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FLOOR DECK DESIGN GUIDE

COMPOSITE DECK
AND NON-COMPOSITE DECK
FOR FLOOR AND ROOF DECK APPLICATIONS

ASC STEEL DECK

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ASC Steel Deck is leading the way in innovation with ongoing testing of our profiles. As a result, our printed catalogs may not contain/reflect the latest test results and values of our products. For the most current load tables, refer to the IAPMO ER-329 report online at **www.ascsd.com**.

Your Feedback is Welcome

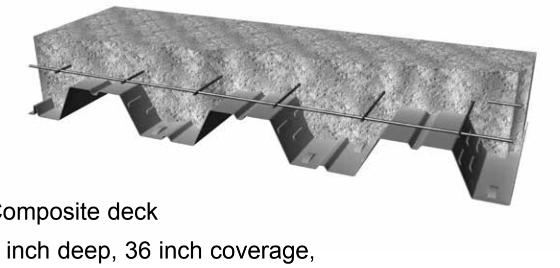
Leading the way in steel deck innovation is dependent upon your feedback. We invite architects, engineers, building owners, and all members of the building design and construction industry to reach out to ASC Steel Deck with any comments, suggestions, or needs for a profile we currently do not offer

Email us at **info@ascsd.com**

IAPMO ER-329 Report

1.1 **Panel Features and Benefits**

3WxH-36 Hi Form®



Composite deck

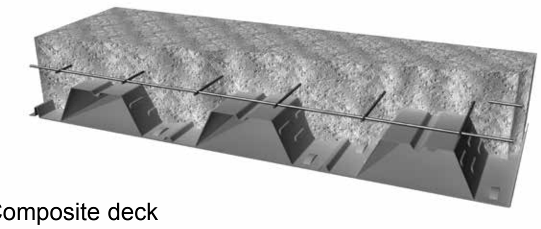
3 inch deep, 36 inch coverage,

10 foot to 14 foot Optimal Span Range

No Acustadek® Options

- Proven for 10 to 14 foot span conditions
- Meets SDI 3x12 inch standard profile requirements
- Longer unshored spans than 2WH-36 and BH-36
- Meets industry standard 4.5" min. flute width
- Compatible with all standard concrete anchors

3WxHF-36 Hi Form®



Composite deck

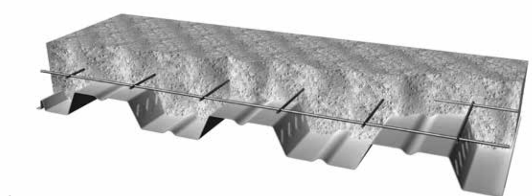
3 inch deep, 36 inch coverage,

11 foot to 15 foot Optimal Span Range

Pan Perforated Acustadek® Option (Available with Smooth Series™ rivet attachments or welded)

- Aesthetic flat pan underside
- Meets SDI 3x12 inch standard profile requirements
- Longer unshored spans than 2WH-36 and BH-36
- Meets industry standard 4.5" min. flute width
- Compatible with all standard concrete anchors

2WH-36 Hi Form®



Composite deck

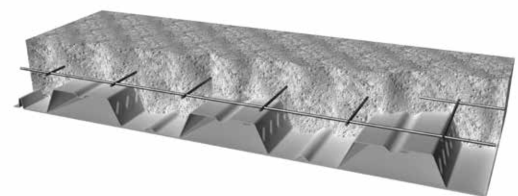
2 inch nominal depth, 36 inch coverage

7 foot to 12 foot Optimal Span Range

No Acustadek® Option

- Least steel weight per square foot floor deck
- Meets SDI 2x12 inch standard profile requirements
- Reduced composite slab depth compared to 3WxH-36 and NH-32

2WHF-36 Hi Form®



Composite deck

2 inch nominal depth, 36 inch coverage

9 foot to 13 foot Optimal Span Range

Pan Perforated Acustadek® Option (Available with Smooth Series™ rivet attachments or welded)

- Aesthetic flat pan underside
- Meets SDI 2x12 inch standard profile requirements
- Reduced composite slab depth compared to 3WxHF-36 and NHF-32

BH-36 Hi Form®

Composite deck

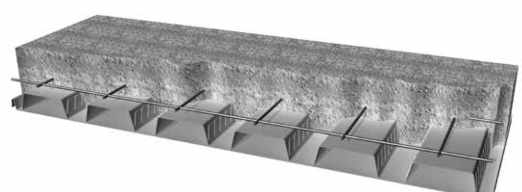
1½ inch depth, 36 inch coverage

7 foot to 10 foot Optimal Span Range

No Acustadek® Option

- Lowest composite deck-slab weight per square foot for the specified concrete thickness above the deck
- Meets SDI 1.5WR (wide rib) standard profile requirements

BHF-36 Hi Form®



Composite deck

1½ inch depth, 36 inch coverage

7 foot to 12 foot Optimal Span Range

Pan Perforated Acustadek® Option (Available with Smooth Series™ rivet attachments or welded)

- Aesthetic flat pan underside
- Meets SDI 1.5WR standard profile requirements

ASC STEEL DECK

Panel Features and Benefits 1.1

NH-32 Hi Form®

Composite deck

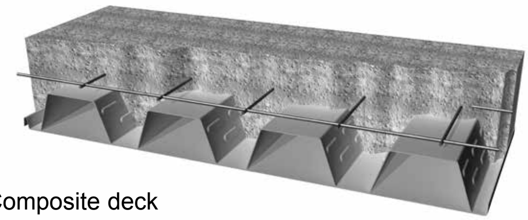
3 inch depth, 32 inch coverage

10 foot to 15 foot Optimal Span Range

No Acustadek® Options

- Longest unshored spans
- Excellent alternate to SDI DR (deep rib) profile
- Lower composite deck-slab weight than 3WxH-36 for the specified concrete thickness
- 8 inch on center low flute spacing to allow for bearing wall studs to be at 16 inches on center

