ECOSPAN®

COMPOSITE FLOOR SYSTEM

DESIGN MANUAL
CANADIAN EDITION

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Vulcraft Canada Inc.

Ecospan® Composite Floor System

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V2.2C

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1.0 The Ecospan® Composite Floor System

The Ecospan® Composite Floor System by Vulcraft Canada Inc. is an innovative, effective, and economical method of providing all steel structural components for elevated floor construction while incorporating the benefits of lighter weight composite design.

5. CONCRETE SLAB (BY OTHERS)

4. CONCRETE REINFORCEMENT (BY OTHERS)

2. ECOSPAN STEEL DECK

3. SHEARFLEX® SCREW
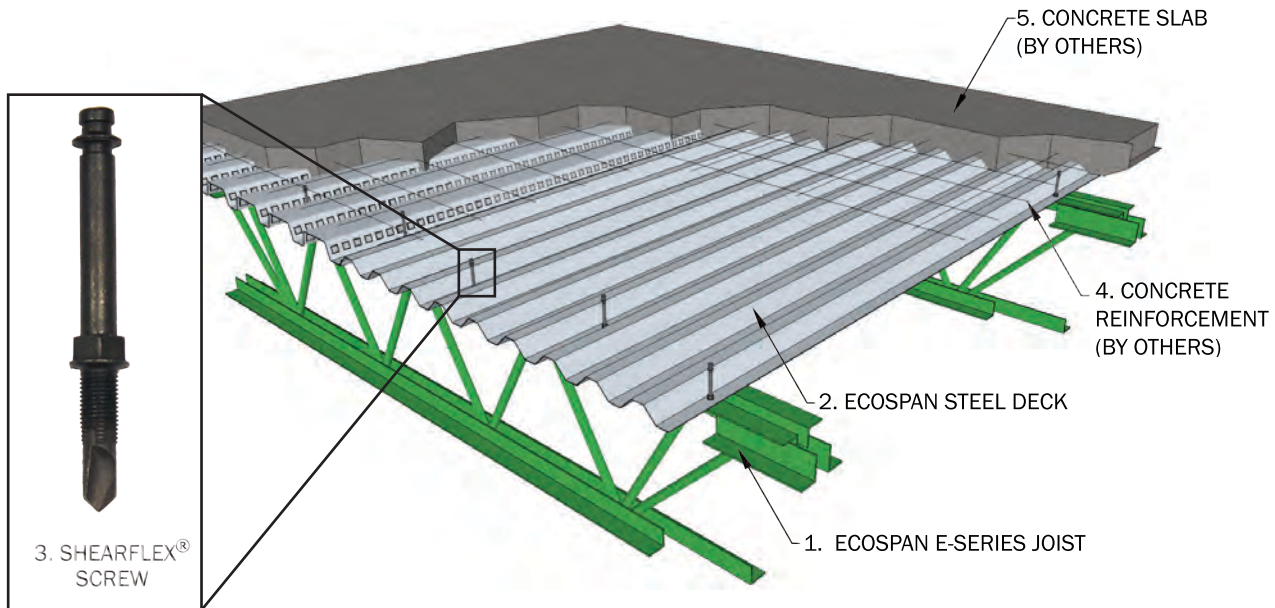
Figure 1-1: The Ecospan® Composite Floor System

1.1   Product Description

1. Joists: The Ecospan® Composite Floor System uses E-Series Vulcraft joists ranging from 250 mm (10") to 750 mm (30") deep and a maximum length of approximately 15200 mm (50'). Joists are typically spaced between 1200 mm (4') o.c. and 1800 mm (6') o.c. The span is the distance from centreline to centreline of the supporting members. (For requirements outside this range please contact your Ecospan® Representative) The design of the Ecospan® Composite Floor System joists are greatly affected by their spacing. The spacing is the distance to the adjacent joist or to the edge of the slab at exterior joists or joists next to slab openings.

2. Decking: Ecospan® utilizes multi-span sheets of steel decking. Generally, conform deck with a depth of 25 mm (1") or 33 mm (1-5/16") will be utilized for residential applications. 38 mm (1.5") composite steel deck may be used for commercial applications or wider joist spaces.

3. Shearflex® Screws: This screw is a self-drilling and self-tapping screw, ranging from 64 mm (2-1/2") to 76 mm (3") in length (not including the threaded section). Screws are installed using the Vulcraft provided Shearset® Tool which uses standard 120V electricity.

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4. Concrete Slab Reinforcement (by Others): Slab reinforcement shall be the responsibility of the design professional. Rebar or welded wire fabric is suggested for form deck applications while distributed fibres may be an acceptable alternate for projects utilizing composite decks. Refer to CAN/CSA-A23.3-14 Standard Composite Steel Floor Deck paragraph 2.4.B.6 for applicable dosage rates for distributed fibres.

5. Concrete slab (by Others): The concrete topping slab (specified by the Design Professional) is typically 64 mm (2 -1/2") normal weight concrete having a minimum 28 day ultimate compressive strength (f'c) of 20 MPa (3000 psi), though thicker slabs may be designed for heavier duty uses or serviceability concerns. Light weight concrete may also be specified with the Ecospan® Composite Floor System.

1.2   Consider the Advantages

- The Ecospan® Composite Floor System is an effective and economical solution for constructing residential and commercial floor systems.

- Erection is safe, easy and cost effective. There are no short deck sheets, plywood forms or shoring; sub-trades can normally continue construction the day after the concrete is placed.

- Floor to floor heights can often be decreased due to the inherent ability to pass mechanical ducts, piping, conduit, etc. through the open web design.

- High strength to weight ratio of composite steel joists allows for greater spans and spacing with lighter members.

- Weight savings due to composite joist design reduces building weight and allows foundation and wall costs to be reduced.

- Constructed with non-combustible materials, achieving multiple ULC & UL listings with gypsum board, acoustical ceilings, or spray applied fire resistant materials.

- With the addition of a gypsum board ceiling, the Ecospan® Composite Floor System has a Sound Transmission Classification (STC) of 57, and meets or exceeds Impact Insulation Classification (IIC) requirements of the National Building Code of Canada (NBC) for residential and commercial construction with commonly used sound attenuation materials.

1.3   Environmental Advantages

The Ecospan® Composite Floor System may contain a significant portion of recycled material which may be beneficial in achieving environmental certification, such as LEED, for your project. (www.cagbc.org)
Please contact your Ecospan® representative or visit:
www.nucor.com/responsibility/sustainability/compliance/leed/ for recycled content information

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2.0 Ecospan® Composite Floor System Design Overview

2.1   Purpose & Scope

The information herein is intended to educate and assist Design Professionals who wish to integrate the Ecospan® Composite Floor System into their project. Section 2.7 provides the Design Professional an opportunity to view general joist depth-to-span values for residential and commercial loads of the Ecospan® Composite Floor System. While Table 2-2 depicts some of the more common loadings and spans typically encountered in residential and commercial floor construction, more specific design requirements may be specified by the Design Professional.

If more specific design requirements are necessary, the Design Professional should provide Vulcraft's Ecospan® National Sales Office with information outlined in Section 2.6, "Design Parameters Checklist for E-Series Joists" in this catalogue, prior to proceeding with preliminary drawings. This provides Ecospan® engineers the ability to assist the Design Professional in the development of the final drawings to meet the unique aspects of each project.

2.2   Non-Composite Joist

Non-composite joists supporting concrete are designed as simply supported members with pinned ends. Figure 2-1 shows a typical joist, deck, and concrete slab configuration
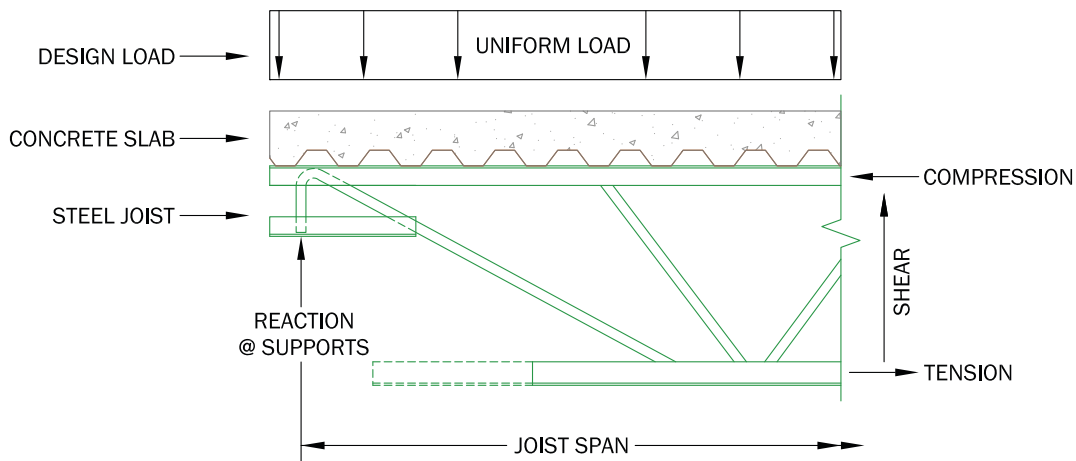
Figure 2-1: Partial Joist Cross-section

The design loads are resisted by the concrete and joist acting independently. The joist strength is based on the cross-sectional area and orientation of the top chord, bottom chord, and web configuration. Under normal gravity load cases, the bottom chord resists the tension and the top chord resists the compression. The effective depth of this section is equal to the distance between the centroids of the top and bottom chord angles. Figure 2-2 illustrates the effective depth of the non-composite joist.
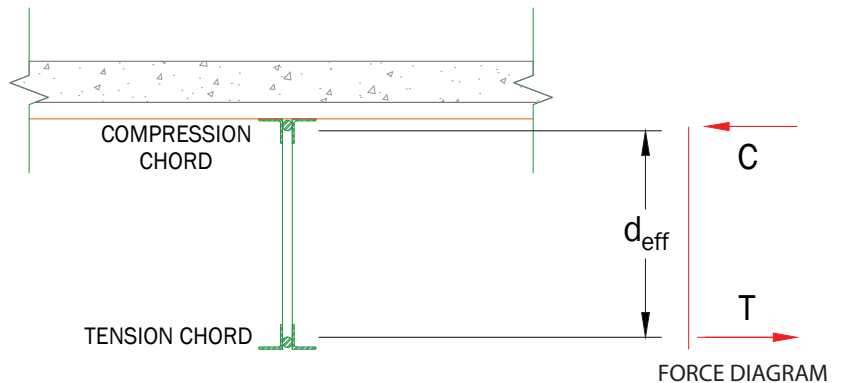
Figure 2-2: Non-Composite Joist Effective Depth (d_{eff})

2.3   Composite Joist

Steel joists and concrete used in composite construction act as a unit creating an assembly that is stronger than each of the materials acting independently. As seen in Figure 2-3, the effective depth (d_{eff}) of the composite section is larger than the non-composite section because the post composite compression forces are resisted by the concrete, not the top chord of the joist. Flexural strength of the assembly is increased proportionally with the increase in d_{eff}. This increase allows longer spans for the same total framing depth.
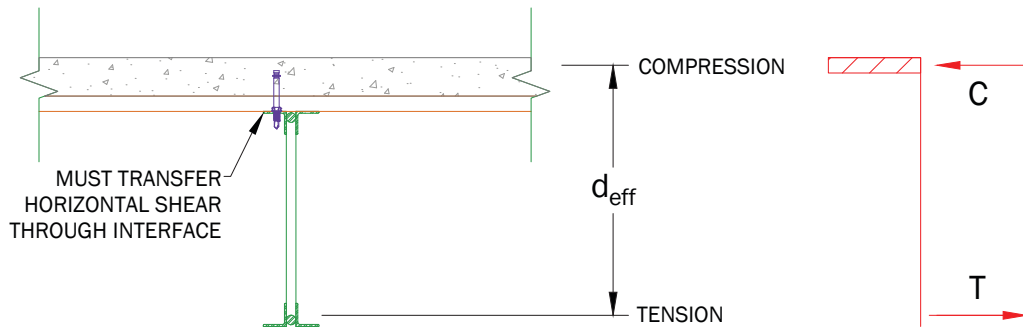
Figure 2-3: Composite Joist Effective Depth (d_{eff})   FORCE DIAGRAM

2.3.1 Development of Composite Action

The equal and opposite forces acting in the concrete and bottom chord of the joist create a couple to resist the bending moment in the section. However, there must be a mechanism to transfer this horizontal shear force between the concrete and steel sections.

The Ecospan® Composite Joist System utilizes the Shearflex® stand-off screw to transfer the horizontal shear forces from the joist top chord into the concrete. The Shearflex® screws are installed into the top chord of the joist through the steel deck and cast into the concrete slab.

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2.3.2 Shearflex® Screw Fastener Capacity

Extensive testing of the behaviour of the Shearflex® stand-off screws used in the Ecospan® Composite Floor System has been completed. Design values used for Shearflex® screws in the design of composite E-series joists were developed based on analytical modeling, small scale push-out testing, and full scale joist tests. The Shearflex® screw capacities are based on tested values as reported in IAPMO UES Evaluation Report 0366 and shown in Table 2-1.

Sheaflex® Standoff Screw Capacities								
Thread Diameter (mm)	Screw Length (mm)	Steel Deck Panel	q_r, Nominal Strength (kN)/S_n, Nominal Slip Capacity (mm)					
			Design Thickness of Structural Support (mm)					
			2.8	3.9	4.8	5.4	6.4	8
9.5	63.5	Vulcraft-SC, NE, TX, 1.0C[6]	19.5 *21.7*	19.5 *21.3*	19.5 *18.4*	19.5 *17.6*	19.5 *24.6*	- -
9.5	63.5	Vulcraft-AL, NY, IN 1.0C[7]	20.2 *18.4*	- -	21.0 *17.3*	- -	21.0 *19.9*	- -
9.5	76.2	Verco 1-5/16 Inch (Deep) VERCO™	18.5 *25*	19.6 *23.7*	21.1 *21.3*	21.6 *20.5*	21.2 *17.7*	20.5 *15.0*
9.5	76.2	Vulcraft 1.5VL, 1.5VLI, 1.5PLVI™, 1.5VLP, 1.5C Inverted, 1.5B, 1.5BI, and 1.5PLB™ Verco PLB™, HSB, PLB™, FORMLOK, B FORMLOK™	19.3 *14.5*	20.1 *12.9*	21.5 *11.7*	21.3 *10.3*	21.0 *9.5*	20.4 *9.3*
9.5	76.2	Vulcraft 1.5C and 1.5VLR Verco BR FORMLOK	31.0 *20.1*	- -	31.6 *18.4*	- -	31.4 *10.6*	28.3 *7.4*

Table 2-1

1) Minimum f'_c = 20MPa.
2) Nominal shear strengths and nominal slip capacities shown in Table 2-1 are based on testing of the Shearflex® in light weight concrete. Normal weight concrete will provide equivalent or greater nominal shear strengths.
3) q_r and S_n values for structural support thickness between those shown in the above table may be determined via linear interpolation.
4) q_r values shown are based on a maximum of one Shearflex® Standoff Screw per steel deck rib with the fastener installed at the centre of the steel deck rib.
5) When q_r values shown above are utilized in the design of composite steel joists, ϕ shall be as stipulated per CSA S-16.
6) As manufactured by Vulcraft South Carolina, Vulcraft Nebraska, or Vulcraft Texas
7) As manufactured by Vulcraft Alabama, Vulcraft of New York, or Vulcraft Indiana.

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2.4 Incorporating Ecospan® into a Project

The Ecospan® Composite Floor System can be utilized for most commercial or residential projects. Ecospan® joists (E-series) are individually designed for the span, spacing, and loading specified on the Contract Documents.

In order for designers and engineers to quickly and efficiently detail and engineer each project with minimal shop drawing review time, some basic design criteria will be needed from the Design Professional.

1. Design Loads
    Unfactored loads that should be specified are as follows:
    a. Non-composite dead load: Includes concrete, joists, deck, and bridging
    b. Construction live load: Indicates the required loading due to work crews and construction equipment before and during the placement of concrete (Ref. ASCE 37-14)
    c. Composite dead load: Includes non-moving partitions, mechanical, electrical, fireproofing, floor covering, and ceiling
    d. Composite live load: The design live load, including moving partitions, as specified.

2. Camber
    E-series joists are designed to be cambered for 100% of the non-composite dead load. The Design Professional may indicate any additional camber requirements. Please note: Due to fabrication tolerances, camber may vary, see the Ecospan Code of Standard Practice Section 2.4 Camber for tolerances.

3. Deflection
    The Design Professional shall indicate the maximum allowable live load deflection for each Ecospan® composite joist. In the absence of a specified live load or total load deflection limit, a $\ell/360$ live load deflection is assumed.

4. Vibration
    Calculations for the predicted floor vibration of the Ecospan® Composite Floor System shall be completed by the Design Professional. Based on this analysis, the Design Professional can indicate a required moment of inertia of the chords required to meet the floor performance requirements.

5. Additional Considerations
    When specifying the Ecospan® Composite Floor System, the Design Professional should consider the following items:
    a. Parallel top and bottom chords are required
    b. Maximum steel floor deck depth is 38 mm (1.5")
    c. Slab thickness above top flute of the deck must be a minimum of 63 mm (2-1/2") for fire rated assemblies
    d. Maintain a constant concrete thickness along the entire joist span

2.5 E-series Joist Designation

Figure 2-4 illustrates the format used to designate an E-series joist. Loading numbers are shown in kilo-newtons per meter (kN/m). Total load is the summation of the un-factored live load, non-composite dead load and composite dead load. (The example shown in Figure 2-4 is based on design loads and joist spacing indicated in Design Example in Section 5.0.)

$$405E6.24/2.32/1.47$$

| JOIST DEPTH (mm) | ECOSPAN® COMPOSITE JOIST DESIGNATION | TOTAL LOAD (kN/m) | COMPOSITE LIVE LOAD (kN/m) | COMPOSITE DEAD LOAD (kN/m) |
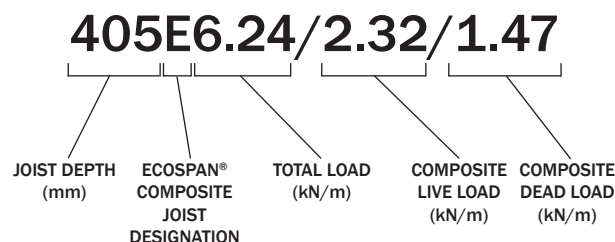
Figure 2-4: E-series Joist Designation Example

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2.6   Design Parameters Checklist for E-series Joists

Project: _____   Area Type: _____   Date: _____

Joist Geometry
1. Depth of steel joist   _____ mm
2. Span   _____ m
3. Adjacent joist spacing (left)   _____ mm
4. Adjacent joist spacing (right)   _____ mm

Deck and Concrete
1. Vulcraft floor deck type   _____
2. Concrete unit weight   _____ kg/m³
3. Concrete compressive strength   _____ MPa
4. Slab thickness (above deck)   _____ mm

Shearflex® screws
Shearflex® fastener pattern to be determined by Vulcraft National Accounts

Un-factored Design Loads
1. Non-composite dead load
   a. Concrete   _____ kPa
   b. Joists   _____ kPa
   c. Decking   _____ kPa
   d. Bridging   _____ kPa

   Total _____ kPa   _____ kN/m

2. Construction live load   _____ kPa   _____ kN/m

3. Composite dead load
   a. Fixed partitions   _____ kPa
   b. MEP   _____ kPa
   c. Fire suppression   _____ kPa
   d. Floor covering   _____ kPa
   e. Ceiling   _____ kPa
   f. Other   _____ kPa

   Total _____ kPa   _____ kN/m

4. Composite live load
   a. Design live load   _____ kPa
   b. Other   _____ kPa

   Total _____ kPa   _____ kN/m

5. Total non-composite and composite loads   _____ kPa   _____ kN/m

Camber and Deflection
1. Max. allowable live load deflection = Span /   _____
2. Ecospan® Joists are cambered for 100% of non-composite dead load (Typical)
3. Additional Camber for _____ % Composite Dead Load and _____ % Composite Live Load
4. I_{chords} required for vibration performance _____ x10⁶mm⁴

E-series Joist Designation
_____ E _____ /_____ /_____

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2.7 Joist Span Capacity

Ecospan® composite floor joists are designed to meet the requirements specified in the Contract Documents. Information supplied by the Design Professional via the Design Parameters Checklist for E-series Joists (see Section 2.6) will be used by Vulcraft Engineers to design E-series joists and develop placement plan.

E-series joists are capable of reaching a span-to-depth ratio of $\ell/30$ and still meet the serviceability requirements of most floors.

$$\text{span to depth } (d) \leq \frac{L}{30} = \frac{span \ (mm)}{30}$$

E-Series Joist Maximum Span Chart (mm)

Typical Loading	Residential Loading Total Load = 5.2kPa Live Load = 1.9 kPa NC Dead Load = 2.1kPa Composite Dead Load = 1.2kPa			Commercial Loading Total Load = 8.1kPa Live Load = 4.8 kPa NC Dead Load = 2.1kPa Composite Dead Load = 1.2kPa		
Depth (mm)	On Centre Joist Spacing (mm)					
	1220	1370	1525	1220	1525	1830
Typical Loading (kN/m)	6.3/2.4/1.5	7.1/2.6/1.7	7.9/2.9/1.8	9.9/5.9/1.5	12.4/7.4/1.9	14.9/8.8/2.2
255	7,600	7,600	7,600	7,600	6,400	5,100
305	9,100	9,100	9,100	9,100	7,600	6,400
355	10,600	10,600	10,600	10,600	8,800	7,300
405	12,100	12,100	11,800	11,200	10,000	8,200
455	13,700	13,400	12,800	11,800	10,600	9,400
510	15,200	14,300	13,400	12,400	11,200	9,700
560	15,800	14,900	14,000	13,100	11,500	10,000
610	16,400	15,500	14,600	13,700	12,100	10,900
660	17,300	16,100	15,200	14,300	12,400	11,500
710	17,900	16,700	15,800	14,900	13,100	11,800
760	18,200	17,300	16,400	15,200	13,700	12,400

Table 2-2

Notes:
1. Assumed 36/4 to 36/6 attachment pattern
2. Assumed 1.0C24 (90mm total slab depth) for Residential
3. Assumed 1.5VL22 (100mm total slab depth) for Commercial
4. Joists ranging from 255-355mm deep are assumed rod web joists, while joists 405mm-760mm may be crimped or uncrimped angle web joists

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3.0 Accessories and Details

3.1 Joist Configuration

E-Series joists are detailed and produced using the same practices and base materials that Vulcraft uses to produce standard composite or non-composite joists. The top and bottom chords are double angles and the web members are either solid rounds, crimped or uncrimped angles, channels, or solid rectangular stock depending on the joist span, joist depth and supported loads. Figure 3-1 below illustrates the typical configuration of E-series joist utilizing a flush seat on the left end and a standard bearing seat on the right. Design Professionals should be familiar with the standard nomenclature used to specify and detail open-web joists, as the E-series permits a larger range of seat configurations and bearing conditions.

FLUSH SEAT   TOP CHORD   STANDARD SEAT

BOTTOM CHORD   CEILING EXTENSION
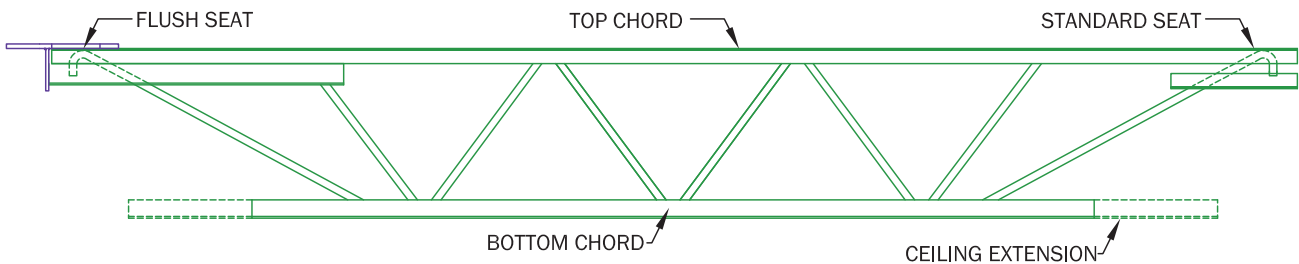
Figure 3-1

3.2 Joist Bearing Conditions

E-series joists may bear on various structural systems. The Ecospan® Composite Floor System can be supported by structural steel, joist girders, cold form steel studs (CFS) load bearing walls, concrete masonry units (CMU), cast in place (CIP) concrete walls, insulated concrete forms (ICF), and proprietary wall systems.

3.2.1 Cold-Formed Steel Studs (CFS)

E-series joists bearing on CFS are normally attached using two self tapping screws. However, attaching with a 3.2 mm (1/8") fillet weld 50 mm (2") long on each side of the joist seat is also an acceptable method. E-series joists should bear on supporting CFS at least 65 mm (2-1/2"), but Design Professionals must consider eccentric bearing where the joist reaction is not centred on the supporting wall. See Concrete LDM Design Guide for additional information.

Figure 3-2: CFS Bearing

3.2.2 Standard Seat on Structural Steel

E-series joists bearing on structural steel are normally attached to the support with two 4.8 mm (3/16") fillet welds 38 mm (1-1/2") long. E-series joists should bear on supporting steel at least 64 mm (2-1/2").
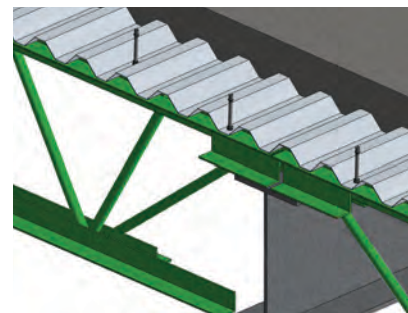
Figure 3-3: Steel Bearing

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3.2.3 Flush Seat on Structural Steel

The Design Professional may choose to utilize a flush joist seat to meet floor to ceiling requirements. The flush seat is limited to moderate joist reactions of 45kN. See Flush Seat Design Guide for additional information.
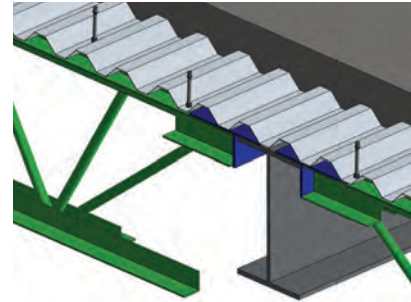
3.2.4 Grouted Concrete Masonry Units (CMU)

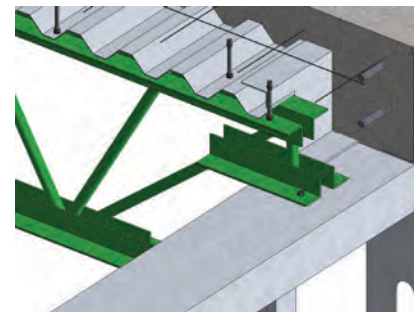E-series joists bearing on CMU/Masonry are normally attached to the support with two masonry anchors. Slots or holes are shop installed to accommodate anchors. E-series joists should bear on supporting CMU at least 100 mm (4"). The Ecospan® Composite Floor System does not require bearing plates when utilizing a CMU/Masonry wall system. E-series joist seats are designed to resist allowable bearing pressures exerted by supporting CMU.

