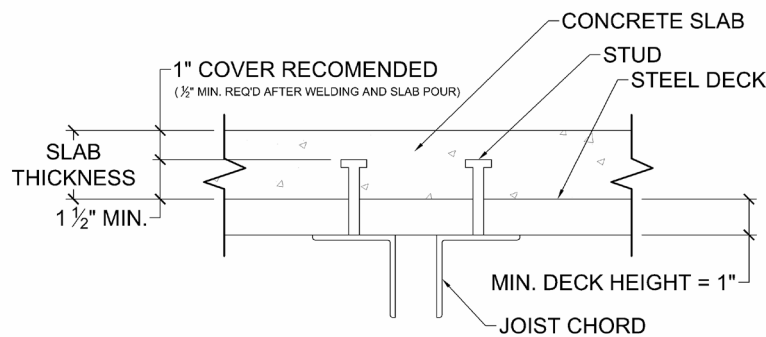
- Size, grade, number, and spacing of bolts
- Design of connection plate attached to the supporting member (girder, column, wall, etc.)
- Location of working point of joist reaction (center of girder, bolt group, or other location)
- See the section on Flush Frames for more guidance.

## 6. STEEL DECK

- Deck Type
  - Vulcraft publishes various literature and online design tools. The Specifying Professional is ultimately responsible for specifying the deck profile and gauge. Available deck types for composite and non-composite joist designs range from 1 to 3½ inches deep. Push-off tests conducted for Vulcraft have produced values for shear studs in decks greater than 3" deep. To learn more about product availability by region, contact your local Vulcraft representative.
- Gauge
  - Available deck gauges range from 24ga to 16ga, depending on deck type.
- Deck coating & finish
  - Mill finish: For floor decks, galvanized G60 is standard; G90 is also available.
  - Shop coating: No added finish is standard. Gray or White primer is available.

## 7. SLAB ABOVE FLOOR DECK

- Concrete
  - ° Topping Thickness
    - The actual final slab thickness (inches) above the top of the deck. The final minimum slab thickness above the top of the deck must be at least 2 inches; however, 2½ inches is the minimum specified thickness recommended by Vulcraft due to tolerances for the after-welded stud length, camber, and concrete placement. After concrete placement, shear connectors must have at least ½ inch of concrete cover. The concrete shall be placed to provide a constant thickness along the span unless other accommodations have been specified and coordinated.
  - ° Concrete Unit Weight (pcf)
    - Normal weight (typically approximately 145 pcf), Lightweight (typically approximately 110 - 120 pcf), or other as specified
  - ° Concrete Compressive Strength
    - The 28-day specified compressive strength of concrete (typically 4 to 5 ksi)



Openings for stairways, elevator shafts, etc., reduce effective slab width and must be considered. Since the concrete slab must have adequate compressive strength to develop the bottom chord force, the joist may need to be conservatively designed non-compositely. Consultation with Vulcraft engineers may be necessary.

Provisions for field inspection of projects involving steel joists are by others. Typical inspections may include verification of the concrete strength and thickness, and in the case of composite joists, shear connector attachment and placement. For more information on shear connector placement and welding, see the "Standard Specifications for Composite Steel Joists," Section 106, on page 29 of the [Vulcraft Composite Joist catalog](#).





## EXAMPLE PROJECTS



### **ASSOCIATED WHOLESALE GROCERS – KANSAS CITY, KS (PICTURED)**

Composite joists spanning 117'-9" were used to clear the span over the existing data center, which could not be shut down when the additional floors were added. Composite steel joists were selected to support second and third-level office floors after considering several solutions offered by George Butler and Associates, Project Architects, Kansas City, KS, and A.T. Renczarski and Co., Structural Engineers, Kansas City, MO.

### **REED ARENA – TEXAS A & M UNIVERSITY**

Composite joists support the 12,000 ft<sup>2</sup> office and conference room area at the end of the arena. These joists span 83 ft. and are spaced at 8 ft. c-c.

### **TORGENSEN HALL - VIRGINIA TECH**

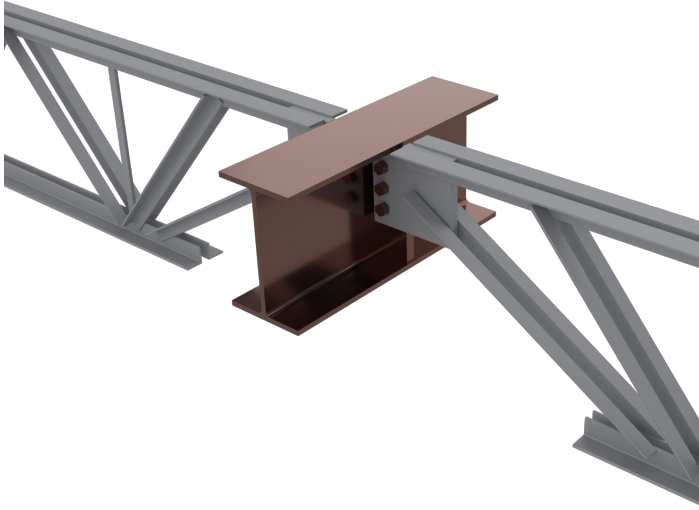
This building utilized 26" deep CJ joists at 10' c-c spanning 39'-7" plus a 7' cantilever.

### **UNIVERSITY OF COLORADO-BOULDER – STUDENT REC CENTER**

This building used 76" deep composite joists spanning 116'-3" at 7' c-c. These joists support a tennis court on the roof over a hockey rink.



## FLUSH FRAME CONNECTIONS



Flush Framed Connections are similar to simple beam-to-girder single-plate shear connections. This connection aligns the top of the joist chord with the top of the girder, eliminating the joist bearings on the girder. While Vulcraft has provided this connection detail for over 10 years, recent research and testing have helped to show and confirm that the issues that may have caused hesitation in the past in utilizing steel joists for floor systems have been resolved. Issues such as floor vibration, floor-to-floor height, heavier non-composite girders due to joist bearings creating a gap between the girder flange and the slab, and tight joist spacing hindering mechanical installation are outdated legacy issues that no longer exist.

### SOME OF THE ADVANTAGES OF FLUSH FRAMED CONNECTIONS OVER TRADITIONAL JOIST SEATS:

**ALL JOIST TYPES:** All joist types can be fabricated with flush framed connections (K, LH, CJ). While joist girders can also be designed compositely, wide flange beam girders or structural steel trusses are generally more economical. For this guide, "girder" refers to a wide flange beam girder.

**GIRDERS CAN BE DESIGNED COMPOSITELY:** Direct contact between the slab and girder allows the girder to be designed compositely, resulting in significant material savings.

#### SIGNIFICANTLY IMPROVED VIBRATION CONTROL:

By eliminating the gap between the slab and girder created by the joist bearing and its associated transverse flexibility, the girder can be connected directly to the slab and participate in vibration control. This increases the girder panel weight ( $W_g$ ) used in vibration calculations by 12.5%. The combined advantages of flush-framed joist connection systems are that they often reduce floor accelerations by 27% compared to joists with standard seats.

**REDUCED FLOOR-TO-FLOOR HEIGHT:** Without the extra depth required for joist seats, overall floor-to-floor heights can be reduced, providing architectural and economic benefits. Mechanical ducts, etc., can often be passed through the joists instead of requiring a plenum underneath or expensive beam penetrations. The plenum may be eliminated, allowing reduced story height or enabling more economical and/or stiffer joists. Bulkheads for ductwork below the ceiling will no longer be needed.

**EFFICIENT MATERIAL USE:** With improved stiffness from composite girders and flexibility of joist depths, designers can achieve the required performance with the same or less material compared to traditional systems. The needed joist stiffness can be achieved by incrementally increasing the depth while using the same or less material. Less material directly results in less embodied carbon.



**DIRECT TRANSFER OF LATERAL FORCES:** The direct contact allows lateral forces to transfer directly between the slab and the girder.

**PROVEN AND PREFERRED RESULTS:** Since 2020, over 90% of all CJ-Series joists have been fabricated with flush-framed top chord bolted seats.

## WORKING POINT, ECCENTRICITY & TORSION

Common connection design methods for single-plate shear connections for wide flange beams to girders incorporate the provisions of AISC and other research to resolve any torsion induced into the girder by the configuration of the bolt group and its eccentricity from the girder centerline. The methods use the ductility of the plate to shed this moment to the beam — in this case, the joist. This does not increase the beam size since simply supported W-shaped beams typically have unutilized moment capacity near the connections. Joists do not typically have this unutilized capacity, so they must be designed to resist this moment due to eccentricity.

The eccentricity can be reduced by adjusting the location of the joist end reaction (working point). The working point determines the design length of the joists and is located at the intersection of the neutral axes of the top chord and the first web member of the joist (see pages 22, 23, and 24). Locating the working point over the bolt group will provide the least costly joist design due to a shorter joist length and no eccentricity applied to the joist. However, this eccentricity will apply torsion to the girder. In the case of a standard shear plate connection, this torsion may not affect the size of the girder depending on girder bracing, construction sequence, and the possibility of unequal superimposed load on opposite sides of the girder during the service life of the floor. During construction, the girder may resist torsion, especially if a brace is applied since only construction loading will be present. After construction, the girder and slab may be able to resist possible torsion from unequal superimposed loads.

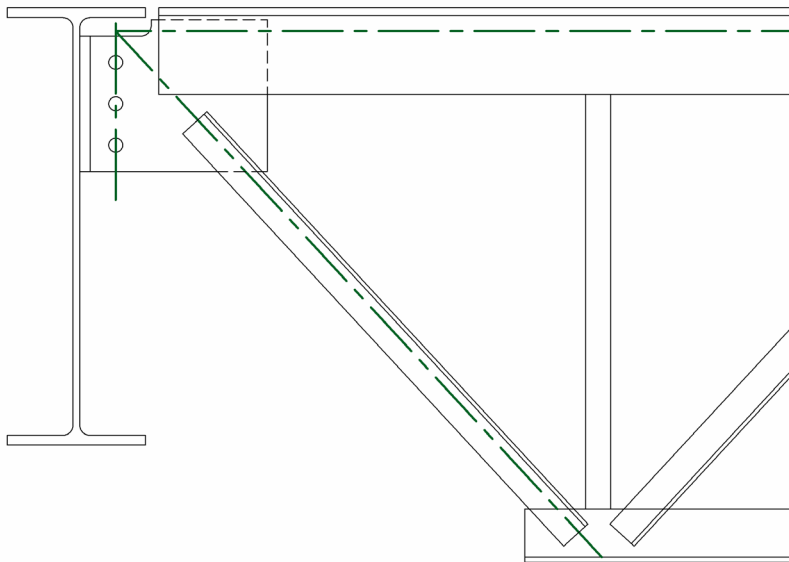
Locating the working point closer to or at the girder centerline will eliminate some or most torsion applied to the girder. The joist must be designed to resist the eccentricity developed due to the distance from the girder centerline to the bolt group. This, along with the longer joist design length, will result in a heavier joist. In the case of perimeter connections where the girder is loaded from only one side, locating the working point at or near the girder centerline may be the best option unless other provisions, such as girder bracing, are made to counter the created eccentricity.

The location of the working point assumed by the specifier when designing the girder must be provided to Vulcraft. Regardless of the working point location, Vulcraft will design the joists for the eccentricity developed. Work with your local Vulcraft engineer to determine the best solution for your project. The working point can be located wherever the best economy or feasibility occurs since both torsion in the girder or moment into the joist can increase the cost. Again, the critical point is that the expectation of the working point location is clearly communicated in the structural documents so that Vulcraft and the connection designer can account for the expected eccentricity.

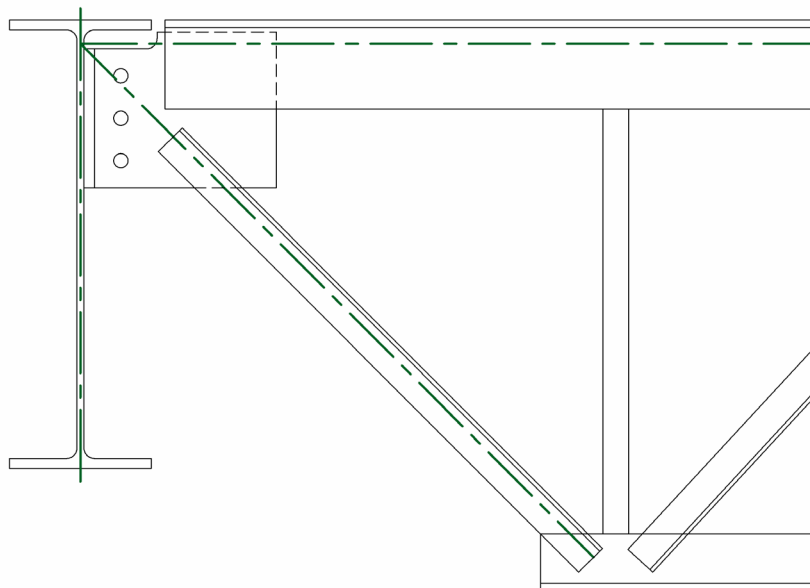


## TYPICAL FLUSH FRAME DETAILS

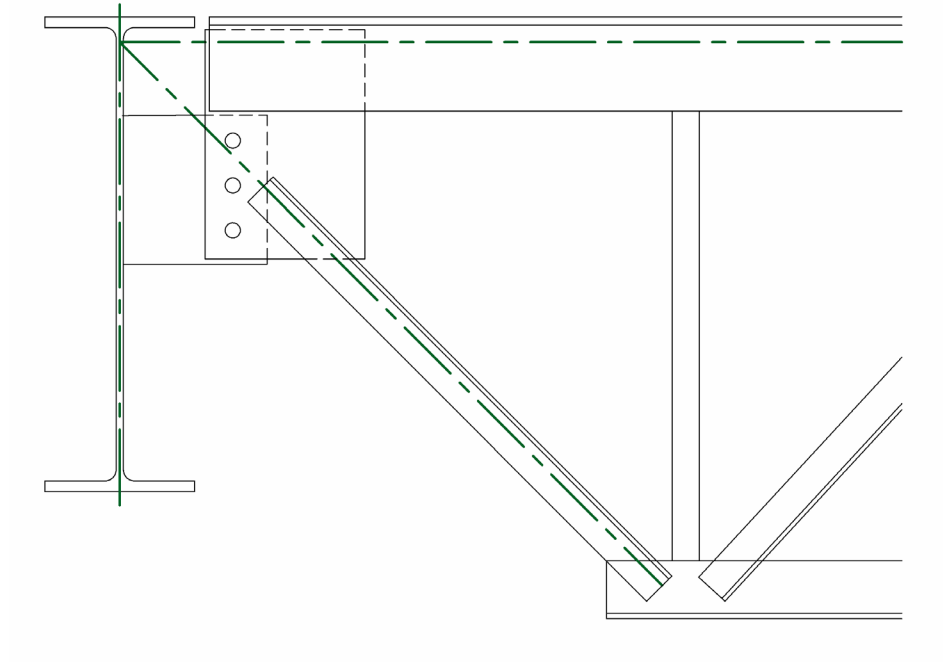
STANDARD SHEAR TAB - WORKING POINT OVER THE BOLT GROUP:



STANDARD SHEAR TAB - WORKING POINT AT OR NEAR THE GIRDER CENTERLINE:

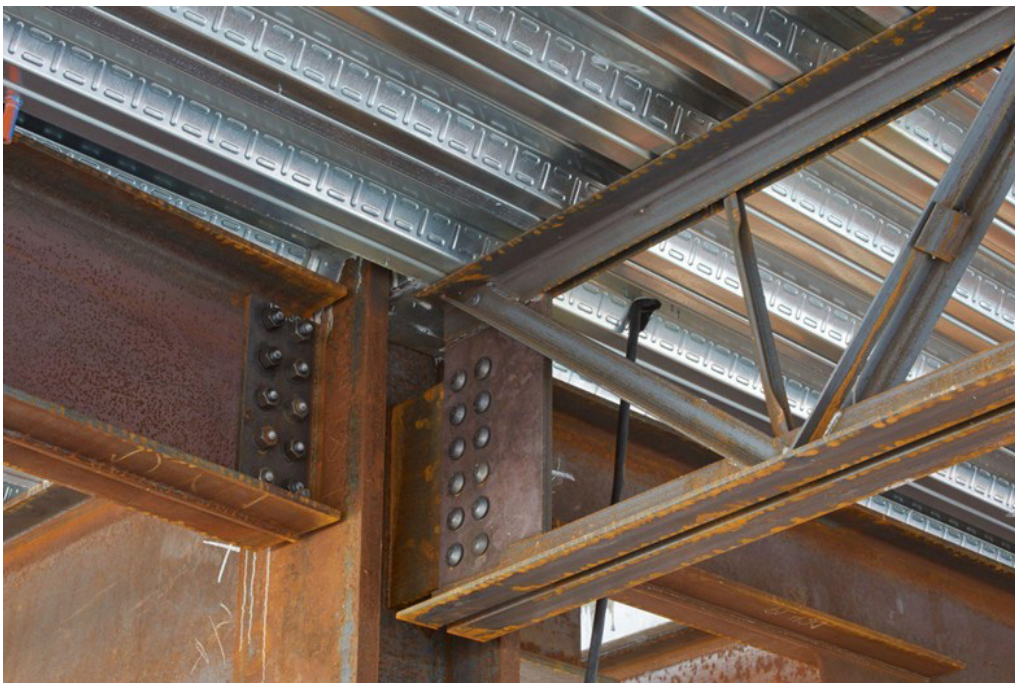
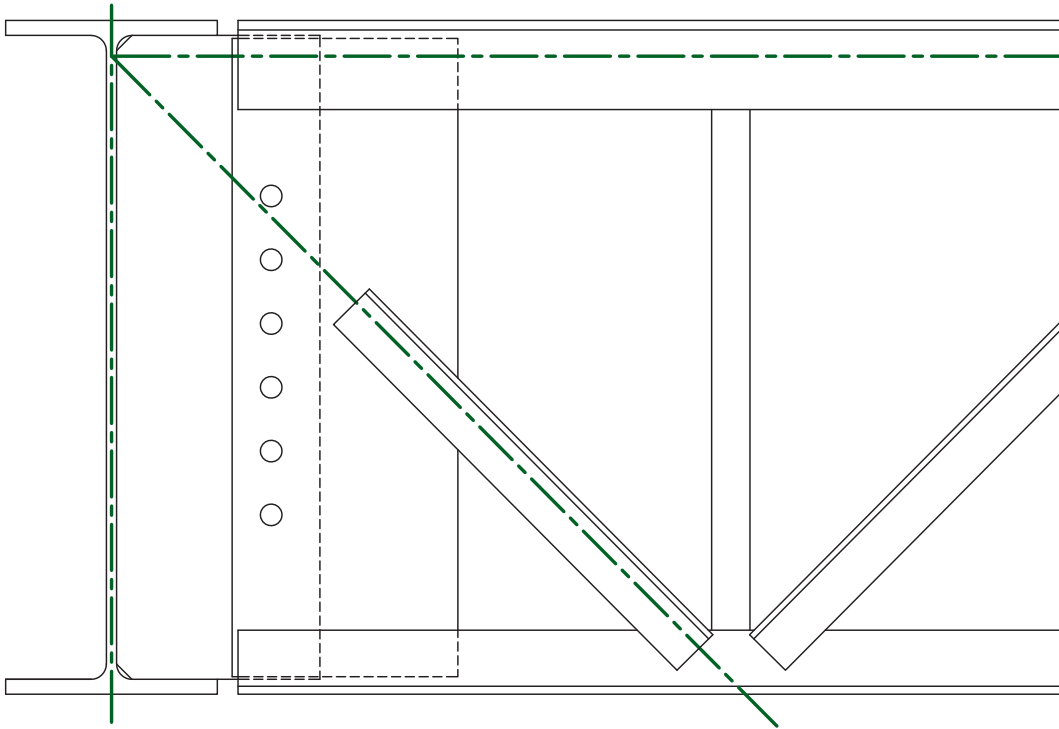


## EXTENDED SHEAR PLATE - WORKING POINT AT OR NEAR THE GIRDER CENTERLINE





## FULL DEPTH EXTENDED SHEAR PLATE



## FLUSH FRAME CONNECTIONS REDUCE VIBRATION

The standard for determining the adequacy of composite and non-composite steel joist-supported concrete floors subject to human movement, such as walking and rhythmic activities, is Technical Digest #5, 2nd Edition, by the Steel Joist Institute and authors Thomas M. Murray, Ph.D., P.E., and Brad Davis, Ph.D., S.E. Technical Digest #5 can be purchased from the Steel Joist Institute.

Vulcraft has conducted additional research and testing, specifically regarding vibration control using flush frame connections. Dr. Murray and Dr. Davis have also conducted this research. The resulting research papers from this Vulcraft research can be found on the Vulcraft website at the links below.

- The research paper, "Vibration of Vulcraft Steel Joists with Flush Framed and Flush Bearing Seat Connections," states that "where steel joists are used with flush framed end connections, vibration behaviors are the same as for W-shape beam and girder systems." See: [Vibration of Vulcraft Steel Joists with Flush Framed and Flush Bearing Seat Connections](#) by Thomas M. Murray, Ph.D., P.E. and Brad Davis, Ph.D., S.E., published January 28, 2020

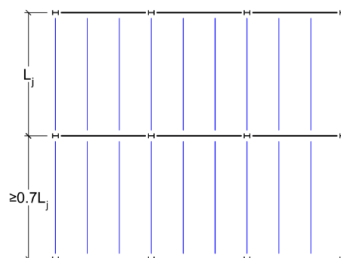


- Case studies such as The Seaport L4 office in Boston and studies with data collected using instrumentation such as the 1785 Columbus Avenue building and retail distribution center buildings have shown that the predicted vibration control is indeed achieved. See [Vulcraft Vibration Research Composite Joists with Flush Framed Connections 1785 Columbus Avenue, Boston, MA](#) by Thomas M. Murray, Ph.D., P.E. and Brad Davis, Ph.D., S.E., published March 15, 2022



A summary of this research has provided these conclusions:

- Joist end connections using Flush Frames connected to the girder web are equivalent to a typical beam-to-girder web connection. For vibration considerations, the girder is fully composite. Since the transverse flexibility of joist-bearing seats is eliminated, the coefficient  $C_g$  can be increased from 1.6 to 1.8 (the same as W-shape beams), which increases the calculated girder panel weight by 12.5%.
- When "an adjacent span is greater than 0.7 times the span under consideration, the effective joist panel weight ( $W_j$ ) can be increased by 50%" (AISC DG11, Sec 4.1.2).



- Joists with flush framed connections provide vibration characteristics equivalent to wide flange beams with the same effective stiffness.
- Steel joists with flush-framed end connections have the same vibration behaviors as the W-shape beam and girder systems.
- The vibration characteristics predicted were confirmed with in-field tests.



Dr. Brad Davis, University of Kentucky, measured floor vibration in a retail distribution center. Vibration testing confirmed the predicted results.

## How do the conclusions about Flush Frame Connections reduce vibration?

Following the procedure in Chapter 3 of SJI TD5, the overall acceleration ratio calculation is defined in Equation 3.1 as,

$$\frac{a_p}{g} = \frac{65e^{-0.35f_n}}{\beta W} < \frac{a_0}{g}$$

The two factors in this equation that can be controlled by design are  $f_n$  and  $W$ .

Where,

$f_n$  = Natural frequency of the bay in consideration, Hz

$W$  = effective weight of the combined mode, lbs.

$f_n$  is a function of the effective stiffness of the joists and girders. This is the only factor that can be affected by the floor framing member designs. Increasing the stiffness of any of the members will decrease the acceleration ratio of the system. The calculation of  $W$  is slightly longer and combines the joist panel weight and girder panel weights. It is defined in Equation 3.6 as

$$W = \frac{\Delta_j}{\Delta_j + \Delta_g} W_j + \frac{\Delta_g}{\Delta_j + \Delta_g} W_g$$

Where,

$W_j$  = joist panel mode weight, lbs. This can be increased by 50% if the adjacent span is at least 70% of the span under consideration, as noted on page 25.

$W_g$  = panel weight of the girder with the lower natural frequency, lbs.



$W_g$  is defined as:

$$W_g = \frac{w_g}{L_{jAvg}} B_g L_g$$

$B_g$  - the effective girder panel width (ft) is:

Equation 3.4

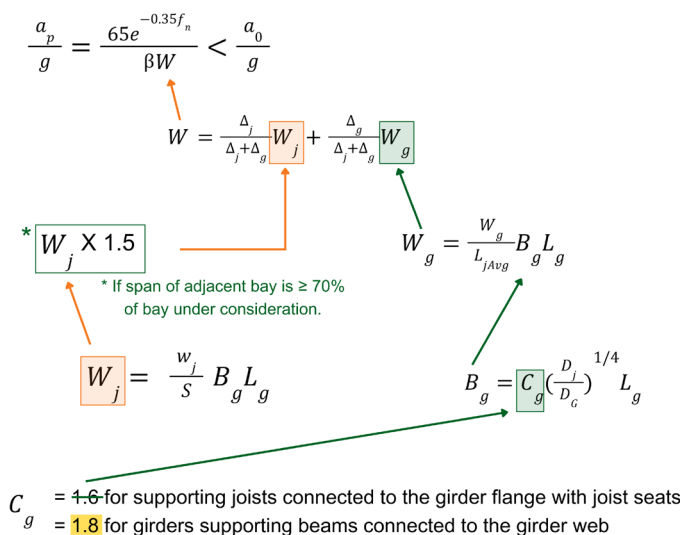
$$B_g = C_g \left( \frac{D_j}{D_g} \right)^{1/4} L_g$$

Where,

$C_g =$  1.6 for girders supporting joists with seats;  
1.8 for girders supporting joists connected to the girder web (12.5% increase) Equation 3.5

The improved  $C_g$  increases the girder panel effective width  $B_g$  by 12.5%, which also increases the girder panel weight  $W_g$  by the same percentage.

This graphic can help understand how the increase of the factor  $C_g$  affects the girder panel weight, and the increased joist panel weight (if it applies) can significantly reduce the acceleration ratio and vibration.



The [Vulcraft Vibration Analysis Tool](#) performs these calculations for you.



## SPECIFYING FLUSH-FRAME CONNECTIONS

Vulcraft will design all the joist components and welds for the specified loading and other requirements, including the shear studs (if composite) and the shear end plate incorporated into the joists. The Specifying Professional or delegated connection engineer designs and specifies the remaining information, requirements, and components of the flush-frame connection. Coordination with Vulcraft is encouraged.

### **SPECIFIER OR CONNECTION DESIGNER:**

1. Determine whether the girder shear plate will be a standard or extended type and specify the minimum width and length of the shear plate. A standard non-extended shear tab is where the vertical row of bolts is within the flange of the girder, while an extended shear tab is where the vertical row of bolts is beyond the flange. This plate can be coped to fit under the beam flange.



2. Determine whether the joist end reaction (working point) should be located at the center of the girder web, bolt line, or other location.
3. Design the bolt group for the moment due to the eccentric reaction.
4. Do not design the bolts as slip-critical (unless considered necessary).
5. For conditions at the building perimeter, consider including additional bracing for the girder to minimize rotation.

### **TYPICAL SUGGESTIONS AND PREFERENCES BY JOIST MANUFACTURERS:**

1. Use A325 or A490  $\frac{3}{4}$ " or 1" diameter bolts.
2. A minimum of three bolts is recommended, ideally arranged in a single line.
3. Typical joist end plate thickness is 1 inch (typical width of joist top chord angle gap).
4. Indicate horizontal short slots in the shear tab.

### **VULCRAFT NEEDS TO KNOW:**

1. Distance from girder centerline to bolt line.
2. Bolt size, grade, quantity, and spacing. Bolts are not provided by Vulcraft.
3. Location of the top bolt from the top of the girder.
4. Location of the expected working point of the joist end reaction.

### **VULCRAFT'S RESPONSIBILITIES INCLUDE:**

1. Design the joist end plate and the joist for all forces and moments.
2. If the specifying professional specifies that the joist end reaction is to be located at the center of the girder web or anywhere other than the bolt line, Vulcraft will design the joist for the eccentric moment created in addition to all other loading unless otherwise specified.
3. Determine and coordinate whether the magnitude of the eccentric moments indicates a recommendation or requirement for braces to reduce the effects on the joist and girder.

## USING COMPOSITE JOISTS IN STORM SHELTERS

Critical infrastructure facilities such as K-12 schools, emergency operations centers, and fire, rescue, ambulance, police, and 911 call stations are particularly vital in tornado-prone areas. Beginning with the 2015 International Building Code, many Risk Category III and IV facilities, such as schools, must include tornado shelters compliant with the ICC 500 "Standard for the Design and Construction of Storm Shelters." Schools are exceptionally high risk due to the large number of occupants commonly present.

Composite joist systems are particularly suited and efficient for resisting the required 100 psf live load and the downward and upward loads created by tornadoes. They have been used in dozens of storm shelters of many sizes and building types.

Due to the ability of composite joists to resist large loads over large clear spans, many of the more common examples of their use have been in K-12 schools. This dual purpose requires enough space to accommodate all students and faculty. Therefore, school gymnasiums are often the most desirable locations for such a shelter. Since the space must be free of columns to not impede the playing area, dozens of school gymnasiums in high-risk regions of the U.S., including Texas, Oklahoma, Kansas, Minnesota, Iowa, and Tennessee, have been constructed with Vulcraft composite joists. Vulcraft has licensed engineers nationwide with considerable experience assisting with efficient design and exchanging information regarding storm shelter design. They can provide valuable support to specifying professionals and other project partners regarding connections, value engineering, and other vital information to help build efficient and safe designs for these structures.

Because of the unique combination of composite steel joists, concrete, and wind loads, upward wind loads should be defined as either net uplift ( $0.9D + 1.0W$ ), or gross uplift with clarification on whether any or all of the composite dead load is to be included in the uplift calculation. Our recommendation is to conservatively assume that none of the composite dead load would be present to resist gross uplift in a storm event.

Please consult your local Vulcraft engineer for information and assistance when considering framing for storm shelters.



52" Deep CJ Joists spanning 83' gymnasium designed as a storm shelter.



ECONOMICAL FLOOR SYSTEM TABLES

The following tables serve as a guide for preliminary floor construction designs using steel joists and deck. They were generated using the Vulcraft Floor Wizard online tool, which is freely accessible to all specifiers. The Floor Wizard allows users to explore alternative scenarios beyond the assumptions that produced these tables. They serve as a useful starting point for preliminary framing layouts by providing the most economical combinations of joist depth, type, and spacing, along with deck type, gauge, and total slab depth. They also show the large spans and loading capacities available.



For each combination of span and superimposed load (composite DL + LL), the tables provide five elements describing the most economical system:

- 1. Combined weight of the steel joists, bridging, and steel deck (psf)
- 2. Recommended joist depth and type
- 3. Recommended deck type, gauge, and total slab depth for the loading and spacing.

Tables are provided for normal-weight concrete (145 pcf) and lightweight concrete (115 pcf). They are created based on common UL fire-rated assemblies of 1 to 3 hours and non-rated designs.

Joist Span (ft)	Joist Depth & Type, Spacing	
	50 (Reducible)	60 (Reducible)
40	3.9 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.01 psf 36CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
45	4.21 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.4 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)
50	4.6 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.7 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)

Combined Weight of Joist + Bridging + Deck

Total Slab Depth on Deck Type (Gauge)

These tables are based on:

- Assumptions of relative costs for joists, deck, shear studs (for composite joists), concrete, and erection based on typical materials and requirements.
- All loading shown is at the ASD level.
  - Since composite joist design includes concrete, the LRFD method is mandated. However, specifiers do not need to provide factored loads. Vulcraft will factor the loads according to the appropriate IBC combinations and design the joists using LRFD.
- Joists are designed with standard parallel chords.
- The concrete strength ( $f'_c$ ) used is 4 ksi.
  - Higher concrete strength may be advantageous or required for longer joist spans or heavier loads.