NHF-32 Hi Form®



Composite deck

3 inch depth, 32 inch coverage

11 foot to 15 foot Optimal Span Range

Pan Perforated Acustadek® Option (Available with Smooth Series™ rivet attachments or welded)

- Aesthetic flat pan underside
- Excellent alternate to SDI DR (deep rib) profile
- 8 inch on center low flute spacing to allow for bearing wall studs to be at 16 inches on center

C0.9-32 (CF⅞)

Non-composite deck

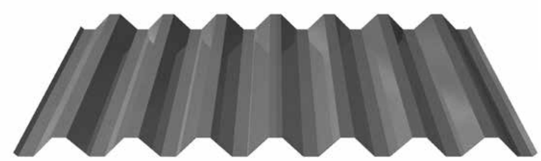
⅞ inch depth, 32 inch coverage

2 foot to 7 foot Span Range

No Acustadek® Options

- Good for short span conditions
- For use when metal deck is used as a leave in place form

C1.4-32 (CF1⅜)



Non-composite deck

1⅜ inch depth, 32 inch coverage

4 foot to 9 foot Span Range

No Acustadek® Options

- Good for intermediate span conditions
- For use when metal deck is used as a leave in place form

1.1 **Panel Features and Benefits**

ASC STEEL DECK

4.5D-12

Non-composite deck

4½ inch depth, 12 inch coverage

12 foot to 21 foot Span Range

No Acustadek® Option

- Allows for longest unshored spans
- For use when metal deck is used as a leave in place form

4.5DF-24

Non-composite deck

4½ inch depth, 24 inch coverage

15 foot to 21 foot Span Range

Pan Perforated Acustadek® Option

- Aesthetic flat pan underside
- Allows for longer unshored span when metal deck is used as a leave in place form
- Longer unshored span than non-cellular profile
- For use when metal deck is used as a leave in place form

6D-12

Non-composite deck

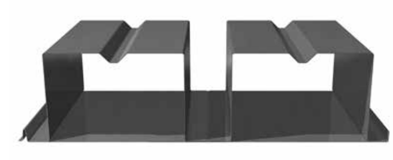
6 inch depth, 12 inch coverage

14 foot to 25 foot Span Range

No Acustadek® Option

- Allows for longest unshored spans
- For use when metal deck is used as a leave in place form

6DF-24



Non-composite deck

6 inch depth, 24 inch coverage

15 foot to 25 foot Span Range

Pan Perforated Acustadek® Option

- Aesthetic flat pan underside
- Allows for longer unshored span when metal deck is used as a leave in place form
- Longer unshored span than non-cellular profile
- For use when metal deck is used as a leave in place form

7.5D-12

Non-composite deck

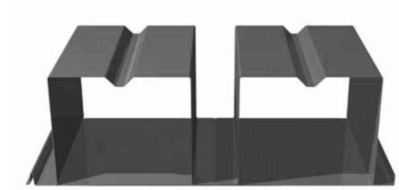
7½ inch depth, 12 inch coverage

16 foot to 26 foot Span Range

No Acustadek® Option

- Allows for longest unshored spans
- For use when metal deck is used as a leave in place form