3.2.5 Concrete

E-series joists bearing on concrete are normally attached to the support with two masonry screws. Slots or holes are shop installed to accommodate anchor bolts. E-series joists should bear on supporting concrete at least 100 mm (4"). The Ecospan® Composite Floor System does not require bearing plates when utilizing a concrete wall system. E-series joist seats are designed to resist allowable bearing pressures exerted by supporting concrete.

3.2.6 Insulated Concrete Forms (ICF)

E-series joists bearing on Insulated Concrete Forms are normally attached using masonry screws. E-series joists should bear on supporting ICF at least 100 mm (4"). When concrete for the wall and slab is placed monolithically, joists will need to be shored directly beneath the joist seat at the inside face of the wall. This bracing system should remain until the concrete cures sufficiently.

Figure 3-4: Flush Seat

Figure 3-5: CMU/Masonry Bearing

Figure 3-6: Concrete Bearing
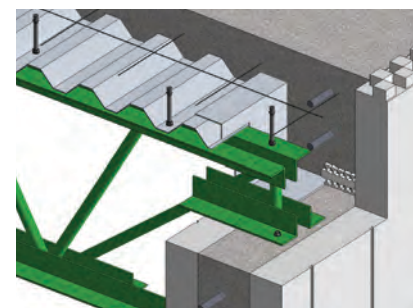
Figure 3-7: ICF Bearing

3.3   Joist Seat Reactions

Table 3-1 illustrates the linear relationship between the seat depth and reaction location. For example, a 64 mm (2-1/2") deep joist seat will typically put the joist reaction at 51 mm (2") from the face of the support. As shown in Figure 3-8, using a 152 mm (6") CFS wall would result in a 25 mm (1") eccentricity.

To match masonry coursing depth and to account for seat rotation tendencies, 115 mm (4 -1/2") deep joist seats are commonly used in Ecospan® projects (see Figure 3-9).

115 mm (4-1/2") seat + 25 mm (1") deck + 64 mm (2-1/2") concrete = 205 mm (8") nominal = standard 205 mm (8") block

Joist Seat Reactions	
Joist Seat Depth (mm)	Reaction Location (mm)
64	51
76	61
89	71
101	81
114	91
127	101

Table 3-1
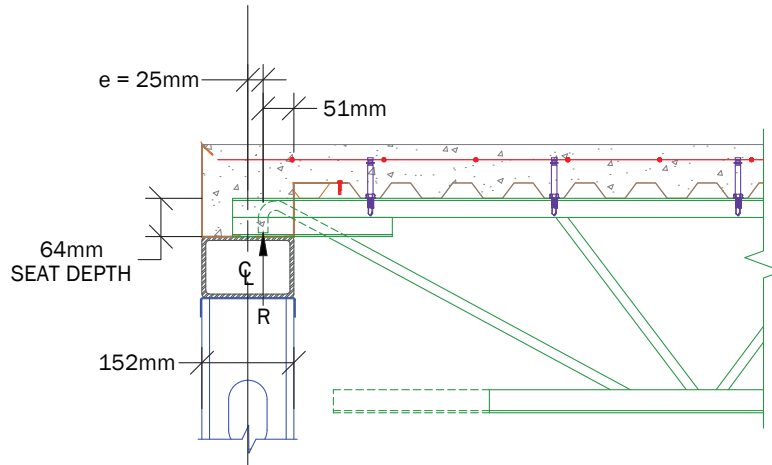
Figure 3-8: Seat Reaction Location with 64 mm (2-1/2") depth on CFS
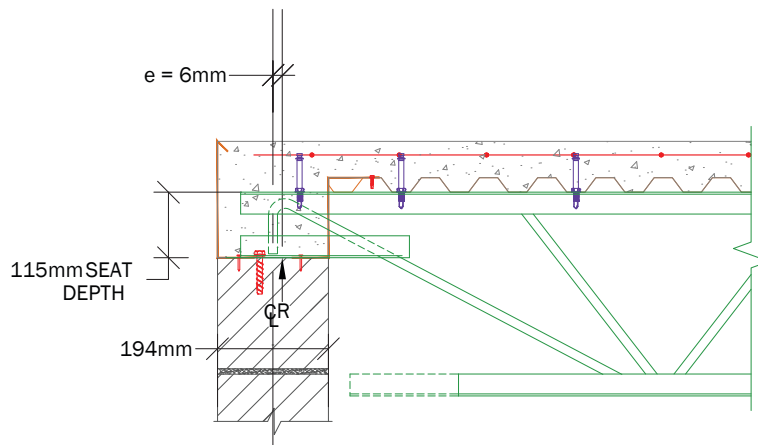
Figure 3-9: Seat Reaction Location with 115 mm (4-1/2") depth on CMU

3.4 Inspections

Provisions for inspection of projects involving Ecospan® shall be included by the Design Professional. Inspections shall ensure installation has taken place according to the Ecospan® Final Plans for Field Use. This inspection shall include checking the concrete strength and thickness as well as the placement of the Shearflex® screws. This inspection is not provided by Vulcraft. Refer to section 3.6.3 for typical inspection requirements as they pertain to shearflex placement.

3.5 Joist Bridging

3.5.1 Horizontal Bridging

Horizontal bridging consists of continuous horizontal steel members. The ratio of unbraced length to least radius of gyration, ℓ/r, of the bridging member is designed to not exceed 300, where ℓ is the distance between attachments, and r is the least radius of gyration of the bridging member.

3.5.2 Diagonal Bridging

Diagonal bridging is designed utilizing cross-bracing with a ℓ/r ratio of no more than 200, where ℓ is the distance between connections and r is the least radius of gyration of the bracing member. Where cross-bridging members are connected at their point of intersection, the ℓ distance is taken as the distance in inches between connections at the point of intersection of the bracing members and the connections to the chord of the joists.

3.5.3 Quantity and Spacing of Bridging

Bridging must be properly spaced and anchored to stabilize the joist during the construction process of deck attachment. The radius of gyration of the top chord about its vertical axis is designed to not be less than $\ell_{br}/170$ where ℓ_{br} is the spacing between lines of bridging. The top chord is considered to be braced laterally by the floor deck when the Shearfex® connectors have been fully installed across the full length of the joist. The radius of gyration of the bottom chord is limited to $\ell_{br}/240$. The attachment of diagonal or horizontal bridging to joist chords shall be by welding or mechanical means capable of resisting an axial load of at least 3kN (670 lbs) in the attached bridging member.

3.5.4 Joist Erection Stability Bridging

Deck bundles placed on Ecospan® joists are limited to a maximum bundle weight of 8.9kN (2000lbs) and must be placed within 305 mm (12") of the bearing surface of the joist end. Bolted diagonal erection bridging, where required, must be installed prior to releasing the joist hoisting cables. No more than one employee shall be allowed on the joist span until all diagonal erection bridging has been installed.

3.6   Steel Deck Design Information

Steel deck supplied as part of the Ecospan® Composite Floor System acts as a form for the concrete and may be utilized as part of the gravity load supporting system. The Design Professional is referred to the Vulcraft Steel Roof & Floor Deck catalogue or the Verco Floor Deck Catalogue (as appropriate for their project) for the properties and allowable design loads. The catalogue tables were developed in accordance with Canadian Standards Association (CSA) S136 North American Specification for the Design of Cold Formed Steel Structural Members and Canadian Sheet Steel Building Institute (CSSBI) Standard 12M for Composite Steel Deck.

3.6.1 Non-Composite Steel Form Deck

Many Design Professionals rely on concrete and welded wire reinforcement to support the gravity loads using concrete beam theory. As an alternate the steel deck can be specified to support the live and dead loads in the Ecospan® Composite Floor System. The typical details for the Ecospan® Composite Floor System use Vulcraft 1.0C, or Verco Deep VERCOR™ non-composite steel floor decks. The Design Professional is again referred to the appropriate catalogue for deck properties and allowable design loads.

3.6.2 Composite Steel Deck

Single span composite steel floor deck may be used in the Ecospan® Composite Floor System to span corridors and other conditions with varying concrete thicknesses. The Design Professional should refer to the Verco Floor Deck Catalogue or the Vulcraft Roof & Floor Deck catalogue to properly specify the composite steel deck for these applications.

When utilizing 38 mm (1-1/2"), 51 mm (2") and 76 (3") mm composite steel deck in the corridor with the construction details described in ULC F916 and other appropriate listings, fire ratings can be obtained for 1, 1 1/2 and 2 hours without the need for a rated ceiling assembly.

3.6.3 Fastener Pattern

Shearflex® connectors shall be located and installed in accordance with the Final Plans for Field Use. Screws will typically be installed based on one of the following Screw Attachment Patterns in Figure 3-10. Screws must be installed alternating between joist top chord angles (see Figure 3-11).
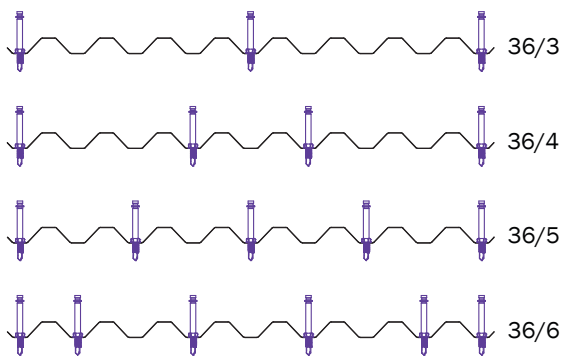

Figure 3-10: Shearflex® Screw Attachment Patterns
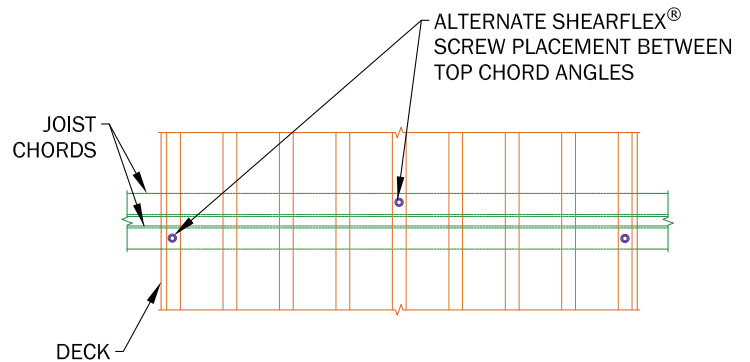
Figure 3-11: Alternate Joist Top Chords

3.6.4 Diaphragm Capacity

The Ecospan® Composite Floor System may be used as an effective diaphragm for transferring lateral forces within a building system. Design Professionals should review the information provided by the Canadian Sheet Steel Building Institute (CSSBI) for the design and detailing of composite and non-composite steel deck diaphragms.

3.6.5 Pour Stop Table

Table 3-2 has been developed for concrete pressure and construction loads in accordance with the ANSI C-2011 Standard for Composite Steel Floor Deck - Slabs.

Slab Depth (mm)	Required Deck Closure Gage						
	Overhang (mm)						
	0	25	50	75	100	125	150
90	20	20	20	20	18	18	16
100	20	20	20	20	18	18	16
110	20	20	20	18	18	16	16
120	20	18	18	18	16	16	16
130	18	18	18	16	16	16	14
140	18	18	16	16	16	14	14
150	18	16	16	16	14	14	12
160	16	16	16	14	14	14	12
170	16	16	14	14	14	12	12
180	16	14	14	14	12	12	12
190	14	14	14	12	12	12	12
200	14	14	12	12	12	12	10

Slab Depth (in.)	Required Deck Closure Gage						
	Overhang (in.)						
	0	1	2	3	4	5	6
3.5	20	20	20	20	18	18	16
4	20	20	20	20	18	16	16
4.5	20	20	18	18	18	16	16
5	20	18	18	18	16	16	14
5.5	18	18	16	16	16	14	14
6	18	16	16	16	14	14	12
6.5	16	16	14	14	14	12	12
7	16	14	14	14	12	12	12
7.5	14	14	12	12	12	12	12
8	14	12	12	12	12	12	10

Table 3-2

Notes:
1. Normal weight concrete 2500 kg/m³ (150 PCF)
2. Horizontal and vertical deflection is limited to 6.3 mm (1/4") maximum for concrete dead load.
3. Design Stress is limited to 138 MPa (20 ksi) for concrete dead load temporarily increased by one-third for the construction live load of 0.96 kPa (20 psf).
4. Pour Stop Selection Chart does not consider the effect of the performance, deflection, or rotation or the pour stop support which may include both supporting the deck and/or the frame.
5. Vertical leg return lip is recommend for all types (gages).
6. This selection table is not meant to replace the judgement of experienced structural engineers and should be considered as a reference only.

Gage Thickness		
Gage	Design Thickness	
	(mm)	(in.)
20	0.91	0.036
18	1.20	0.047
16	1.52	0.060
14	1.90	0.075
12	2.66	0.105
10	3.42	0.135

POURSTOP

SLAB DEPTH

75 mm

ATTACHMENT TO CMU

PDF/PAF/ MASONRY ANCHOR

CMU WALL
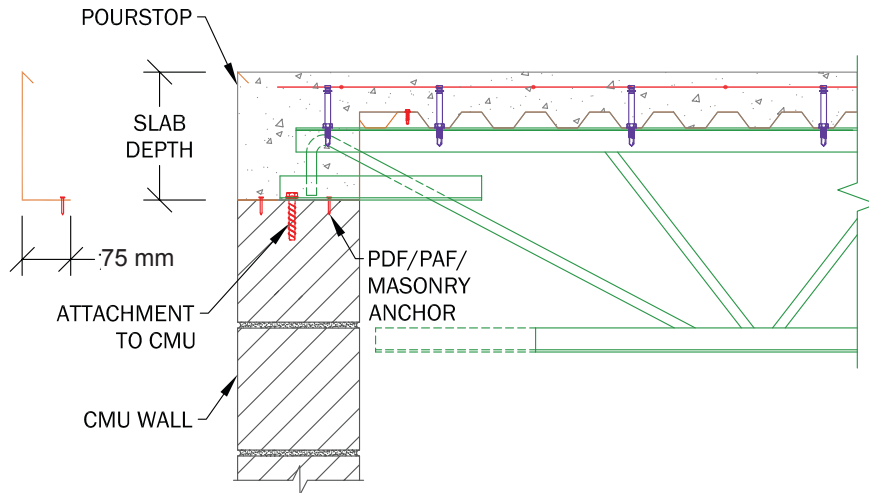
Figure 3-12: Pour Stop Bearing on CMU

POURSTOP

SLAB DEPTH

50 mm

SELF DRILLING SCREW

CFS WALL
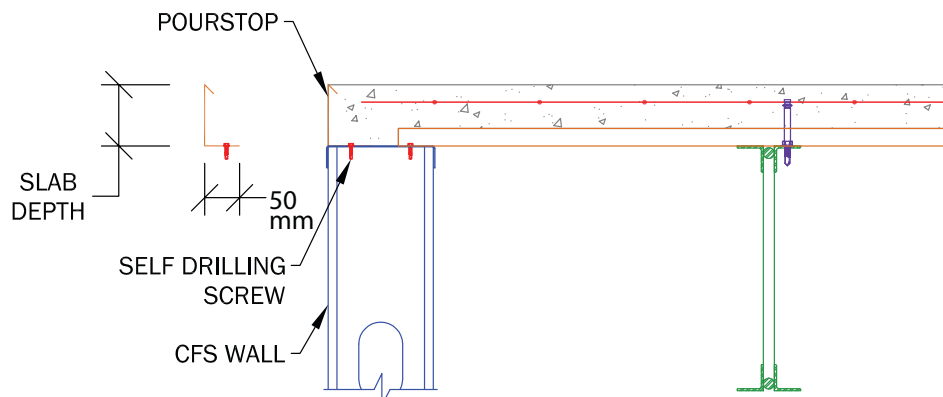
Figure 3-13: Pour Stop Bearing on CFS

25@305

POURSTOP

SLAB DEPTH

OVERHANG NOT TO EXCEED 305mm

50mm MIN. BEARING

STEEL BEAM
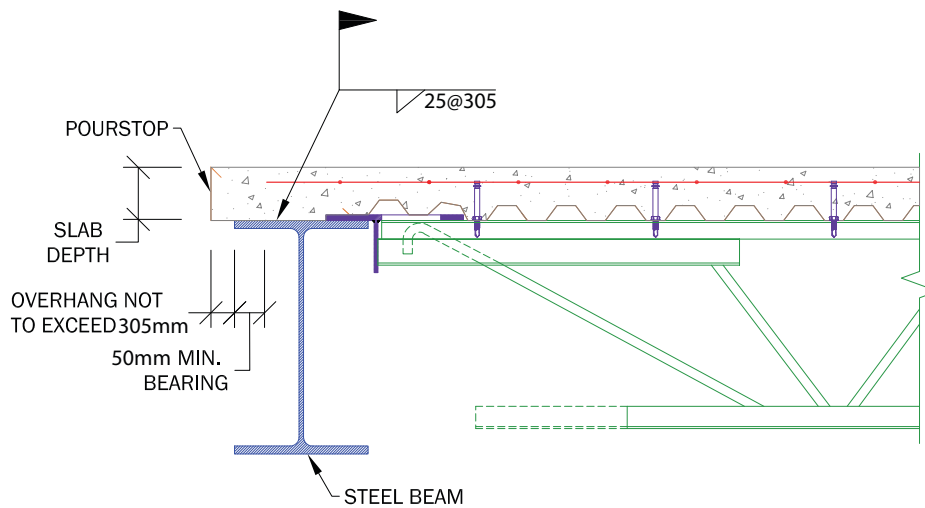
Figure 3-14: Pour Stop Bearing on Steel

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3.6.6 E-Closure

E-closure is supplied for the purpose of creating a concrete seal between joists with standard seats. Projects utilizing flush joist seats will not require E-closures.

A = TOP LEG LENGTH
B = DECK DEPTH
C = JOIST SEAT DEPTH
D = BOTTOM LEG LENGTH
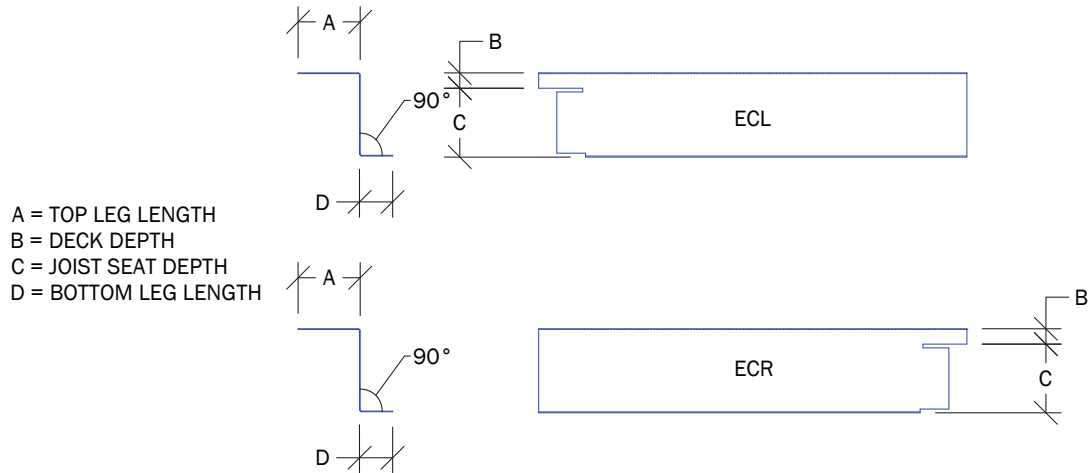
Figure 3-16: E-Closure Details

Typically, E-Closures are provided as a pre-cut and notched light gauge angles that are placed on the bearing wall or beam surface and attached to the deck. A left and a right piece will be supplied for each joist space. These two pieces will be lapped, adjusted, and connected with self-drilling and tapping screws to accommodate the required joist spacing. See Figure 3-17. (See Concrete LDM Design Guide for additional information)
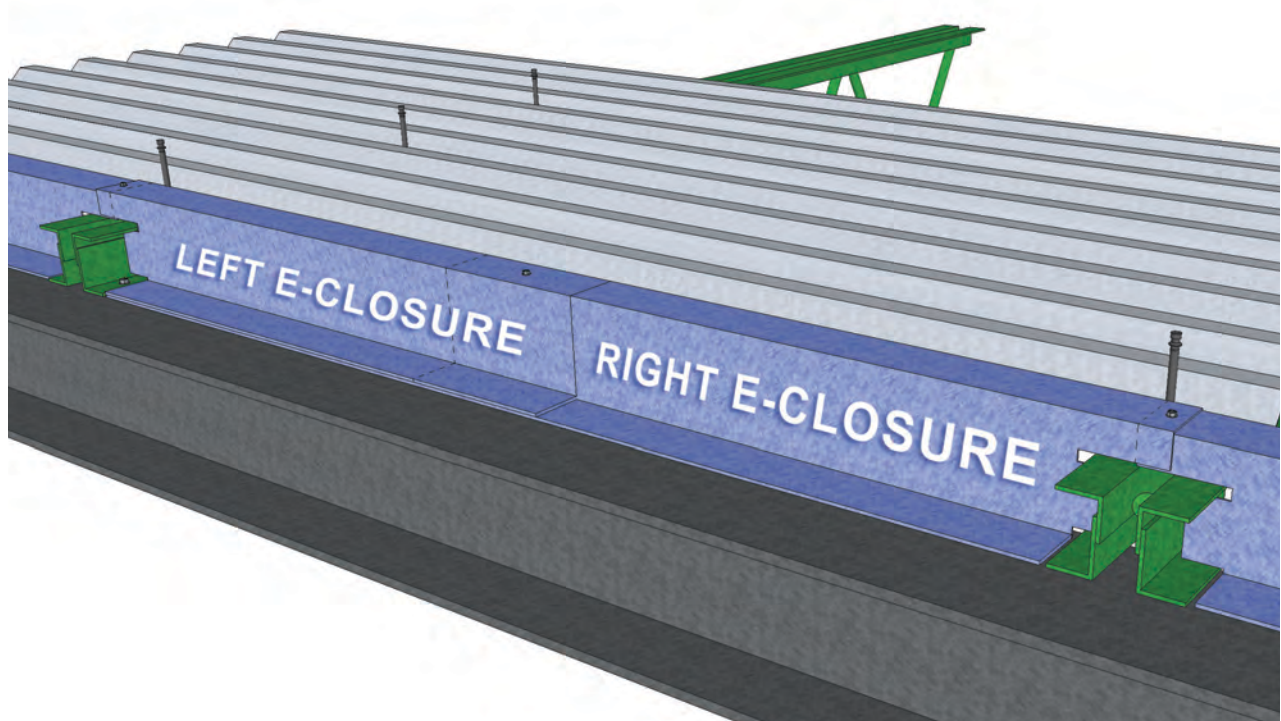
Figure 3-17: E-Closure Installation Example
Pour Stop not shown for clarity

3.6.7 Deck Support Closures

Deck supports/bearing parallel to E-series joist spans may not allow direct bearing of deck. Deck support closures, also referred to as Z-closures, enable the Design Professional to maintain support height at all edges. Properly specified deck support closures may reduce CFS panel variations and minimize CMU and ICF block cutting in the field.

Closure Depth (mm)	Required Deck Closure Gage						Closure Depth (in)	Required Deck Closure Gage					
	Vertical Load (Service) kN/m							Vertical Load(Service) plf					
	4	6	8	10	12	14		250	400	550	700	850	1,000
65	20	18	18	18	18	18	2.5	20	18	18	18	18	18
80	18	18	18	16	16	16	3.0	18	18	18	16	16	16
95	18	16	16	16	16	14	3.5	18	18	16	16	16	16
110	16	16	16	14	14	14	4.0	18	16	16	16	14	14
125	16	14	14	14	14	12	4.5	16	16	14	14	14	14
140	16	14	14	12	12	12	5.0	16	14	14	14	14	12
155	14	14	12	12	12	12	5.5	16	14	14	12	12	12
170	14	12	12	12	12	12	6.0	14	14	12	12	12	12
185	14	12	12	12	12	12	6.5	14	14	12	12	12	12
200	12	12	12	12	12	10	7.0	14	12	12	12	12	12
215	12	12	12	12	10	10	7.5	14	12	12	12	12	12
230	12	12	12	10	10	10	8.0	12	12	12	12	10	10

Table 3-3

Notes:
1. Reference CSA S136-16 E2
2. Z-closure F_y = 230 MPa (33 ksi)
3. Normal weight concrete with reinforcing weighs 23.5 kN/m³ (12.5 psf/inch) of thickness. (Example: 75mm (3") concrete solid concrete slab = 1.8kPa (37.5 psf))
4. Z-closure to be attached to support and deck at 305mm (12") o.c. maximum.
5. Web of the Z-closure shall be fully supported by the structure below.
6. Deck shall extend 25mm (1") minimum beyond the web of the Z-closure
7. Typical Z-closure horizontal legs 50mm (2") min. Legs resting on concrete or masonry 64mm (2- 1/2") min.
8. Factor of Safety against buckling F.S. = 3.