All superimposed loading is assumed to be live load.

Deflection from superimposed loads is limited to  $L/360$ . No other considerations for serviceability are considered since no parameters or requirements are known. To check vibration, use the [Vulcraft Vibration Analysis tool](#).

- For the non-composite deck profiles, the minimum slab thickness is determined only by the fire rating. The determination of deck gauge is based solely on the maximum allowable unshored span. Final deck-slab design for superimposed loads is by others.
- The cost of fireproofing, if required, is not considered in the cost comparison.
- Unshored clear spans were determined assuming a 2-span condition.

The provided deck gauges are for estimation and comparison purposes only. The final sizes should be determined in an overall engineering analysis.

# ECONOMICAL GUIDE TABLES

## Most Economic Joist & Deck/Slab System Normal Weight Concrete, 1-Hour Unprotected Deck Assembly

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
40	3.9 psf	4.03 psf	4.17 psf	4.36 psf	4.62 psf	5.12 psf	5.76 psf
	40CJ @ 9'-0" c-c	36CJ @ 9'-0" c-c	36CJ @ 9'-0" c-c	40CJ @ 9'-0" c-c	40CJ @ 9'-0" c-c	40CJ @ 6'-6" c-c	36CJ @ 9'-0" c-c
	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)
45	4.19 psf	4.21 psf	4.43 psf	4.54 psf	4.91 psf	5.77 psf	6.07 psf
	40CJ @ 9'-0" c-c	40CJ @ 6'-6" c-c	44CJ @ 9'-0" c-c	40CJ @ 9'-0" c-c	44CJ @ 9'-0" c-c	44CJ @ 9'-0" c-c	44CJ @ 9'-6" c-c
	5 1/2" on 2VLI (20)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)
50	4.29 psf	4.43 psf	4.73 psf	4.87 psf	5.35 psf	6.06 psf	6.59 psf
	40CJ @ 6'-6" c-c	40CJ @ 6'-6" c-c	44CJ @ 9'-0" c-c	44CJ @ 9'-0" c-c	36CJ @ 9'-0" c-c	44CJ @ 7'-6" c-c	44CJ @ 7'-6" c-c
	5" on 1.5VL (22)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (22)	5 1/2" on 2VLI (22)
55	4.67 psf	4.85 psf	4.9 psf	5.27 psf	5.58 psf	6.68 psf	7.41 psf
	40CJ @ 6'-6" c-c	48CJ @ 8'-6" c-c	40CJ @ 6'-6" c-c	44CJ @ 9'-0" c-c	40CJ @ 9'-0" c-c	52CJ @ 6'-6" c-c	52CJ @ 9'-0" c-c
	5" on 1.5VL (22)	5 1/2" on 2VLI (20)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)
60	4.99 psf	5.12 psf	5.27 psf	5.39 psf	5.71 psf	7.35 psf	8.02 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 9'-0" c-c	48CJ @ 6'-6" c-c	44CJ @ 6'-6" c-c	56CJ @ 9'-0" c-c	48CJ @ 9'-0" c-c
	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5" on 1.5VL (22)	5" on 1.5VL (22)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)
65	5.36 psf	5.63 psf	5.76 psf	5.91 psf	6.37 psf	8.21 psf	8.99 psf
	48CJ @ 9'-0" c-c	56CJ @ 10'-0" c-c	56CJ @ 10'-0" c-c	52CJ @ 10'-0" c-c	52CJ @ 10'-0" c-c	56CJ @ 10'-0" c-c	66CJ @ 10'-0" c-c
	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)
70	5.75 psf	5.97 psf	5.94 psf	6.07 psf	6.51 psf	8.58 psf	9.26 psf
	56CJ @ 10'-0" c-c	56CJ @ 10'-0" c-c	56CJ @ 9'-0" c-c	56CJ @ 9'-0" c-c	48CJ @ 9'-0" c-c	48CJ @ 9'-0" c-c	66CJ @ 10'-0" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (19)
75	5.91 psf	6.03 psf	6.16 psf	6.35 psf	7.03 psf	9.14 psf	10.08 psf
	56CJ @ 9'-0" c-c	56CJ @ 9'-0" c-c	56CJ @ 9'-0" c-c	56CJ @ 9'-0" c-c	56CJ @ 10'-0" c-c	56CJ @ 9'-0" c-c	66CJ @ 9'-6" c-c
	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (19)
80	6.28 psf	6.43 psf	6.62 psf	6.86 psf	7.52 psf	9.7 psf	10.41 psf
	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 9'-0" c-c	56CJ @ 10'-0" c-c	72CJ @ 10'-0" c-c	66CJ @ 9'-6" c-c
	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)
90	7.17 psf	7.37 psf	7.69 psf	8.07 psf	8.35 psf	10.78 psf	11.8 psf
	60CJ @ 10'-0" c-c	60CJ @ 10'-0" c-c	60CJ @ 10'-0" c-c	60CJ @ 10'-0" c-c	60CJ @ 9'-6" c-c	66CJ @ 10'-0" c-c	72CJ @ 9'-0" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)
100	7.94 psf	8.55 psf	8.62 psf	8.73 psf	9.16 psf	11.71 psf	13.1 psf
	88DLH @ 9'-0" c-c	88DLH @ 8'-6" c-c	60CJ @ 8'-6" c-c	60CJ @ 9'-0" c-c	60CJ @ 9'-0" c-c	72CJ @ 8'-6" c-c	72CJ @ 7'-6" c-c
	5 1/2" on 2VLI (20)	5" on 1.5VL (19)	5" on 1.5VL (19)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (20)	5 1/2" on 2VLI (22)
110	9.05 psf	9.19 psf	9.35 psf	9.63 psf	9.97 psf	13.65 psf	14.54 psf
	96DLH @ 10'-0" c-c	80CJ @ 10'-0" c-c	66CJ @ 10'-0" c-c	72CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	88CJ @ 9'-0" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)
120	9.38 psf	9.7 psf	9.77 psf	10.14 psf	10.61 psf	14.15 psf	15.94 psf
	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 8'-6" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)
130	10.61 psf	10.59 psf	10.64 psf	11.03 psf	11.52 psf	15.52 psf	17.81 psf
	88DLH @ 8'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 8'-6" c-c	96CJ @ 8'-6" c-c
	5" on 1.5VL (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)	5" on 1.5VL (19)
140	11.28 psf	11.79 psf	11.83 psf	12.27 psf	12.88 psf	17.56 psf	19.84 psf
	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 8'-6" c-c	96CJ @ 8'-6" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (20)	5" on 1.5VL (19)
150	11.82 psf	12.28 psf	12.48 psf	12.86 psf	13.66 psf	18.68 psf	21.2 psf
	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 7'-6" c-c	96CJ @ 7'-6" c-c
	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (19)	5 1/2" on 2VLI (22)	5" on 1.5VL (20)

**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 2-Hour Unprotected Deck Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	4.12 psf 36CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	4.24 psf 36CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	4.39 psf 36CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	4.55 psf 36CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.05 psf 36CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	5.55 psf 36CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.08 psf 36CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>45</b>	4.5 psf 40CJ @ 7'-0" c-c 6" on 1.5VL (20)	4.4 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.74 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	4.88 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.11 psf 40CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.06 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.73 psf 40CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>50</b>	4.6 psf 40CJ @ 7'-0" c-c 6" on 1.5VL (22)	4.7 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.98 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.22 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.72 psf 44CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	6.57 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	7.19 psf 44CJ @ 9'-0" c-c 6 1/2" on 2VLI (20)
<b>55</b>	4.91 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	5.02 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	5.16 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	5.66 psf 44CJ @ 7'-0" c-c 6" on 1.5VL (20)	6.06 psf 40CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	7.13 psf 40CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	7.99 psf 48CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>60</b>	5.4 psf 48CJ @ 7'-0" c-c 6" on 1.5VL (20)	5.48 psf 48CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.55 psf 48CJ @ 6'-0" c-c 6" on 1.5VL (22)	5.84 psf 48CJ @ 7'-0" c-c 6" on 1.5VL (20)	6.42 psf 44CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	7.61 psf 48CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	8.12 psf 48CJ @ 6'-0" c-c 6" on 1.5VL (22)
<b>65</b>	6.04 psf 56CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	6.06 psf 56CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	6.14 psf 56CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	6.31 psf 52CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	6.48 psf 52CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	8.35 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	9.17 psf 52CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)
<b>70</b>	6.08 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.18 psf 52CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.45 psf 56CJ @ 8'-6" c-c 6 1/2" on 2VLI (19)	6.42 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.94 psf 48CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	9.22 psf 56CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	9.53 psf 66CJ @ 9'-6" c-c 7 1/2" on 3VLI (20)
<b>75</b>	6.36 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.49 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.63 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	7.19 psf 56CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	7.34 psf 52CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	9.44 psf 52CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	10.51 psf 66CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>80</b>	6.85 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	7.04 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	7.53 psf 60CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	7.3 psf 56CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	8.03 psf 60CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.28 psf 66CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.86 psf 66CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>90</b>	8.2 psf 88DLH @ 7'-0" c-c 6" on 1.5VL (20)	8.01 psf 60CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	8.39 psf 60CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	8.69 psf 60CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	8.76 psf 60CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	11.42 psf 72CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.16 psf 66CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)
<b>100</b>	8.76 psf 88DLH @ 8'-0" c-c 6 1/2" on 2VLI (20)	9.39 psf 88DLH @ 7'-6" c-c 6" on 1.5VL (19)	9.34 psf 66CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	9.59 psf 72CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	9.87 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.31 psf 72CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	13.45 psf 72CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
<b>110</b>	9.5 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	9.88 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	9.93 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.24 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.67 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	14.08 psf 88CJ @ 10'-0" c-c 7 1/2" on 3VLI (20)	15.51 psf 88CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)
<b>120</b>	10.46 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.53 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.9 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	10.95 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	11.43 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	15.07 psf 96CJ @ 9'-6" c-c 6 1/2" on 2VLI (18)	17.14 psf 96CJ @ 10'-0" c-c 7 1/2" on 3VLI (20)
<b>130</b>	11.34 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	11.68 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	11.78 psf 80CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.22 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.47 psf 96CJ @ 10'-0" c-c 7 1/2" on 3VLI (20)	16.37 psf 96CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	18.12 psf 96CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
<b>140</b>	12.1 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.4 psf 88CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	12.75 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	13.09 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	13.92 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	18.49 psf 96CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	20.21 psf 96CJ @ 7'-6" c-c 6" on 1.5VL (19)
<b>150</b>	13.09 psf 96CJ @ 9'-6" c-c 6 1/2" on 2VLI (18)	13.32 psf 96CJ @ 9'-6" c-c 6 1/2" on 2VLI (18)	13.78 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	14.04 psf 96CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	14.66 psf 96CJ @ 10'-0" c-c 6 1/2" on 2VLI (18)	19.89 psf 96CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	22.07 psf 96CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)



**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 3-Hour Unprotected Deck Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	4.33 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	4.39 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	4.55 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	4.72 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.04 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.65 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	6.47 psf 36CJ @ 7'-6" c-c 7 1/4" on 2VLI (18)
<b>45</b>	4.64 psf 40CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	4.88 psf 44CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	5 psf 40CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	5.05 psf 40CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.32 psf 40CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	6.32 psf 40CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.55 psf 40CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>50</b>	4.98 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.07 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.17 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.43 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.77 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	6.72 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.21 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>55</b>	5.34 psf 48CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.39 psf 48CJ @ 7'-0" c-c 7 1/4" on 2VLI (20)	5.47 psf 40CJ @ 5'-6" c-c 6 3/4" on 1.5VL (22)	5.82 psf 44CJ @ 6'-6" c-c 6 3/4" on 1.5VL (20)	6.3 psf 40CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	7.25 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.93 psf 40CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>60</b>	5.9 psf 56CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	5.73 psf 48CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	5.92 psf 48CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	6.13 psf 48CJ @ 6'-6" c-c 6 3/4" on 1.5VL (20)	6.71 psf 48CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	7.83 psf 44CJ @ 7'-0" c-c 7 1/4" on 2VLI (20)	8.77 psf 44CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>65</b>	6.08 psf 52CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.18 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.31 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.51 psf 52CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	7.01 psf 48CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	8.6 psf 52CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	9.15 psf 52CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>70</b>	6.47 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.59 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.57 psf 56CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	6.71 psf 56CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.41 psf 52CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	9.45 psf 66CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	9.93 psf 66CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)
<b>75</b>	6.82 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	6.79 psf 56CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.05 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	7.27 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	7.81 psf 56CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	9.6 psf 52CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	10.89 psf 66CJ @ 9'-0" c-c 7 1/4" on 2VLI (18)
<b>80</b>	7.18 psf 56CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.39 psf 56CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	7.95 psf 56CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	7.99 psf 60CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	8.32 psf 60CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	10.24 psf 60CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	11.36 psf 66CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)
<b>90</b>	8.54 psf 60CJ @ 8'-0" c-c 6 3/4" on 1.5VL (18)	8.73 psf 60CJ @ 8'-0" c-c 6 3/4" on 1.5VL (18)	8.98 psf 60CJ @ 8'-0" c-c 6 3/4" on 1.5VL (18)	9.04 psf 60CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	9.21 psf 60CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)	11.56 psf 72CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	12.45 psf 72CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>100</b>	9.35 psf 88DLH @ 7'-6" c-c 7 1/4" on 2VLI (20)	9.44 psf 80CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	9.54 psf 72CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	9.77 psf 80CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	10.26 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	13.02 psf 72CJ @ 8'-0" c-c 7 1/4" on 2VLI (19)	14.26 psf 72CJ @ 7'-6" c-c 7 1/4" on 2VLI (20)
<b>110</b>	10.24 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	10.28 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	10.59 psf 80CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	10.67 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	11.15 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	14.49 psf 88CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	15.59 psf 88CJ @ 9'-0" c-c 8 1/4" on 3VLI (20)
<b>120</b>	10.92 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	11.3 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	11.36 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	11.78 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	11.91 psf 80CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	15.37 psf 96CJ @ 9'-0" c-c 8 1/4" on 3VLI (20)	17.11 psf 96CJ @ 8'-0" c-c 7 1/4" on 2VLI (19)
<b>130</b>	12.05 psf 96CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	12.15 psf 96CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	12.35 psf 88CJ @ 10'-0" c-c 8 1/4" on 3VLI (19)	12.76 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	13.35 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	16.98 psf 88CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	19.65 psf 96CJ @ 8'-6" c-c 6 3/4" on 1.5VL (16)
<b>140</b>	12.67 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	13.16 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	13.3 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	13.74 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	14.43 psf 96CJ @ 9'-0" c-c 7 1/4" on 2VLI (18)	18.88 psf 88CJ @ 8'-6" c-c 8 1/4" on 3VLI (20)	21.34 psf 96CJ @ 8'-0" c-c 6 3/4" on 1.5VL (18)
<b>150</b>	13.91 psf 88CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	14.25 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	15.17 psf 96CJ @ 10'-0" c-c 7 1/4" on 2VLI (16)	14.76 psf 96CJ @ 8'-6" c-c 7 1/4" on 2VLI (19)	15.31 psf 96CJ @ 9'-6" c-c 7 1/4" on 2VLI (18)	20.2 psf 96CJ @ 7'-0" c-c 7 1/4" on 2VLI (20)	22.89 psf 96CJ @ 7'-0" c-c 6 3/4" on 1.5VL (19)