7.5DF-24



Non-composite deck

7½ inch depth, 24 inch coverage

16 foot to 27 foot Span Range

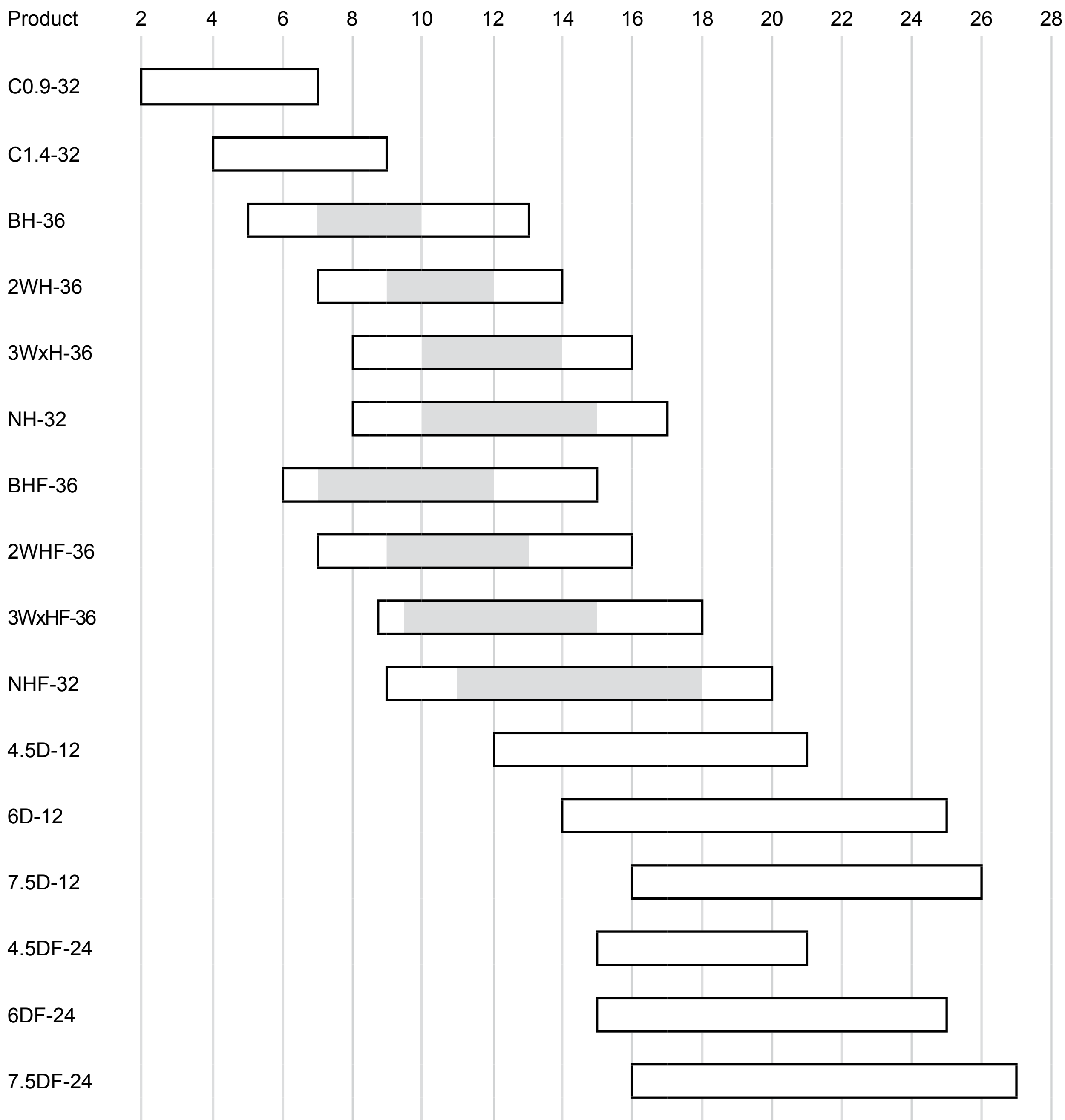
Pan Perforated Acustadek® Option

- Aesthetic flat pan underside
- Allows for longer unshored span when metal deck is used as a leave in place form
- Longer unshored span than non-cellular profile
- For use when metal deck is used as a leave in place form

ASC STEEL DECK

Panel Features and Benefits 1.1

Economical Selection Guide based on Recommended Unshored Spans



Box outlines the range of unshored spans from the recommended unshored span range

Gray cells are based on 1 hour and 2 hour fire ratings with 20 and 18 gauge decks

1.2 **Product Offer**

ASC Steel Deck offers a robust selection of products. Our lightweight composite and non composite steel deck profiles have depths that range from ⅞" to 7½". Panel lengths range from 3'-6" to 45'. Steel deck panels are supplied with both galvanized and painted finishes to meet an array of project finish requirements.

Product Description

To assist designers with specifying the correct steel deck profile, see figure 1.2.3 which details how to specify the intended product. Following these guidelines will help to eliminate requests for information and change orders due to insufficient product descriptions in the plans and specifications. Designers can be assured that the product delivered is the product intended. Simply specify the gage, panel profile, panel coverage, metallic/paint coating, and any modifiers appropriate for the desired product.

Deck Panel Lengths

All ASC Steel Deck products are manufactured to the specified length for the project. The following table summarizes the minimum and maximum lengths which can be manufactured for each profile.

Figure 1.2.1: **MANUFACTURED PANEL LENGTHS**

Profile		Factory Cut Length	
		Minimum	Maximum
Non-cellular	BH-36, NH-32, 2WH-36, 3WxH-36	3'-6"	45'-0"
	C0.9-32 & C1.4-32	4'-0"	45'-0"
	4.5D-12, 6D-12, 7.5D-12	6'-0"	32'-0"
Cellular	BHF-36, NHF-32, 2WHF-36, 3WxHF-36	5'-0"	40'-0"
	4.5DF-24, 6DF-24, 7.5DF-24	6'-0"	32'-0"

Tolerances

ASC Steel Deck manufactures to industry standard tolerances. The tolerances are summarized as follows:

Figure 1.2.2: **PANEL TOLERANCES**

Length	±½"
Coverage Width	-⅜" +¾"
Sweep	¼" in 10' length
Square	⅛" per foot width
Height	±1⁄16"

Finish Options

ASC Steel Deck offers several finish options that are appropriate for a variety of applications. Our standard G60 galvanized finish is suitable for most applications, offering excellent corrosion protection and compatibility with fire proofing when used in UL fire rated assemblies. We also offer Prime Shield®, an economical prime paint system over bare cold rolled steel. Prime Shield® offers the steel limited interim protection from rusting during transport and erection before the concrete topping is applied. Prime Shield® should not be used in high humidity or corrosive environments. Prime paint over galvanized steel deck can also be specified to obtain the benefit of the corrosion protection of galvanized steel deck with a factory applied prime paint substrate.

Galvanized

ASC Steel Deck offers steel deck products that are galvanized in accordance with ASTM A653. The standard galvanized coating is G60 (0.6 ounce per square foot). G-90 (0.9 ounce per square foot) is recommended for high humidity and corrosive conditions. G-40 (0.4 ounce per square foot) may also be specified for greater economy. Heavier galvanized finishes than G-90 can be specified for more severe environmental conditions and exposures. Inquire for product availability and minimum order sizes for G-40 or galvanizing heavier than G-90.

All ASC Steel Deck galvanized decks are manufactured from chemically treated steel coil in accordance with ASTM A653. Chemical treatment is often referred to as passivation. The chemical treatment protects the galvanized steel from developing white rust during storage and transport of both coil and finished product. Some field-applied paint systems may not be compatible with the chemical treatment. The paint manufacture should be consulted to determine how the deck should be prepared prior to painting. ASC Steel Deck is not responsible for the adhesion of field applied primers and paints.