Gage Thickness		
Gage	Design Thickness	
	(mm)	(in.)
20	0.91	0.036
18	1.20	0.047
16	1.52	0.060
14	1.90	0.075
12	2.66	0.105
10	3.42	0.135

Deck Support Closure Example
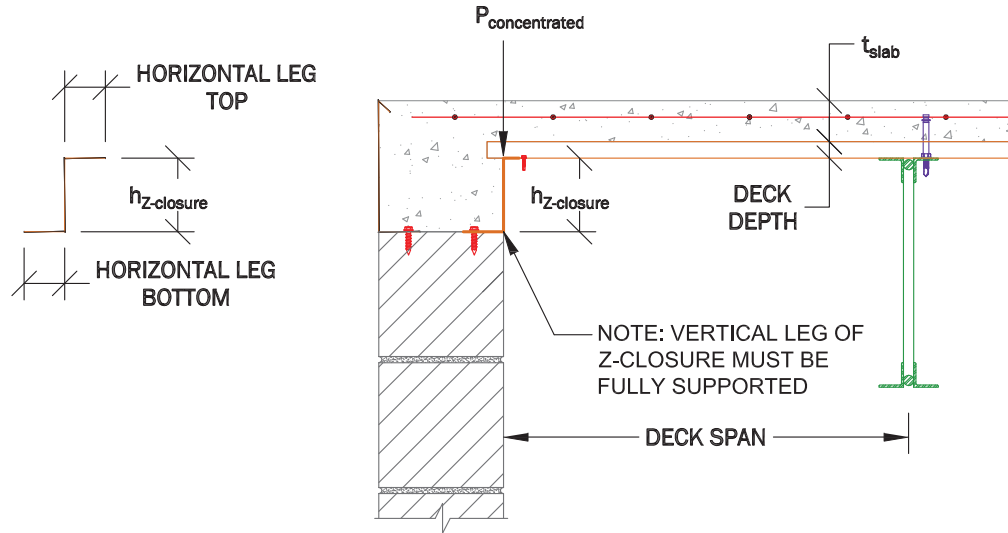
Figure 3-18: Deck Closure Support Example

Given:

- $h_{Z\text{-closure}}$ = 100mm (4")
- DECK SPAN = 1220 mm (4')
- DECK DEPTH = 25.4 mm (1") (1.0C Deck)
- t_{slab} = 64 mm (2.5")
- TOTAL SLAB DEPTH = 89 mm (3.5")
- $t_{equivalent}$ = 76 mm (3"). (Equivalent concrete thickness from Table 3-4)
- $\gamma_{concrete}$ = 23.54 kN/m³ (150 pcf)
- $P_{concentrated}$ = 4.413 kN/m (300 lb.) (Construction worker with tools and equipment)

$$\text{Vertical Load} = P_{concentrated} + (t_{equivalent})(\gamma_{conrete})(\frac{\text{DECK SPAN}}{2}) = 4.4 \text{ kN/m} + (\frac{76 \text{ mm} * 23.54 kN/m^3 * 1220 \text{ mm}}{2}) = 5.5 kN/m$$

$$\text{Vertical Load} = P_{concentrated} + (t_{equivalent})(\gamma_{conrete})(\frac{\text{DECK SPAN}}{2}) = 300 \text{ lbs} + (3 \text{ in.})(\frac{150 \text{ pcf}}{12 \text{ in/ft}})(\frac{4 \text{ ft.}}{2}) = 375 \text{ plf}$$

From Table 3-3:

A 16 gauge closure with depth of 100 mm (4") will support 6kN/m (400 plf).

Allowable load = 6 kN/m > 5.5kN/m (400 plf > 375 plf) required - O.K.

Detailed Closure:

- Horizontal Top Leg = 64 mm (2.5")
- $h_{Z\text{-closure}}$ = 100 mm (4")
- Horizontal Bottom Leg = 64 mm (2.5")
- 16 Gauge

23
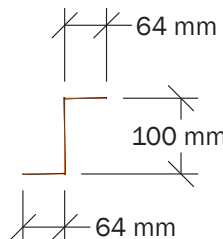
3.7 Concrete

Concrete is an integral component of the Ecospan® Composite Floor System. It's specification is the sole responsibility of the Design Professional. The slab associated with the Ecospan® Composite Floor System should be detailed with the same standard of care as any other elevated slab. Specific considerations are discussed in further detail below.

3.7.1 Concrete Reinforcement

It is the Design Professional's responsibility to determine welded wire reinforcement, blended fibre-mesh or reinforcing bar quantities for flexural capacity and/or temperature and shrinkage control in the concrete slab. CSA A23.3 "Design of Concrete Structures" provides design information regarding welded wire reinforcement and deformed bar reinforcement. Information concerning blended fibre reinforcing for slabs meeting ASTM C1116 may be supplied.

The Design Professional should specify flexural reinforcement if the specified steel deck has not been designed to support full gravity loads (See Vulcraft/Verco Deck catalogues for most current information). Superimposed load values shown in bold type require that mesh be draped.

3.7.2 Concrete Placement

With the camber present in an E-Series joist, it is suggested that the concrete be placed across the full length of the composite joist at a constant thickness. Benefits for doing this include the following:

- Resulting deflections of the E-Series joist can be more accurately predicted if the concrete is placed at a constant thickness.
- The potential for concrete over runs is greatly reduced.
- Sufficient concrete cover over the tops of the Shearflex® fasteners can more easily be obtained.
- ULC fire ratings require a minimum slab depth.
- Having a uniform concrete depth is beneficial for carrying composite forces transferred into the concrete slab by the shear connectors.

Concrete construction joints should be placed between the longitudinal axis of E-Series joists when parallel to joists. When perpendicular to joists, they should be placed over the joists supporting member. Should a concrete construction joint fall within 305 mm (12") of the longitudinal axis of the E-Series joist, it is the responsibility of the Design Professional to determine if extra transverse reinforcing steel is required.

3.7.3 Concrete Curing

The concrete slab shall be cured following recommends by CSA A23.1 "Concrete Materials and Methods of Concrete Construction".

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3.7.4 Concrete Volumes and Equivalent Thickness on Deck

Concrete volumes shown in Table 3-4 can be used to determine the dead load of the concrete as well as for estimating concrete volume per floor system.

Concrete Volumes and Equivalent Thickness on Deck						
Deck Profile	Total Slab Depth		Theo. Concrete Volume		Equivalent Thickness	
	mm	in.	m³ / 100 m²	ft³ / ft²	mm	in.
Vulcraft 1.0C	89	3.5	7.654	0.25	76	3
	102	4	8.888	0.292	89	3.5
	114	4.5	10.122	0.333	102	4
	127	5	11.439	0.375	114	4.5
	152	6	13.990	0.458	140	5.5
Verco Deep VERCOR	102	4	8.476	0.278	85	3.35
	114	4.5	9.793	0.321	98	3.85
	127	5	11.028	0.362	110	4.35
	140	5.5	12.262	0.402	123	4.85
	152	6	13.579	0.446	136	5.35
1.5" Composite	102	4	7.736	0.253	76	3
	114	4.5	8.970	0.294	89	3.5
	127	5	10.205	0.336	102	4
	140	5.5	11.521	0.378	114	4.5
	152	6	12.756	0.419	127	5
Vulcraf 1.5VLR Verco BR Formlok	102	4	8.806	0.289	102	4
	114	4.5	10.040	0.331	114	4.5
	127	5	11.357	0.372	127	5
	140	5.5	12.591	0.414	140	5.5
	152	6	13.908	0.456	152	6
2.0" Composite	114	4.5	7.654	0.25	89	3.5
	127	5	10.122	0.333	102	4
	140	5.5	11.439	0.375	114	4.5
	152	6	12.674	0.417	127	5
	165	6.5	13.990	0.458	140	5.5
3.0" Composite	140	5.5	10.122	0.333	102	4
	152	6	11.439	0.375	114	4.5
	165	6.5	12.674	0.417	127	5
	178	7	13.990	0.458	140	5.5
	191	7.5	15.225	0.5	152	6
	203	8	16.542	0.542	165	6.5

Table3-4

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4.0 Architectural Considerations

In addition to structural performance, the Ecospan® Composite Floor System will be required to meet other design requirements. This chapter discusses some of these requirements and indicates how the system can be coordinated with other trades' constraints.

4.1 ULC/UL Fire Ratings

The Ecospan® Composite Floor System is listed by Underwriters Laboratories Inc. with multiple Fire Ratings for Acoustical and Gypsum ceiling applications. The most common ULC and UL fire rated assemblies encountered in construction utilizing the Ecospan® Composite Floor System are listed with bold type in Table 4-1. Figures 4-1 through 4-2 illustrate examples of fire rated assemblies.

ULC/UL Fire Rated Assemblies	
ULC/UL Design Number	Application
*Design No. I533	Direct Applied and/or Suspended Gypsum Board Ceiling
*Design No. G561	Direct Applied and/or Suspended Gypsum Board Ceiling
Design No. G213	Suspended Acoustical Ceiling
Design No. G227	Suspended Acoustical Ceiling
*Design No. G229	Suspended Acoustical Ceiling
Design No. G236	Suspended Acoustical Ceiling
Design No. G243	Suspended Acoustical Ceiling
Design No. G222	Suspended Gypsum Board Ceiling
Design No. G547	Suspended Gypsum Board Ceiling
*Design No. G710	Spray-on Fire Proofing
Design No. N789	Spray-on Fire Proofing
*Design No. D902	Unprotected Comp. Deck in Corridor Areas
*Design No. F916	Unprotected Comp. Deck in Corridor Areas
Design No. F906	Unprotected Comp. Deck in Corridor Areas
Design No. F915	Unprotected Comp. Deck in Corridor Areas
Design No. F917	Unprotected Comp. Deck in Corridor Areas
Design No. D918	Unprotected Comp. Deck in Corridor Areas
Design No. D919	Unprotected Comp. Deck in Corridor Areas

*Most commonly utilized ULC/UL Ratings

Table 4-1

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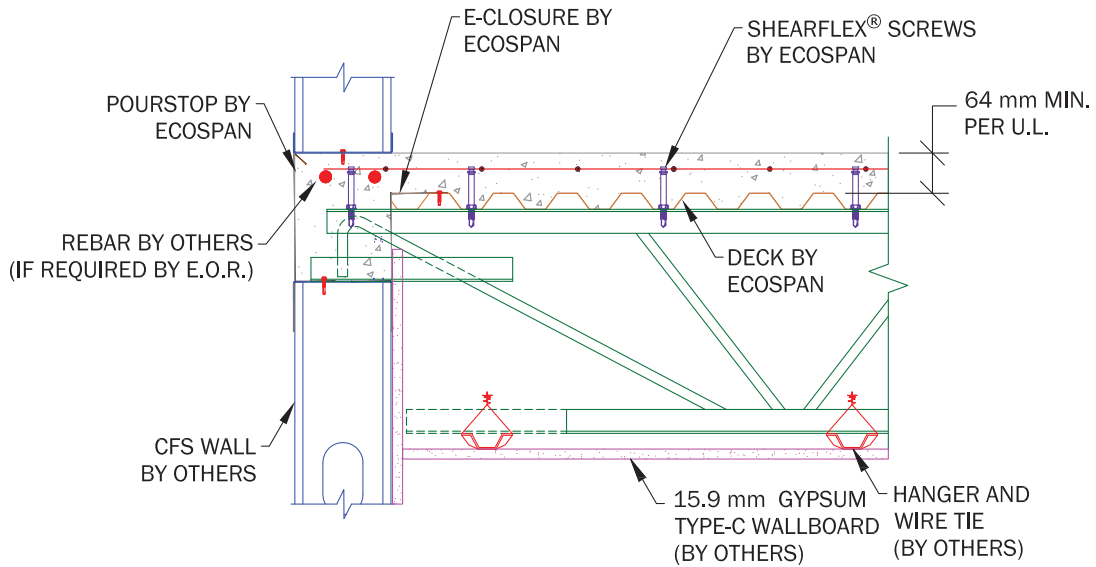
Figure 4-1
I533 Assembly Joist Bearing on CFS

Labels in figure:
- E-CLOSURE BY ECOSPAN
- SHEARFLEX® SCREWS BY ECOSPAN
- POURSTOP BY ECOSPAN
- 64 mm MIN. PER U.L.
- REBAR BY OTHERS (IF REQUIRED BY E.O.R.)
- DECK BY ECOSPAN
- CFS WALL BY OTHERS
- 15.9 mm GYPSUM TYPE-C WALLBOARD (BY OTHERS)
- HANGER AND WIRE TIE (BY OTHERS)

Labels in figure:
- 64 mm MIN. PER U.L.
- 89 mm MIN PER U.L. (1 HR)
- 114 mm MIN PER U.L. (2 HR)
- 64 mm MIN. PER U.L.
- 115 mm
- DECK DEPTH
- CORRIDOR DECK SPAN
- ULC I533 OR UL G561
- ULC F916

Figure 4-2
Fire Rated Assembly Corridor Deck Bearing on CFS

When utilizing composite steel deck in the corridor with construction details as described in ULC F916, and other appropriate listings; fire ratings can be obtained for 1, 1-1/2, and 2 hours without the utilization of a rated ceiling assembly.

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4.2 Sound Ratings

Sound Transmission Classifications (STC) were computed in accordance with ASTM designations E90 and E413. Impact Insulation Classifications (IIC) were computed in accordance with the ASTM designations E492 and E989.   All tests were performed at Riverbank Acoustical Laboratories in Geneva, IL. Full reports of each test are available upon request. For testing information, visit www.ecospansystem.ca
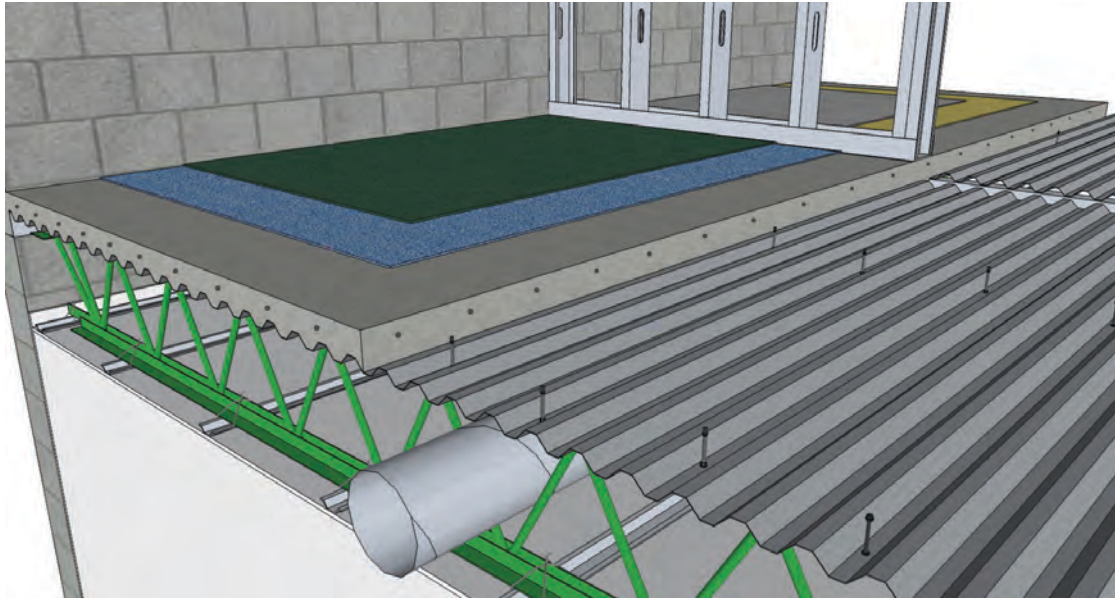
Figure 4-3

4.2.1 Full Scale Tests:

Full Scale Tests		
Flooring Materials/Thickness	IIC	STC
Bare Concrete	26, 30*	57
Carpet 1. 6PCF Pad (10 mm) 2. 100% Pet Polyester Carpet (11 mm)	77	57
Ceramic Tile 1. Loose-laid Cork (6 mm) 2. Thinset Mortar 3. Glazed Ceramic Tile (7.5 mm)	51, 54*	Not Tested
Wood Laminate 1. Underlayment (1.8 mm) 2. Wood Laminate Floor (9 mm)	54	Not Tested

*Resilient sound isolation clips (RSIC-1) used in place of wire ties.

Table 4-2

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4.2.2 Small Scale Tests:

Small Scale Tests			
	Flooring Materials/Thickness	Total Depth	IIC
CERAMIC TILE	Ceramic Tile (7.5 mm) Nobleseal CIS (0.8 mm) Levelrock 2500 (25.4 mm) SRM-25 (6 mm)	41 mm	54
	Ceramic Tile (7.5 mm) Nobleseal CIS (0.8 mm) Levelrock 2500 (38 mm) USG SRB (9 mm) SRM-25 (6 mm)	63 mm	58
	Ceramic Tile (7.5 mm) Nobleseal CIS (0.8 mm) USG Underlayment (6.4 mm) Levelrock 2500 (38 mm) USG SRB (9 mm) SRM-25 (6 mm)	63 mm	62
	Ceramic Tile (7.5 mm) USG Wonderboard (6.4 mm) Enkasonic Underlayment (10 mm)	26 mm	59
	Ceramic Tile (7.5 mm) USG Wonderboard (12.8 mm) Enkasonic Underlayment (10 mm)	32 mm	58
	Ceramic Tile (7.5 mm) Cork (6.4 mm)	16 mm	51
HARDWOOD	Hardwood Flooring (14 mm) Sound Underlayment (1.588 mm) Levelrock 2500 (25.4 mm) SRM-25 (6 mm)	48 mm	53
	Hardwood Flooring (14 mm) Sound Underlayment (1.588 mm)	16 mm	53
PERGO	Pergo Flooring (9 mm) Sound Underlayment (1.588 mm) Levelrock 2500 (25.4 mm) SRM-25 (6 mm)	43 mm	54*
	Pergo Flooring (9 mm) Sound Underlayment (1.588 mm)	11 mm	53

Table 4-3

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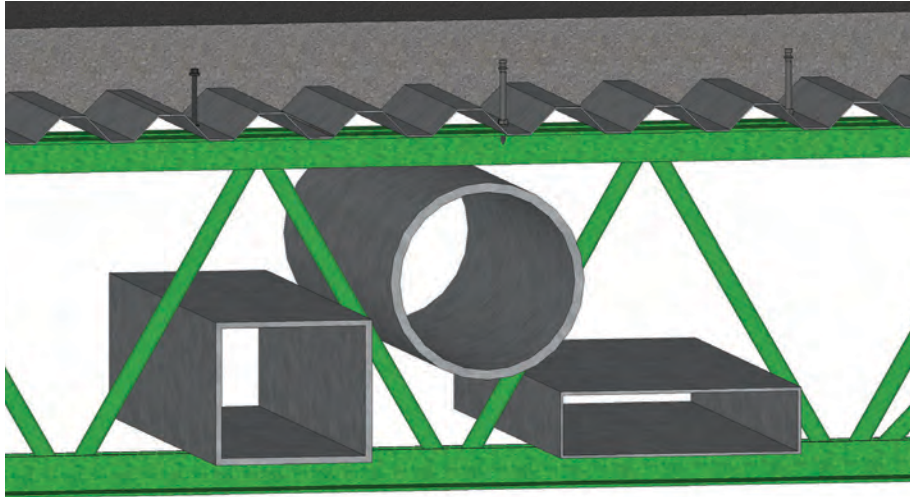
4.3 Duct Opening

Figure 4-4: Joist Opening

Ecospan® composite joists are open web steel joists with double angle top and bottom chords and webs consisting of rods or angles. Web configurations are typically uniform for a specific depth of joist. The following table illustrates the approximate duct penetrations for standard E-series joists. When requested, our engineers may modify typical web configurations to align webs or allow additional space for duct penetrations. Vierendeel openings are also available. If larger duct openings are required, contact your local sales office for assistance with vierendeel opening requirements.

Approximate Duct Opening (mm)					Approximate Duct Opening (in)				
Joist		Duct Shapes & Allowable Sizes			Joist		Duct Shapes & Allowable Sizes		
Joist Depth	Panel Distance	Round (diameter)	Square	Rectangular	Joist Depth	Panel Distance	Round (diameter)	Square	Rectangular
255	485	150	125	150x75	10"	19"	6"	5"	6"x3"
305	485	180	150	180x100	12"	19"	7"	6"	7"x4"
355	485	205	150	230x125	14"	19"	8"	6"	9"x5"
405	610	230	180	330x125	16"	24"	9"	7"	13"x5"
455	610	255	205	330x150	18"	24"	10"	8"	13"x6"
510	610	280	230	330x150	20"	24"	11"	9"	13"x6"
560	610	305	230	205x305	22"	24"	12"	9.5"	8"x12"
610	610	330	255	205x330	24"	24"	13"	10"	8"x13"
660	610	380	305	230x455	26	24"	15"	12"	9"x18"
710	610	405	330	230x455	28	24"	16"	13"	9"x18"
760	610	430	355	255x455	30	24"	17"	14"	10"x18"

Table 4-4

4.4 Serviceability Considerations

As in all structural systems, serviceability considerations shall be considered on all projects.

4.4.1 Deflection

E-Series joists are typically cambered for the non-composite dead load of the concrete, joists, decking, and bridging. This provides for a flat floor following the placement of concrete. The Design Professional has the option of cambering for the actual predicted dead and live loads applied after the concrete slab has hardened. However, since the actual live loading commonly falls between 10 – 25% of the design live load, it is not recommended that the live load deflections be included when determining camber requirements. See the Code of Standard Practice for camber tolerances.

4.4.2 Vibration

Evaluating the vibration characteristics of an Ecospan® Composite Floor System requires a review of the supporting structural system. The Design Professional must understand the supporting structure and ancillary framing in order to determine the dynamic response and damping properties. The vibrational response of a system supported by a structural steel frame will vary considerably from one supported by a load bearing wall system. Likewise open office spaces will have lower damping coefficients than residential units where full height partition walls provide extensive damping.

Determination of the vibrational characteristics of the Ecospan® Composite Floor system can be completed by utilizing the Steel Joist Institute Technical Digest No.5: "Vibration of Steel Joist – Concrete Floors" and AISC Design Guide 11: "Floor Vibrations Due to Human Activity". The information in Table 4-5 provides the Design Professional with the range of non-composite moments of inertia available for E-Series composite joist based on joist depth.

Joist Depth	Joist, I_{chords} (10^6 x mm⁴)		Joist Depth	Joist, I_{chords} (in⁴)	
	Minimum	Maximum		Minimum	Maximum
255	8	23	10	20	55
305	15	35	12	35	85
355	21	48	14	50	115
405	27	108	16	65	260
455	35	139	18	85	335
510	44	239	20	105	575
560	54	289	22	130	695
610	65	348	24	155	835
660	85	410	26	205	985
710	100	477	28	240	1145
760	114	549	30	275	1320

Table 4-5

5.0 Ecospan® Design Example

Step 1:

Fill out the Joist Parameter checklist for E-Series joists shown in Section 2.4.

Project: _____   Area Type: _____   Date: _____

Joist Geometry

1.	Depth of steel joist	405	mm
2.	Span	9	m
3.	Adjacent joist spacing (left)	1220	mm
4.	Adjacent joist spacing (right)	1220	mm

Deck and Concrete

1.	Vulcraft floor deck type	1.0C	24GA w/ 915 mm cover
2.	Concrete unit weight	2400	kg/m³
3.	Concrete compressive strength	20	MPa
4.	Slab thickness (above deck)	64	mm

Shearflex® screws

Shearflex® fastener pattern to be determined by Vulcraft National Accounts

Un-factored Design Loads

1. Non-composite dead load

a.	Concrete	1.81	kPa		
b.	Joists	0.19	kPa		
c.	Decking	0.06	kPa		
d.	Bridging	0.01	kPa		
	Total	2.07	kPa	2.52	kN/m

2. Construction live load 1.2 kPa 1.46 kN/m

3. Composite dead load

a.	Fixed partitions	0.96	kPa		
b.	MEP	0.12	kPa		
c.	Fire suppression	0.0	kPa		
d.	Floor covering	0.0	kPa		
e.	Ceiling	0.12	kPa		
f.	Other	0.0	kPa		
	Total	1.2	kPa	1.46	kN/m

4. Composite live load

a.	Design live load	1.9	kPa		
b.	Other	0.0	kPa		
	Total	1.9	kPa	2.33	kN/m

5. Total non-composite and composite loads 5.17 kPa 6.31 kN/m

Camber and Deflection

1. Max. allowable live load deflection = Span / 360
2. Ecospan® Joists are cambered for 100% of non-composite dead load (Typical)
3. Additional Camber for __0__ % Composite Dead Load and __0__ % Composite Live Load
4. I_{chords} required for vibration performance _____ x10⁶mm⁴

E-series Joist Designation
405E6.4/2.4/1.5

Step 2:

Determine loading criteria for non-composite and composite design checks.

Note: there are additional load cases the joist manufacturer must consider but is beyond the scope of this design example.

Load Case 1: Non-composite load case where the joist must support all non-composite loads prior to development of concrete and composite strength.

Factored $TL_{non-composite}$ = $1.25*DL_{non-composite}$ + $1.5*LL_{non-composite}$
= 1.25 * (2.07kPa) + 1.5 * (1.2kPa) = 4.39kPa
= (1220mm) * (4.39kPa) = 5.4kN/m

Load Case 2: Composite load case where composite section must support loads required by current building code for designated occupancy.

Factored $TL_{composite}$ = $1.25*(DL_{non-composite}+DL_{composite})$ + $1.5*LL_{composite}$
= 1.25 * (2.07kPa + 1.2kPa) + 1.5 * (1.9kPa) = 6.94kPa
= (1220mm) * (6.94kPa) = 8.5kN/m

Step 3:

Calculate the required design moment for the non-composite and composite load cases.

The joists are supported on 152.4 mm (6 in.) cold formed steel (CFS) wall studs. Utilize a joist bearing seat depth of 115 mm so that the centre of the joist reaction coincides with the centerline of the wall studs. Therefore the Ecospan® design length, L = Joist span = 9 m. Ecospan® joists are designed as simply supported members.

$$M_{fnc} = \frac{Factored\ TL_{non-composite}*L^2}{8} = \frac{5.4\frac{kN}{m}*(9m)^2}{8} = 54.7kNm$$

$$M_{fc} = \frac{Factored\ TL_{composite}*L^2}{8} = \frac{8.5\frac{kN}{m}*(9m)^2}{8} = 86.1kNm$$

Step 4:

Determine minimum top and bottom chord areas for non-composite loads.