**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 2.5" Topping Thickness**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	3.71 psf	3.83 psf	3.78 psf	4.2 psf	4.37 psf	5.02 psf	5.37 psf
	40CJ @ 9'-6" c-c	36CJ @ 9'-6" c-c	36CJ @ 8'-0" c-c	32CJ @ 8'-6" c-c	40CJ @ 9'-6" c-c	36CJ @ 8'-6" c-c	36CJ @ 8'-6" c-c
	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4" on 1.5VL (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>45</b>	4.09 psf	4.03 psf	4.07 psf	4.31 psf	4.48 psf	5.39 psf	5.82 psf
	40CJ @ 8'-6" c-c	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	44CJ @ 9'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c
	4" on 1.5VL (20)	4" on 1.5VL (22)	4" on 1.5VL (22)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>50</b>	4.09 psf	4.21 psf	4.36 psf	4.49 psf	4.83 psf	5.82 psf	6.39 psf
	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c
	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>55</b>	4.29 psf	4.55 psf	4.54 psf	4.71 psf	5.07 psf	6.44 psf	7.12 psf
	40CJ @ 7'-0" c-c	48CJ @ 9'-6" c-c	48CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	40CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	52CJ @ 9'-6" c-c
	4" on 1.5VL (22)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (20)
<b>60</b>	4.47 psf	4.57 psf	4.81 psf	5.19 psf	5.39 psf	6.9 psf	7.68 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c
	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4" on 1.5VL (20)	4" on 1.5VL (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>65</b>	4.74 psf	4.92 psf	5.34 psf	5.52 psf	5.8 psf	7.68 psf	8 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	52CJ @ 9'-6" c-c	52CJ @ 9'-6" c-c	52CJ @ 8'-6" c-c
	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4" on 1.5VL (20)	4" on 1.5VL (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)
<b>70</b>	5.01 psf	5.19 psf	5.61 psf	5.74 psf	6.17 psf	8.05 psf	8.94 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	56CJ @ 9'-6" c-c	48CJ @ 9'-6" c-c	48CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c
	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4" on 1.5VL (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>75</b>	5.54 psf	5.67 psf	5.79 psf	5.93 psf	6.19 psf	8.77 psf	9.69 psf
	56CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	52CJ @ 8'-6" c-c	56CJ @ 9'-6" c-c	66CJ @ 10'-0" c-c
	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (19)
<b>80</b>	5.67 psf	5.83 psf	5.98 psf	6.16 psf	6.79 psf	9.37 psf	10.09 psf
	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	80CJ @ 9'-6" c-c	66CJ @ 9'-6" c-c
	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4" on 1.5VL (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)
<b>90</b>	6.62 psf	6.82 psf	6.75 psf	6.98 psf	7.72 psf	10.24 psf	10.96 psf
	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	60CJ @ 9'-6" c-c	72CJ @ 9'-6" c-c	72CJ @ 8'-6" c-c
	4" on 1.5VL (20)	4" on 1.5VL (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)
<b>100</b>	7.3 psf	7.65 psf	8.04 psf	8.06 psf	8.37 psf	11.36 psf	12.64 psf
	88DLH @ 9'-6" c-c	88DLH @ 9'-6" c-c	88DLH @ 8'-6" c-c	56CJ @ 8'-6" c-c	60CJ @ 8'-6" c-c	72CJ @ 8'-6" c-c	72CJ @ 7'-6" c-c
	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4" on 1.5VL (20)	4" on 1.5VL (20)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)	4 1/2" on 2VLI (22)
<b>110</b>	8.19 psf	8.47 psf	8.87 psf	9.25 psf	9.77 psf	12.96 psf	13.89 psf
	96DLH @ 10'-0" c-c	96DLH @ 9'-6" c-c	96DLH @ 8'-6" c-c	72CJ @ 10'-0" c-c	66CJ @ 10'-0" c-c	88CJ @ 9'-6" c-c	88CJ @ 9'-6" c-c
	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4" on 1.5VL (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)
<b>120</b>	8.83 psf	9.06 psf	9.38 psf	9.73 psf	10.17 psf	13.91 psf	15.17 psf
	88DLH @ 8'-6" c-c	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 9'-6" c-c	96CJ @ 9'-0" c-c
	4" on 1.5VL (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)
<b>130</b>	9.36 psf	9.7 psf	9.85 psf	10.18 psf	10.63 psf	14.89 psf	16.99 psf
	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 9'-0" c-c	96CJ @ 8'-6" c-c
	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)
<b>140</b>	10.25 psf	10.62 psf	10.99 psf	11.16 psf	11.65 psf	16.5 psf	-
	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 9'-6" c-c	80CJ @ 9'-6" c-c	96CJ @ 8'-6" c-c	-
	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (22)	-
<b>150</b>	11.04 psf	11.72 psf	11.93 psf	12.36 psf	12.87 psf	-	-
	96DLH @ 8'-6" c-c	96CJ @ 10'-0" c-c	96CJ @ 9'-6" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	-	-
	4" on 1.5VL (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (20)	4 1/2" on 2VLI (19)	4 1/2" on 2VLI (19)	-	-

**Most Economic Joist & Deck/Slab System**  
**Lightweight Concrete, 1-Hour Unprotected Deck Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	3.4 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.48 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.62 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.73 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.06 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.85 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.31 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>45</b>	3.58 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.76 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.98 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.04 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.32 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.19 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.7 psf 44CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)
<b>50</b>	3.96 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.05 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.24 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.31 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.64 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.73 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.26 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>55</b>	4.11 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.26 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.42 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.52 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.85 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.3 psf 52CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.92 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>60</b>	4.25 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.4 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.51 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.64 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.19 psf 44CJ @ 7'-6" c-c 4" on 1.5VL (22)	6.67 psf 56CJ @ 7'-0" c-c 4" on 1.5VL (22)	7.46 psf 56CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)
<b>65</b>	4.48 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.6 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.76 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.06 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.61 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.21 psf 52CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	8.03 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>70</b>	4.84 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.98 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.04 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.29 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.78 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.7 psf 60CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)	8.62 psf 56CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>75</b>	5.39 psf 56DLH @ 7'-6" c-c 4" on 1.5VL (22)	5.39 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.5 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.62 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.99 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.35 psf 52CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	9.16 psf 66CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>80</b>	5.44 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.68 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.83 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	6 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	6.38 psf 56CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)	8.93 psf 56CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	9.49 psf 66CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>90</b>	6.15 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	6.31 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	6.48 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	6.85 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	7.07 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	9.66 psf 72CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	10.7 psf 66CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>100</b>	6.59 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	7.08 psf 88DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.36 psf 88DLH @ 9'-0" c-c 4 1/2" on 2VLI (22)	8.05 psf 88DLH @ 8'-6" c-c 4" on 1.5VL (20)	8.04 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.82 psf 72CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	12.39 psf 72CJ @ 8'-0" c-c 4" on 1.5VL (20)
<b>110</b>	7.5 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.8 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.02 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.89 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.14 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	12.71 psf 88CJ @ 10'-0" c-c 4 1/2" on 2VLI (19)	13.68 psf 88CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>120</b>	8.13 psf 88DLH @ 8'-6" c-c 4" on 1.5VL (20)	8.67 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.94 psf 72CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.08 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.49 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	13.69 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (19)	14.88 psf 96CJ @ 9'-6" c-c 4 1/2" on 2VLI (19)
<b>130</b>	8.68 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.22 psf 88DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.4 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.79 psf 72CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.28 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	14.27 psf 88CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	16.25 psf 96CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>140</b>	9.3 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.44 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.89 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.32 psf 80CJ @ 9'-6" c-c 4 1/2" on 2VLI (20)	11.1 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	15.77 psf 96CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	- - -
<b>150</b>	10.19 psf 96DLH @ 9'-0" c-c 4 1/2" on 2VLI (22)	11.02 psf 96DLH @ 8'-6" c-c 4" on 1.5VL (20)	11.2 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	11.52 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	12.51 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	- - -	- - -

**Most Economic Joist & Deck/Slab System**  
**Lightweight Concrete, 2-Hour Unprotected Deck Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	3.69 psf	3.94 psf	4.05 psf	3.99 psf	4.37 psf	4.9 psf	5.35 psf
	40CJ @ 9'-6" c-c	40CJ @ 8'-6" c-c	36CJ @ 8'-6" c-c	36CJ @ 7'-0" c-c	40CJ @ 9'-6" c-c	36CJ @ 7'-0" c-c	40CJ @ 8'-6" c-c
	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (22)
<b>45</b>	4.09 psf	4.22 psf	4.07 psf	4.31 psf	4.4 psf	5.41 psf	5.8 psf
	40CJ @ 8'-6" c-c	40CJ @ 8'-6" c-c	40CJ @ 7'-0" c-c	44CJ @ 9'-6" c-c	40CJ @ 8'-6" c-c	44CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c
	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (22)
<b>50</b>	4.06 psf	4.16 psf	4.36 psf	4.48 psf	4.71 psf	5.7 psf	6.28 psf
	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c	40CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c	44CJ @ 8'-6" c-c
	4 3/4" on 1.5VL (22)	4 3/4" on 1.5VL (22)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)
<b>55</b>	4.29 psf	4.45 psf	4.56 psf	4.69 psf	5.06 psf	6.4 psf	7.12 psf
	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	40CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c	40CJ @ 8'-6" c-c	44CJ @ 8'-0" c-c	52CJ @ 9'-6" c-c
	4 3/4" on 1.5VL (22)	4 3/4" on 1.5VL (22)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (20)
<b>60</b>	4.46 psf	4.87 psf	4.98 psf	5.22 psf	5.45 psf	6.8 psf	7.67 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	56CJ @ 9'-6" c-c	48CJ @ 7'-0" c-c	44CJ @ 8'-6" c-c
	5 1/4" on 2VLI (22)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (22)	5 1/4" on 2VLI (22)
<b>65</b>	4.65 psf	4.78 psf	4.96 psf	5.52 psf	5.8 psf	7.53 psf	8 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	52CJ @ 9'-6" c-c	60CJ @ 8'-6" c-c	52CJ @ 8'-6" c-c
	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)
<b>70</b>	5.27 psf	5.44 psf	5.61 psf	5.77 psf	5.99 psf	8 psf	8.69 psf
	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c	52CJ @ 9'-6" c-c	48CJ @ 8'-6" c-c	48CJ @ 8'-6" c-c
	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)
<b>75</b>	5.49 psf	5.58 psf	5.79 psf	5.81 psf	6.11 psf	8.37 psf	9.69 psf
	52CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	56CJ @ 9'-6" c-c	56CJ @ 8'-6" c-c	52CJ @ 8'-6" c-c	66CJ @ 10'-0" c-c
	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (19)
<b>80</b>	5.91 psf	6.08 psf	6.23 psf	6.38 psf	6.79 psf	8.88 psf	9.99 psf
	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	60CJ @ 8'-6" c-c	66CJ @ 10'-0" c-c
	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (19)
<b>90</b>	6.45 psf	6.82 psf	7.01 psf	7.17 psf	7.41 psf	10.16 psf	10.96 psf
	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	56CJ @ 8'-6" c-c	72CJ @ 10'-0" c-c	72CJ @ 8'-6" c-c
	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (22)
<b>100</b>	7.35 psf	7.55 psf	8.04 psf	8.06 psf	8.39 psf	11.17 psf	12.42 psf
	88DLH @ 10'-0" c-c	88DLH @ 9'-6" c-c	88DLH @ 8'-6" c-c	56CJ @ 8'-6" c-c	60CJ @ 9'-0" c-c	72CJ @ 9'-0" c-c	72CJ @ 8'-0" c-c
	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)
<b>110</b>	8.09 psf	8.36 psf	8.91 psf	9.2 psf	9.68 psf	12.62 psf	13.72 psf
	96DLH @ 10'-0" c-c	96DLH @ 9'-6" c-c	96DLH @ 9'-6" c-c	80CJ @ 10'-0" c-c	72CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	88CJ @ 10'-0" c-c
	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	6 1/4" on 3VLI (22)	6 1/4" on 3VLI (22)
<b>120</b>	8.79 psf	9.02 psf	9.38 psf	9.46 psf	10.15 psf	13.86 psf	15.17 psf
	88DLH @ 8'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	88CJ @ 10'-0" c-c	96CJ @ 9'-0" c-c
	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)
<b>130</b>	9.52 psf	9.47 psf	9.79 psf	10.17 psf	10.62 psf	14.77 psf	16.6 psf
	88DLH @ 10'-0" c-c	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	80CJ @ 10'-0" c-c	96CJ @ 9'-0" c-c	96CJ @ 8'-0" c-c
	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (20)
<b>140</b>	10.25 psf	10.38 psf	10.76 psf	11.03 psf	11.64 psf	16.45 psf	18.31 psf
	96DLH @ 9'-6" c-c	80CJ @ 8'-6" c-c	80CJ @ 9'-6" c-c	80CJ @ 10'-0" c-c	80CJ @ 9'-6" c-c	96CJ @ 8'-6" c-c	96CJ @ 8'-0" c-c
	5 1/4" on 2VLI (20)	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (20)	5 1/4" on 2VLI (22)	5 1/4" on 2VLI (22)
<b>150</b>	11.01 psf	11.5 psf	11.82 psf	11.92 psf	12.86 psf	17.62 psf	22.98 psf
	96DLH @ 8'-6" c-c	80CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 10'-0" c-c	96CJ @ 8'-0" c-c	96CJ @ 8'-6" c-c
	4 3/4" on 1.5VL (20)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (19)	6 1/4" on 3VLI (22)	5 1/4" on 2VLI (19)	5 1/4" on 2VLI (22)	4 3/4" on 1.5VL (20)



**Most Economic Joist & Deck/Slab System**  
**Lightweight Concrete, 3-Hour Unprotected Deck Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	3.81 psf 36CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.01 psf 40CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.04 psf 32CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.27 psf 36CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.47 psf 36CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	5.05 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	5.64 psf 40CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)
<b>45</b>	4.15 psf 40CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.17 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	4.36 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.45 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.76 psf 40CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	5.5 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	6.19 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)
<b>50</b>	4.25 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	4.35 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	4.65 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.8 psf 44CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)	5.15 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.24 psf 44CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.75 psf 40CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)
<b>55</b>	4.5 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	4.7 psf 48CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.8 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	5.03 psf 40CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	5.42 psf 44CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	6.56 psf 44CJ @ 7'-6" c-c 6 3/16" on 2VLI (22)	7.29 psf 52CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)
<b>60</b>	4.82 psf 48CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.95 psf 48CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	4.96 psf 48CJ @ 7'-6" c-c 6 3/16" on 2VLI (22)	5.24 psf 48CJ @ 7'-6" c-c 6 3/16" on 2VLI (22)	5.79 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	7.15 psf 48CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	7.72 psf 56CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)
<b>65</b>	5.46 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.6 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.74 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.76 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	6.2 psf 48CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	7.99 psf 52CJ @ 9'-6" c-c 6 3/16" on 2VLI (19)	8.39 psf 52CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)
<b>70</b>	5.64 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.77 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.87 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	5.96 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.25 psf 48CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	8.41 psf 52CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	9.25 psf 66CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)
<b>75</b>	5.75 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	5.89 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.01 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.18 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.6 psf 52CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	8.79 psf 56CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)	9.76 psf 66CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)
<b>80</b>	6.22 psf 56CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	6.25 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.43 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	6.67 psf 56CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)	7.1 psf 56CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	9.22 psf 52CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)	10.39 psf 66CJ @ 9'-6" c-c 6 3/16" on 2VLI (19)
<b>90</b>	7.03 psf 60CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	7.06 psf 56CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	7.28 psf 56CJ @ 6'-6" c-c 5 11/16" on 1.5VL (22)	7.7 psf 60CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	8.05 psf 60CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	10.41 psf 66CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	11.55 psf 66CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)
<b>100</b>	7.66 psf 88DLH @ 9'-0" c-c 6 3/16" on 2VLI (20)	8.34 psf 88DLH @ 8'-6" c-c 5 11/16" on 1.5VL (19)	8.82 psf 88DLH @ 8'-6" c-c 5 11/16" on 1.5VL (19)	8.66 psf 60CJ @ 8'-6" c-c 5 11/16" on 1.5VL (19)	8.79 psf 60CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)	11.7 psf 72CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)	12.67 psf 72CJ @ 7'-6" c-c 6 3/16" on 2VLI (22)
<b>110</b>	8.72 psf 96DLH @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.26 psf 96DLH @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.2 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.38 psf 66CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.92 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	13.55 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	14.25 psf 88CJ @ 10'-0" c-c 7 3/16" on 3VLI (20)
<b>120</b>	9.07 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.38 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.73 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	9.8 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	10.22 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	14.15 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	15.9 psf 96CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)
<b>130</b>	9.81 psf 80CJ @ 9'-6" c-c 6 3/16" on 2VLI (19)	10.22 psf 80CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	10.6 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	11 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	11.46 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	15.98 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	17.41 psf 96CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)
<b>140</b>	10.74 psf 80CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	11.29 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	11.45 psf 80CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	11.89 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	12.48 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	16.84 psf 96CJ @ 9'-0" c-c 6 3/16" on 2VLI (20)	19.42 psf 96CJ @ 8'-0" c-c 6 3/16" on 2VLI (22)
<b>150</b>	11.72 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	12.06 psf 88CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	12.36 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	12.82 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	13.59 psf 96CJ @ 10'-0" c-c 6 3/16" on 2VLI (19)	18.75 psf 96CJ @ 8'-6" c-c 6 3/16" on 2VLI (20)	21.11 psf 96CJ @ 8'-6" c-c 5 11/16" on 1.5VL (19)