Galvanized with Prime Paint

ASC Steel Deck offers all of its standard galvanized options with factory applied prime paint on the underside of the deck. The prime paint is available in standard gray. White primer is also available. The standard 0.3mil water-based gray acrylic primer has been specially developed to provide superior adhesion to the galvanized steel deck and is suitable for use in many UL fire rated assemblies. Factory applied primer is an impermanent interim coating that is intended to have finish paint applied after the deck is installed. The galvanized with prime paint option may eliminate the need for any special surface preparation for field applied paint applications which is often a requirement for chemically treated bare galvanized steel deck panels. ASC Steel Deck is not responsible for the adhesion of paint systems applied in the field.

Cellular deck is offered with a galvanized steel pan or a prime paint over galvanized steel pan. This 0.3mil gray primer is applied to the underside of the pan prior to resistance welding or riveting the cellular deck beam to the pan. Our new Smooth Series™ rivet attachment is flush with the exposed bottom surface, omitting visible “bumps” and burn marks, eliminating the cost of touch-ups associated with resistance welded deck products. Resistance welded deck, the current industry standard, leaves burn marks on the pan which generally require cleaning and touch-up prior to the application of a finish paint system being applied. Touching up the burn marks is generally much more cost effective than preparing an unpainted, chemically treated surface for the application of a field primer. The prime painted galvanized pan provides a good substrate for the application of most field-applied paint systems. ASC Steel Deck is not responsible for the adhesion of paint systems applied in the field.

Product Offer 1.2

Figure 1.2.3: **PRODUCT OFFER DESCRIPTION**

Gage(s)	DeltaGrip Modifier	Panel Profile	HiForm Modifier	Configuration Modifier	–	Panel Coverage	Optional Modifier	Metallic Coating(s)	Top Side Paint / Bottom Side paint	Special Modifiers
18/20	DG	B	H	F	–	36	A	G60/G60	Gray / Gray	

Gage(s): Specify Required Gage(s) of Deck
- 22
- 21[1]
- 20[2]
- 19[1]
- 18[2]
- 16[2]
- 14[2]
- 20/20[3]
- 20/18[3]
- 20/16[3]
- 18/20[3]
- 18/18[3]
- 18/16[3]
- 16/20
- 16/18[3]
- 16/16[3]

[1] 2W & 3Wx only on special order

[2] D is only available in these gages

[3] DF is only available in these gages

DeltaGrip Modifier:
- **Omit:** Standard standing seam side lap interlock
- **DG:** DeltaGrip standing seam side lap interlock

Panel Profile: See Deck Profiles and Coverage List

HiForm Modifier:
- **Omit:** Non-embossed smooth deck (Roof)
- **H:** Embossed HiForm composite deck (Floor)

Configuration Modifier:
- **Omit:** Standard profiles non-cellular with standard standing seam side lap interlock
- **F:** Cellular **(Welded)**
- **Fr: Cellular (Smooth Series™ Rivet Attachment)**
- ***N:*** Nestable side lap, **(B and N Deck only)**
- ***S:*** Standing seam screwable side lap (2WHS-36 only)

Panel Coverage: See Deck Profiles and Coverage List

Optional Modifier:
- **Omit:** Standard profiles without Acustadek® perforations
- **AW:** Acustadek® web perforation for use with non-cellular standard or DeltaGrip, DG, profiles only
- **AT:** Acustadek® total perforation for use with non-cellular standard or DeltaGrip, DG, profiles only
- **A:** Acustadek® pan perforation for use with cellular profile modifier, F, only
- **V:** Venting (non-cellular only)

Metallic Coating(s):
- **Omit:** Bare Non-Galvanized Steel
- **G60:** Galvanized
- **G90:** Galvanized
- **G60/G60:** Galvanized
- **G90/G90:** Galvanized

Note: Inquire for other galvanized coating weights

Top Side Paint / Bottom Side paint:
- **None:** No primer
- **Prime Shield®:** Gray primer on bare steel or GO1 galvanized
- **Gray:** Primer over galvanized (Available for cellular deck)
- **Weldable Primer:** (Only available for cellular decks span underside only)
- **White:** Primer over galvanized

Special Modifiers:
- **Omit:** None
- **NS:** No Swage, B-36 only

DECK PROFILE AND COVERAGE LIST

Non-Composite	Roof	Coverage
Not Applicable	B	36 inches
	N	32 inches
	2W	36 inches
	3Wx	36 inches
C0.9-32	Not Applicable	32 inches
C1.4-32	CP-32	32 inches
Not Applicable	4.5D	12 inches
	4.5DF	24 inches
	6D	12 inches
	6DF	24 inches
	7.5D	12 inches
	7.5DF	24 inches

Prime Shield®

Prime Shield® is prime painted cold-rolled, ASTM 1008[1], steel deck. The standard gray primer is applied to the underside of the steel deck (as compared to both sides for roof deck) leaving the top side bare for concrete adhesion. The formation of light rust on the top side of the deck prior to concrete placement is common and does not adversely impact the deck or composite deck-slab assembly. This primer is suitable for use in many UL fire rated assemblies. The prime paint is intended to be an impermanent interim coating to protect the bare cold-rolled steel, for a short period, from ordinary atmospheric conditions prior to weathertighting the building. Prime Shield® should receive a finish paint system if left exposed in the interior of a building. This 0.3mil water-based acrylic primer provides a good base for most field-applied paint systems. ASC Steel Deck is not responsible for the adhesion of paint systems applied in the field.

[1]ASC Steel Deck may substitute ASTM A653 G01 galvanized steel deck for ASTM A1008.