Assume the following nominal stresses and resistance factors in these calculations:

F_y = 380 MPa E_s = 200,000 MPa   Resistance factor, ϕ = 0.9

Estimate effective depth for steel joist. d_{eff} = 0.92* D = 0.92 * 405mm = 372.6mm

area of top chord * factored tensile resistance

Where: n = 1.34

$$C_r = \frac{\phi*TC_{area}*F_y}{(1+\lambda^{2n})^{\frac{1}{n}}}$$

$$\lambda = \sqrt{\frac{F_y}{F_e}}$$

$$F_e = \frac{\pi^2 * E_s}{(\frac{K*L}{r_x})^2}$$

Where K=0.9, L = distance between panel points (assume 610mm), and r_x is the radius of gyration of the top chord as a single angle.

assume $\quad \dfrac{1}{(1+\lambda^{2n})^{\frac{1}{n}}} = 0.8$

area of bottom chord * factored tensile resistance $\quad Tr = \phi * BC_{area} * Fy$

These assumptions are reasonable for most Ecospan® joist depths and web confgurations. Now an estimate of the required area of the chords can be calculated. The effective depth assumption will be verfied once the final angle sizes have been determined.

$$TC_{area} = \frac{M_{r\,nc}}{d_{eff}*\phi*0.8*Fy} = \frac{54.7kNm}{372.6mm*0.9*0.8*380MPa} = 537mm^2$$

$$BC_{area} = \frac{M_{r\,nc}}{d_{eff}*\phi*Fy} = \frac{54.7kNm}{372.6mm*0.9*380MPa} = 429mm^2$$

Step 5:

Choose TC and BC angles based on required areas.

Chord	Angle	Thickness	Area	$y_{centroid}$	I_x	r_x
TC	2-L51x51	3.5	682	14.0	0.086	15.86
BC	2-L38x38	3.1	456	10.7	0.016	11.82

Table 5-1

Step 6:

Estimate the required bottom chord area to support the composite design moment.

Assume depth of compressive area for the concrete (a=20mm).

$$e' = D - y_{BC} + d_{slab} - \frac{a}{2} = 405mm - 10.7mm + 89mm - \frac{20mm}{2} = 473.7mm$$

$$BC_{area} = \frac{M_{r\,c}}{e'*\phi*Fy} = \frac{86.1kNm}{473.3mm*0.9*380MPa} = 532mm^2$$

The below bottom chord is selected to support the total composite load.

Chord	Angle	Thickness	Area	$y_{centroid}$	I_x	r_x
BC	2-L51x51	3.5	682	14.0	0.086	15.86

Table 5-2

Step 7:

7a: Check Non-Composite Design Assuptions:

d_{eff} = D - y_{BC} - y_{TC} = 405mm - 14.0mm -14.0mm = 377mm

Assumed d_{eff} = 372.6mm < Actual d_{eff} = 377mm ∴ OK

Check Non-composite Moment
Mr = smaller of C_r * Deff noncomp or T_r * d_{eff} noncomp   where:
C_r * d_{eff} = 192.2kN * 377mm = 73.0kNm
T_r * d_{eff} = 233.2kN * 377mm = 87.9kNm

M_r = 73.0 kNm > M_{fnc} = 54.7kNm ∴ OK

7b: Check Composite Design Assuptions:

The effective width, b_{eff}, is the lesser of:
- 0.25 * Span = 0.25 * 9m = 2250mm
- Sum of ½ the distance left and right to the adjacent joist = 610mm + 610mm = 1220mm

$$a = \frac{\phi * A_s * F_y}{\alpha_1 * \phi_c * b_{eff} * f'_c} = \frac{0.9*682mm*380MPa}{0.82*0.65*1220mm*20MPa} = 17.9mm < a_{assumed} = 20mm ∴ OK$$

(from S16 Clause 17.9.3a),
ϕconcrete = 0.65
α_1 = 0.85-0.0015*f'_c but not less than 0.67

$$e' = D - y_{BC} + d_{slab} - \frac{a}{2} = 405mm - 14.0mm + 89mm - \frac{17.9mm}{2} = 471mm$$

M_{rc} = T_r * e' = ϕ * A_s * F_y * e' = 0.9 * 682mm² * 380MPa * 471mm = 109.8kNm

M_{rc} = 109.8 kNm > M_{fc} = 86.1kNm ∴ OK
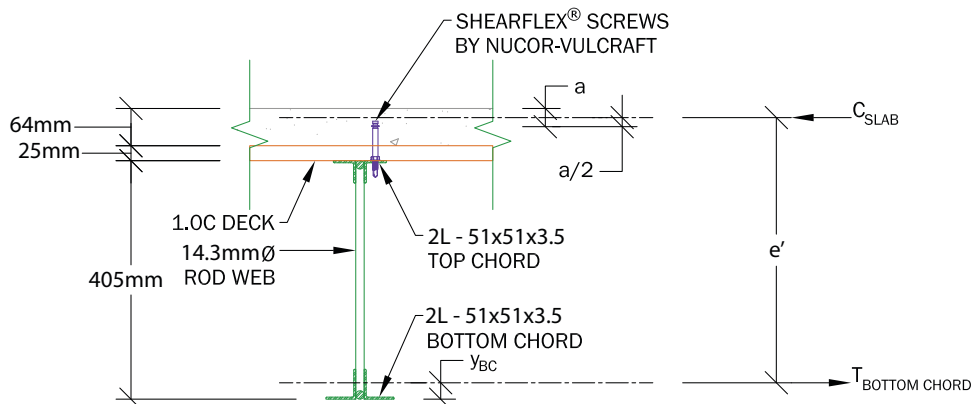
Figure 5-1: Composite Joist Diagram

COMPOSITE FLOOR SYSTEM

Step 8:

Determine Joist Bridging Required

From S16 Clause 16.7.9, bridging must be spaced no more than the following:
- 170 * r for chords in compression
- 240 * r for chords always in tension

Where r is the chord radius of gyration about its axis in the plane of the web

Check Top Chord

r_{yy} = 26.5mm for the top chord with a 14.3mm gap between the top chord angles.

L_{max} = 170 * r_{yy} = 170 * 26.5mm = 4503mm

Spaces = Span / L_{max} = 9m / 4503mm = 2.01 ∴ 2 rows are required

Check Bottom Chord

r_{yy} = 26.5mm for the bottom chord with a 14.3mm gap between the bottom chord angles.

Lmax = 240 * r_{yy} = 240 * 26.5mm = 6358mm

Spaces = Span / L_{max} = 9m / 6358mm = 1.42 ∴ 1 row is required

Determine required size of bridging:

For horizontal bridging, the ratio of unbraced length to least radius of gyration, l/r, shall not exceed 300.

Check a L-25 x 25 x2.8 bridging angle: r_z = 4.98mm

Conservatively assume that the unbraced length of the horizontal bridging = Joist Spacing = 1220mm

$$\frac{L}{r_z} = \frac{1220mm}{4.98mm} = 245 < 300 ∴ OK$$

Use two rows of horizontal L-25 x 25 x 2.8 bridging at the joist span 1/3 points

Step 9:

Determine Shearfex® screw pattern required to transfer the required horizontal shear force.

From Table 2-1, the nominal Shearfex® screw capacity (q_r) can be determined by interpolating between the design thicknesses the top chord thickness falls between. Assuming that Vulcraft-NY is the supplying plant for the 1.0C deck, qr = 20.4kN.

(Per S16 Clause 17.9.3a), $Q_r \geq f * A_s * F_y = 0.9 * 568mm * 380MPa = 194.3kN$

$$\text{Minimum number of screws per half span} = \frac{T_r}{\phi_{sc}*q_r} = \frac{194.3kN}{0.8*20.4kN} = 11.9 \frac{screws}{\text{half span}}$$

∴ 24 screws per span are required

Determine Shearflex® screw pattern

$$\text{Spacing} = \frac{Span}{\text{No. Screws}-1} = \frac{9m}{24-1} = 391mm$$

The screw pattern is determined on the deck cover / number of screws per sheet.

$$\text{No. Screws / sheet} = \frac{\text{deck cover}}{\text{Spacing}} +1 = \frac{915mm}{391mm} +1 = 3.3$$

∴ use 4 screws per deck sheet at 305mm on centre (36/4 screw pattern)

Step 10:

Determine camber requirements for the E-series joist.

From the design parameter check list, the joist is to be cambered for 100% of the noncomposite dead load.

From S16 Clause 17.3.1, I_s should be reduced by 15% to account for shear deformations. Note the joist supplier will perform a more detailed analysis once the web configuration and member sizes are selected.

$$\Delta_{Camber} = \frac{5*w_{nc}*L^4}{384*E_s*I_s} = \frac{5*2.52\frac{kN}{m}*(9m)^4}{384*200\frac{kN}{mm^2}*41.2E^6mm^4} = 26 \text{ mm}$$

where: w_{nc} = service non-composite dead loads applied prior to concrete curing = 2.52kN/m

$$I_s=0.85*\left[\frac{A_{TC}*A_{BC}*d_{eff}^2}{A_{BC}+A_{TC}} +I_{xTC} +I_{xBC}\right] =$$

$$0.85*\left[\frac{682mm*682mm*377mm^2}{682mm+682mm} +0.0859E^6mm^4+0.0859E^6mm^4\right] = 41.2E^6mm^4$$

Cambering the E-series joists 26 mm will result in a flat foor after the placement of the bridging, deck, and concrete.

Step 11:

Determine the live load defection.

S16 Clause 17.3.1 lists deflection into 3 categories which will be addressed individually.

a) Deflection due to partial shear connection and interfactial slip

$$I_e = I_s + 0.85*\rho^{0.25}*(I_t - I_s) = 41.2E^6mm^4 + 0.85*1^{0.25}*(91.9E^6mm^4 - 41.2E^6mm^4) = 84.3E^6mm^4$$

where: $\rho = 1.0$ for fully composite design

   I_t = Transformed moment of Inertia

$$y_{joist} = \frac{A_{BC}}{A_{TC}+A_{BC}}*d_{eff} + y_{TC} = \frac{682mm^2}{682mm^2+682mm^2}*377mm+14.0mm = 202.5mm$$

$$n = \frac{E_s}{E_c} = 9.94$$

$$E_c = 4500*\sqrt{f_c'} = 4500*\sqrt{20MPa} = 20,125MPa$$

$$b = \frac{b_{eff}}{n} = \frac{1220mm}{9.94} = 122.7mm$$

$$I_t = \frac{A_{BC}*b*d_{slab}}{A_{BC}+b*d_{slab}}\left(d_{deck}+\frac{t_{slab}}{2}+y_{joist}\right)^2 + I_s + \frac{b*t_{slab}^3}{12} =$$

$$\frac{682mm*122.7mm*89mm}{682mm+122.7mm*89mm}\left(25.4mm+\frac{64mm}{2}+202.5mm\right)^2 + 41.2E^6mm^4 + \frac{122.7mm*89mm^3}{12}$$

$$= 91.9E6\ mm^4$$

The applied service loads are listed below in Table 5-3 along with their estimated deflection determined by:

$$\Delta_{LLa} = \frac{5*w_{LL}*L^4}{384*E_s*I_e} = \frac{5*2.32\frac{kN}{m}*(9m)^4}{384*200\frac{kN}{mm^2}*84.3E^6mm^4} = 13.8mm$$

Load Type		Area Load = kN/m2	Line Load = kN/m	Δ = mm
Composite Dead Load	w_{CDL} =	1.20	1.46	9
Live Load	w_{LL} =	1.90	2.32	14
Total Load	w_{TL} =	5.17	6.31	23

Table 5-3

Note that wTL does not include deflection from the non-composite dead load since the joists are cambered for 100% of the non-composite dead load.

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b) Deflection due to creep

Increase deflection from dead loads and long term live loads from a) by 15%
Assume that half of the live load is applied as long term loading.

$w_{creep} = w_{NCDL} + w_{CDL} + ½ * w_{LL} = 2.52kN/m + 1.46kN/m + ½ * 2.32kN/m = 5.14kN/m$

$$\Delta_b = 0.15*\frac{5*w_{creep}*L^4}{384*E_s*I_e} = 0.15*\frac{5*5.14\frac{kN}{m}*(9m)^4}{384*200\frac{kN}{mm^2}*84.3E^6mm^4} = 5 \text{ mm}$$

c) Deflection due to concrete shrinkage

$$\Delta_c = \frac{L^2}{8}\psi = \frac{L^2}{8}*c*\frac{\epsilon_f*A_c*y}{n_s*I_{es}}$$

where: $c = 0.5$

$\epsilon_f = 583x10^{-6}$

$A_c = {}_{beff} * t_{slab} = 1220mm * 64mm = 78,080mm2$

$$y = y_{joist} + d_{deck} + \frac{t_{slab}}{2} = 202.5mm + 25.4mm + \frac{64mm}{2} = 259.9mm$$

$$n_s = \frac{E_s}{E'_c} = \frac{200,000MPa}{6773MPa} = 29.5$$

where: $$E'_c = \frac{E_c}{1+X*\phi} = \frac{20,125MPa}{1+0.73*2.7} = 6,773MPa$$

where: $X = 0.73$
$\Phi = 2.7$

$$I_{es} = I_s + 0.85*\rho^{0.25}*(I_{ts} - I_s) = 82.5E^6mm4$$

where: $$b_s = \frac{b_{eff}}{n_s} = \frac{1220mm}{29.5} = 41.3mm$$

$$I_t = \frac{A_{BC}*b_s*d_{slab}}{A_{BC}+b_s*d_{slab}}\left(d_{deck} + \frac{t_{slab}}{2} + y_{joist}\right)^2 + I_s + \frac{b_s*t_{slab}^3}{12} = 89.8E^6 \text{ mm4}$$

$$\Delta_c = \frac{L^2}{8}*c*\frac{\epsilon_f*A_c*y}{n_s*I_{es}} = \frac{9m^2}{8}*0.5*\frac{583E^{-6}*78,080mm^2*259.9mm}{29.5*82.5E^6mm^4} = 25 \text{ mm}$$

Note that concrete shrinkage should be applied as a long term deflection and is not considered in the live load deflection check.

Since Live Loads are applied after the camber has been negated by the non-composite dead loads, they are not used in the following calculation.

$$\Delta_{LL} = \Delta_{LLa} + \Delta_{LLb} = 14 \text{ mm} + 5 \text{ mm} = 19.0 \text{mm} < \text{Span}/360 = 25 \text{mm} \therefore \text{ok}$$

Check total long term deflection of the composite joist.

$$\Delta_{TLabc} = \Delta_{TLa} + \Delta_b + \Delta_c = 23 \text{ mm} + 5 \text{ mm} + 25 \text{ mm} = 53 \text{ mm}$$

Step 12:

Check the floor for vibration

Figure 5-2: Floor Plan

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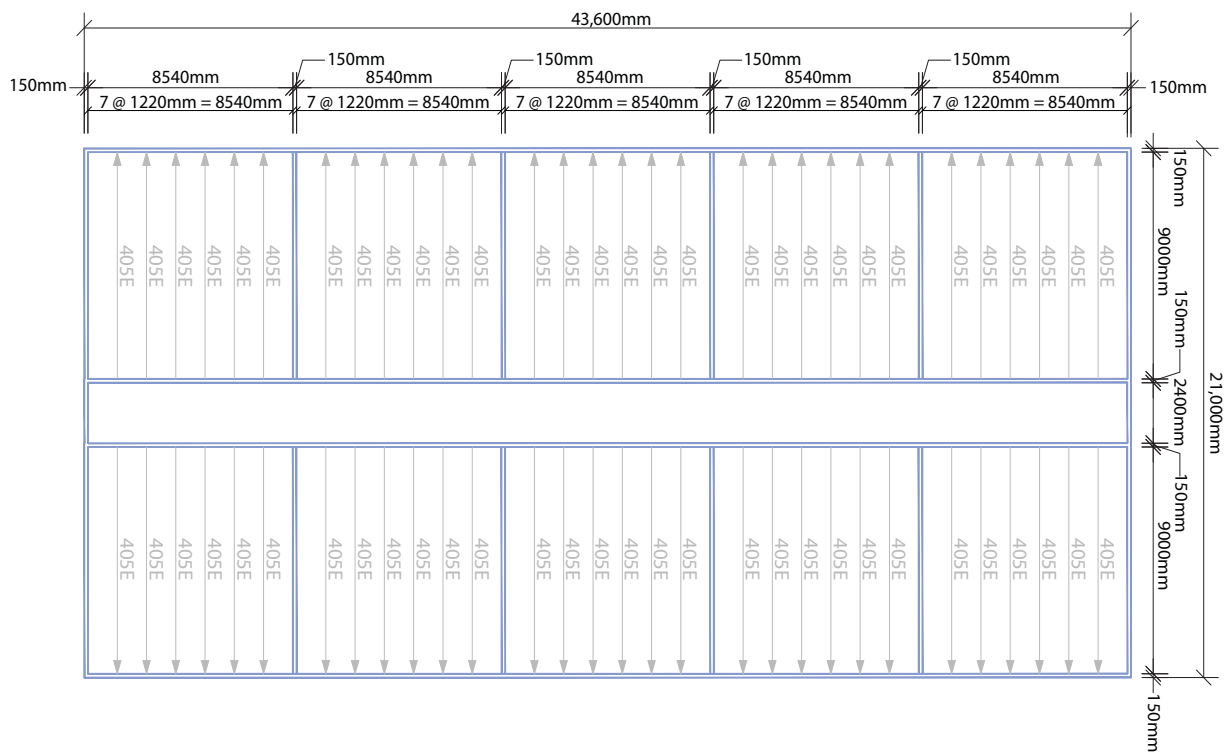
Input vibration values:

β = 0.08 (assuming full height partitions)
P_o = 29.5 kg

Overall floor width perpendicular to the joists, F_{lw} = 43,600 mm
Overall floor length parallel to the joists, F_{ll} = 21,000 mm

Variables already established from above:

D = Nominal Depth of Joist = 405 mm
L = Joist theoretical length = 9000 mm
I_{chords} = 48.5E6 mm^4 Unreduced for shear deformation

Determine the transformed effective moment of inertia for the composite joist and slab = Ie
Reference AISC Steel Design Guide 11 2nd Edition

$$I_e = \frac{1}{\frac{\gamma}{I_{chords}} + \frac{1}{I_{comp}}}$$

Where:

$$\gamma = \frac{1}{c_r} - 1 = \frac{1}{0.882} - 1 = 0.134$$

$$c_r = 0.721 + 0.00725 * \left(\frac{L}{D}\right) =$$

$$0.721 + 0.00725 * \left(\frac{9000mm}{405mm}\right) = 0.882 \le 0.9$$

$$E_c = \left(3300 * \sqrt{f_c'} + 6900\right) * \left(\frac{\gamma_c}{2300}\right)^{1.5} = (3300 * \sqrt{20MPa} + 6900) * \left(\frac{2400\frac{kg}{m^3}}{2300}\right)^{1.5} = 23,086MPa$$

$$n = \frac{E_s}{1.35 * E_c} = \frac{200,000MPa}{1.35 * 23,086MPa} = 6.42$$

$$b = \frac{b_{eff}}{n} = \frac{1220mm}{6.42} = 190mm$$

$$I_{comp} = \frac{A_{BC} * b * d_{slab}}{A_{BC} + b * d_{slab}}\left(d_{deck} + \frac{t_{slab}}{2} + y_{joist}\right)^2 + I_{chords} + \frac{b * t_{slab}^3}{12} =$$

$$\frac{682mm * 190mm * 89mm}{682mm + 190mm * 89mm}\left(25.4mm + \frac{64mm}{2} + 202.5mm\right)^2 + 48.5E^6mm^4 + \frac{190mm * 89mm^3}{12}$$

$$= 104.1E^6 \ mm^4$$

$$I_e = \cfrac{1}{\cfrac{0.134}{I_{chords}} + \cfrac{1}{I_{comp}}} = \cfrac{1}{\cfrac{0.134}{48.5E^6 mm^4} + \cfrac{1}{104.1E^6 mm^4}} = 80.9E^6 mm^4$$

Non-composite dead load of slab, deck, & bridging, w_{sdb} = 1.88 kPa

Actual composite dead load acting on the foor, w_{DL} = 0.192 kPa

Actual composite live load acting on the foor, w_{LL} = 0.527 kPa

Actual weight of joist, w_{josit} = 0.144 kPa

Joist spacing, S_j = 1220 mm

$w_j = (w_{sbd} + w_{DL} + w_{LL} + w_{joist})\, S_j$ = (1.879kPa + 0.192kPa + 0.527kPa + 0.144kPa) * 1220mm = 3.35 kN/m

$$\Delta_{joist} = \frac{5 * w_j * L^4}{384 * E_s * I_e} = \frac{5 * 3.35\frac{kN}{m} * (9m)^4}{384 * 200\frac{kN}{mm^2} * 80.9E^6 mm^4} = 17.7mm$$

$$f_{joist} = 0.18\sqrt{\frac{g}{\Delta_{joist}}} = 0.18\sqrt{\frac{9.81\frac{m}{s^2}}{17.7mm}} = 4.24Hz$$

Effective depth of concrete slab, d_e = 76mm from Table 3-4

Using an average concrete thickness, d_e = 76 mm, the transformed moment of inertia of the concrete slab per unit width in the slab direction is:

$$D_{slab} = \frac{d_e^3}{12 * n} = \frac{76^3}{12 * 6.42} = 5700mm^3$$

Determine the transformed moment of inertia per unit width in the joist direction, D_{joist}

$$D_{joist} = \frac{I_e}{S_j} = \frac{80.9E^6 mm^4}{1220mm} = 66,289mm^3$$

The effective width of the joist panel mode,

$$B_{joist} = min\left(C_{joist} * \left(\frac{D_{slab}}{D_{joist}}\right)^{0.25} * L\ ,\ \frac{2}{3}F_{lw} \right)$$

where: C_{joist} = 2.0 for joists or beams that are not parallel to an interior edge

$$B_{joist}=\min\left(2.0*\left(\frac{5700mm^3}{66,289mm^3}\right)^{0.25}*9m\ ,\ \frac{2}{3}*43.6m\right) = \min(9.75m, 29.06m) = 9.75m$$

W_j = Effective joist panel weight

$$W_j=\frac{w_j*B_{joist}*L}{S_j} = \frac{3.35\frac{kN}{m}*9.75m*9m}{1220mm} = 240.5kN$$

AISC Design Guide 11 indicates that the foor system is satisfactory if the peak acceleration, a_p , due to walking excitation does not exceed 0.5% of the acceleration due to gravity (See Table 4.1 of Design Guide 11).

$$\frac{a_p}{g} = \frac{P_o*e^{-0.35*f_n}}{\beta*W_{joist}} = \frac{0.29kN*e^{-0.35*3.95Hz}}{0.08*240.5kN} = 0.347\% < 0.5\% \ \therefore OK$$

ECOSPAN®

COMPOSITE FLOOR SYSTEM

NOTES:

6.0 Ecospan® Composite Floor System Details

The Ecospan® Composite Floor System is compatible with any wall framing system. As a result there are numerous detail section possibilities. The following are typical details and are for reference only.