**Most Economic Joist & Deck/Slab System**  
**Lightweight Concrete, 2.5" Topping Thickness**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
<b>40</b>	3.4 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.48 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.62 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.73 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.06 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.85 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.31 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>45</b>	3.58 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.76 psf 40CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	3.98 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.04 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.32 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.19 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.7 psf 44CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)
<b>50</b>	3.96 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.05 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.24 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.31 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.64 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.73 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.26 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>55</b>	4.11 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.26 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.42 psf 40CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.52 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.85 psf 36CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.3 psf 52CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	6.92 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>60</b>	4.25 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.4 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.51 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.64 psf 44CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.19 psf 44CJ @ 7'-6" c-c 4" on 1.5VL (22)	6.67 psf 56CJ @ 7'-0" c-c 4" on 1.5VL (22)	7.46 psf 56CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)
<b>65</b>	4.48 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.6 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	4.76 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.06 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.61 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.21 psf 52CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	8.03 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>70</b>	4.84 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	4.98 psf 48CJ @ 7'-6" c-c 4" on 1.5VL (22)	5.04 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.29 psf 48CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	5.78 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.7 psf 60CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)	8.62 psf 56CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>75</b>	5.39 psf 56DLH @ 7'-6" c-c 4" on 1.5VL (22)	5.39 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.5 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.62 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.99 psf 52CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.35 psf 52CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	9.16 psf 66CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>80</b>	5.44 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.68 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	5.83 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	6 psf 56CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	6.38 psf 56CJ @ 8'-6" c-c 4 1/2" on 2VLI (22)	8.93 psf 56CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	9.49 psf 66CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>90</b>	6.15 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	6.31 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	6.48 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	6.85 psf 56CJ @ 8'-6" c-c 4" on 1.5VL (20)	7.07 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	9.66 psf 72CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	10.7 psf 66CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>100</b>	6.59 psf 56CJ @ 7'-6" c-c 4" on 1.5VL (22)	7.08 psf 88DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.36 psf 88DLH @ 9'-0" c-c 4 1/2" on 2VLI (22)	8.05 psf 88DLH @ 8'-6" c-c 4" on 1.5VL (20)	8.04 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.82 psf 72CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	12.39 psf 72CJ @ 8'-0" c-c 4" on 1.5VL (20)
<b>110</b>	7.5 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	7.8 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.02 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.89 psf 96DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.14 psf 60CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	12.71 psf 88CJ @ 10'-0" c-c 4 1/2" on 2VLI (19)	13.68 psf 88CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)
<b>120</b>	8.13 psf 88DLH @ 8'-6" c-c 4" on 1.5VL (20)	8.67 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	8.94 psf 72CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.08 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.49 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	13.69 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (19)	14.88 psf 96CJ @ 9'-6" c-c 4 1/2" on 2VLI (19)
<b>130</b>	8.68 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.22 psf 88DLH @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.4 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.79 psf 72CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.28 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	14.27 psf 88CJ @ 10'-0" c-c 5 1/2" on 3VLI (22)	16.25 psf 96CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)
<b>140</b>	9.3 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.44 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	9.89 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	10.32 psf 80CJ @ 9'-6" c-c 4 1/2" on 2VLI (20)	11.1 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	15.77 psf 96CJ @ 9'-0" c-c 4 1/2" on 2VLI (22)	- - -
<b>150</b>	10.19 psf 96DLH @ 9'-0" c-c 4 1/2" on 2VLI (22)	11.02 psf 96DLH @ 8'-6" c-c 4" on 1.5VL (20)	11.2 psf 80CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	11.52 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	12.51 psf 96CJ @ 10'-0" c-c 4 1/2" on 2VLI (20)	- - -	- - -

**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 1-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	2.93 psf	2.96 psf	3.09 psf	3.47 psf	3.23 psf	3.35 psf	3.68 psf
	26K @ 5'-6" c-c	28K @ 5'-6" c-c	28K @ 5'-6" c-c	26K @ 6'-0" c-c	26K @ 5'-6" c-c	26LH @ 5'-6" c-c	28LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>30</b>	2.98 psf	3.01 psf	3.11 psf	3.33 psf	3.52 psf	3.75 psf	3.86 psf
	28K @ 5'-6" c-c	30K @ 5'-6" c-c	28K @ 5'-6" c-c	28LH @ 5'-6" c-c	28LH @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>35</b>	3.15 psf	3.33 psf	3.64 psf	3.89 psf	4.1 psf	4.25 psf	4.24 psf
	30K @ 5'-6" c-c	30K @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c	28LH @ 5'-6" c-c	28LH @ 5'-6" c-c	36CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)
<b>40</b>	3.41 psf	3.75 psf	3.96 psf	4.18 psf	4.2 psf	4.31 psf	4.47 psf
	30K @ 5'-6" c-c	30LH @ 5'-6" c-c	30LH @ 5'-6" c-c	30LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	36CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>50</b>	4.11 psf	4.39 psf	4.52 psf	4.54 psf	4.7 psf	4.97 psf	5.28 psf
	36LH @ 5'-6" c-c	36LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.4 psf	4.89 psf	4.92 psf	5.41 psf	5.36 psf	5.49 psf	5.69 psf
	44LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	52DLH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)

**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 2-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	3.22 psf	3.29 psf	2.98 psf	3.47 psf	3.04 psf	3.88 psf	3.94 psf
	28K @ 6'-0" c-c	28K @ 6'-0" c-c	26K @ 4'-6" c-c	26K @ 6'-0" c-c	28K @ 4'-6" c-c	28LH @ 6'-0" c-c	28LH @ 6'-0" c-c
	4" on 1.5VL (22)	4" on 1.5VL (22)	3" on 1.0C (26)	4" on 1.5VL (22)	3" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>30</b>	3.26 psf	3.33 psf	3.04 psf	3.08 psf	3.18 psf	3.34 psf	3.54 psf
	30K @ 6'-0" c-c	28K @ 6'-0" c-c	28K @ 4'-6" c-c	30K @ 4'-6" c-c	30K @ 4'-6" c-c	28K @ 4'-6" c-c	28LH @ 4'-6" c-c
	4" on 1.5VL (22)	4" on 1.5VL (22)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)
<b>35</b>	3.05 psf	3.14 psf	3.24 psf	3.42 psf	3.62 psf	4.02 psf	4.18 psf
	28K @ 4'-6" c-c	28K @ 4'-6" c-c	30K @ 4'-6" c-c	30K @ 4'-6" c-c	30LH @ 4'-6" c-c	28LH @ 4'-6" c-c	30LH @ 4'-6" c-c
	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)
<b>40</b>	3.16 psf	3.4 psf	3.63 psf	3.98 psf	4.2 psf	4.31 psf	4.47 psf
	30K @ 4'-6" c-c	30K @ 4'-6" c-c	30K @ 4'-6" c-c	30LH @ 4'-6" c-c	30LH @ 4'-6" c-c	40CJ @ 6'-0" c-c	36CJ @ 6'-0" c-c
	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>50</b>	4.03 psf	4.58 psf	4.44 psf	4.54 psf	4.7 psf	4.97 psf	5.28 psf
	30K @ 4'-6" c-c	44LH @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.27 psf	4.52 psf	4.9 psf	5.18 psf	5.36 psf	5.49 psf	5.69 psf
	44LH @ 4'-6" c-c	44LH @ 4'-6" c-c	44LH @ 4'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3" on 1.0C (26)	3" on 1.0C (26)	3" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)

**Most Economic Joist & Deck/Slab System**  
**Normal Weight Concrete, 3-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	3.17 psf	3.18 psf	3.23 psf	3.27 psf	3.3 psf	3.6 psf	3.88 psf
	24K @ 4'-0" c-c	24K @ 4'-0" c-c	26K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>30</b>	3.34 psf	3.34 psf	3.3 psf	3.35 psf	3.45 psf	3.57 psf	3.78 psf
	28K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	28K @ 4'-0" c-c	28LH @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>35</b>	3.31 psf	3.43 psf	3.53 psf	3.71 psf	3.91 psf	4.3 psf	4.53 psf
	28K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30LH @ 4'-0" c-c	28LH @ 4'-0" c-c	30LH @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>40</b>	3.5 psf	3.74 psf	4 psf	4.34 psf	4.56 psf	4.78 psf	5.02 psf
	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30LH @ 4'-0" c-c	30LH @ 4'-0" c-c	30LH @ 4'-0" c-c	30LH @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>50</b>	4.5 psf	4.74 psf	5.1 psf	5.16 psf	5.4 psf	5.78 psf	5.94 psf
	30K @ 4'-0" c-c	36LH @ 4'-0" c-c	32CJ @ 4'-0" c-c	44LH @ 4'-0" c-c	32CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.88 psf	5.12 psf	6.01 psf	6 psf	6.12 psf	6.3 psf	6.49 psf
	44LH @ 4'-0" c-c	44LH @ 4'-0" c-c	44LH @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)

**Most Economic Joist & Deck/Slab System**  
**Lightweight Concrete, 1-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	2.89 psf	2.92 psf	2.97 psf	3.26 psf	3.53 psf	3.28 psf	3.68 psf
	24K @ 5'-6" c-c	26K @ 5'-6" c-c	28K @ 5'-6" c-c	28K @ 5'-6" c-c	26K @ 6'-0" c-c	26K @ 5'-6" c-c	28LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>30</b>	3.03 psf	2.97 psf	3.03 psf	3.21 psf	3.41 psf	3.62 psf	3.78 psf
	28K @ 5'-6" c-c	28K @ 5'-6" c-c	30K @ 5'-6" c-c	28K @ 5'-6" c-c	28LH @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>35</b>	3.09 psf	3.22 psf	3.42 psf	3.39 psf	3.94 psf	4.17 psf	4.3 psf
	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30K @ 4'-6" c-c	30LH @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (26)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>40</b>	3.3 psf	3.56 psf	3.83 psf	4.05 psf	4.19 psf	4.25 psf	4.44 psf
	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30LH @ 5'-6" c-c	30LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>50</b>	4.1 psf	4.23 psf	4.32 psf	4.46 psf	4.61 psf	4.82 psf	5.08 psf
	30LH @ 5'-6" c-c	36LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	36CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.18 psf	4.56 psf	4.66 psf	4.94 psf	5.19 psf	5.53 psf	5.67 psf
	44LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)



**Most Economic Joist & Deck/Slab System  
Lightweight Concrete, 2-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	2.89 psf	2.92 psf	2.97 psf	3.26 psf	3.53 psf	3.28 psf	3.68 psf
	24K @ 5'-6" c-c	26K @ 5'-6" c-c	28K @ 5'-6" c-c	28K @ 5'-6" c-c	26K @ 6'-0" c-c	26K @ 5'-6" c-c	28LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>30</b>	3.03 psf	2.97 psf	3.03 psf	3.21 psf	3.41 psf	3.62 psf	3.78 psf
	28K @ 5'-6" c-c	28K @ 5'-6" c-c	30K @ 5'-6" c-c	28K @ 5'-6" c-c	28LH @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>35</b>	3.09 psf	3.22 psf	3.42 psf	3.39 psf	3.94 psf	4.17 psf	4.3 psf
	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30K @ 4'-6" c-c	30LH @ 5'-6" c-c	28LH @ 5'-6" c-c	30LH @ 5'-6" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (26)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)
<b>40</b>	3.3 psf	3.56 psf	3.83 psf	4.05 psf	4.19 psf	4.25 psf	4.44 psf
	30K @ 5'-6" c-c	30K @ 5'-6" c-c	30LH @ 5'-6" c-c	30LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>50</b>	4.1 psf	4.23 psf	4.32 psf	4.46 psf	4.61 psf	4.82 psf	5.08 psf
	30LH @ 5'-6" c-c	36LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	36CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.18 psf	4.56 psf	4.66 psf	4.94 psf	5.19 psf	5.53 psf	5.67 psf
	44LH @ 5'-6" c-c	44LH @ 5'-6" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	40CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c	48CJ @ 6'-0" c-c
	3 1/2" on 1.0C (24)	3 1/2" on 1.0C (24)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)

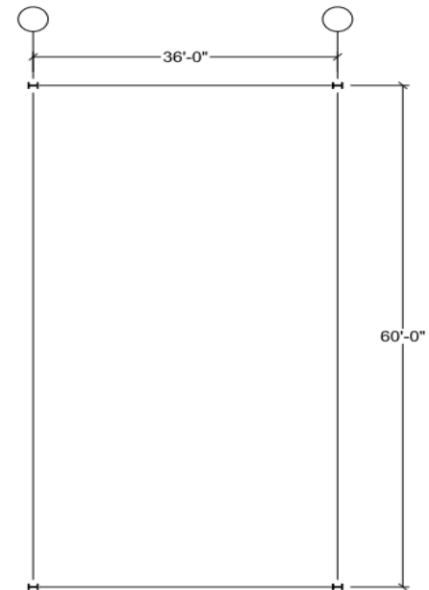
**Most Economic Joist & Deck/Slab System  
Lightweight Concrete, 3-Hour Gypsum Board Assembly**

Joist Span (ft)	Load Superimposed on Slab (PSF)						
	40 (Reducible)	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	90 (Reducible)	100 (Reducible)
<b>25</b>	3.4 psf	3.17 psf	3.18 psf	3.23 psf	3.28 psf	3.32 psf	3.71 psf
	18K @ 4'-0" c-c	24K @ 4'-0" c-c	24K @ 4'-0" c-c	26K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c
	4" on 1.5VL (22)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>30</b>	3.28 psf	3.34 psf	3.35 psf	3.3 psf	3.36 psf	3.41 psf	3.64 psf
	26K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c	30K @ 4'-0" c-c	28K @ 4'-0" c-c	28K @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>35</b>	3.31 psf	3.32 psf	3.45 psf	3.58 psf	3.77 psf	4.08 psf	4.4 psf
	28K @ 4'-0" c-c	28K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	28LH @ 4'-0" c-c	28LH @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)
<b>40</b>	3.4 psf	3.57 psf	3.81 psf	4.11 psf	4.41 psf	4.63 psf	4.99 psf
	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30K @ 4'-0" c-c	30LH @ 4'-0" c-c	30LH @ 4'-0" c-c	32CJ @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)
<b>50</b>	4.2 psf	5.01 psf	4.86 psf	5.19 psf	5.3 psf	5.51 psf	5.84 psf
	30K @ 4'-0" c-c	32CJ @ 4'-0" c-c	36LH @ 4'-0" c-c	32CJ @ 4'-0" c-c	32CJ @ 4'-0" c-c	32CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)
<b>60</b>	4.63 psf	4.9 psf	5.22 psf	6.22 psf	5.99 psf	6.15 psf	6.32 psf
	44LH @ 4'-0" c-c	44LH @ 4'-0" c-c	44LH @ 4'-0" c-c	44LH @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c	40CJ @ 4'-0" c-c
	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4 1/4" on 1.0C (26)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)	4" on 1.5VL (22)

## COMPOSITE JOIST DESIGN EXAMPLE

This example demonstrates the typical use of the Vulcraft Design Tools and how to specify Composite Floor Joists. Given the following bay and other criteria, determine the proper joist designation and other criteria necessary to specify the joist and deck floor system

- Span = 60'
- Type of Occupancy: Office (Business)
  - Per IBC: Live Load (LL) = 50 psf (reducible)
  - Add 15 psf for partitions
  - Collateral/Composite Dead Load (CDL): Mechanical, Electrical, Fireproofing, Floor Covering, Ceiling, Misc.: Use 15 psf
- Fire Rating: 2 hours, assume unprotected deck
- Floor to floor height = 14'. Minimum clear height from floor to joists bottom chord = 10'-6"
- Maximum joist + slab depth = 42"
- Normal Weight Concrete (145 pcf). Recommended for vibration and confirmed by GC.
- 42" - (6" probable minimum slab depth) = 36" max joist depth to maintain floor-to-floor height.
- According to the corresponding economical table in this guide, the least-cost system for an 80 psf superimposed load is 48CJ @ 6' c-c with a 1.5VL 22-gauge deck.