Cellular Deck

Cellular deck is a good choice when a flat appearance on the underside of steel deck is desired. Cellular deck is manufactured from a top fluted section of steel deck referred to as the beam and a flat bottom section referred to as the pan. The male and female side seam interlock is formed on the edges of the pan.

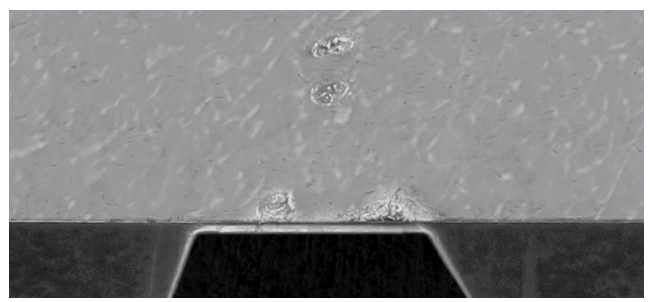


Figure 1.2.4: WELDED ATTACHMENT
(Pictured from topside)

The welded method offers resistance welds in accordance with UL 209. There is one row of resistance welds in each low flute of the beam.

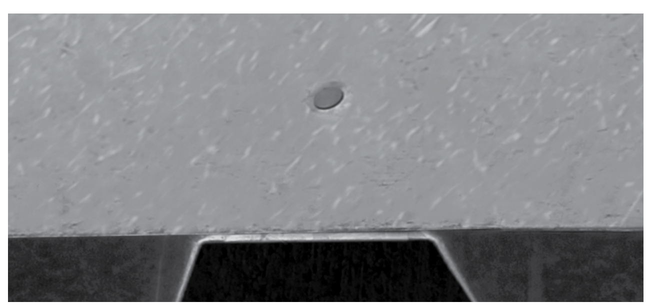


Figure 1.2.5: SMOOTH SERIES™ RIVET ATTACHMENT
(Pictured from topside)

The new Smooth Series™ rivet attachment is flush with the exposed bottom surface, eliminating "bumps" and burn marks and the need for touch-ups in the field. Smooth Series rivets are available in galvanized and white finish, complementing our factory applied Prime Shield® primer gray and white finish cellular deck. The high quality rivet attachments are uniformly repeated along the deck profile.

1.2 **Product Offer**

This product should not be used in floor assemblies where spray on fire proofing is to be applied to the bottom surface of the deck.

Cellular deck beam and pan may be manufactured out of the same gage or out of different gages. The following shows how to correctly specify the desired beam and pan gage combination.

Specify Cellular Deck Gage "xx/yy"

- The first (xx) is the gage of the beam (top fluted section)
- The second number (yy) is the gage of the pan (the bottom flat section with the side seam)

Venting

Some materials in building assemblies, including composite or non composite steel deck, may require the deck to be vented. Venting does not impact structural performance of steel deck and has no bearing on fire ratings. Venting does not influence the rate at which the concrete moisture content drops during curing of the slab on the deck.

Some materials that are bonded by adhesives to the surface of the concrete slab on the composite deck may be sensitive to the moisture content of the concrete. Venting is sometimes specified, with the intent of creating a route for moisture to escape from the bottom of the concrete through the steel deck vents. Research performed by the Expanded Shale Clay and Slate Institute, however, demonstrated that venting has no bearing on how quickly the moisture content of concrete on steel deck decreases (concrete drying time)[2].

Deck should not be specified as vented when it is not required by another materials' performance specification. The drawback of venting deck is when concrete is poured, the slurry drips through the vent tabs creating debris on the surface below. Cleaning up the slurry or protecting the surfaces underneath with plastic sheets adds cost to the project without providing any added value to the owner when venting is not required. The requirement for venting the deck should be clearly indicated in the specifications and be clearly stated in the deck schedule on the structural drawings to avoid confusion.

Note: *2. Craig, Peter A. (2011) Lightweight Concrete Drying Study. Chicago, IL: Expanded Shale Clay and Slate Institute*

Figure 1.2.7: **3WxH-36V WITH VENTING**
(Pictured from topside)

Vent Tabs

All ASC Steel Deck composite decks including; BH, NH, 2WH, and 3WxH deck, have upward protruding vent tabs which are factory punched in the low flutes of the steel deck when venting is specified. (See Figures 1.2.6, and 1.2.7) C0.9-32 and C1.4-32 do not have a venting option. CP-32 roof deck may be used as an alternate to C1.4-32 when venting is required. The CP-32 has embossments in the side lap that holds the side lap open creating a vent at each side.

Die Set Ends (Swage)

Die set ends allow for deck panels to be end lapped. This is not a common practice for composite deck but is common for roof decks. The die set swages the top flange and webs of the steel deck which allows the top sheet of end lapped deck to nest tightly over the bottom sheet. When deck is not die set, the installer may have to hammer the deck to get the ends to nest together tightly to ensure good quality connections. The die set ends are standard for BH-36 and NH-32 profiles. BH-36 is optionally available without die set ends. 2WH-36, 3WxH-36, Deep Deck, and cellular profiles are not end lapped and do not have die set ends. Figure 1.2.8 shows a die-set end on NH-32 deck.