6.1   Ecospan® System on Cold Formed Steel (CFS) Details

TRACK ATTACHMENT TO SLAB BY OTHERS
POURSTOP BY ECOSPAN
E-CLOSURE BY ECOSPAN
SELF DRILLING SCREW
SHEARFLEX® SCREWS BY ECOSPAN
REINFORCEMENT BY OTHERS
DECK BY ECOSPAN
HOLLOW STRUCTURAL SECTION (HSS) LOAD DISTRIBUTION MEMBER (LDM) BY OTHERS
CEILING EXTENSION
JOIST BY ECOSPAN
CFS WALL BY OTHERS

6.1.1   STANDARD SEAT ON CFS
Not To Scale

TRACK ATTACHMENT TO SLAB BY OTHERS
POURSTOP BY ECOSPAN
E-CLOSURE BY ECOSPAN
SELF DRILLING SCREW
SHEARFLEX® SCREWS BY ECOSPAN
REINFORCEMENT BY OTHERS
DECK BY ECOSPAN
CFS WALL BY OTHERS
CEILING EXTENSION
JOIST BY ECOSPAN
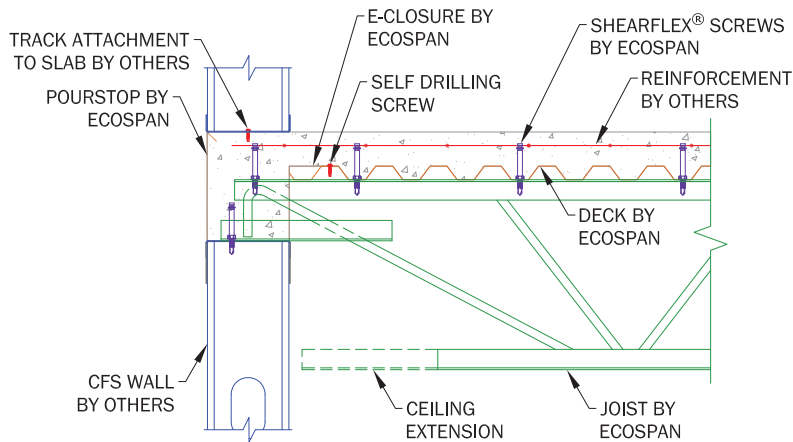
6.1.2   DEEP SEAT ON CFS
Not To Scale
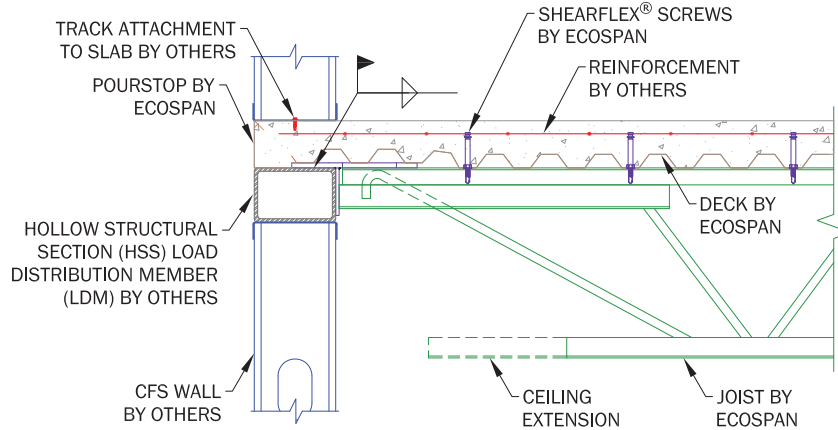
6.1.3 — FLUSH SEAT ON CFS
Not To Scale

TRACK ATTACHMENT
TO SLAB BY OTHERS

POURSTOP BY
ECOSPAN

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

HOLLOW STRUCTURAL
SECTION (HSS) LOAD
DISTRIBUTION MEMBER
(LDM) BY OTHERS

DECK BY
ECOSPAN

CFS WALL
BY OTHERS

CEILING
EXTENSION

JOIST BY
ECOSPAN
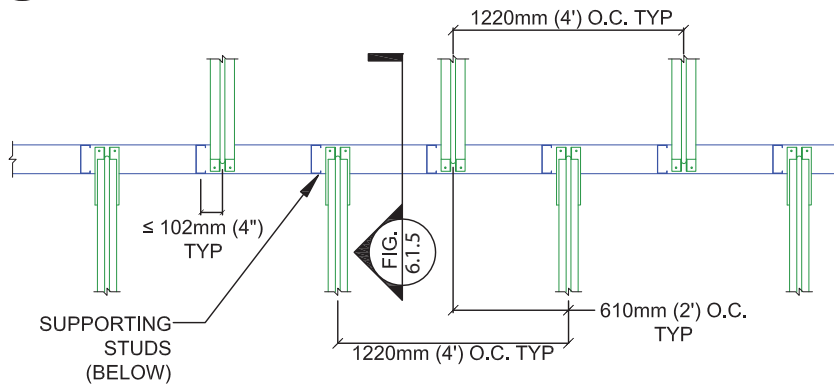
6.1.4 — STAGGERED JOISTS ON CFS - PLAN VIEW
Not To Scale

1220mm (4') O.C. TYP

≤ 102mm (4")
TYP

FIG.
6.1.5

SUPPORTING
STUDS
(BELOW)

610mm (2') O.C.
TYP

1220mm (4') O.C. TYP
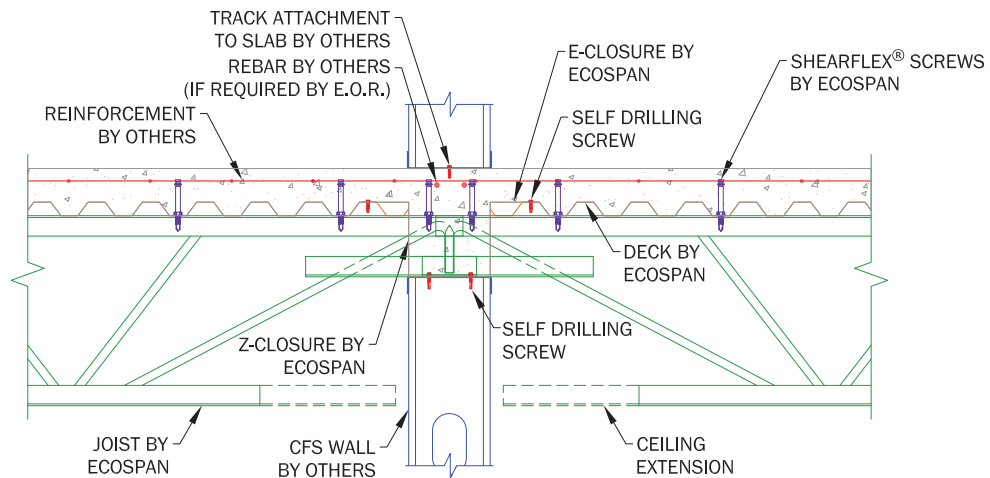
6.1.5 — STAGGERED JOISTS ON CFS
Not To Scale

TRACK ATTACHMENT
TO SLAB BY OTHERS

REBAR BY OTHERS
(IF REQUIRED BY E.O.R.)

REINFORCEMENT
BY OTHERS

E-CLOSURE BY
ECOSPAN

SHEARFLEX® SCREWS
BY ECOSPAN

SELF DRILLING
SCREW

DECK BY
ECOSPAN

Z-CLOSURE BY
ECOSPAN

SELF DRILLING
SCREW

JOIST BY
ECOSPAN

CFS WALL
BY OTHERS

CEILING
EXTENSION

ECOSPAN®
COMPOSITE FLOOR SYSTEM

TRACK ATTACHMENT
TO SLAB BY OTHERS

E-CLOSURE BY
ECOSPAN

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

SELF DRILLING
SCREW

DECK BY
ECOSPAN

DECK BY
ECOSPAN

Z-CLOSURE BY
ECOSPAN

HOLLOW STRUCTURAL
SECTION (HSS) LOAD
DISTRIBUTION MEMBER
(LDM) BY OTHERS

CFS WALL
BY OTHERS

CEILING
EXTENSION

JOIST BY
ECOSPAN

6.1.6 DECK DIRECTION CHANGE AT DEEP SEAT ON CFS
Not To Scale

SHEARFLEX® SCREWS
BY ECOSPAN
(IF REQUIRED BY E.O.R.)

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

POURSTOP BY
ECOSPAN

DECK BY
ECOSPAN

CFS WALL
BY OTHERS

SELF DRILLING
SCREW

JOIST BY
ECOSPAN
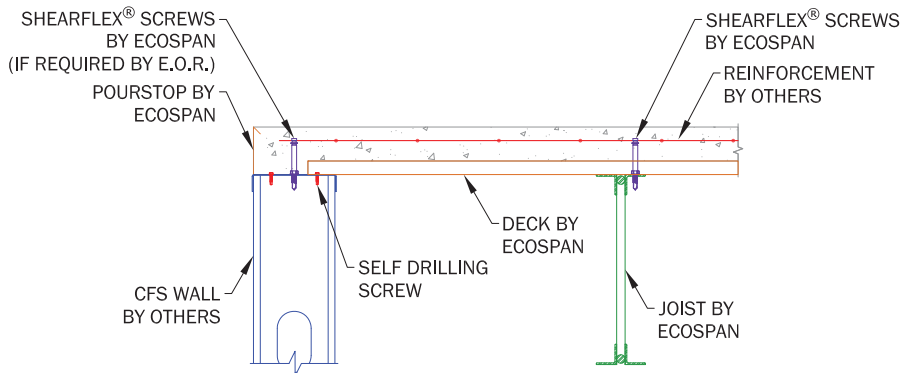
6.1.7 DECK EDGE ON CFS
Not To Scale

CONCRETE DISTRIBUTION/
COLLECTOR BEAM

SHEARFLEX® SCREWS
BY ECOSPAN

SHEARFLEX® SCREWS
BY ECOSPAN
(IF REQUIRED BY E.O.R.)

REINFORCEMENT
BY OTHERS

SELF DRILLING
SCREW

POURSTOP BY
ECOSPAN

DECK BY
ECOSPAN

Z-CLOSURE BY
ECOSPAN

CFS WALL
BY OTHERS

JOIST BY
ECOSPAN
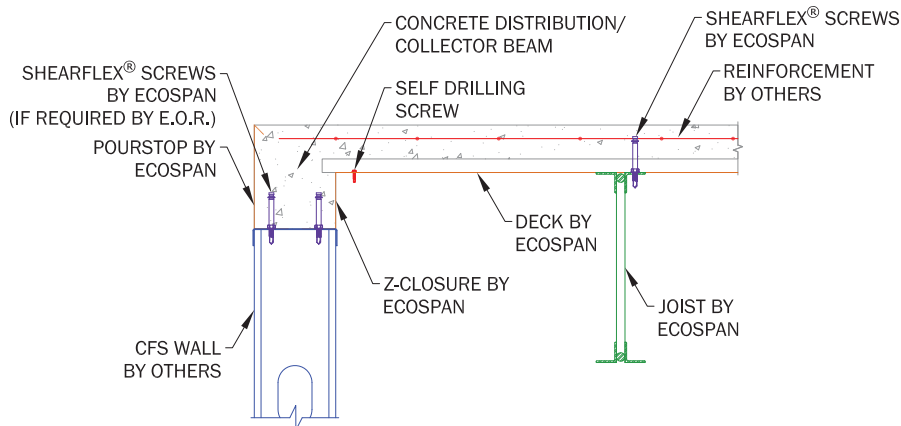
6.1.8 DECK LAP ON CFS
Not To Scale

NUCOR
VULCRAFT CANADA, INC.

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

SELF DRILLING SCREW

DECK BY ECOSPAN

Z-CLOSURE BY ECOSPAN

JOIST BY ECOSPAN

CFS WALL BY OTHERS
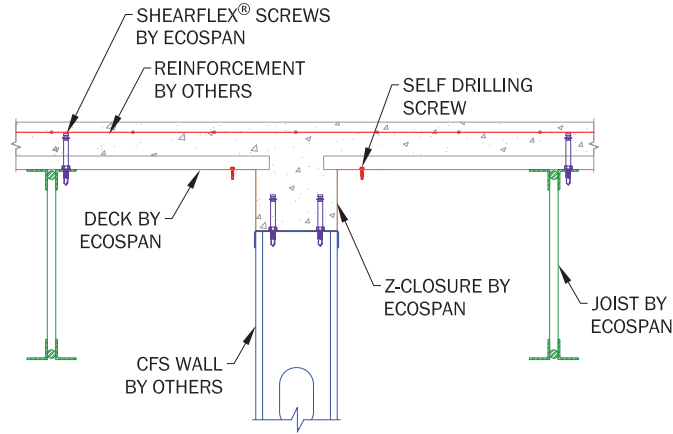
6.1.9 — DECK SUPPORT OVER CFS

Not To Scale

6.2 Ecospan® System on WF Beam Details

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

POURSTOP BY ECOSPAN

DECK BY ECOSPAN

CEILING EXTENSION

JOIST BY ECOSPAN

BEAM BY OTHERS

6.2.1 — STANDARD JOIST SEAT ON BEAM

Not To Scale

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

POURSTOP BY ECOSPAN

DECK BY ECOSPAN

CEILING EXTENSION

JOIST BY ECOSPAN

BEAM BY OTHERS

6.2.2 — FLUSH SEAT ON BEAM

Not To Scale

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

DECK BY
ECOSPAN

JOIST BY
ECOSPAN

CEILING
EXTENSION
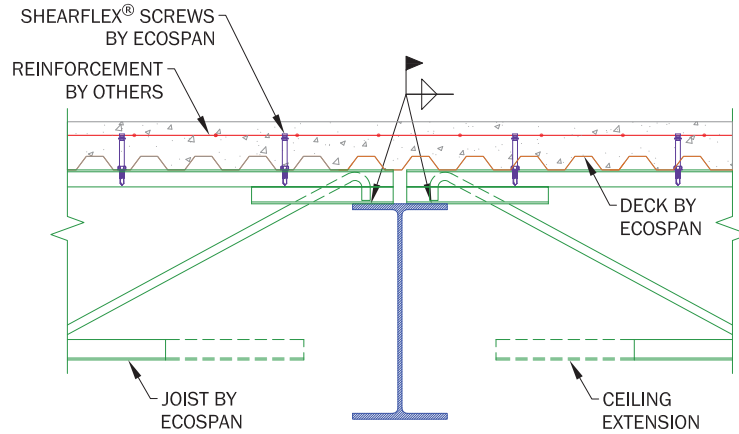
6.2.3 STANDARD BEARING ON BEAM

Not To Scale

HEADED STUD AS
REQ'D TO TRANSFER
DIAPHRAGM FORCES
BY OTHERS

E-CLOSURE BY
ECOSPAN

SHEARFLEX® SCREWS
BY ECOSPAN

SELF DRILLING
SCREW

REINFORCEMENT
BY OTHERS

DECK BY
ECOSPAN

JOIST BY
ECOSPAN

CEILING
EXTENSION

BRACED FRAME
BY OTHERS
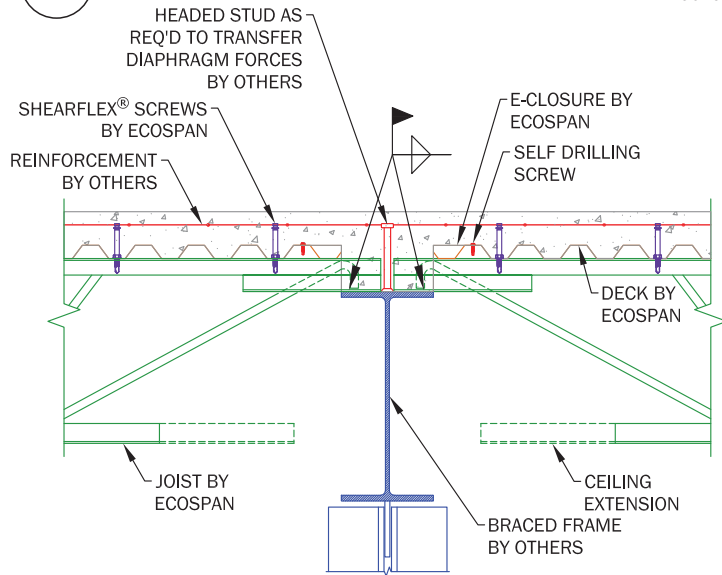
6.2.4 STANDARD SEATS ON BRACED FRAME

Not To Scale

POURSTOP BY
ECOSPAN

REINFORCEMENT
BY OTHERS

OVERHANG NOT
TO EXCEED 305mm (1')

DECK BY
ECOSPAN

BEAM BY
OTHERS
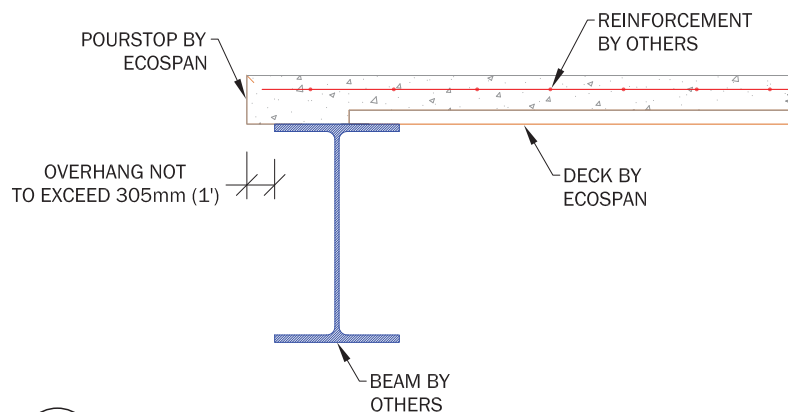
6.2.5 DECK EDGE AT BEAM

Not To Scale

NUCOR
VULCRAFT CANADA, INC.

BENT PLATE BY OTHERS

REINFORCEMENT BY OTHERS

DECK BY ECOSPAN

BEAM BY OTHERS
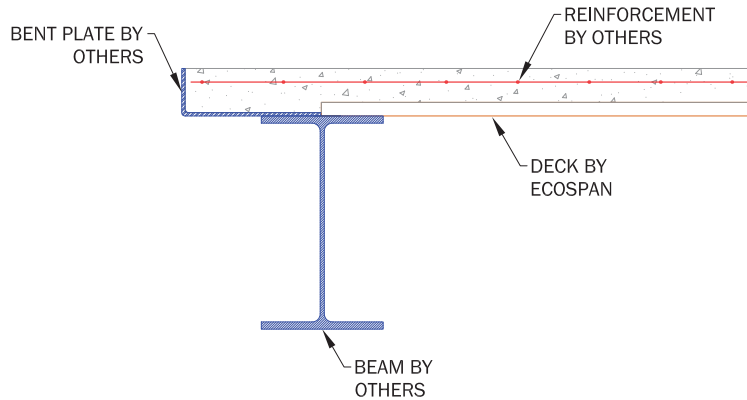
6.2.6 DECK EDGE WITH BENT PLATE
Not To Scale

POURSTOP BY ECOSPAN

REINFORCEMENT BY OTHERS

SELF DRILLING SCREW

DECK BY ECOSPAN

BEAM BY OTHERS
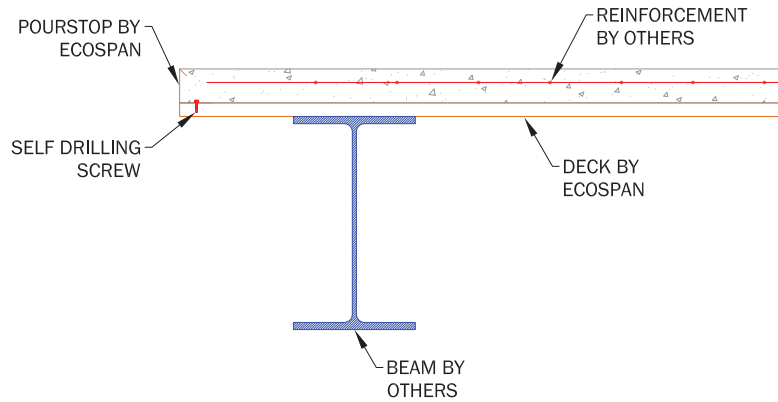
6.2.7 CANTILEVERED DECK EDGE
Not To Scale

REINFORCEMENT BY OTHERS

SELF DRILLING SCREW

DECK BY ECOSPAN

Z-CLOSURE BY ECOSPAN

BEAM BY OTHERS
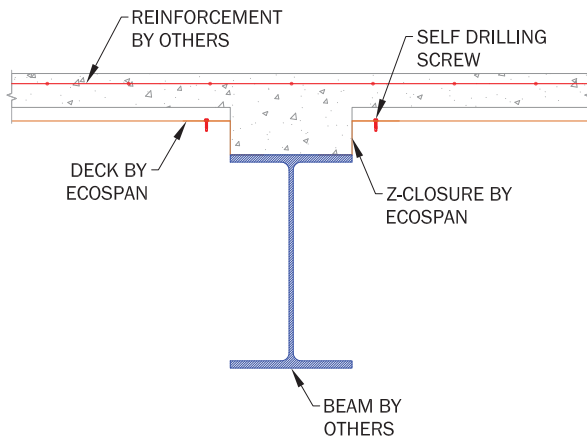
6.2.8 DECK SUPPORT OVER BEAM
Not To Scale

6.3 Ecospan® System on Masonry/Concrete Details

E-CLOSURE BY ECOSPAN

SHEARFLEX® SCREWS BY ECOSPAN

SELF DRILLING SCREW

REINFORCEMENT BY OTHERS

POURSTOP BY ECOSPAN

ATTACHMENT TO CMU BY OTHERS

DECK BY ECOSPAN

CMU WALL BY OTHERS

CEILING EXTENSION

JOIST BY ECOSPAN
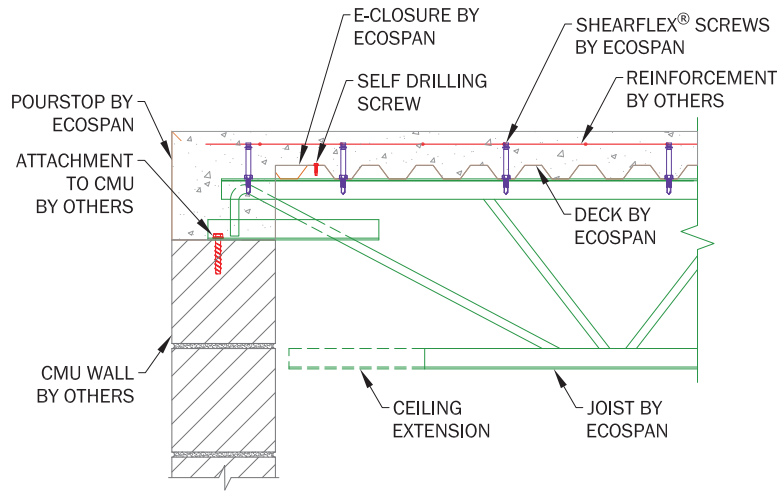
6.3.1 **DEEP JOIST SEAT ON CMU**   Not To Scale

EXPANSION JOINT MATERIAL BY OTHERS

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

DECK BY ECOSPAN

CONTINUOUS ANGLE BY OTHERS

CMU WALL BY OTHERS

CEILING EXTENSION

JOIST BY ECOSPAN
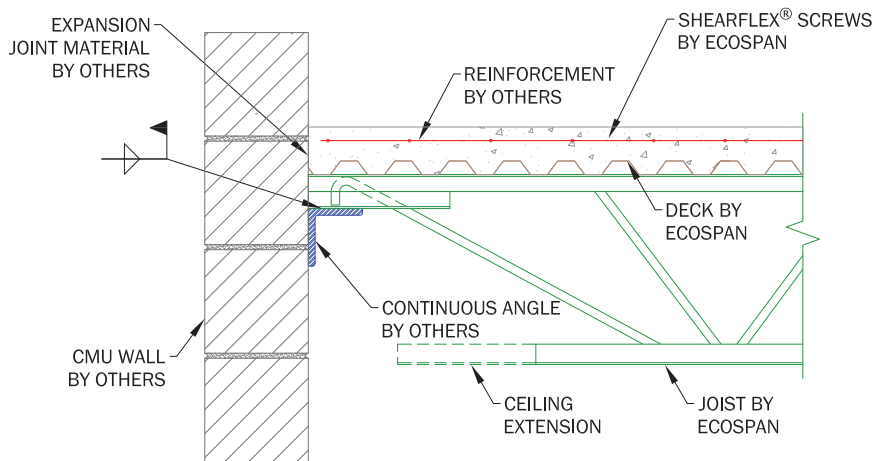
6.3.2 **STANDARD SEAT AT FACE OF CMU**   Not To Scale

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

POURSTOP BY ECOSPAN

ATTACHMENT TO CMU BY OTHERS

PDF/PAF BY OTHERS

DECK BY ECOSPAN

CMU WALL BY OTHERS

JOIST BY ECOSPAN
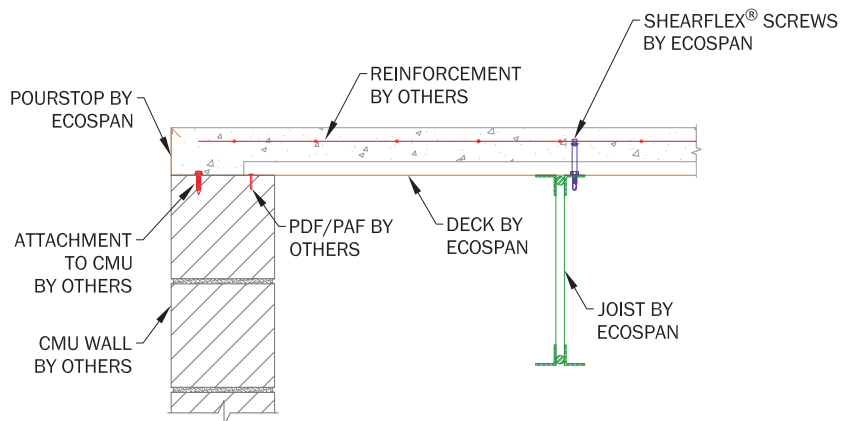
6.3.3 **DECK EDGE AT CMU**   Not To Scale

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ECOSPAN®
COMPOSITE FLOOR SYSTEM

REINFORCEMENT BY OTHERS

E-CLOSURE BY ECOSPAN

SHEARFLEX® SCREWS BY ECOSPAN

SELF DRILLING SCREW

DECK BY ECOSPAN

DECK BY ECOSPAN

Z-CLOSURE BY ECOSPAN (ATTACHMENT NOT SHOWN FOR CLARITY)

MASONRY ANCHOR BY OTHERS

CEILING EXTENSION

JOIST BY ECOSPAN

CMU WALL BY OTHERS
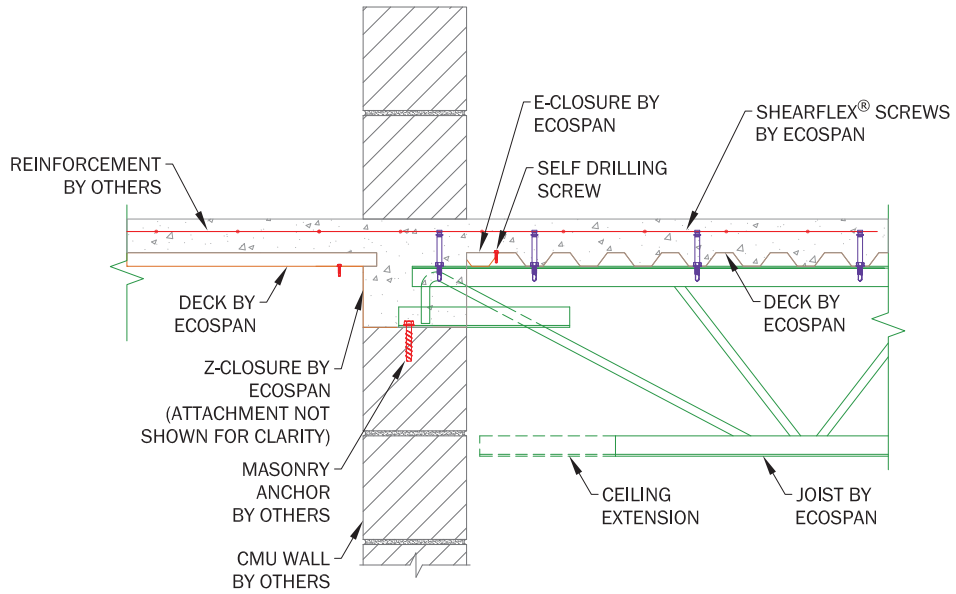
6.3.4 DECK DIRECTION CHANGE AT CMU
Not To Scale

E-CLOSURE BY ECOSPAN

SELF DRILLING SCREW

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

DECK BY ECOSPAN

ATTACHMENT TO CMU BY OTHERS

JOIST BY ECOSPAN

CMU WALL BY OTHERS

CEILING EXTENSION
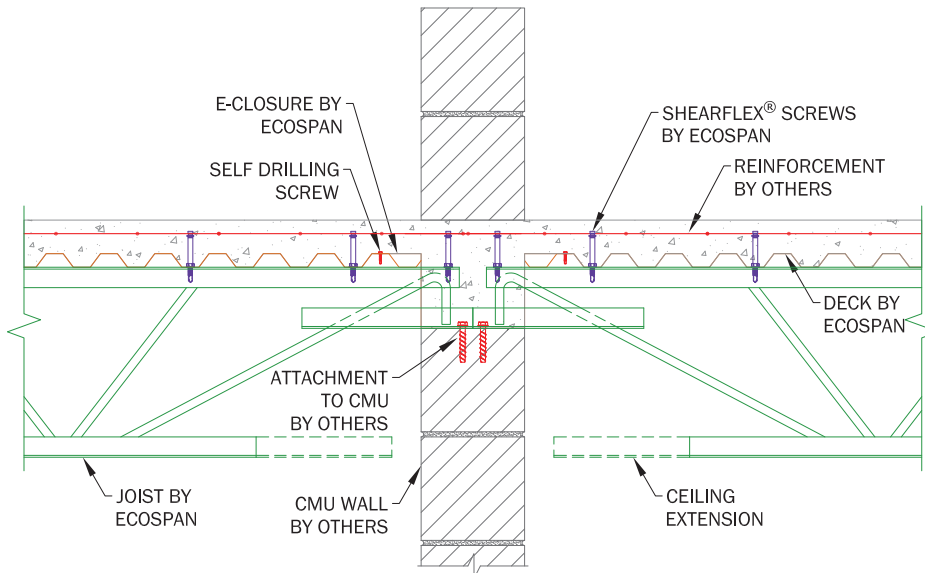
6.3.5 DEEP SEATS ON CMU
Not To Scale

NUCOR
VULCRAFT CANADA, INC.