Joist Span (ft)	Load Superimposed on Slab (PSF)						
	50 (Reducible)	60 (Reducible)	70 (Reducible)	80 (Reducible)	100 (Reducible)	125	150
40	3.9 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.01 psf 36CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.22 psf 36CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.29 psf 32CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.62 psf 32CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.32 psf 32CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.72 psf 36CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
	4.21 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.4 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.56 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.75 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	4.94 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.78 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	6.28 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
45	4.6 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.7 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	4.98 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	5.02 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.32 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	6.57 psf 44CJ @ 8'-0" c-c 6 1/2" on 2VLI (20)	6.9 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
	4.91 psf 40CJ @ 6'-0" c-c 6" on 1.5VL (22)	5 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.1 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.29 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.73 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	6.85 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	7.5 psf 40CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
50	5.15 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.27 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.43 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	5.69 psf 48CJ @ 6'-0" c-c 6" on 1.5VL (22)	6.42 psf 44CJ @ 9'-0" c-c 6 1/2" on 2VLI (19)	7.47 psf 44CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)	8.06 psf 48CJ @ 7'-0" c-c 6 1/2" on 2VLI (22)
	5.78 psf	6.06 psf	6.14 psf	6.22 psf	6.48 psf	8.09 psf	9.19 psf

- Since 48" is too deep, use the Vulcraft Floor Wizard design tool with the system depth limitations above.
  - Result: same spacing and deck with a 36" deep joist.
  - Download the associated report from the design tool.
- The report downloaded from the Floor Wizard shows that the 50 psf LL was reduced to 41 psf per IBC Equation 16-7. Please check and confirm.
- 4½" concrete on 1½" composite floor decking. Total slab thickness = 6"
- Construction LL = 20 psf. OK, per GC.
- Vulcraft deck tables, slab & deck weight = 63 psf



VULCRAFT  
FLOOR WIZARD

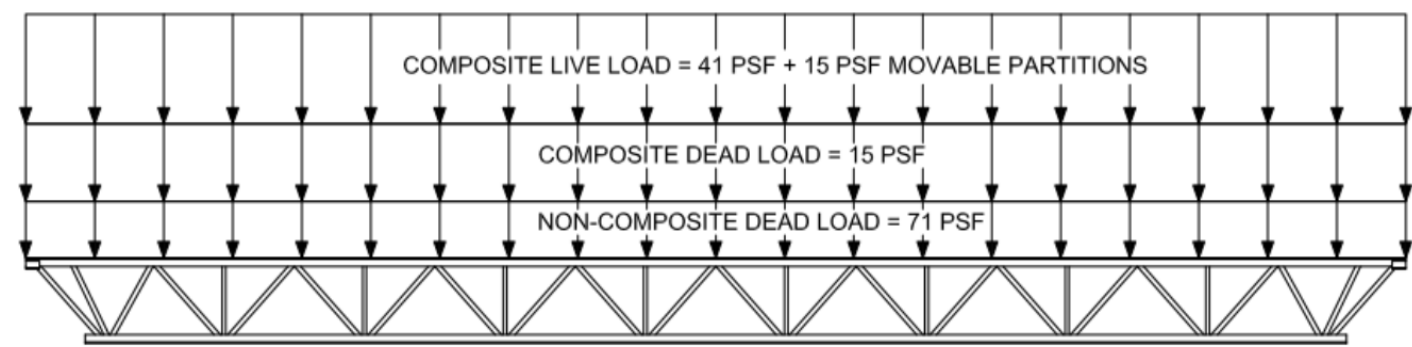
**JOIST GEOMETRY SUMMARY FROM VULCRAFT FLOOR WIZARD TOOL:**

1. Depth	36 in.
2. Span	60 ft.
3. Spacing	6 ft.

**CONCRETE AND DECK SUMMARY:**

1. Type of Floor Deck	1.5VL Composite Steel Deck
2. Depth of Floor Deck	1½ in.
3. Slab Thickness	4.5 + 1.5 = 6 in.
4. Concrete Unit Weight	145 pcf
5. Concrete Compressive Strength	4 ksi

Composite Live Load = 41 + 15 partitions = 56 psf  
Composite Dead Load = 15 psf  
Non-Composite Dead Load = 63 + (assume) 8 psf joists = 71 psf



**ASD LEVEL LOADS:**

1. Composite Live Load (CLL)	56 psf x 6' = 336 plf
2. Composite Dead Load (CDL)	15 psf x 6' = 90 plf
3. Non-composite Construction Dead Load (NCDL)	71 psf x 6' = 426 plf
<b>Total Design Load</b>	<u>852 plf</u>

Joist Designation Summary:

Joist Designation: Depth CJ / Total Load / Composite Live Load / Composite Dead Load

The composite steel joist designation (Service Level): 36CJ 852/336/90

Compare with the designation shown in the downloaded report from the Vulcraft Floor Wizard design tool.

Report designation: 36CJ839/333/90. **The Wizard tool did a great job estimating!**

Alternative LRFD level designation: 36CJ1158/538/108

Specify:

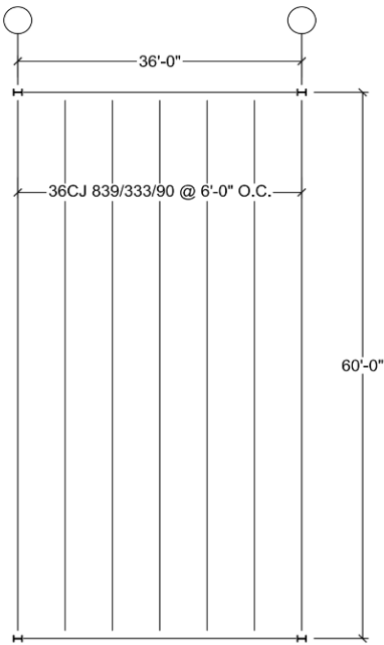
- Whether joist designations include Service or Factored Level loading
- Construction Live Load during Concrete Placement 20 psf
- Bridging: designed and provided by Vulcraft

**CAMBER AND DEFLECTION**

Specify Load to Camber For (e.g.):

Non-Composite Dead Load	100%
Composite Dead Load	0%
Composite Live Load	0%

Maximum Allowable Composite Live Load Deflection: Span/360 unless noted otherwise.



**DUCT OPENING AVAILABLE**

The Approximate Duct Opening Sizes table, located in the back of this guide, shows that a 26-inch round duct opening is available for passage through the web openings of a 36-inch deep composite steel joist. Coordinate larger sizes with Vulcraft and provide the opening size and approximate location on the structural drawing.



# FIRE RATING RECOMMENDATIONS

## FIRE-RESISTANCE RATINGS WITH COMPOSITE AND NON-COMPOSITE STEEL JOISTS

CJ-Series Composite Steel Joists and non-composite steel joists can easily be substituted for the tested structural member in many fire resistance designs published by UL Solutions: UL Standard 263, as explained here.

The following information is from:

ANSI/UL 263, Section IV.

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### **Beam Substitution**

*Beam ratings depend upon the type of floor or roof the beam supports, the protection on the floor or roof units, and the type and thickness of protection material applied to the beam. The substitution of beams into a floor assembly (A-, D-, G- or J- Design) or roof assembly (P- Design) should be limited to assemblies that have a similar or greater capacity for heat dissipation from the beam as compared to the capacity for heat dissipation of the floor or roof construction specified in the design from which the beam is being transferred. Concrete floors have an equal or greater capacity for heat dissipation when they have an equal or greater density range and volume per unit floor area.*

### **Spray-applied Fire-Resistive Materials**

#### **Application of N Series Designs**

*When it is the intent only to maintain the existing Assembly Rating, the beams, steel joists, and steel trusses from N Series designs may be substituted for the tested structural member, provided the hourly Unrestrained Beam Rating of the structural member being transferred is at least equal to the Unrestrained Beam Rating of the structural member being replaced. Additionally, for steel joists and steel trusses, the Restrained Beam Rating of the joist or truss being transferred should be equal to or greater than the Restrained Assembly Rating of the floor-ceiling assembly into which the joist or truss is being transferred.*

*When it is the intent to comply with requirements that the structural member's hourly rating be equal to or greater than the assembly's hourly rating, the structural member from the N Series design may be substituted for the tested structural member, provided that the hourly Beam Rating of the structural member being transferred is at least equal to the hourly rating of the requirement. Additionally, the Restrained Beam Rating of the structural member being transferred should be equal to or greater than the Restrained Assembly Rating of the floor assembly into which the structural member is being transferred.*

*For applications where the assembly's hourly rating differs from the structural member rating, particular attention should be paid to the thickness of fire-protection materials applied to the underside of the floor adjacent to the structural member. The thickness of the fire-protection material required within 12 in. beyond the edges of the structural member should be the lesser of the beam protection thickness or the deck protection thickness as required by the N Series design but not less than the thickness of the fire-protection material required by the assembly.*

**Application of A, D, G, J, and P Series Designs**

*When it is the intent only to maintain the existing Assembly Rating, the beams from A, D, G, J, and P Series designs may be substituted for the tested beam, provided that: (1) the Unrestrained Beam Rating of the beam being transferred is equal to or greater than the Unrestrained Beam Rating of the beam being replaced, and (2) the Restrained Assembly Rating of the assembly from which the beam is being transferred is equal to or greater than the Restrained Assembly Rating of the assembly into which the beam is being transferred.*

*When it is the intent to comply with requirements that the beam's hourly rating be equal to or greater than the assembly's hourly rating, the beams from A, D, G, J, and P Series designs may be substituted for the tested beam, provided that the hourly Unrestrained Rating of the beam being transferred is at least equal to the hourly rating of the requirement.*



Beam designs N789, N736, and N825 are appropriate for this purpose. The joist manufacturer shall design joists to meet the minimum requirements of the UL Beam Design Numbers specified. The minimum component sizes specified in these ratings will rarely govern; however, the specifier should require the joist manufacturer to provide these minimum component sizes.

The following tables give some of the various fire-rated floor-ceiling assemblies that can incorporate Steel Joists by substituting the joists described by these UL beam ratings for the tested structural member. These tables are identical to the tables in the Vulcraft Deck Catalog. They are reprinted here for convenience. Disregarding tolerances in construction, fabrication, etc., the concrete thickness above the steel deck when using CJ-Series joists can be 2 inches above the deck (stud 1½ above + ½ cover). 2½ inches is the recommended minimum due to the reality of tolerances of trades and materials. Therefore, assemblies shown in these tables with 2-inch topping are not recommended for composite joists.

Fire protection costs can be a significant portion of the overall system cost. Consequently, when spray-applied protection is specified, the joists should be spaced as far apart as practical to reduce the number of joists receiving fire protection. Additionally, in most cases the bridging can be removed from CJ-Series joists after the concrete has cured, further decreasing the fire protection cost. Contact Vulcraft before removing any bridging.

## REPRESENTATIVE FIRE RATED ASSEMBLY

The table on the following pages lists the UL fire rated assemblies that include Vulcraft composite and non-composite decks profiles. This summary table is provided to assist in identification of assemblies to meet specific project requirements. Refer to the particular UL assembly for full details of construction including, specific information about concrete slab, framing, type of fire protection, deck types and span limitations. Specifiers can also utilize the [Vulcraft UL fire assembly selection tool](#).

### NOTES:

1. Refer to the UL "Fire Resistance Directory" for the necessary construction details.
2. 1.5VL = 1.5VL, 1.5VLI, and 1.5PLVLI  
 2VL = 2VLI, 2VLJ, and 2PLVLI  
 3VL = 3VLI, 3VLJ, and 3PLVLI  
 1.5VLP = 1.5VLP and 1.5PLVLP  
 2VLP = 2VLP, and 2PLVLP  
 3VLP = 3VLP, and 3PLVLP
3. Concrete thickness is thickness of slab above deck, in.
4. 1.5VLR may be used in designs D832, D902, and D916.  
 All Dovetail FormLok composite deck assemblies are subject to an upper live load limit of 130 psf.
5. Fluted deck finish shall be galvanized unless noted otherwise.  
 + Denotes fluted deck finish is not critical when used in D2-- & D5-- Series designs. Deck finish shall be galvanized or phosphatized/painted.  
 \* Fluted deck finish is critical for fire resistance. Fluted deck finish shall be galvanized or phosphatized/painted. This gray paint is a special type of paint and is compatible with the spray-applied fire protection and is U.L. approved for use in the denoted D7-- & D8-- Series designs.  
 # Denotes fluted deck finish is not critical for fire resistance. Fluted deck finish shall be galvanized or phosphatized/painted.
6. Vulcraft cellular deck used in the listed assemblies shall be galvanized.
7. Vulcraft cellular deck units are approved by UL for use as electrical raceways under UL Standard 209.
8. Dramix® fibers may be used in UL or ULC fire rated assemblies in lieu of WWR. See UL file R19307 for additional information.
9. Restrained Assembly Rating is 1½ hr with listed NW concrete thickness.

NOTICE: Design defects that could cause injury or death may result from relying on the information in this document without independent verification by a qualified professional. The information in this document is provided "AS IS". Nucor Corporation and its affiliates expressly disclaim: (i) any and all representations, warranties and conditions and (ii) all liability arising out of or related to this document and the information in it.