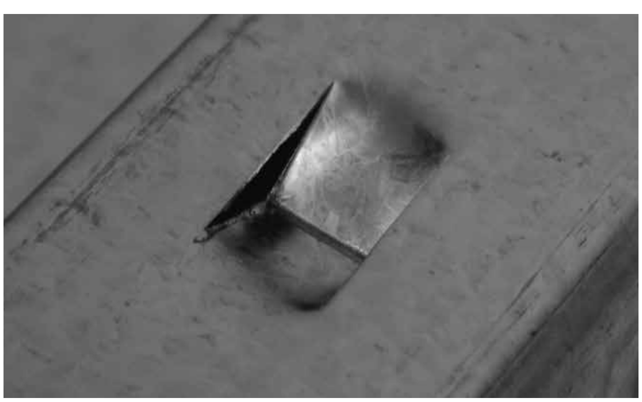


Figure 1.2.6: **BH-36V WITH VENTING**
(Pictured from underside)

Figure 1.2.8 **N-32 WITH DIE-SET (Swage)**

ASC Steel Deck

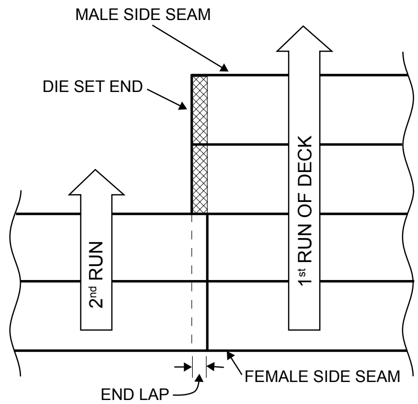


Figure 1.2.9: **DECK LAYOUT**

Die set ends affect detailing and layout of the steel deck. Deck is spread in the direction of the male leg of the side seam. This allows the next sheet's female side seam to drop over the male side seam. The die set is on the left side relative to the direction of spreading deck. The next adjacent run of deck will be on the left side of the deck relative to the spreading direction to nest over the dies set ends. (See figure 1.2.9)

Exposed Deck

ASC Steel Deck roof and floor deck products are designed to be structural components for steel framed structures. As part of the normal manufacturing, handling, and transport procedures, it is common for the panel bundles to exhibit some degree of incidental scratching and denting. The surface defects are typically superficial and do not impact the structural capacity of the deck. On projects where the deck will be exposed to view after installation, it may be desirable to minimize the occurrence of these marks. In these cases, it is important for the designer specifying and the customer or contractor ordering the deck to request that the product be manufactured, handled, and transported for "EXPOSED" installation. This will result in modified handling and loading procedures designed to minimize (not eliminate) typical scratching and denting. Figure 1.2.10 and 1.2.11 shows typical handling marks from forklifts or dunnage.

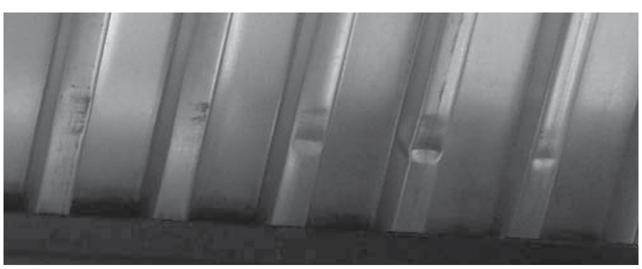


Figure 1.2.10: **UNDERSIDE HANDLING MARKS**

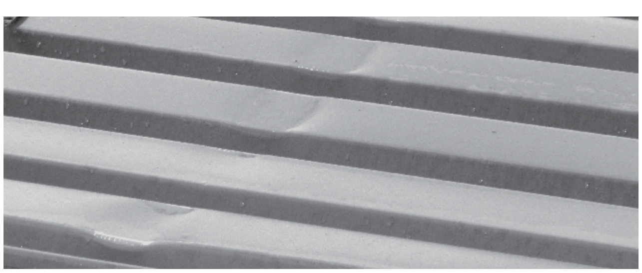


Figure 1.2.11: **TOPSIDE HANDLING MARKS**

Product Approvals 1.3

ASC Steel Deck conducts extensive test and engineering programs with independent testing labs to ensure that our products comply with the stringent criteria of today's building codes. The structural performance of our composite and non-composite steel deck products have been verified and evaluated by reputable evaluation agencies, such as the International Association of Plumbing and Mechanics Officials Uniform Evaluation Services (IAPMO-ES), Los Angeles City Research Reports (LARR), and Underwriters Laboratory (UL).

IAPMO-ES

ASC Steel Deck's composite and non-composite steel deck panels are independently evaluated for conformance with the IBC by IAPMO-ES. IAPMO-ES is accredited by the American Standards Institute (ANSI) per ISO/IEC Guide 65 General Requirements for Bodies Operating Product Certification Systems. LA City Research Reports (LARR) for ASC composite and non-composite steel decks are derived from IAPMO-ES reports. The technical evaluation for conformance with the IBC is made available to code officials, contractors, specifiers, architects, engineers, and others. IAMPO-ES reports provide evidence that ASC Steel Deck products meet the most rigorous standards and are compliant under current code requirements.

Underwriters Laboratories UL-Fire Ratings

ASC Steel Deck products which bare the UL approved mark have been investigated for fire resistance. Underwriters Laboratories is an independent, product safety testing and certification organization. ASC Steel Deck has been evaluated for fire resistance per UL 263 Fire Tests of Building Construction and Materials. See UL directory for fire rated assemblies.

The **Fire Ratings** table (See figure 1.4.1) offers a quick reference summary of design numbers, fire ratings, deck type, SFRM Spray Applied Fire Resistive material listings and more. The details of each design assembly are listed on the UL Online Certification Directory ***www.ul.com***.