ECOSPAN®
COMPOSITE FLOOR SYSTEM

POURSTOP BY ECOSPAN

SELF DRILLING SCREW

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

ATTACHMENT TO CMU BY OTHERS

DECK BY ECOSPAN

CMU WALL BY OTHERS

Z-CLOSURE BY ECOSPAN

JOIST BY ECOSPAN
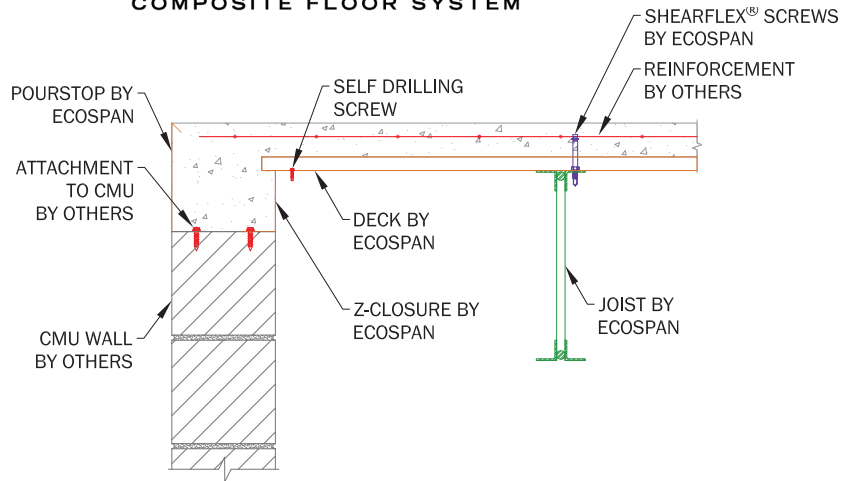
6.3.6 DECK LAP ON CMU

Not To Scale

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

SELF DRILLING SCREW

ATTACHMENT TO CMU BY OTHERS

DECK BY ECOSPAN

Z-CLOSURE BY ECOSPAN

JOIST BY ECOSPAN

CMU WALL BY OTHERS
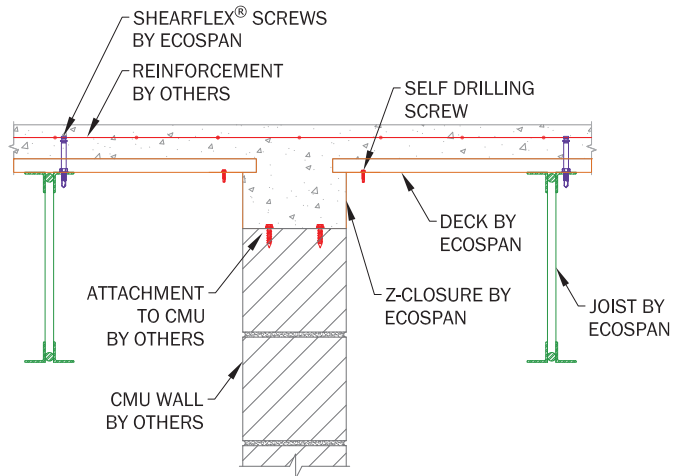
6.3.7 DECK SUPPORT OVER CMU

Not To Scale

EXPANSION JOINT MATERIAL BY OTHERS

SELF DRILLING SCREW FOR DECK ATTACHMENT

REINFORCEMENT BY OTHERS

SHEARFLEX® SCREWS BY ECOSPAN

DECK BY ECOSPAN

CONTINUOUS ANGLE BY OTHERS

JOIST BY ECOSPAN

CMU WALL BY OTHERS
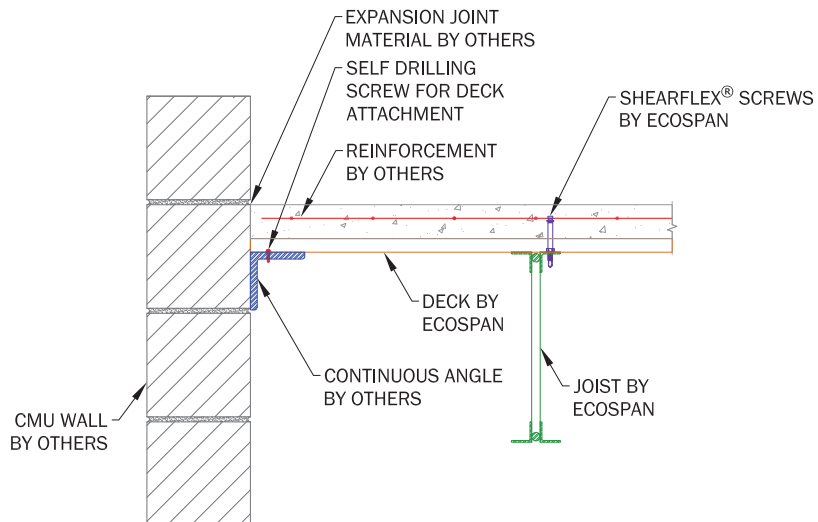
6.3.8 DECK AT CMU WALL CONT. ANGLE

Not To Scale

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VULCRAFT CANADA, INC.

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ECOSPAN®

COMPOSITE FLOOR SYSTEM

6.4 Ecospan® System on Insulated Concrete Form (ICF) Details

INSULATED CONCRETE FORM (ICF) BY OTHERS

NOTCH ICF FOR JOIST PLACEMENT

SHEARFLEX® SCREWS BY ECOSPAN

SELF DRILLING SCREW

REINFORCEMENT BY OTHERS

CONCRETE SCREW W/ EMBEDMENT BY OTHERS

DECK BY ECOSPAN

CEILING EXTENSION

JOIST BY ECOSPAN

6.4.1 DEEP SEAT ON ICF

Not To Scale

INSULATED CONCRETE FORM (ICF) BY OTHERS

SHEARFLEX® SCREWS BY ECOSPAN

REINFORCEMENT BY OTHERS

DECK BY ECOSPAN

NOTCH ICF FOR JOIST PLACEMENT

CONCRETE SCREW W/ EMBEDMENT BY OTHERS

CEILING EXTENSION

JOIST BY ECOSPAN

6.4.2 DEEP SEATS ON ICF

Not To Scale

NUCOR® VULCRAFT CANADA, INC.

INSULATED
CONCRETE FORM
(ICF) BY OTHERS

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

DECK BY
ECOSPAN

NOTCH ICF
FOR JOIST
PLACEMENT

CONCRETE
SCREW W/
EMBEDMENT
BY OTHERS

CEILING
EXTENSION

JOIST BY
ECOSPAN
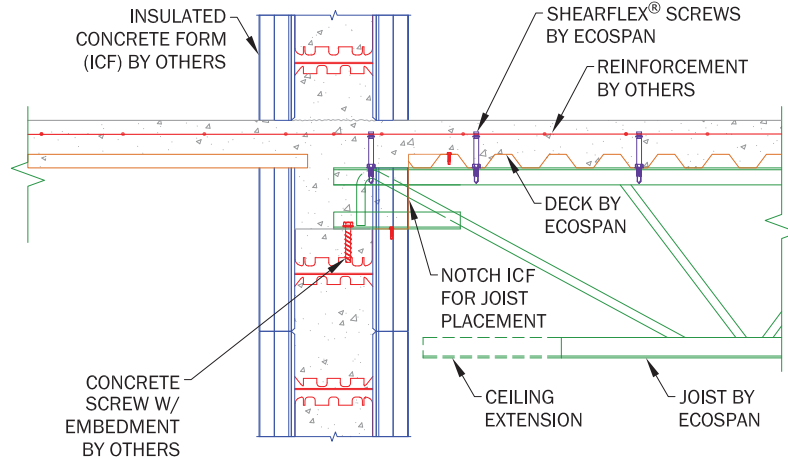
6.4.3 — DECK DIRECTION CHANGE ON ICF DEEP SEAT
Not To Scale

SHEARFLEX® SCREWS
BY ECOSPAN

REINFORCEMENT
BY OTHERS

DECK BY
ECOSPAN

INSULATED
CONCRETE FORM
(ICF) BY OTHERS

JOIST BY
ECOSPAN
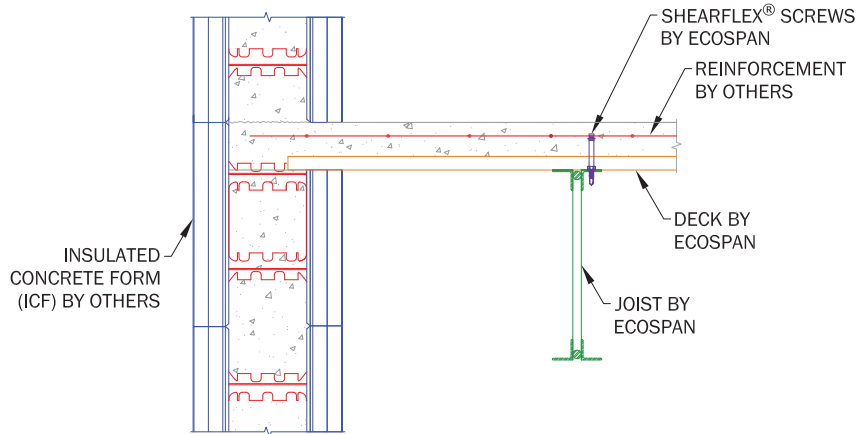
6.4.4 — DECK EDGE AT ICF
Not To Scale

NUCOR® VULCRAFT CANADA, INC.

6.5 Ecospan® System at Corridor Details

TRACK ATTACHMENT TO SLAB BY OTHERS
DECK CLOSURE BY ECOSPAN
E-CLOSURE BY ECOSPAN
SHEARFLEX® SCREWS BY ECOSPAN
REINFORCEMENT BY OTHERS
SELF DRILLING SCREW
CORRIDOR DECK BY ECOSPAN
HOLLOW STRUCTURAL SECTION (HSS) LOAD DISTRIBUTION MEMBER (LDM) BY OTHERS
DECK BY ECOSPAN
CFS WALL BY OTHERS
CEILING EXTENSION
JOIST BY ECOSPAN

6.5.1 STANDARD SEAT ON HSS AT CORRIDOR — Not To Scale

SHEARFLEX® SCREWS BY ECOSPAN (IF REQUIRED BY E.O.R.)
CLOSURE BY ECOSPAN
REINFORCEMENT BY OTHERS
POURSTOP BY ECOSPAN
CORRIDOR DECK BY ECOSPAN
CFS WALL BY OTHERS
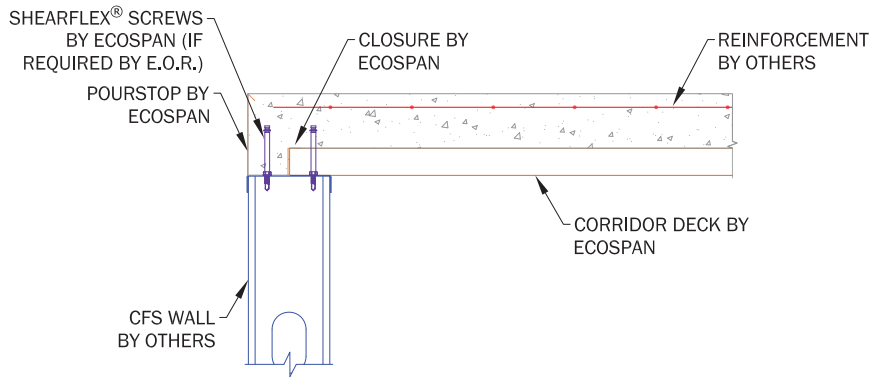
6.5.2 DECK EDGE AT CFS — Not To Scale

SELF DRILLING SCREW
SHEARFLEX® SCREWS BY ECOSPAN (IF REQUIRED BY E.O.R.)
REINFORCEMENT BY OTHERS
DECK BY ECOSPAN
Z-CLOSURE BY ECOSPAN
CORRIDOR DECK BY ECOSPAN
GIRDER FILLER ECOSPAN
CFS WALL BY OTHERS
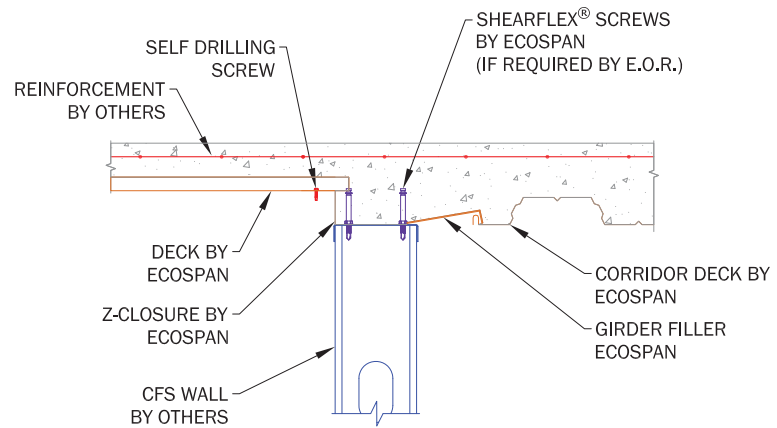
6.5.3 CORRIDOR TRANSITION — Not To Scale

NUCOR®
VULCRAFT CANADA, INC.

ECOSPAN®

COMPOSITE FLOOR SYSTEM
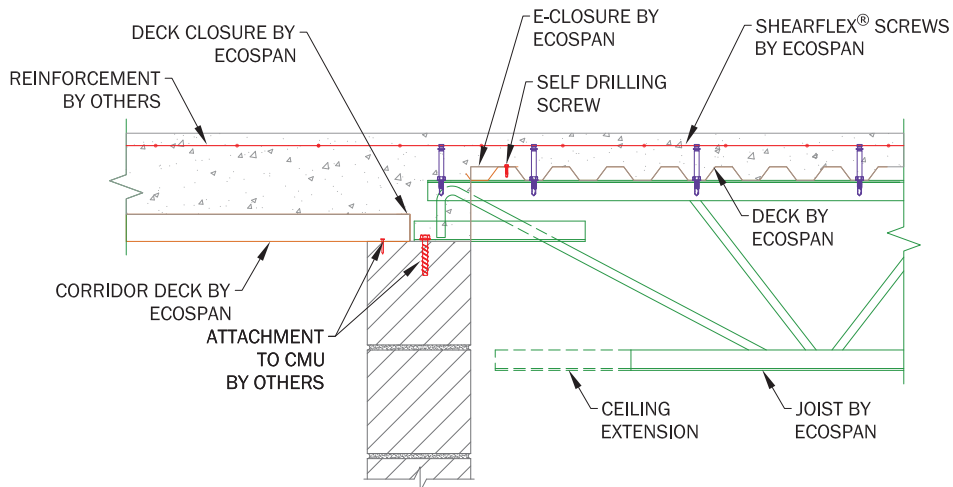
DEEP SEAT ON CMU AT CORRIDOR — 6.5.4 — Not To Scale

Labels:
- REINFORCEMENT BY OTHERS
- DECK CLOSURE BY ECOSPAN
- E-CLOSURE BY ECOSPAN
- SELF DRILLING SCREW
- SHEARFLEX® SCREWS BY ECOSPAN
- DECK BY ECOSPAN
- CORRIDOR DECK BY ECOSPAN
- ATTACHMENT TO CMU BY OTHERS
- CEILING EXTENSION
- JOIST BY ECOSPAN
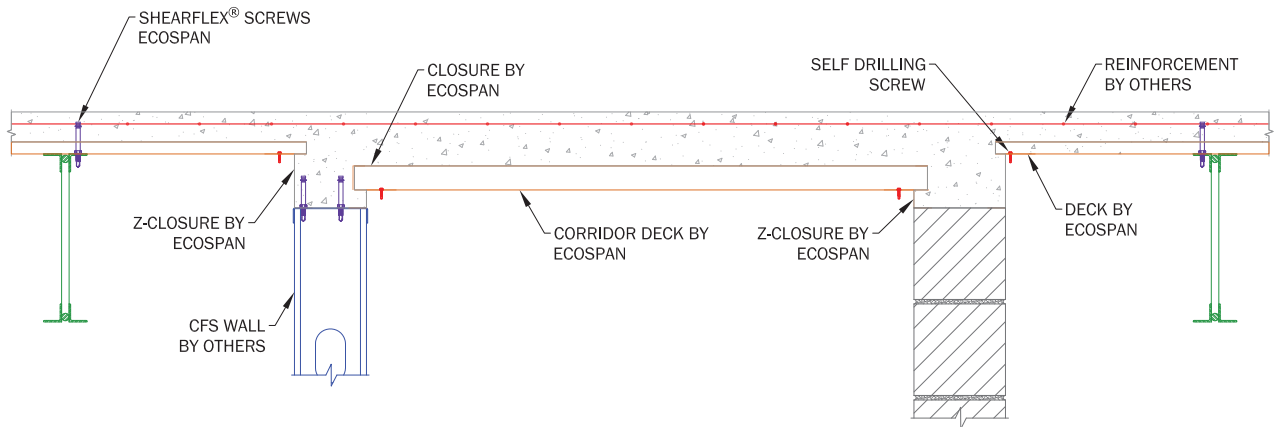
CORRIDOR SECTION - DECK BEARING — 6.5.5 — Not To Scale

Labels:
- SHEARFLEX® SCREWS ECOSPAN
- CLOSURE BY ECOSPAN
- SELF DRILLING SCREW
- REINFORCEMENT BY OTHERS
- Z-CLOSURE BY ECOSPAN
- CORRIDOR DECK BY ECOSPAN
- Z-CLOSURE BY ECOSPAN
- DECK BY ECOSPAN
- CFS WALL BY OTHERS

CORRIDOR SECTION AT CFS - DEEP JOIST SEAT — 6.5.6 — Not To Scale

Labels:
- E-CLOSURE BY ECOSPAN
- CLOSURE BY ECOSPAN
- REINFORCEMENT BY OTHERS
- SHEARFLEX® SCREWS BY ECOSPAN
- SELF DRILLING SCREW
- CORRIDOR DECK BY ECOSPAN
- Z-CLOSURE BY ECOSPAN
- CFS WALL BY OTHERS
- JOIST BY ECOSPAN
- JOIST GIRDER BY ECOSPAN
- CEILING EXTENSION

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VULCRAFT CANADA, INC.

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6.6 Ecospan® System Balcony and Mechanical Header Details

1.5 X CANTILEVER LENGTH PREFERRED

SHEARFLEX® SCREWS
BY ECOSPAN

SELF DRILLING
SCREW

REINFORCEMENT
BY OTHERS

A

CLOSURE BY
ECOSPAN

CANTILEVER LENGTH
N.T.S.

DECK BY
ECOSPAN

CEILING
EXTENSION

JOIST BY
ECOSPAN

A
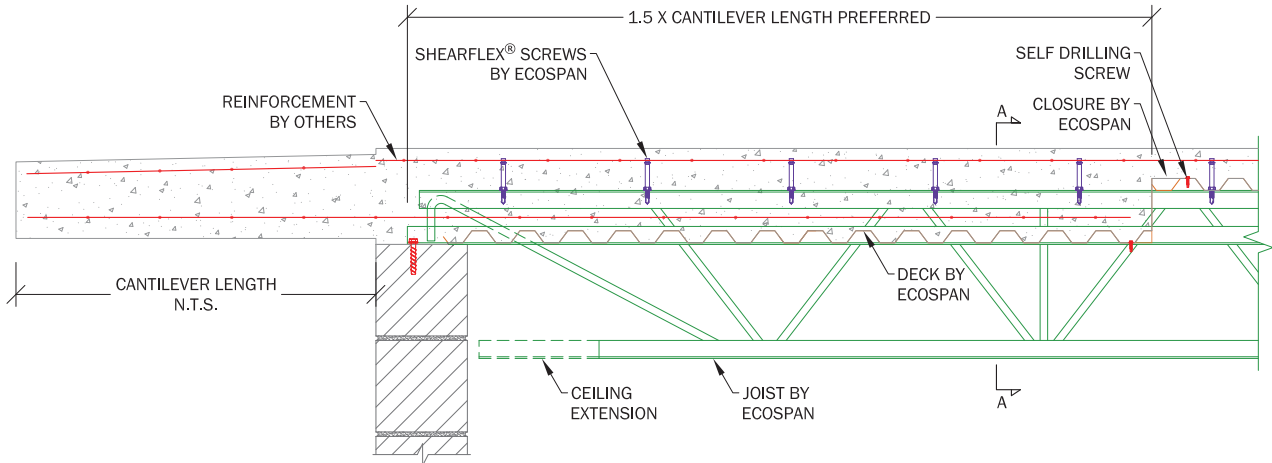
6.6.1 BALCONY PARALLEL TO JOIST

Not To Scale

SHEARFLEX® SCREWS
BY ECOSPAN

Z-CLOSURE BY
ECOSPAN

REINFORCEMENT
BY OTHERS

JOIST BY
ECOSPAN

DECK BY
ECOSPAN

SHOP INSTALLED
CONTINUOUS ANGLE
FOR DECK SUPPORT
BY ECOSPAN

SECTION A - A

REINFORCEMENT BY OTHERS

Z-CLOSURE BY ECOSPAN

B

Z-CLOSURE BY ECOSPAN

SHEARFLEX® SCREWS BY ECOSPAN

DECK BY ECOSPAN

B

SHALLOW JOIST IF REQUIRED (SEE CHART)

SHOP INSTALLED CONTINUOUS ANGLE FOR DECK SUPPORT BY ECOSPAN

JOIST BY ECOSPAN
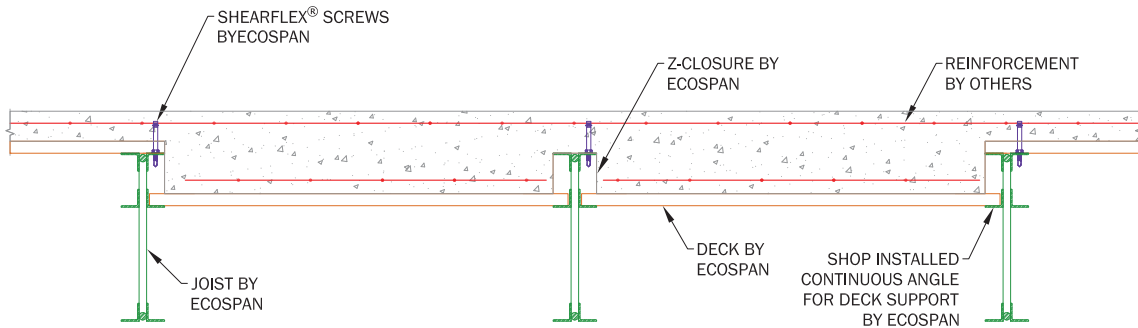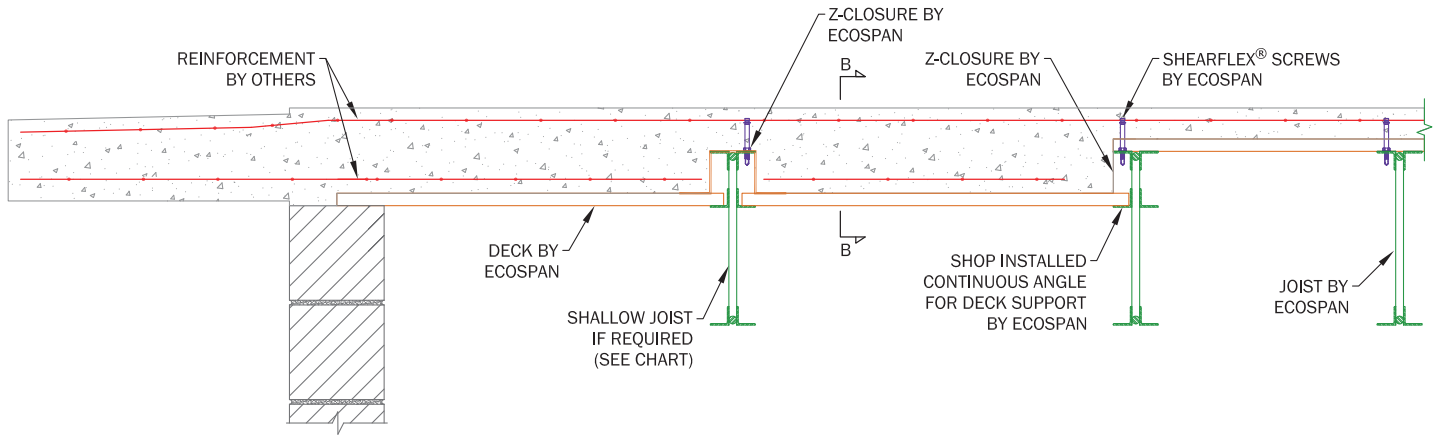
6.6.2 BALCONY PERPENDICULAR TO JOIST

Not To Scale

REINFORCEMENT BY OTHERS

Z-CLOSURE BY ECOSPAN

SHEARFLEX® SCREWS BY ECOSPAN

DECK BY ECOSPAN

DECK BY ECOSPAN

JOIST BY ECOSPAN

SECTION B - B

COMPOSITE FLOOR SYSTEM
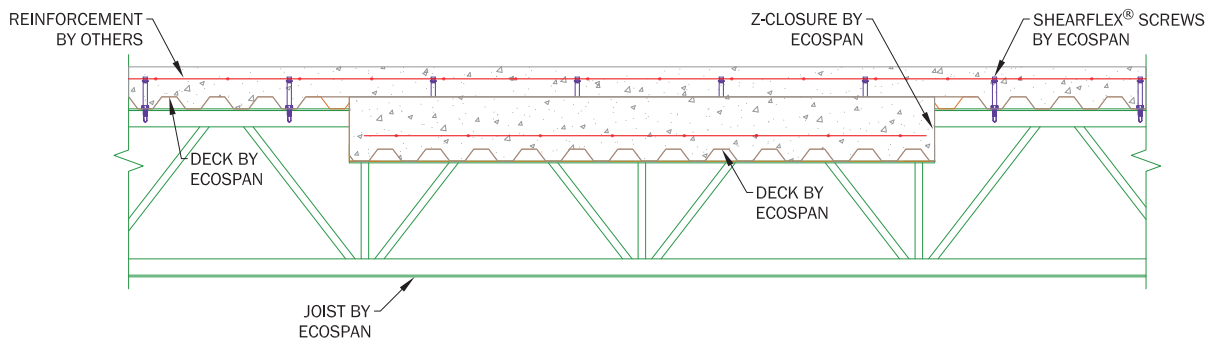
8.0 Installation Guide

This guide must be read in its entirety prior to installation. The information contained in this Installation Guide is intended to assist erectors with the installation practices involved in erecting the Ecospan® Composite Floor System. However, the information herein **does not** replace installation practices required by local codes. In the case of a discrepancy between the information provided in this Installation Guide and local codes, the most stringent method shall take precedence.