# VULCRAFT® NON-COMPOSITE DECK

## UL FIRE RATED ASSEMBLIES

### UL Fire Resistance Ratings

Restrained Assembly Ratings (hr.)	Type of Protection	Concrete Thickness & Type	UL Design No.	Deck Type				Unrestrained Beam Rating (hr.)
				0.6C	1.0C	1.3C	1.5C	
<b>1</b>	Exposed Grid	2½" NW	<b>G256 +</b>	✓	✓	✓	✓	1,2,3
	Cementitious	2½" NW & LW	<b>G701</b>	✓	✓	✓	✓	1,1½,2,3
			<b>G705</b>	✓	✓	✓	✓	1,1½,2,3
	Sprayed Fiber	2¾" NW & LW	<b>G801</b>	✓	✓	✓	✓	1,1½,2
<b>1½</b>	Exposed Grid	2" NW	<b>G229 +</b>	✓	✓	✓	✓	1½,2,3
		2½" NW	<b>G228 +</b>	✓	✓	✓	✓	1½,2
			<b>G243 +</b>	✓	✓	✓	✓	1½,2
			<b>G213 +</b>	✓	✓	✓	✓	1½,2,3
	Gypsum Board	2" NW & LW	<b>G502 +</b>	✓	✓	✓	✓	
	Cementitious	2½" NW & LW	<b>G701</b>	✓	✓	✓	✓	1,1½,2,3
			<b>G705</b>	✓	✓	✓	✓	1,1½,2,3
	Sprayed Fiber	2¾" NW & LW	<b>G801</b>	✓	✓	✓	✓	1,1½,2
<b>2</b>	Exposed Grid	2½" NW	<b>G227 +</b>	✓	✓	✓	✓	2,3
			<b>G228 +</b>	✓	✓	✓	✓	1½,2
			<b>G229 +</b>	✓	✓	✓	✓	1½,2,3
			<b>G243 +</b>	✓	✓	✓	✓	1½,2
			<b>G256 +</b>	✓	✓	✓	✓	1,2,3
			<b>G213 +</b>	✓	✓	✓	✓	1½,2,3
	Gypsum Board	2" NW	<b>G505 +</b>	✓	✓	✓	✓	
		2½" NW & LW	<b>G529 +</b>	✓	✓	✓	✓	2,3
		2½" NW	<b>G514 +</b>	✓	✓	✓	✓	3
			<b>G523 +</b>	✓	✓	✓	✓	2,3
	Cementitious	2½" NW & LW	<b>G701</b>	✓	✓	✓	✓	1,1½,2,3
			<b>G705</b>	✓	✓	✓	✓	1,1½,2,3
	Sprayed Fiber	2¾" NW & LW	<b>G801</b>	✓	✓	✓	✓	1,1½,2
<b>3</b>	Exposed Grid	3¼" NW	<b>G229 +</b>	✓	✓	✓	✓	1½,2,3
		3½" NW	<b>G213 +</b>	✓	✓	✓	✓	1½,2,3
			<b>G256 +</b>	✓	✓	✓	✓	1½,2,3
	Gypsum Board	3¼" NW & LW	<b>G529 +</b>	✓	✓	✓	✓	2,3
	Cementitious	2¾" NW & LW	<b>G701</b>	✓	✓	✓	✓	1,1½,2,3
			<b>G705</b>	✓	✓	✓	✓	1,1½,2,3
	Sprayed Fiber	2¾" NW & LW	<b>G801</b>	✓	✓	✓	✓	1,1½,2



UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>						Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP	Deck	Beam				
<a href="#">D216</a>	1, 1½, 2, 3	2½-3½ <sup>8</sup>	147-153 NW 107-113 LW	✓	✓	✓		✓	✓	Acoustical Material below	Acoustical Material below	Beams: W8x15, OWSJ: 10J3, 12K4 or LH Series, OWSG: 20 in. deep at 13 plf	6x6-W1.4xW1.4, or Synthetic or Steel Fibers	1, 1½, 2, 3	<a href="#">D216</a>
<a href="#">D219</a>	1, 1½, 2, 3	2½-3½ <sup>8</sup>	147-153 NW 107-113 LW	✓	✓	✓		✓	✓	Acoustical Material below	Acoustical Material below	Beams: W8x15, OWSJ: 10J3, 12K4 or LH Series, OWSG: 20 in. deep at 13 plf	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D219</a>
<a href="#">D303</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	Mineral Fiber Board	Mineral Fiber Board	Beams: W8x28	6x6-10/10 SWG	1, 1½, 2	<a href="#">D303</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓						
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓						
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	¾, 1	2½	107-113 LW	✓	✓	✓	✓	✓	✓						
	1	2¾	107-120 LW	✓	✓	✓	✓	✓	✓						
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW	✓	✓	✓	✓	✓	✓						
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓						
	3	4 <sup>7</sup> / <sub>16</sub>	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4 <sup>7</sup> / <sub>16</sub>	114-120 LW	✓	✓	✓	✓	✓	✓						
<a href="#">D502</a>	1½, 2	2½	147-153 NW	✓	✓	✓		✓	✓	Gypsum Board below	Gypsum Board below	Beams: W8x28, OWSJ: 12K1 or LH Series, OWSG: 20 in. deep at 13 plf	6x6-W1.4xW1.4	1½, 2	<a href="#">D502</a>
<a href="#">D703</a>	1, 1½, 2, 3	2½	142-148 NW 105 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x20	6x6-W2.9xW2.9	1, 1½	<a href="#">D703</a>
<a href="#">D708</a> <a href="#">D768</a>	3	2½	145-151 NW 109-115 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W10x17	6x6-W2.9xW2.9	1½, 3	<a href="#">D708</a> <a href="#">D768</a>
<a href="#">D712</a>	1, 1½, 2	2½	147-153 NW 110 LW		✓	✓			✓	SFRM	SFRM	Beams: W8x24	6x6-10/10 SWG	1½, 2	<a href="#">D712</a>
<a href="#">D716</a>	2	2½	139 NW 109-115 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W8x28	6x6-10/10 SWG	1½, 2	<a href="#">D716</a>
<a href="#">D722</a>	1, 1½, 2	2½	142-148 NW 112 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W6x12	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D722</a>
<a href="#">D730</a>	2	2½	147-153 NW		✓	✓		✓	✓	SFRM	SFRM	None	6x6-10/10 SWG	1½, 2	<a href="#">D730</a>
<a href="#">D739</a>	1, 1½, 2, 3, 4	2½	142-148 NW 102-120 LW 110 LW with OWSJ	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x28, W6x12, OWSJ, Concrete Beams	Beams:6x6-W1.4xW1.4 Joists:6x6-W2.9xW2.9 or Synthetic Fibers	1, 1½, 2, 3, 4	<a href="#">D739</a>
<a href="#">D742</a> <a href="#">D771</a>	2 3	2½ 3½	147-153 NW	✓	✓	✓				SFRM	SFRM	Beams: W8x24	6x6-W1.4xW1.4	½	<a href="#">D742</a> <a href="#">D771</a>
<a href="#">D743</a>	1, 1½, 2, 3	2	147-153 NW 107-113 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W8x20, W8x28, W8x15, Concrete Beams	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D743</a>

UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>						Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP	Deck	Beam				
<a href="#">D745</a>	2	2½	142-148 NW 108-114 LW		✓	✓				SFRM	SFRM	Beams: W8x21, OWSJ or OWSG	6x6-W1.4xW1.4	1, 1½	<a href="#">D745</a>
<a href="#">D746</a>	2,3	2½	109-115 LW	✓						SFRM	SFRM	Beams: W8x21, OWSJ or OWSG	6x6-W1.4xW1.4	2, 3	<a href="#">D746</a>
<a href="#">D750</a>	2	2½	142-148 NW 105-111 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x21	6x6-W1.4xW1.4	1½, 2	<a href="#">D750</a>
<a href="#">D752</a>	2	2½	106-112 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x21, W8x28, OWSJ or OWSG	6x6-W1.4xW1.4	1, 1½	<a href="#">D752</a>
<a href="#">D754</a>	3, 4	3¼	115-121 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28	6x6-W1.4xW1.4	1½, 2	<a href="#">D754</a>
<a href="#">D755</a>	2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x24, W8x28, OWSJ: 10H3, 12J6	6x6-W1.4xW1.4 only when electrical inserts are used	1, 1½, 2, 3	<a href="#">D755</a>
<a href="#">D759</a>	1, 1½, 2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x28, OWSJ or OWSG	Beams:6x6-W1.4xW1.4 Joists: 6x6-W2.9xW2.9	1, 1½, 2, 3	<a href="#">D759</a>
<a href="#">D760</a>	2, 3, 4	2½	144-150 NW 107-113 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ or OWSG	6x6-W1.4xW1.4	1, 1½, 2, 3, 4	<a href="#">D760</a>
<a href="#">D764</a>	2	2½	147-153 NW 117 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ or OWSG	6x6-6/6 SWG	2	<a href="#">D764</a>
<a href="#">D767</a> <a href="#">D796</a>	1, 1½, 2, 3, 4	2½	142-148 NW 102-120 LW 110 LW with OWSJ	✓	✓	✓				SFRM	SFRM	Beams: W8x28, W6x12, OWSJ, Concrete Beams	Beams:6x6-W1.4xW1.4 Joists:6x6-W2.9xW2.9	1, 1½, 2, 3, 4	<a href="#">D767</a> <a href="#">D796</a>
<a href="#">D775</a>	2	2½	142-148 NW 105-111 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x21	6x6-W1.4xW1.4	1½, 2	<a href="#">D775</a>
<a href="#">D777</a>	3, 4	3¼	115-121 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28	6x6-W1.4xW1.4	1½, 2	<a href="#">D777</a>
<a href="#">D779</a>	1, 1½, 2, 3, 4	2½	142-148 NW 102-120 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: 8K1	6x6-W1.4xW1.4 or Synthetic Fibers	1, 1½, 2, 3, 4	<a href="#">D779</a>
<a href="#">D780</a>	1, 1½, 2, 3	2½	147-153 NW 107-113 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: 10K1, 12K3, 16K2	6x6-W2.0xW2.0	1, 1½, 2, 3	<a href="#">D780</a>
<a href="#">D782</a>	1, 1½, 2, 3, 4	4½ 3¼	142-148 NW 115-121 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: Minimum 10" depth.	6x6-W1.4xW1.4	1, 1½, 2, 3, 4	<a href="#">D782</a>
<a href="#">D785</a>	2, 3, 4	2½	142-148 NW 102-120 LW	✓	✓	✓				SFRM	MIC	Beams: W6x16	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D785</a>
<a href="#">D786</a>	2	2½	142-148 NW 102-120 LW	✓	✓	✓				SFRM	MIC	Beams: W12x106	6x6-W1.4xW1.4	1, 1½	<a href="#">D786</a>
<a href="#">D788</a>	1, 1½, 2, 3, 4	2½	NW, LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: 10K1	6x6-8/8 SWG	1, 1½, 2, 3, 4	<a href="#">D788</a>
<a href="#">D794</a>	2	2½	147-153 NW 117 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ or OWSG	6x6-6/6 SWG	2	<a href="#">D794</a>
<a href="#">D795</a>	1, 1½, 2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ	Beams:6x6-W1.4xW1.4 Joists:6x6-W2.9xW2.9	1, 1½, 2, 3	<a href="#">D795</a>

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		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP	Deck	Beam				
<a href="#">D798</a>	1, 1½, 2, 3, 4	2½	142-148 NW 107-113 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: 10K1	Beams:6x6-10/10 SWG Joists:6x6-W1.4xW1.4 or Synthetic Fibers	1, 1½, 2, 3, 4	<a href="#">D798</a>
<a href="#">D799</a>	1, 1½, 2, 3	2½	150-153 NW 112-115 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x28, OWSJ: 10K1 or 10 in. deep at 4.8 plf	Beams:6x6-W1.4xW1.4 Joists:6x6-W2.9xW2.9	1, 1½, 2, 3	<a href="#">D799</a>
<a href="#">D816</a>	3	2½	147-153 NW 107-113 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W10x17, W10x25	None	1½, 2	<a href="#">D816</a>
<a href="#">D822</a>	2	2½	147-153 NW 110-120 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W10x21	6x6-W1.4xW1.4	1	<a href="#">D822</a>
<a href="#">D825</a>	2	2½	147-153 NW 105-111 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W8x17	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D825</a>
<a href="#">D831</a>	2, 3	2½	148-154 NW 117-123 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W6x12, W8x28	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D831</a>
<a href="#">D832</a>	1, 1½, 2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x28, OWSJ	6x6-W1.4xW1.4 only when electrical inserts used	1, 1½, 2, 3	<a href="#">D832</a>
<a href="#">D833</a> <a href="#">D884</a>	2, 3	2½	147-153 NW 107-115 LW	✓	✓	✓		✓	✓	SFRM	SFRM	Beams: W10x25	WWF Optional	2, 3	<a href="#">D833</a> <a href="#">D884</a>
<a href="#">D840</a> <a href="#">D888</a>	2	3¼ 3½ 3¼	107-113 LW 107-120 LW 107-116 LW	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓ ✓	None	SFRM	Beams: W8x28	6x6-10/10 SWG	1½	<a href="#">D840</a> <a href="#">D888</a>
<a href="#">D847</a>	1, 1½, 2	2½	147-153 NW 112 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W6x12, W8x17, W10x25, W8x24, W8x28	6x6-W1.4xW1.4	1, 1½	<a href="#">D847</a>
<a href="#">D858</a> <a href="#">D891</a>	1, 1½, 2, 3, 4	2½	147-153 NW 108-115 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W8x28, OWSJ, Concrete Beams	6x6-W1.4xW1.4	1, 1½, 2, 3, 4	<a href="#">D858</a> <a href="#">D891</a>
<a href="#">D859</a> <a href="#">D875</a>	1, 1½, 2, 3	2	142-148 NW 108-115 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W8x20	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D859</a> <a href="#">D875</a>
<a href="#">D860</a>	2, 3, 4	3¼	115-121 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x20, W8x28	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D860</a>
<a href="#">D861</a>	2	2½	137-150 NW 109-115 LW		✓	✓				SFRM	SFRM	Beams: W8x15, W10x25	6x6-W1.4xW1.4	1, 1½	<a href="#">D861</a>
<a href="#">D862</a>	2	2½	109-115 LW		✓	✓				SFRM	SFRM	Beams: W8x21	6x6-W1.4xW1.4	1	<a href="#">D862</a>
<a href="#">D871</a>	1, 1½, 2, 3	2½	147-153 NW 108-115 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W8x21, Concrete Beams	6x6-W1.4xW1.4 or Synthetic Fibers	1, 1½, 2, 3	<a href="#">D871</a>
<a href="#">D877</a>	2	2½	147-153 NW 105-111 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x17	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D877</a>
<a href="#">D878</a>	2	3¼	108-114 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x20	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D878</a>
<a href="#">D883</a>	1, 1½, 2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓				SFRM	SFRM	Beams: W8x24, W8x28	6x6-W1.4xW1.4 only when electrical inserts used	1, 1½, 2, 3	<a href="#">D883</a>

UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>						Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)							Deck	Beam				
				1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP						
<a href="#">D898</a>	1, 1½, 2, 3	2½	147-153 NW 108-115 LW		✓	✓				SFRM	SFRM	Beams: W8x21, Concrete Beams	6x6-W1.4xW1.4 or Synthetic Fibers	1, 1½, 2, 3	<a href="#">D898</a>
<a href="#">D902</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, W8x24, W6x12, OWSJ: 8K1, 12K5	6x6-W1.4xW1.4 or Negative Reinforcement with Synthetic Fibers	1, 1½, 2, 3	<a href="#">D902</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓						
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓						
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	1	2½	107-113 LW	✓	✓	✓	✓	✓	✓						
	1	2¾	107-120 LW	✓	✓	✓	✓	✓	✓						
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW		✓	✓		✓	✓						
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓						
	3	4¾	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4¾	114-120 LW	✓	✓	✓	✓	✓	✓						
<a href="#">D907</a>	2	3¼	110 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x17, W8x28	6x6-W1.4xW1.4	1, 2	<a href="#">D907</a>
<a href="#">D913</a>	2	3¼	102 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x17	6x6-W1.4xW1.4	1	<a href="#">D913</a>
<a href="#">D914</a>	¾, 1	2½	110 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28	6x6-W1.4xW1.4	0	<a href="#">D914</a>

UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>						Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP	Deck	Beam				
<a href="#">D916</a> <a href="#">D922</a> <a href="#">D925</a> <a href="#">D927</a> <a href="#">D929</a> <a href="#">D931</a> <a href="#">D949</a> <a href="#">D957</a> <a href="#">D958</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ, OWSG	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D916</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ, OWSG	6x6-10/10 SWG	3	<a href="#">D922</a>
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, W12x16, OWSJ: 8K1	6x6-10/10 SWG, Optional: Negative Reinforcing with Synthetic Fibers	1, 1½, 2, 3	<a href="#">D925</a>
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	¾ or 1	2½	107-113 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ, OWSG	6x6-10/10 SWG	1, 1½, 2, 3	<a href="#">D927</a>
	1	2¾	107-120 LW	✓	✓	✓	✓	✓	✓						
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓	None	MFB	Beams: W8x28	6x6-10/10 SWG	1, 1½, 2	<a href="#">D929</a>
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓	None	MIC	Beams: W8x28	6x6-10/10 SWG	1	<a href="#">D931</a>
	2	3¼	107-116 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ: 10K1	6x6-10/10 SWG	1, 1½, 2, 3	<a href="#">D949</a>
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W12x14, W8x28, W8x24, W6x12, OWSJ	6x6-10/10 SWG	1, 1½, 2, 3	<a href="#">D957</a>
	3	4⅞	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4⅞	114-120 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ, OWSG	6x6-10/10 SWG	3	<a href="#">D958</a>
<a href="#">D919</a> <a href="#">D968</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28	6x6-W1.4xW1.4	1½	<a href="#">D919</a> <a href="#">D968</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓						
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓						
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	1	2½	107-113 LW	✓	✓	✓	✓	✓	✓						
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW	✓	✓	✓	✓	✓	✓						
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓						
	3	4⅞	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4⅞	114-120 LW	✓	✓	✓	✓	✓	✓						
<a href="#">D920</a>	2	3¼	110-120 LW		✓	✓		✓	✓	None	SFRM	Beams: W8x28	6x6-W1.4xW1.4	1½	<a href="#">D920</a>
<a href="#">D923</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28	6x6-10/10 SWG	1½	<a href="#">D923</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓						
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓						
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	¾ or 1	2½	107-113 LW	✓	✓	✓	✓	✓	✓						
	1	2¾	107-120 LW	✓	✓	✓	✓	✓	✓						
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW		✓	✓		✓	✓						
	2	3½	107-120 LW	✓	✓	✓	✓	✓	✓						
	3	4⅞	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4⅞	107-120 LW	✓	✓	✓	✓	✓	✓						



UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>						Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	1.5VLP	2VLP	3VLP	Deck	Beam				
<a href="#">D924</a> <a href="#">D969</a>	2	4 <sup>5</sup> / <sub>8</sub>	142-148 NW <sup>9</sup>	✓	✓	✓				None	SFRM	Beams: W8x28	Negative Reinforcing and Synthetic Fibers	1½	<a href="#">D924</a>
	3	5	142-148 NW <sup>9</sup>	✓	✓	✓									
	2	4 <sup>3</sup> / <sub>8</sub>	142-148 NW <sup>10</sup>	✓	✓	✓									
	3	5 <sup>3</sup> / <sub>8</sub>	142-148 NW <sup>10</sup>	✓	✓	✓								1½	<a href="#">D969</a>
	2	3 <sup>3</sup> / <sub>8</sub>	105-111 LW	✓	✓	✓									
	3	4	105-111 LW	✓	✓	✓									
<a href="#">D966</a>	2	3¼	102 LW	✓	✓	✓				None	SFRM	Beams: W8x17	6x6-W1.4xW1.4	1	<a href="#">D966</a>
<a href="#">D967</a>	¾, 1	2½	110 LW	✓	✓	✓				None	SFRM	Beams: W8x28	6x6-W1.4xW1.4	0	<a href="#">D967</a>
<a href="#">D978</a> <a href="#">D985</a>	1	3½	147-153 NW	✓	✓	✓	✓	✓	✓	None	MIC	Beams: W6x16	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">D978</a>
	1½	4	147-153 NW	✓	✓	✓	✓	✓	✓						
	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓						
	3	5¼	147-153 NW	✓	✓	✓	✓	✓	✓						
	¾ or 1	2½	107-113 LW	✓	✓	✓	✓	✓	✓						
	1	2 <sup>3</sup> / <sub>8</sub>	107-120 LW	✓	✓	✓	✓	✓	✓	None	SFRM	Beams: W8x28, OWSJ: 10K1	6x6-10/10 SWG Optional Negative Reinforcing and Synthetic Fibers	1, 1½, 2, 3	<a href="#">D985</a>
	1½	3	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW		✓	✓		✓	✓						
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓						
	3	4 <sup>3</sup> / <sub>8</sub>	107-113 LW	✓	✓	✓	✓	✓	✓						
	3	4 <sup>7</sup> / <sub>8</sub>	114-120 LW	✓	✓	✓	✓	✓	✓						
<a href="#">D981</a>	2	4½	147-153 NW	✓	✓	✓	✓	✓	✓	None	MIC	Beams: W6x12	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">D981</a>
	2	3¼	107-113 LW	✓	✓	✓	✓	✓	✓						
	2	3¼	107-116 LW		✓	✓		✓	✓						
	2	3½	114-120 LW	✓	✓	✓	✓	✓	✓						
<a href="#">D996</a>	2	3¾	142-148 NW		✓	✓				None	MIC or SFRM	Beams: W8x28	Fiber Reinforcement	2	<a href="#">D996</a>
<a href="#">E701</a>	1, 1½, 2, 3	2½	147-153 NW 109-115 LW	✓	✓	✓	✓	✓	✓	SFRM	SFRM	Beams: W8x28, Concrete Beams	6x6-W1.4xW1.4 only when electrical inserts used	1, 1½, 2, 3	<a href="#">E701</a>
<a href="#">E702</a>	1, 1½, 2, 3, 4	2½	147-153 NW 108-115 LW		✓	✓		✓	✓	SFRM	SFRM	Beams: W8x28, Concrete Beams	6x6-W1.4xW1.4	1, 1½, 2, 3, 4	<a href="#">E702</a>
<a href="#">E703</a>	2, 3	2½	142-148 NW 102-120 LW	✓	✓	✓	✓	✓	✓	SFRM	MIC	Beams: W6x16	6x6-W1.4xW1.4	1, 1½, 2	<a href="#">E703</a>
<a href="#">E704</a>	2, 3, 4	2½	142-148 NW 102-120 LW	✓	✓	✓	✓	✓	✓	SFRM	MIC	Beams: W6x16	6x6-W1.4xW1.4	1, 1½, 2, 3	<a href="#">E704</a>

UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>		Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	2.0D	3.5D	Deck	Beam				
<a href="#">D904</a> <a href="#">D961</a>	1	2	147 NW	✓							
	1½	2¾	147 NW	✓							
	2	3¼	147 NW	✓							
	3	4¾	147 NW	✓							
	2	3	130 SLW	✓		None	SFRM	Beams: W8x28, W10x29	6x6-6/6 SWG	¾, 1, 1½	<a href="#">D904</a> <a href="#">D961</a>
	3	4	130 SLW	✓							
	1	2	112 LW	✓							
	2	2½	112 LW	✓							
	3	3¼	112 LW	✓							
<a href="#">D917</a> <a href="#">D928</a>	1	2	147-153 NW	✓							
	1½	2¾	147-153 NW	✓							
	2	3¼	147-153 NW	✓						¾	<a href="#">D917</a>
	3	4¾	147-153 NW	✓							
	2	3	130 SLW	✓		None	SFRM	Beams: W10x29	6x6-6/6 SWG		
	3	4	130 SLW	✓							
	1	2	107-113 LW	✓							
	2	2½	107-113 LW	✓						¾, 1	<a href="#">D928</a>
	3	3¼	107-113 LW	✓							
<a href="#">D506</a>	2	2¼, 2	147-153 NW 107-113 LW		✓	None	None	Beams: W6x9	6x6-W1.4xW1.4	1	<a href="#">D506</a>
<a href="#">D947</a> <a href="#">D964</a> <a href="#">D984</a>	1½	2	147-153 NW		✓						
	2	2¼	147-153 NW		✓						
	3	3¾	147-153 NW		✓						
	1½	2	107-113 LW		✓	None	SFRM	Beams: W8x28, W10x29	6x6-W1.4xW1.4	¾, 1½	<a href="#">D947</a> <a href="#">D964</a> <a href="#">D984</a>
	2	2	107-113 LW		✓						
	3	2¼	107-113 LW		✓						

UL Design Number	Restrained Assembly Rating <sup>1</sup> (hr.)	Concrete Topping		Deck Type <sup>2, 4, 5, 6, 7</sup>					Type of Protection <sup>3</sup>		Minimum Beam or Joist	Minimum Concrete Reinforcement <sup>12</sup>	Unrestrained Assembly Rating <sup>1</sup> (hr)	UL Design Number
		Thickness (in.)	Type (pcf)	1.5VL	2VL	3VL	0.6C	1.0C	Deck	Beam				
<a href="#">G213</a>	1½, 2, 3	2½	152 NW	✓	✓	✓	✓	✓	Acoustical Material below	Acoustical Material below	Beams: W6x9, W8x24, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4	1½, 2, 3	<a href="#">G213</a>
<a href="#">G222</a>	2	2½	144-150 NW	✓	✓	✓	✓	✓	Gypsum Board below	Gypsum Board below	Beams: W6x9, W8x24, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4	2	<a href="#">G222</a>
<a href="#">G227</a>	2	2½	147-153 NW	✓	✓	✓	✓	✓	Acoustical Material below	Acoustical Material below	Beams: W6x9, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4	2	<a href="#">G227</a>
<a href="#">G229</a>	1½, 2	2½	147-153 NW	✓	✓	✓	✓	✓	Acoustical Material below	Acoustical Material below	Beams: W8x24, OWSJ or OWSG: 8 in. deep	6x6-W1.4xW1.4	1½, 2, 3	<a href="#">G229</a>
	3	¾	147-153 NW	✓	✓	✓	✓	✓						
<a href="#">G236</a>	1½, 2	2½	147-153 NW	✓	✓	✓	✓	✓	Acoustical Material below	Acoustical Material below	Beams: W6x9, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4	1½, 2	<a href="#">G236</a>
<a href="#">G243</a>	1½, 2	2½	144-150 NW	✓	✓	✓	✓	✓	Acoustical Material below	Acoustical Material below	Beams: W6x9, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4	1½, 2	<a href="#">G243</a>
<a href="#">G547</a>	2	2½	149-155 NW	✓	✓	✓	✓	✓	Gypsum Board below	Gypsum Board below	Beams: W10x21, OWSJ or OWSG: 8K1, 10K1	6x6-W1.4xW1.4	2, 3	<a href="#">G547</a>
	3	3												
<a href="#">G561</a>	1, 1½, 2, 3	2½	147-153 NW 108-120 LW	✓	✓	✓		✓	Gypsum Board below	Gypsum Board below	Beams: W6x9, W8x24, OWSJ or OWSG: 10 in. deep at 4.9 plf	6x6-W1.4xW1.4 or Synthetic or Steel Fibers	1, 1½, 2, 3	<a href="#">G561</a>
<a href="#">G710</a> <sup>11</sup>	1, 1½, 2, 3	¾	150 NW 117 LW	✓					SFRM	SFRM	OWSJ or OWSG: 8 in. deep at 4.9 plf	6x6-W2.1xW2.1	1, 1½, 2	<a href="#">G710</a> <sup>11</sup>
<a href="#">N789</a>	1, 1½, 2, 3, 4	2½	142-148 NW 104-120 LW	✓	✓	✓	✓	✓	None	SFRM	OWSJ or OWSG: 8K1	6x6-W1.4xW1.4	1, 1½, 2, 3, 4	<a href="#">N789</a>

# DUCT OPENING SIZES

## ALLOWABLE DUCTWORK CLEARANCE (INCHES)

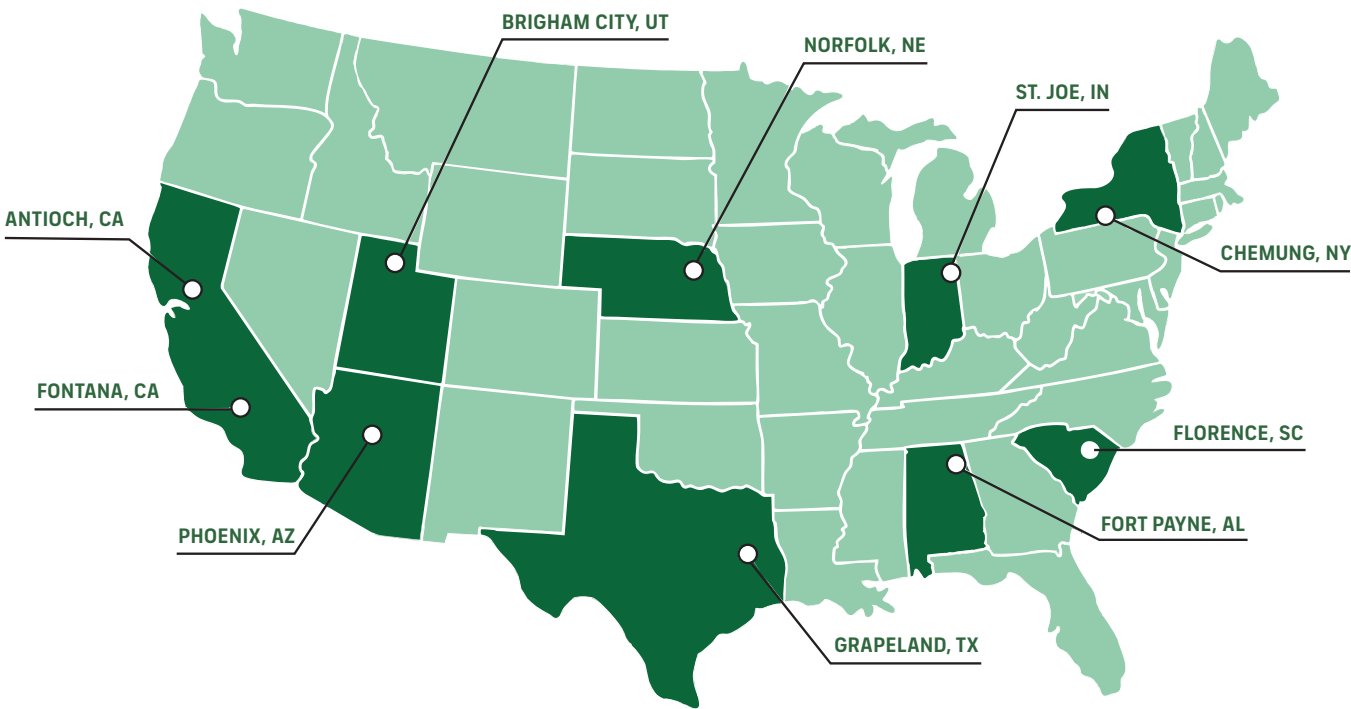
Joist Depth	Round	Square	Rectangular Height	Width
10	5	5	2	x 9
12	6	6	4	x 7
14	7	6	4	x 9
16	11	9	8	x 12
18	13	11	8	x 18
20	14	12	8	x 21
22	16	13	10	x 19
24	17	14	10	x 22
26	18	15	10	x 24
28	19	16	12	x 22
30	20	17	12	x 24
32	23	18	14	x 26
36	26	21	14	x 33
40	29	24	16	x 36
44	32	26	18	x 40
48	35	29	20	x 43
52	38	31	22	x 47
56	42	34	24	x 50
60	45	36	26	x 54
64	48	39	28	x 57
68	51	41	30	x 61
72	54	44	32	x 64
76	57	46	34	x 68
80	61	49	36	x 71
84	64	52	38	x 75
88	67	54	40	x 78
92	70	57	42	x 82
96	73	59	42	x 89

# VULCRAFT MANUFACTURING LOCATIONS

Whether it's manufacturing, engineering, or transportation, each of our teammates is here to ensure that our products meet the demands of your unique project. Our more than 2,500 teammates, located throughout North America in nine different divisions, are ready to help you with your next project.



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PROJECT FEATURED ON BACK COVER

SEAPORT L4, BOSTON MA

- Project Completion: 2022
- Structural EOR: McNamara Salvia
- Steel Fabricator: Cives Steel Company
- Architect: Gensler
- General Contractor: Suffolk
- Owner: WS Development
- 525,000 square feet



# PARTNERS FROM THE START

Today's construction projects are more challenging than ever. That's why collaborating with the Vulcraft team early in your design process can make all the difference when determining the best solutions for your next project. Our number one goal is to help make you and your project a success. That's what good partnerships are all about.