Joists are typically installed prior to the installation of the other floor components. However, some projects may require the pourstop and Z-Closure to be installed prior to joists. Care should be taken in the order of installation of the individual components.

Delivery

Check quantities and mark numbers and condition of joists and accessories on arrival. Note on the delivery ticket any shortages or discrepancies. Nucor will not be liable for any shortages or damage not noted.

Unloading

When unloading joists by crane, always hook chains or sling to top or bottom chords at panel points (approximately at 1/3 points). Never hook to web members or jerk while lifting. When unloading by hand use extreme care when breaking bundles and unload each joist separately.
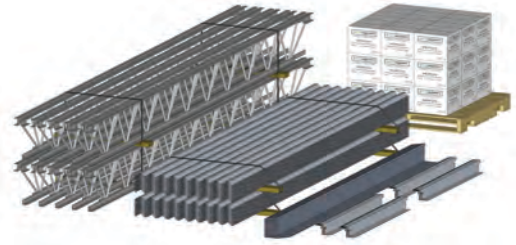
Store joists in bundles in a vertical position on wood blocking placed at panel points. Lighter joists should be stacked on heavier joists if more than one layer is required. Store joists on sides if height of bundle is greater than twice its width. Joists from broken bundles should be laid flat on blocking to prevent sagging of joists. If joists are not erected immediately, cover joists in a manner that provides adequate ventilation to protect primer coat.
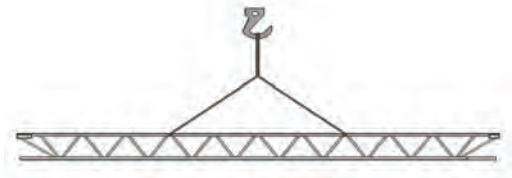
Installation - Joists

Erection must be done with plans noted "Final Plans for Field Use" and executed in accordance with the latest CANOSH requirements. Reference the erection drawings from orientation of the tagged ends of joists and joist girders and any bolted erection stability bridging requirements.

Nucor shall be notified at once if joists, joists girders and accessories cannot be erected according to the final erection plans. Nucor will not be responsible for any field repairs or changes made without prior consent.
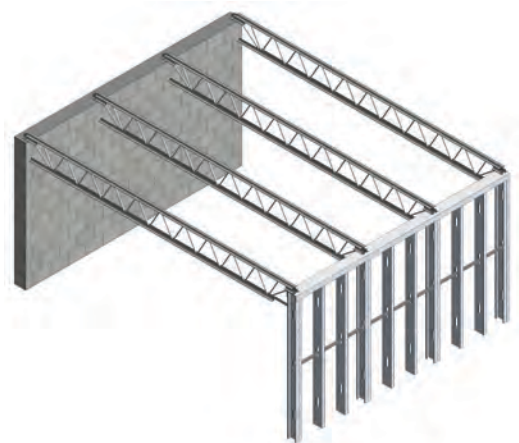
Installation - Bridging

Bolted/Screwed Horizontal & Diagonal Bridging: Snug tighten bolted or screwed horizontal and diagonal bridging.

Welded Horizontal Bridging: Lap bridging a minimum of 76mm (3"). Connect bridging to joist with a minimum of 3.2mm (1/8") fillet weld 25.4mm (1") long. Use drops where possible.

Welded Diagonal Bridging: Weld at intersection with a minimum 3.2mm (1/8")fillet weld 25.4mm (1")inch long or equivalent.

Typically (1) or (2) rows of bridging will be required per bay. Locate bridging as shown on the Final Plans for Field Use. If more than one row is required, locate bridging equally spaced along the joist.

In cases where bridging is not required, care must be taken to align joists in accordance with the Final Plans for Field Use.
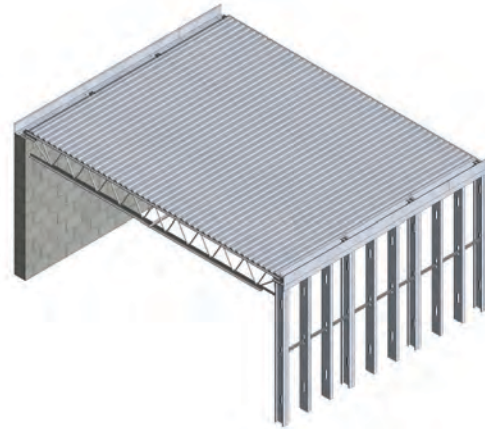
Installation - Accessories

Attach the deck accessories by screwing, welding, or button punching using the following **minimum** attachment requirements or as scheduled on the contract documents and Final Plans for Field Use:

Accessory Attachment Requirements	
Type	Maximum Spacing
Pour Stop	305mm (12") O.C.
Z-Closure	305mm (12") O.C.
Split Deck Sheets	455mm (18") O.C.
Cell Closure	915mm (36") O.C.
Flat Plate	455mm (18") O.C.
Girder Filler	305mm (12") O.C.
E-Closure	Each End

Shearset® Tool

Installation - Decking

- Attachment of deck to joists as a working platform is the responsibility of the contractor.
- Fasten deck with Shearflex® Screws in accordance with deck attachment requirements on the Final Plans for Field Use. **(See Installation - Shearflex® Screws)**
- **Important Note:** Puddle welds or other fasteners **may not** be substituted in place of Shearflex® Screws.
- Ensure minimum deck bearing has been provided per manufacture's requirements.
- Ensure deck sheet end laps are a minimum of 51mm (2") and occur over a joist top chord angle or other support, unless noted otherwise.

Installation - E-Closure

E-closure is supplied for the purpose of creating a concrete seal between joists. Note: E-closure may not be required on all Ecospan® projects.
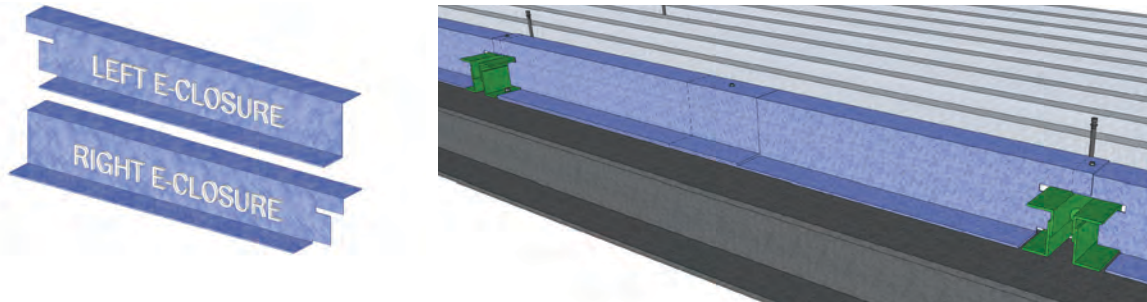
Figure 8-1

A combination of two pieces of E-Closure will be supplied (per joist spacing) with opposing profiles at one end (one Left Side and one Right Side). These two pieces are designed to be lapped and adjusted to accommodate the required joist spacing. See Figure 8-1 for example of E-closure installation. E-closure should be screwed at each end (one screw where pieces lap).

Installation - Shearflex® Screws

Locate and install Shearflex® screws per the Final Plans for Field Use using the Shearset® Tool supplied by Vulcraft.
1. Insert the Shearflex® screws into the end of the shaft of the tool.
2. Locate the placement area and stand vertically at 90° angle over the location.
3. When starting the drilling process, pull the trigger and let the weight of the drill start the screw into the deck. Once the screw has penetrated the deck, then apply downward pressure. Do not put all your weight on the tool.
4. Once the drill tip cuts through the decking and into the joist top chord, the threading on the screw will pull it down into the joist cord.
5. When you hear the tool shaft "ratcheting", the screw should be seated so there is no space between the collar and the decking.
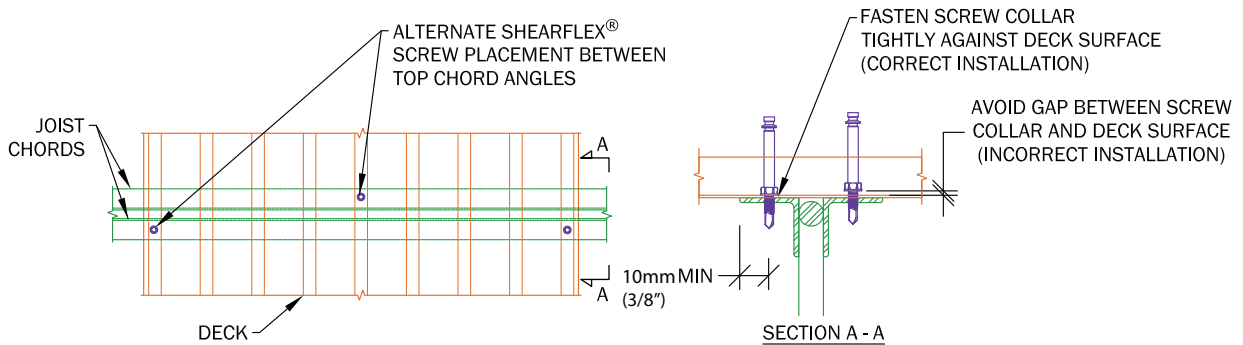
Figure 8-2

Installation - Concrete Reinforcing and Concrete

The Design Professional shall specify required concrete reinforcing. Install concrete reinforcing in accordance with Canadian Standards Association (CSA) & Concrete Reinforcing Steel Institute (CRSI) installation guidelines. The Design Professional shall specify concrete material properties and strength requirements. Install concrete in accordance with CSA installation guidelines. Concrete shall be installed to a uniform depth.

NOTES:

Specifier Notes: This guide specification is written in Construction Specifications Institute (CSI) 3-Part Format in accordance with The *CSI Construction Specifications Practice Guide*, including *MasterFormat, SectionFormat,* and *PageFormat*.

This section must be carefully reviewed and edited by the Architect or Engineer to meet the requirements of the Project and local building code. Coordinate this section with Division 01, other specification sections, and the Drawings. Delete all Specifier Notes after editing this section.

Section numbers and titles are based on *MasterFormat 2014 Update*.

SECTION 05 22 00
COMPOSITE FLOOR SYSTEM

Specifier Notes: This section covers Vulcraft Canada Inc. "Ecospan" composite floor system.   Consult your local Ecospan sales representative for assistance in editing this section for the specific application.

PART 1 GENERAL

1.1   SECTION INCLUDES
  A.Composite Floor System:
    1.Steel joists.
    2.Steel decking.
    3.Shear connectors.
    4.Slab reinforcement.
    5.Concrete slab.
    6.Accessories.

1.2   RELATED REQUIREMENTS

Specifier Notes: Edit the following list of related sections as required for Project. Limit the list to sections with specific information that the reader might expect to find in this section, but is specified elsewhere.

  A.Section 03 20 00 – Concrete Reinforcing: Slab reinforcement.
  B.Section 03 30 00 – Cast-in-Place Concrete: Concrete slab.

1.3   REFERENCE STANDARDS

Specifier Notes: List reference standards used elsewhere in this section, complete with designations and titles.

  A.American Concrete Institute (ACI) (www.concrete.org):
    1.ACI 318 – Building Code Requirements for Structural Concrete and Commentary.

  B.American Welding Society (AWS) (www.aws.org):
    1.AWS D1.1/D1.1M – Structural Welding Code - Steel.
    2.AWS D1.3/D1.3M – Structural Welding Code - Sheet Steel.

C.ASTM International (ASTM) (www.astm.org):

    1.ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.

    2.ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

    3.ASTM A529/A529M – Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.

    4.ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts.

    5.ASTM A572/A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

    6.ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

    7.ASTM A992/A992M – Standard Specification for Structural Steel Shapes.

    8.ASTM A1008/A1008M – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

    9.ASTM C1513 – Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

    10.ASTM F436 – Standard Specification for Hardened Steel Washers.

D. Canadian Institute of Steel Construction (CISC) (www.cisc-icca.ca)

    1. Handbook of Steel Construction.

E. Canadian Paint Manufacturers Association (CPMA) (www.canpaint.com)

    1. Standard 1-73a - A Quick-Drying One-Coat Pain for Use on Structural Steel

    2. Standard 2-75 - A Quick-Drying Primer for Use on Structural Steel

F. Canadian Sheet Steel Building Institute (CSSBI) (www.cssbi.ca)

    1. CSSBI 10M - Standard for Steel Roof Deck

    2. CSSBI 12M - Standard for Composite Steel Deck

G. Canadian Standards Association (CSA) (www.csagroup.org)

    1. CAN/CSA A23.1 - Concrete Materials and Methods of Concrete Construction

    2. CAN/CSA A23.2 - Test Methods and Standard Practices for Concrete

    3. CAN/CSA A23.3 - Design of Concrete Structures

    4. CAN/CSA G40.20 - General Requirements for Rolled or Welded Structural Quality Steel

    5. CAN/CSA G40.21 - Structural Quality Steel

    6. CAN/CSA S136 - North American Specification for the Design of Cold-Formed Steel Structural

    7. CAN/CSA S16 - Design of Steel Structures

H. Canadian Welding Bureau (CWB) (www.cwbgroup.org)

    1. CSA W47.1 - Certification of Companies for Fusion Welding of Steel

    2. CSA W48 - Filler Metals and Allied Materials for Metal Arc Welding

    3. CSA W59 - Welded Steel Construction (Metal Arc Welding)

    4. CSA W178.1 - Certification of Welding Inspection Organizations

    5. CSA W178.2 - Certification of Welding Inspectors

I. Cement Association of Canada (www.cement.ca)

    1. Concrete Design Handbook

J.Vulcraft Canada Inc. (www.ecospansystem.ca):

    1.Ecospan COSP – Code of Standard Practice.

1.4   PRE-INSTALLATION MEETINGS

Specifier Notes: Edit pre-installation meetings as required for Project. Delete if not required.
    A.Convene pre-installation meeting [1 week] [2 weeks] before start of Work of this Section.

    B.Require attendance of parties directly affecting Work of this Section, including Contractor, Architect, Engineer, installer, and manufacturer's representative.

    C.Review the Following:
        1.Materials.
        2.Installation/erection.

Specifier Notes: Include field quality control and adjusting if those requirements are specified in Part 3 of this section.

        3.Field quality control.
        4.Adjusting.
        5.Protection.
        6.Coordination with other Work.

1.5   SUBMITTALS

Specifier Notes: Edit submittal requirements as required for Project. Delete submittals not required.

    A.Comply with Division 01.

    B.Submittals for Review:
        1.Product Data: Submit manufacturer's product data, indicating joist and decking profiles, characteristics, dimensions, structural properties, materials, and finishes.
        2.Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating the following:
                a.Joists: Joist identification numbers, types, locations, spacings, bridging, and attachments.
                b.Decking: Decking plan, support locations, projections through decking, openings, relevant details, and accessories.

    C.Sustainable Design Submittals: Submit manufacturer's certificates prepared by independent, third party certifying the following:
        1.Recycled Content: Certify percentages of post-consumer and pre-consumer recycled content, show cost of products containing recycled content, and certify recycled content information source.
        2.Regional Materials: Certify that materials have been harvested, extracted, recovered, or manufactured within 800 km (500 mile) radius of Project site.

    D.Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.

    E.Warranty Documentation: Submit manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

Specifier Notes: Edit the following paragraphs to specify a minimum level of experience of the parties performing the Work of this section.

A.Manufacturer's Qualifications: Manufacturer regularly engaged, for a minimum of 10 years, in the manufacturing of composite floor systems.

B.Welder's Qualifications: CSA W48.

1.7 DELIVERY, STORAGE, AND HANDLING

A.Deliver, store, and handle joists, decking, and accessories in accordance with manufacturer's instructions.

B.Store joists and decking off ground.

C.Protect materials from damage in accordance with SDI MOC2.

D.Store decking in accordance with SDI MOC2, with one end elevated to provide drainage.

E.Protect decking with vented, waterproof covering.

F.Place decking bundles on structural steel members in accordance with SDI MOC2.

G.Tie down loose decking bundles to prevent wind damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A.Manufacturer: Vulcraft Canada Inc., 1362 Osprey Drive Ancaster, ON L9G 4V5. Phone: 289-443-2000. Website www.ecospansystem.ca.

Specifier Notes: Specify if substitutions will be permitted.

B.Substitutions: [Not permitted] [Comply with Division 01].

2.2 DESIGN CRITERIA

A.Design Requirements:
    1.Design composite floor system including layouts, spans, and fasteners under supervision of professional engineer registered in state in which Project is located.

Specifier Notes: 100 percent of non-composite dead load is standard. Insert additional camber requirements as required for Project.

    2.Camber joists based on [100 percent of non-composite dead load] [_____].
    3.Design welded connections in accordance with CAN/CSA W59.
    4.Where steel deck is not designed to support load, design slab in accordance with recognized construction principles or manufacturer's recommendations.

Specifier Notes: Provide loads as required for Project.

B.Design composite floor system to withstand following unfactored loads:
    1.Non-composite Dead Load:
        a.Concrete: _____kPa.
        b.Joists: _____kPa.
        c.Decking: _____kPa.
        d.Bridging: _____ kPa.
        e.Total: _____ kPa.
    2.Construction Live Load: _____kPa.
    3.Composite Dead Load:
        a.Fixed Partitions: _____ kPa.
        b.Mechanical, Electrical, Plumbing: _____ kPa.
        c.Fire Suppression: _____ kPa.
        d.Fireproofing: _____ kPa.
        e.Floor Coverings and Ceilings: _____ kPa.
        f.Total: _____ kPa.
    4.Composite Live Load:
        a.Design Live Load: _____ kPa.
        b.Reduction Factor: _____ percent.
        c.Reduced Design Live Load: _____ kPa.
        d.Movable Partitions: _____ kPa.
        e.Total: _____ kPa.
    5.Total Non-composite and Composite Loads: _____ kPa.
    6.Maximum Allowable Live Load Deflection: Span/_____.

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COMPOSITE FLOOR SYSTEM

2.3   MATERIALS

A.Composite Floor System: "Ecospan" composite floor system.

B.Steel Shapes:

Specifier Notes: Edit as required for Project. Delete reference standards for steel shapes not required.

      1.ASTM A572/A572M, [380 mPa] [_____ MPa].
      2.ASTM A529/A529M, [380 mPa] [_____ MPa].
      3.ASTM A992/A992M.
      4.CSA G40-21-50W, [350 MPa]
      5.CSA G40-21-55W, [380 MPa]

Specifier Notes: Obtain percent of recycled content for each material based on closest Vulcraft Canada Inc. fabrication facility to Project site.

      4.Recycled Content: Minimum _____ percent recycled steel, with minimum _____ percent classified as post consumer.

Specifier Notes: Include the first paragraph for galvanized steel decking OR the second paragraph for uncoated or prime-painted steel decking. Delete paragraph not required for Project.

C.Galvanized Steel Sheet:
      1.ASTM A653/A653M.
      2.Recycled content: Minimum _____ percent recycled steel, with minimum _____ percent classified as post consumer.

D.Steel Sheet:
      1.ASTM A1008/A1008M.
      2.Recycled content: Minimum _____ percent recycled steel, with minimum _____ percent classified as post consumer.

Specifier Notes: Include the section number for the section specifying slab reinforcement.

E.Slab Reinforcement: Specified in Section [03 20 00] [03 __ __].

Specifier Notes: Include the section number for the section specifying concrete slab.

F.Concrete Slab: Specified in Section [03 30 00] [03 __ __].

2.4   ACCESSORIES

A.Shear Connectors: "Shearflex" screws.
      1.Self-drilling, self-tapping connectors.

B.Bolts, Nuts, and Washers: ASTM A307, ASTM A325M, ASTM A563, and ASTM F436.

C.Screws: ASTM C1513.

D.Touch-Up Paint for Galvanized Surfaces: SSPC-Paint 20, Type I or II.

E.Welding Materials: CWB W48 & W59; type required for materials being welded.

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2.5 FABRICATION OF STEEL JOISTS

A.Fabricate steel joists in accordance with manufacturer's standard practice.

Specifier Notes: Specify depth of joists. Joists are available in depths from 10 to 48 inches.

B.Joist Depth: [_____ inches] [As indicated on the Drawings].

C.Top and Bottom Chord Members:
    1.Two equal-sized angles.
    2.Minimum Yield Strength: 380 mPa.

D.Web Members:
    1.Round rods; crimped or un-crimped angles; rectangular bars.
    2.Minimum Yield Strength: 380 mPa.

Specifier Notes: Specify joist bearing seats.

E.Joist Bearing Seats: [Flush or standard.] [Indicated on the Drawings.]

F.Welding Materials and Methods: In accordance with Ecospan COSP.

G.Primer: Apply manufacturer's standard gray primer in accordance with SSPC Painting Manual.

2.6 FABRICATION OF STEEL DECKING

A.Manufacture steel decking and accessories in accordance with CSSBI 10M & 12M.

Specifier Notes: Specify gauge of steel sheets and depth of decking.

B.Manufacture decking from _____ gage to _____ gage steel sheets to [25.4mm (1")] [33mm (1-5/16")] [38mm (1-1/2")] [50mm (2")] [76mm (3")] [_____-mm] depth.

C.Detail deck units to span 3 or more supports when possible, with lapped ends and nesting side laps.
    1.For deck units which do not nest, butt ends in accordance with manufacturer's instructions.

D.Accessories: Fabricate in accordance with manufacturer's instructions.

Specifier Notes: Specify finish of decking.

E.Finish: [Uncoated] [Manufacturer's standard gray primer] [Galvanized, G60 coating class] [Galvanized, G90 coating class] [_____].

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PART 3 EXECUTION

3.1   EXAMINATION

A.Examine areas to receive composite floor system.

B.Verify surfaces to support composite floor system are clean, dry, flat, plumb, level, square, stable, rigid, and capable of supporting the weight.

C.Notify Architect of conditions that would adversely affect installation.

D.Do not begin installation until unacceptable conditions are corrected.

3.2   INSTALLATION – GENERAL

A.Install composite floor system in accordance with manufacturer's instructions at locations indicated on the Drawings.

B.Install composite floor system plumb, level, square, and true to line.

C.Anchor composite floor system securely in place to supports as indicated on the Drawings.

D.Tolerances: Install composite floor system within manufacturer's installation tolerances.

3.3   ERECTION OF STEEL JOISTS

A.Erect steel joists and accessories in accordance with manufacturer's instructions, Ecospan COSP, and as indicated on the Drawings.

B.Lift and support joists in upright position during unloading and erection.

C.Place joists plumb, at elevations, lines, and spacings as indicated on the Drawings.

D.Complete joist attachment to supporting members before placing decking.

E.Complete joist and decking attachments in each bay before applying construction loads.

F.Provide minimum bearing length of 2-1/2 inches on steel, 4 inches on masonry or concrete, or as indicated on the Drawings.

G.Bridging:
     1.Install horizontal bridging before installing decking.
     2.Terminate horizontal bridging rows with diagonal X-bridging or positive anchorage to wall before placing decking.

H.Provide for distribution of concentrated loads incurred during erection.

I.Welding: Conform to manufacturer's requirements.

J.Do not make corrections or alterations to joists without manufacturer's approval.

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3.4 INSTALLATION OF STEEL DECKING

A. Install steel decking and accessories in accordance with manufacturer's instructions and as indicated on the Drawings.

B. Laps:
1. Lap ends minimum of 75mm (3")inches for form deck.
2. Center laps over supports.
3. Nest side laps.

C. Place decking flat and square, without warp or deflection.

D. Provide minimum bearing on steel in accordance with manufacturer's instructions.

E. Attachment to Supporting Members:
1. Mechanically fasten or weld decking to supporting members as indicated on the Drawings.
2. Deck may be tack welded to secure in position before shear connectors are installed.
3. Welding: Conform to CSA W59.

F. Shear Connectors:
1. Install shear connectors at spacings indicated on the Drawings.
2. Drive shear connectors using equipment provided by manufacturer, through decking, and into joist top cord, until bottom collar is tight against decking.

G. Cutting and Fitting Decking:
1. Cut and fit deck units and accessories at perimeter and around projections and openings.
2. Make cuts neat and trim.

H. Pour Stops:
1. Install pour stops at edges and around projections and openings, upturned to top of slab.
2. Provide pour stops of sufficient strength to remain stationary under weight of wet concrete without distortion.
3. Screw or weld pour stops in place.

3.5 PLACEMENT OF CONCRETE SLAB

A. Slab Reinforcement:
1. Place slab reinforcement for concrete slab as specified in Section [03 20 00] [03 __ __].
2. Lap reinforcement in accordance with CAN/CSA A23.3.

B. Place concrete for slab as specified in Section [03 30 00] [03 __ __] and SDI MOC2.

C. Maintain minimum concrete slab thicknesses as indicated on the Drawings.

D. Locate slab openings not shown on the Drawings a minimum of 6 inches from edge of top chord of joists.

E. Terminate Concrete Placement:
1. Above beams or girders, wherever possible.
2. Parallel to joists midway between joists.

F. Locate Joints:
1. Perpendicular to joists over supporting member.
2. Parallel to joists midway between joists.

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Specifier Notes: Include the following article for testing and inspection services to be provided by an outside entity. Coordinate with Division 01 requirements for testing and inspection services. Delete if not required.

3.6 FIELD QUALITY CONTROL

A.Testing Laboratory Services:
 1.Inspect steel joists for conformance to specified requirements:
  a.Verify placement including location, alignment, and bearing.
  b.Inspect joist-to-seat and seat-to-support welds.
 2.Inspect steel decking for conformance to specified requirements:
  a.Verify decking type and gage.
  b.Verify decking placement and alignment.
  c.Inspect welds and weld pattern.
  d.Inspect fastener types, locations, quantities, and placement.

Specifier Notes: Include the following article if composite floor system surfaces will be exposed to view after installation. Edit as required for Project. Delete if not required.

3.7 ADJUSTING

A.Clean welds and abrasions after installation of composite floor system.

B.Touch-up painted surfaces with same primer as originally applied.

C.Touch-up galvanized coatings with galvanizing repair paint; apply as recommended by manufacturer.

3.8 PROTECTION

A.Protect installed composite floor system from damage during construction.

END OF SECTION

CODE OF STANDARD PRACTICE
For Ecospan® Composite Floor Systems

[Adapted from the Steel Joist Institute Code of Standard Practice for Composite Steel Joists]

SECTION 1
GENERAL

1.1 SCOPE

The practices and customs set forth herein are in accordance with good engineering practice, tend to ensure safety in composite steel construction, and are standard within the industry. There shall be no conflict between this code and any legal building regulation. This code shall only supplement and amplify such laws. Unless specific provisions to the contrary are made in a contract for the purchase of Ecospan® Composite Floor System material, this code along with the Steel Deck Institute Code of Standard Practice for Composite Deck, Form Deck and Roof Deck Construction, are understood to govern the interpretation of such a contract.

1.2 APPLICATION

This Code of Standard Practice is to govern as a standard unless otherwise covered in the architects' and engineers' plans and specifications.

1.3 DEFINITIONS

Buyer. The entity that has agreed to purchase material from the manufacturer and has also agreed to the terms of sale.

Erector. The entity that is responsible for the safe and proper erection of the materials in accordance with all applicable codes and regulations.

Material. Ecospan composite steel joists, steel deck, and accessories as provided by the seller.

Owner. The entity that is identified as such in the contract documents.

Placement Plans. Drawings which are prepared depicting the interpretation of the contract documents requirements for the material to be supplied by the seller. These plans are approved by the specifying professional, buyer or owner for conformance with the design requirements. The seller uses the information contained on these drawings for final material design. A unique piece mark number is typically shown for the individual placement of the material along with sections that describe the end bearing conditions and minimum attachment required so that material is placed in the proper location in the field.

Seller. Vulcraft Canada Inc.

Specifying Professional. The licensed professional who is responsible for sealing the building contract documents, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Structural Drawings. The graphic or pictorial portions of the contract documents showing the design, location and dimensions of the work. These documents generally include plans, elevations, sections, details, connections, all loads, schedules, diagrams and notes.

1.4 DESIGN

In the absence of ordinances or specifications to the contrary, all designs prepared by the **specifying professional** shall be in accordance with the Ecospan® Composite Floor System Information & Design Manual.

1.5 RESPONSIBILITY FOR DESIGN AND ERECTION

When material requirements are specified, the seller shall assume no responsibility other than to furnish the items listed in Section 5.2 (a). When material requirements are not specified, the seller shall furnish the items listed in Section 5.2 (a) in accordance with the Ecospan® Composite Floor System Information & Design Manual,. Pertinent design information shall be provided to the seller as stipulated in Section 6.1. The seller shall identify material by showing size and type. In no case shall the seller assume any responsibility for the erection of the material furnished.

SECTION 2
E-SERIES COMPOSITE JOISTS
AND ACCESSORIES

2.1 E-SERIES COMPOSITE STEEL JOISTS

E-Series joists shall carry the loads required by the contract documents (refer to Section 6 of this standard) and meet the requirements of the Ecospan® Composite Floor System Information & Design Manual, of latest adoption.

E-Series joists are furnished with parallel chords only, and with minimum standard end bearing depth of 102 mm (4"). Non-standard flush seat bearing may also be provided. Refer to the Ecospan® Composite Floor System Information & Design Manual for more information.

2.2 JOIST LOCATION AND SPACING

Where sidewalls, wall beams or tie beams are capable of supporting the floor slab or roof deck, the first adjacent composite steel joists may be placed one full space from these members. **E-Series** joists are provided with camber. These joists may have a significant difference in elevation with respect to the adjacent structure because of this camber. This difference in elevation should be given consideration when locating the first E-Series joist adjacent to a sidewall, wall beam or tie beam. Therefore, it is recommended that this joist be located one full space away from these members.

Where load bearing partitions occur parallel to joists, joists are generally placed under each such partition, and more than one such joist shall be provided if necessary to safely support the weight of such partition and the adjacent floor, less the live load, on a strip of floor one meter in width. Where partitions occur perpendicular to the joists, they shall be treated as concentrated loads in accordance with Section 6.1.

2.3 BRIDGING AND BRIDGING ANCHORS

(a) Bridging, standard with the manufacturer and complying with the Ecospan® Composite Floor System Information & Design Manual of latest adoption, shall be used for bridging all joists furnished by the manufacturer. Positive anchorage shall be provided at the ends of each bridging row at both top and bottom chords.

(b) Diagonal cross bridging consisting of angles or other shapes connected to the top and bottom chords of **E-Series** joists shall be used when required.

Diagonal bridging, when used, shall have a ℓ/r ratio not exceeding 200.

(c) For the **E-Series** joists, horizontal bridging is recommended for spans up to and including 18.3 m (60 feet) except where code requirements for erection stability require bolted diagonal bridging.

E-Series joists, exceeding 18.3 m (60 feet) in length shall have bolted diagonal bridging for all rows.

Refer to CANOSH Safety Standards or local jurisdictional requirments for Steel Erection.– Open Web Steel Joists for erection stability requirements.

Horizontal bridging shall consist of continuous horizontal steel members. The ℓ/r ratio for horizontal bridging shall not exceed 300.

(d) When bolted diagonal erection bridging is required, the following shall apply:
1. The bridging shall be indicated on the joist placement plan.
2. The joist placement plan shall be the exclusive indicator for the proper placement of this bridging.
3. Shop installed bridging clips, or functional equivalents, shall be provided where the bridging bolts to the steel joist.
4. When two pieces of bridging are attached to the steel joist by a common bolt, the nut that secures the first piece of bridging shall not be removed from the bolt for the attachment of the second piece.
5. Bridging attachments shall not protrude above the top chord of the steel joists.

2.4 CAMBERING

(a) Manufacturing Tolerances

The camber tolerance for **E-Series** joists, as shown in Table 2.6, shall be., ±6 mm (1/4 in) or, ± L/1600 [where L = top chord length, mm (in)] whichever is greater. Negative camber is not permitted.

TABLE 2.6
Camber Tolerances

TOP CHORD LENGTH mm (feet)	TOLERANCE - or + mm (inches)
6,096 (20)	± 6 (1/4)
9,144 (30)	± 6 (1/4)
12,192 (40)	± 6 (1/4)
15,240 (50)	± 9 (3/8)
18,288 (60)	± 12 (1/2)

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(b) Camber Design

It is standard practice that **E-Series** joists be furnished with sufficient camber for 100 percent of the non-composite dead load (joist, bridging, deck, and concrete slab). Joist bearings act as pinned/pinned-end connections with negligible end rotation restraint provided. Hence one shall obtain 100% of the predicted non-composite joist deflection when the full non-composite dead load has been placed on the composite joist. With the composite joist cambered for 100% of the non-composite dead load and the floor slab placed to a uniform thickness as suggested in Section 9, Concrete Placement, the floor shall be approximately level after the concrete has been placed.

Should the **specifying professional** strive to achieve a level floor after the composite dead and live loads are placed on the floor, additional joist camber can be specified on the "Design Parameters Checklist for E-Series Joist", see **Ecospan® Composite Floor System Information & Design Manual Section 2.4**. However, it is typical for the actual composite dead and live loads supported by the composite steel joist to be less than the design composite dead and live loads.

(c) Shop Inspection

When a check is to be made of the camber of an E-Series joist, the joist shall be carefully laid on its side with the joist intermittently supported prior to measuring the camber. With the joist lying on its side, the joist shall be in an unstressed condition at which time the amount of camber provided can be accurately determined.

Joists having measured camber outside of the camber tolerances shown in Table 2.6 shall have their camber adjusted. The joists shall be permitted to be rebuilt with the corrected camber.

2.5 SHEAR CONNECTORS

The joist manufacturer shall indicate the size, quantity, and spacing of the Shearflex® shear connectors required on the installation drawings. Shearflex® shear connectors and Shearset® installation tool shall be provided by the seller.

SECTION 3
MATERIALS

3.1 STEEL

The steel used in the manufacturing of E-Series joists shall comply with the Ecospan® Composite Floor System Guide Specification, section 2.3 .

3.2 PRIMER

Standard shop practice is to supply Ecospan® Composite Floor System joists with gray primer. The primer is intended to be an impermanent and provisional coating which shall protect the steel for only a short period of exposure in ordinary atmospheric conditions.

Since Joists are coated using a standard dip coating, the coating shall be permitted to not be uniform and shall be permitted to include drips, runs and sags. Coatings applied over the standard shop primer shall be the responsibility of the specifier and/or painting contractor.

The shop applied primer may require field touch-up/repair as a result of, but not limited to, the following:

1. Abrasions from: Bundling, banding, loading and unloading, chains, dunnage during shipping, cables and chains during erection, bridging installation, and other handling at the jobsite. **Note: Rusting should be expected at any abrasion.**
2. Dirt.
3. Diesel smoke
4. Road salt.
5. Weather conditions during storage

The manufacturer shall not be responsible for the condition of the primer if it is not properly protected after delivery.

SECTION 4
INSPECTION

Inspection of E-Series joists at the joist manufacturer's plant shall be made in accordance with the manufacturers **Shop Practice Manual**, of latest adoption.

Provisions for field inspection of projects involving composite steel joists shall be made by the **specifying professional**. This field inspection shall include verifying the concrete strength, concrete thickness and placement of the Shearflex® shear connectors. This field inspection shall not be provided by the manufacturer

SECTION 5
ESTIMATING

5.1 PLANS FOR BIDDING

Plans to serve as the basis for bids shall show the character of the work with sufficient clarity to permit making an accurate estimate and shall show the following:

- Designation and location of material (see Section 5.2(a)), including any special design or configuration requirements.
- Locations and elevations of all steel and concrete supporting members and bearing walls.
- Sections and connection details
- Joist depth.
- Joist span.
- Distance, each side of the joist centreline, to adjacent joists or other supporting members.
- Type and depth of floor and roof deck.
- Concrete unit weight.
- Concrete compressive strength.
- Total depth of concrete slab.
- Loads and their locations as defined in Section 6.1(a).
- Location and length of joist extended ends.
- Location and size of all openings in floors and roofs.
- Location of all partitions.
- Composite Steel Joists requiring extended bottom chords.
- Deflection limitation.
- Joist moment of inertia for vibration mitigation, if required.
- Primer Requirements.

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5.2 SCOPE OF ESTIMATE

(a) Unless otherwise specified, the following items shall be included in the estimate, and requirements shall be determined as outlined in Section 6.1.

- E-Series Joists.
- Joist Extensions.
- Ceiling Extensions.
- Extended bottom chord used as strut.
- Bridging and bridging anchors.
- Shearflex® shear connectors.
- Shearset® tool(s).
- Centering (Decking) material and attachments.
- Standard accessories, as required.

(b) The following items shall not be included in the estimate but may be quoted and identified by the joist manufacturer as separate items:
- Headers for E-Series joists.
- Miscellaneous framing between joists for openings at ducts, dumbwaiters, ventilators, skylights, etc.
- Loose individual or continuous bearing plates and bolts or anchors for such plates.
- Erection bolts for composite joist end anchorage.
- Horizontal bracing in the plane of the top and bottom chords from joist to joist or joist to structural framing and walls.
- Moment plates.
- Special joist configuration or bridging layouts for ductwork or sprinkler system.

SECTION 6
PLANS AND SPECIFICATIONS

6.1 PLANS FURNISHED BY BUYER

The buyer shall furnish the seller plans and specifications as prepared by the **specifying professional** showing all material requirements and composite steel joist designations.

(a) Design Input Required for the Ecospan® Composite Floor System:

The following basic information shall be provided by the **specifying professional**.

1. Joist Depth:
   The joist depth includes the steel joist portion only, not the deck or concrete slab, mm (in).
2. Joist Layout:
   The joist plans shall show the layout of the E-Series joists, walls, columns, beams, girders and other supports, as well as floor and roof openings. The manufacturer shall determine the required E-Series joist span to be manufactured based on this information.
3. Finished Floor, Roof, and Bearing Elevations:
   The elevation of finished floors, roofs, and bearings shall be shown with due consideration taken for the effects of dead load deflection.
4. Adjacent Member Spacing:
   This is the distance to the adjacent member or to the edge of the slab (if an exterior joist), m (feet).

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5.Type of Floor Deck:

Review the manufacturer's deck capacity for load capacity and deflection and un-shored span characteristics and specify the deck depth, profile and thickness to meet the building design. Refer to the Ecospan® Information and Design Manual for more information regarding deck specification.

6.Concrete Unit Weight, kg/m³ (lb/ft.³).

7.Concrete Compressive Strength:

28 day specified compressive strength of concrete, MPa (ksi).

8.Slab Thickness above the top ribs of the deck, mm (in).

9.Loads:

The **specifying professional** shall provide the nominal loads and load combinations as stipulated by the applicable Building Code under which the structure is designed. At the present time, **E-Series** joists are designed utilizing a LRFD design basis.

The **specifying professional** shall calculate and provide the magnitude and location of ALL JOIST LOADS including those shown below. When necessary to clearly convey information, a Load Diagram or Load Schedule shall be provided.

a.Non-composite DL, kPa (lb/ft.²) - Concrete, joists, deck, bridging, and any other non-composite dead loads.

b.Construction LL, kPa (lb/ft.²) – It is suggested that construction live load be determined considering the tributary area for each composite steel joist. For more information on Construction LL, refer to ASCE/SEI 37, Design Loads on Structures During Construction.

c.Composite DL, kPa (lb/ft.²) – Non-moving partitions, mechanical, electrical, fireproofing, floor covering, ceilings, and other composite dead loads. The magnitude and location of composite dead loads shall be clearly dimensioned.

d.Composite LL, kPa (lb/ft.²) – Specified live load including provisions for moving partitions, where applicable. Reduced design live loads shall be permitted to be specified if applicable.

10.Special Loads:

The **specifying professional** shall be responsible for determining the applicable building code combinations. If the loading criteria are too complex to be adequately communicated in a simple load diagram, then the **Specifying Professional** shall provide a load schedule showing the specified design loads, load categories and required load combinations with applicable load factors.

The **specifying professional** shall show on the structural drawings and give due consideration to the following special loads and load effects:

a.Snow drift loads including the accumulation of snow in the vicinity of obstructions such as penthouses, signs, parapets, adjacent buildings, etc.

b.Axial loads at the joist end supports.

c.Type and magnitude of end moments. For moment resisting joists framing near the end of a column, due consideration shall be given to extend the column length to allow a plate type connection between the top of the joist top chord and the column. Whenever possible, avoid resolving joist end moment forces through the joist bearing seat connection. A note shall be provided on the structural drawings stating that all moment resisting joists shall have all dead loads applied to the joist before the bottom chord struts are welded to the supporting connection whenever the moments provided do not include dead load. The top and bottom chord moment connection details and reinforcing steel placed in the concrete slab to resist negative flexural moments shall be designed by the specifying professional. The joist designer shall furnish the **specifying professional** with the joist detail information if requested.

d.Structural bracing loads.

e.Ponded rain water.

f.Wind Uplift - When composite steel joists are utilized in roof applications, the magnitude and location of all wind uplift loads shall be clearly shown in terms of net uplift.

g.Concentrated loads from mechanical units, fans, blowers, tanks, monorails, etc. - Where concentrated loads occur, the magnitude and location of these concentrated loads shall be shown on the structural drawings when, in the opinion of the **specifying professional**, they shall require consideration by the manufacturer.

For nominal concentrated loads, which have been accounted for in the specified uniform design loads, a "strut" to transfer the load to a panel point on the opposite chord shall not be required provided the sum of the concentrated loads within a chord pane, does not exceed 100 pounds and the attachments are concentric to the chord. If the slab is already designed to transfer concentrated loads from above to top chord panel points, the added member would not be required.

> 11. Camber:
>> E-Series joists, unless otherwise specified, are cambered, mm (in), for 100% of the non-composite weight of joist, bridging, deck and concrete slab. Additional camber to accommodate for actual sustained composite dead and live loads and concrete shrinkage/creep shall be identified by the **specifying professional**.

(b)Design Parameter Checklist

The design Parameter Checklist for E-Series Joist (shown in section 2.4 of the **Ecospan® Composite Floor System Information and Design Manual**) provides a form for filling in the above standard design information listed in Section 6.1(a)(1) and Sections 6.1(a)(4) – 6.1(a)(9).

(c)Ecospan® Composite Floor System Joist Limitations

> E-Series Joists have some limitations that the **specifying professional** shall be aware of. These include:
> • The maximum deck depth is 76 mm (1.5").
> • The minimum slab thickness above the top of the deck shall be 51 mm (2 inches). 64 mm (2 1/2") minimum topping is required when a UL rated floor is desired.
> • Shearflex® shear connectors shall have at least 13mm (1/2 inch) of concrete cover and shall be 76 mm (1 1/2") above the top of the deck.
> • The concrete shall be placed to provide a constant thickness along the entire span.

(d)Connections

> The adequacy of the end anchorage connection (bolted or welded) between the E-Series joist bearing seat and the supporting structure is the responsibility of the specifying professional. The contract documents shall clearly illustrate the end anchorage connection.

> When the end anchorage is welded, it is recommended that the **specifying professional** consider a smaller fillet weld thickness in conjunction with a longer weld length.

> The **specifying professional** is responsible for bridging termination connections. The contract documents shall clearly illustrate these termination connections.

> The joist manufacturer is responsible for the design of the bearing seats of E-Series joists for the loads designated by the **specifying professional** in the contract documents.

(e)Special Considerations

> The **specifying professional** shall indicate on the construction documents special considerations including:
> a)Oversized or other non-standard web openings
> b)Extended ends
> c)Non-standard bridging

6.2 PLANS FURNISHED BY SELLER

The seller shall furnish the buyer with steel placement plans to show the material as specified on the construction documents and are to be utilized for field installation in accordance with specific project requirements as stated in Section 6.1. Ecospan® Composite Floor System placement plans shall include, at a minimum, the following:

1. Listing of all applicable loads as stated in Section 6.1 and used in the design of the composite steel joists as specified in the construction documents
2. Connection requirements for:
    a) Joist supports
    b) Field splices
    c) Bridging attachments
3. Deflection criteria for live load and total load
4. Shearflex® shear connector information showing:
    a) Size, quantity, and spacing of all shear connectors to be installed on the E-Series joists
5. Size, location, and connections for all bridging
6. Joist headers

All material shall be identified with its piece mark which also appears on the bill of material. **Ecospan® Composite Floor System placement plans do not require the seal and signature of the joist manufacturer's registered design professional.**

6.3 DISCREPANCIES

The **specifying professional's** bid plans and specifications shall be assumed to be correct in the absence of written notice from the buyer to the contrary. When discrepancies exist between the Design Drawings and Specifications, the Design Drawings shall govern. When discrepancies exist between scale dimensions in the Design Drawings and the figures written in them, the figures shall govern. When discrepancies exist between the structural Design Drawings and the architectural, electrical or mechanical Design Drawings or Design Drawings for other trades, the structural Design Drawings shall govern.

6.4 APPROVAL

When Ecospan® Composite Floor System placement plans are furnished by the seller, prints thereof are submitted to the buyer and owner for examination and approval. The seller allows a maximum of fourteen (14) calendar days in his schedule for the return of placement plans noted with the owner's and customer's approval, or approval subject to corrections as noted. The seller makes the corrections, furnishes corrected prints for field use to the owner/customer and is released by the owner/customer to start composite joist manufacture.

Approval by the owner/customer of the placement plans, sections, notes and joist schedule prepared by the seller indicates that the seller has correctly interpreted the contract requirements, and is released by the owner/customer to start manufacture. This approval constitutes the owner's/customer's acceptance of all responsibility for the design adequacy of any detail configuration of joist support conditions shown by the seller as part of his preparation of these placement plans.

Approval does not relieve the seller of the responsibility for accuracy of detail dimensions on the plans, nor the general fit-up of joists to be placed in the field.

6.5 CHANGES

When any changes in plans are made by the buyer (or the buyer's representative) either prior to or after approval of detailed plans, or when any material is required and was not shown on the plans used as the basis of the bid, the cost of such changes and/or extra material shall be paid by the buyer at a price to be agreed upon between buyer and seller.

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6.6 CALCULATIONS

The **specifying professional** may require submission of the E-Series joist calculations as prepared by a registered design professional responsible for the product design. If requested by the **specifying professional**, the Ecospan® Composite Floor System manufacturer shall submit design calculations with a cover letter bearing the seal and signature of the manufacturer's registered design professional. In addition to standard calculations under this seal and signature, submittal of the following shall be included:

      1. Connection details for:
            a)Non- standard connections (e.g. flush framed or framed connections)
            b)Field splices
            c)Joist headers
      2. Shearflex® shear connector requirements

SECTION 7
HANDLING AND ERECTION*

The current OSHA SAFETY STANDARDS FOR STEEL ERECTION, 29 CFR PART 1926, SUBPART R - STEEL ERECTION, refers to certain joists at or near columns to be designed with sufficient strength to allow one employee to release the hoisting cable without the need for erection bridging. **This STANDARD shall not be interpreted that any joist at or near a column line is safe to support an employee without bridging installed.** Many limitations exist that prevent these joists from being designed to safely allow an employee on an unbridged joist. Because of these limitations and as required by OSHA, these joists shall be erected by incorporating erection methods ensuring joist stability and either:

      1. Installing bridging or otherwise stabilizing the joist prior to releasing the hoisting cable, or
      2. Releasing the hoisting cable without having a worker on the joist.

An E-Series joist shall not be placed on any support structure unless such structure is stabilized. When E-Series joists are landed on a structure, they shall be secured to prevent unintentional displacement prior to installation.

A bridging terminus point shall be established before joist bridging is installed.

E-Series joists shall not be used as anchorage points for a fall arrest system unless written direction to do so is obtained from a "qualified person."

No modification to an E-Series joist shall be made without the written approval of the **specifying professional**.

The buyer and/or erector shall check quantities, mark numbers and condition of joists, joist girders, deck and deck accessories on arrival. Note on the delivery ticket (Bill of Lading) any shortage or discrepancies. In addition the buyer and/or erector shall promptly notify the seller of any shortage or discrepancies. The seller will not be liable for any shortage or discrepancies not noted.

The seller shall not be responsible for improper fit of material due to inaccurate construction work.

SECTION 8
INSTALLATION AND INSPECTION OF SHEAR CONNECTORS

8.1 INSTALLATION AND INSPECTION

(a) Locate Shearflex® shear connectors, hereafter referred to as shear connectors, on E-Series joists per details shown on the manufacturer's placement plans. Start laying out shear connectors from each end of the joist and working toward the center. Alternate installation of the shear connectors from one top chord angle to the other. The shear connector shall be located such that there is a minimum 10mm (3/8 in) edge distance from the connector to the edge of the outstanding leg of the angle.

(b) All shear connectors shall be screwed through the steel deck after the deck has been placed on the joists. The shear connector, once installed, shall be fully seated such that there is not a gap between the deck and the clamping collar on the connector.

(c) Prior to connecting, the steel deck shall rest tightly against the top chord of the E-Series joist.

SECTION 9
CONCRETE PLACEMENT

It is normal practice for E-Series joist manufacturers to camber joists for the full non-composite dead load. This joist camber, while theoretically providing a flat floor surface after placing of the concrete is complete, requires special consideration relative to concrete placement.

The suggested method for concrete placement is to utilize the "Constant Slab Thickness Method." In this method the concrete slab is placed at a constant thickness across the entire length of the composite steel joist. The reasons to use this method include the following:

- Full concrete slab thickness shall be provided along the entire composite joist span to carry the composite steel joist compressive loads.
- A full thickness slab is necessary to provide required fire protection.
- Sufficient concrete cover shall be provided over the heads of the shear connector.
- The potential for over runs in concrete placing volumes will be greatly reduced.
- Deflections of the composite steel joist under the non-composite loading can be more accurately predicted vs. with a variable thickness slab.

Concrete construction joints should ideally be located between joists. When a construction joint is located closer than 305 mm (12 in) from the longitudinal centreline of any given E-Series joist, it is the responsibility of the **specifying professional** to determine whether extra transverse steel reinforcing needs to be provided to assure that the composite properties of the supporting member with shear studs has not been affected.

SECTION 10
BUSINESS RELATIONS

10.1 PRESENTATION OF PROPOSALS

All proposals for furnishing material shall be made on a Sales Contract Form. After acceptance by the buyer, these proposals shall be approved or executed by a qualified official of the seller. Upon such approval the proposal becomes a contract.

10.2 ACCEPTANCE OF PROPOSALS

All proposals are intended for prompt acceptance and are subject to change without notice.

10.3 BILLING

Contracts on a lump sum basis are to be billed proportionately as shipments are made.

10.4 PAYMENT

Payments shall be made in full on each invoice without retention.

10.5 ARBITRATION

All business controversies which cannot be settled by direct negotiations between buyer and seller shall be submitted to arbitration. Both parties shall sign a submission to arbitration and if possible agree upon an arbitrator. If they are unable to agree, each shall appoint an arbitrator and these two shall appoint a third arbitrator. The expenses of the arbitration shall be divided equally between the parties, unless otherwise provided for in the agreements to submit to arbitration. The arbitrators shall pass finally upon all questions, both of law and fact, and their findings shall be conclusive.

ECOSPAN®

COMPOSITE FLOOR SYSTEM

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Ecospan® Composite Floor System

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