1.4 Fire Ratings

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8]	Minimum Concrete Reinforcing	Fire Proofing[2] On	
		hr		Beam	Deck
D216	W8x15, 10J3, 12K1, 20LH with a minimum of 13 lbs per foot weight	1, 1½, 2, 3	6x6 W1.4xW1.4	None (ceiling system below)	none
D303	W8x28	1, 1½, 2	6x6 10x10 SWG	Mineral fiber board	Mineral fiber board
D502	W8x28, 20" Joist Girders at 20plf, 12K1, LH Series joists	1½, 2	6x6 W1.4xW1.4	none (ceiling system below)	none
D703	W8x20	1, 1½	6x6 W2.9xW2.9	SFRM	SFRM
D708	W10x17	1½,3	6x6 W2.9xW2.9	SFRM	SFRM
D712	W8x24	1½, 2	6x6, 10x10 SWG	SFRM	SFRM
D722	W6x12	1, 1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D739	W8x28, W6x12,OWSJ, Cast in place concrete beams	1, 1½, 2, 3, 4	6x6 W2.9xW2.9, Synthetic fibers	SFRM	SFRM
D740	W10x15	1	6x6 10x10 SWG	SFRM	SFRM
D743	W8x20, W8x28, W8x15, Cast in place concrete beams	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D750	W8x21	1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D754	W8x28	1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D755	W8x24, W8x28, 10H3, 12J6	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete		CF 1⅜	Deck[3]											Smooth Series™ Option	Note	UL Design Number
	Thickness	Type		BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36			
hr	in	pcf															
1, 1½, 2, 3	varies depending on accustic material, see UL listing	"147-153 NW 107-113 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y	3	D216
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D303
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
3	5¼	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
¾ or 1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
2	3¼	107-116 LW						✓	✓	✓	✓	✓	✓	✓	N		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
1	2 ⅝	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
2	3½	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
3	4⁷⁄₁₆	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
1½, 2	2½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y	3	D502
1, 1½, 2, 3	2½	"142-148 NW 105 LW"									✓	✓	✓	✓	N	3	D703
3	2½	"145-151 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D708
1, 1½, 2	2½	"147-153 NW 110 LW"						✓	✓	✓	✓	✓	✓	✓	N	3	D712
1, 1½, 2	2½	"142-148 NW 112 LW"						✓	✓	✓	✓	✓	✓	✓	N	3	D722
1, 1½, 2, 3, 4	2½	"142-148 NW 102-120 LW (110 LW with joists)"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D739
2	2½	147-153 NW		✓	✓	✓	✓								N		D740
1, 1½, 2, 3	2	"147-153 NW 107-113 LW"									✓	✓	✓	✓	N	3	D743
2	2½	"142-148 NW 105-111 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D750
3, 4	3¼	115-121 LW		✓	✓	✓		✓	✓		✓		✓		N/A		D754
2, 3	2½	"147-13 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D755

1.4 Fire Ratings

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8]	Minimum Concrete Reinforcing	Fire Proofing[2] On	
		hr		Beam	Deck
D759	W8x28, 12K5, 12" deep OWSJ at 7.1plf	1, 1½, 2, 3	6x6 W1.4xW1.4 with beams, 6x6 W2.9xW2.9 with joists, Fiber reinforcement	SFRM	SFRM
D760	W8x28, OWSJ	1, 1½, 2, 3, 4	6x6 W1.4xW1.4	SFRM	SFRM
D764	W8x28, OWSJ	2	6x6, 6x6 SWG	SFRM	SFRM
D767	W8x28, W6x12,OWSJ, Cast in place concrete beams	1, 1½, 2, 3, 4	6x6 W1.4xW1.4 with beams, 6x6 W2.9xW2.9 with OWSJ	SFRM	SFRM
D768	W10x17	1½, 3	6x6 W2.9xW2.9	SFRM	SFRM
D775	W8x21	1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D779	W8x28, 8K1	1, 1½, 2, 3, 4	6x6 W1.4xW1.4, Synthetic fibers	SFRM	SFRM
D782	W8x28, 10" Deep OWSJ	1, 1½, 2, 3, 4	6x6 W1.4xW1.4	SFRM	SFRM
D788	W8x28, 10K1	1, 1½, 2, 3, 4	6x6 8x8 SWG	SFRM	SFRM
D794	W8x28, OWSJ	2	6x6 6x6 SWG	SFRM	SFRM
D795	W8x28, OWSJ	1, 1½, 2, 3	6x6 W1.4xW1.4 with beams, 6x6 W2.9xW2.9 with OWSJ	SFRM	SFRM
D798	W8x28, OWSJ	1, 1½, 2, 3, 4	6x6 10X10 with beams, 6x6 W1.4xW1.4 with OWSJ	SFRM	SFRM
D799	W8x28, 10K1	1, 1½, 2, 3	6x6 W1.4xW1.4 with beams, 6x6 W2.9xW2.9 with OWSJ	SFRM	SFRM
D825	W8x17	1, 1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D826	W8x20	0	6x6 W1.4xW1.4	SFRM	SFRM
D832	W8x24, W8x28	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D833	W10x25	2, 3	WWF Optional	SFRM	SFRM
D840	W8x28	0	6x6 10x10 SWG	SFRM	SFRM
D858	W10x25, Concrete beam	1, 1½, 2, 3, 4	6x6 W1.4xW1.4	SFRM	SFRM
D859	W8x20	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM

ASC STEEL DECK

Fire Ratings 1.4

UL

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete		CF 1⅜	Deck[3]											Smooth Series™ Option	Note	UL Design Number
	Thickness	Type		BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36			
hr	in	pcf															
1, 1½, 2, 3	2½	"147-13 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D759
2, 3, 4	2½	"144-150 NW 107-113 LW"		✓	✓	✓					✓		✓		N		D760
2	2½	117 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D764
1, 1½, 2, 3, 4	2½	"142-148 NW 102-120 LW (110 LW with joists)"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D767
3	2½	"145-151 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D768
2	2½	"142-148 NW 105-111 LW"		✓	✓	✓		✓	✓				✓		N/A		D775
1, 1½, 2, 3, 4	2½	"142-148 NW 102-120 LW"		✓	✓	✓		✓	✓		✓		✓		N/A		D779
1, 1½, 2, 3, 4	3¼	115-121 LW		✓	✓	✓		✓	✓		✓		✓		N/A		D782
1, 1½, 2, 3, 4	2½	"NW LW"	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D788
2	2½	"147-153 NW 117 LW"		✓	✓	✓					✓	✓	✓	✓	N		D794
1, 1½, 2, 3	2½	"147-153 NW 109-115 LW"		✓							✓	✓	✓	✓	N		D795
1, 1½, 2, 3, 4	2½	"142-148 NW 107-113 LW"		✓	✓	✓		✓	✓		✓		✓		N/A		D798
1, 1½, 2, 3	2½	"147-153 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D799
2	2½	"147-153 NW 105-111 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D825
2	3¼	108-114 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N	3	D826
1, 1½, 2, 3	2½	"147-153 NW 109-115 LW"		✓	✓	✓	✓	✓	✓	✓	✓		✓		N	3	D832
2, 3	2½	"147-153 NW 109-115 LW"									✓	✓	✓	✓	N	3	D833
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D840
	3¼	107-116 LW						✓	✓	✓	✓	✓	✓	✓	N		
	3½	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		
1, 1½, 2, 3, 4	2½	"147-153 NW 108-115 LW"									✓		✓		N/A	3	D858
1, 1½, 2, 3	2	"142-148 NW 108-115 LW"									✓	✓	✓	✓	N	3	D859

1.4 Fire Ratings

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8] hr	Minimum Concrete Reinforcing	Fire Proofing[2] On: Beam	Fire Proofing[2] On: Deck
D861	W8x15, W10x25	1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D862	W8x21	1	6x6 W1.4xW1.4	SFRM	SFRM
D867	W8x18	1½, 2	6x6 6x6 SWG	SFRM	SFRM
D871	W8x21, Concrete beam	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D875	W8x20	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D877	W8x17	1, 1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D878	W8x20	0	6x6 W1.4xW1.4	SFRM	SFRM
D883	W8x24, W8x28	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D884	W10x25	2, 3	WWF Optional	SFRM	SFRM
D888	W8x28	0	6x6 10x10 SWG	SFRM	None
D891	W10x25, Concrete beam	1, 1½, 2, 3, 4	6x6 W1.4xW1.4	SFRM	SFRM
D892	W8x15, W10x25	1½, 2	6x6 W1.4xW1.4	SFRM	SFRM
D893	W8x21	1	6x6 W1.4xW1.4	SFRM	SFRM
D898	W8x21, Concrete beam	1, 1½, 2, 3	6x6 W1.4xW1.4	SFRM	SFRM
D902	W12x14, W8x28, W8x24, W6x21, 8K1, 12K5, OWSJ	1, 1½, 2, 3	6x6 10x10 SWG, Fiber reinforcement	SFRM	none

ASC STEEL DECK

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Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete			Deck[3]													
	Thickness	Type	CF 1⅜	BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36	Smooth Series™ Option	Note	UL Design Number
hr	in	pcf															
2	2½	"137-150 NW 107-115 LW"									✓		✓		N		D861
2	2½	99-105 LW						✓	✓		✓		✓		N/A		D862
3	-	"144-150 NW 107-113 LW"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N		D867
1, 1½, 2, 3	2½	"147-153 NW 108-115 LW"									✓		✓	✓	N	3	D871
1, 1½, 2, 3	2	"142-148 NW 108-115 LW"									✓		✓		N/A	3	D875
2	2½	"147-153 NW 105-111 LW"									✓		✓		N/A	3	D877
2	3¼	108-114 LW		✓	✓	✓					✓		✓		N/A	3	D878
1, 1½, 2, 3	2½	"147-153 NW 109-115 LW"									✓		✓		N/A	3	D883
2, 3	2½	"147-153 NW 107-115 LW"									✓				N/A	3	D884
2	3¼	107-113 LW		✓	✓	✓		✓	✓		✓		✓		N/A		D888
	3¼	107-116 LW						✓	✓		✓		✓				
	3½	107-120 LW	✓	✓	✓	✓		✓	✓		✓		✓				
1, 1½, 2, 3, 4	2½	"147-153 NW 108-115 LW"									✓		✓		N/A	3	D891
2	2½	"137-150 NW 107-115 LW"									✓				N/A	3	D892
2	2½	109-115 LW									✓		✓		N/A		D893
1, 1½, 2, 3	2½	"147-153 NW 108-115 LW"									✓		✓		N/A	3	D898
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D902
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-116 LW						✓	✓	✓	✓	✓	✓	✓	Y		
3	4 3/16	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2⅝	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3½	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4 7/16	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		

1.4 Fire Ratings

ASC STEEL DECK

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8]	Minimum Concrete Reinforcing	Fire Proofing[2] On	
		hr		Beam	Deck
D907	W8x17, W8x28	0	6x6 W1.4xW1.4	SFRM	none
D914	W8x28	0	6x6 W1.4xW1.4	SFRM	none
D916	W8x28, OWSJ	0	6x6 10x10 SWG	SFRM	none
D918	W8x20	0	6x6 W1.4xW1.4	SFRM	none
D919	W8x28	0	6x6 W1.4xW1.4	SFRM	none
D920	W8x28	0	6x6 W1.4xW1.4	SFRM	none
D922	W8x28, OWSJ	0	6x6 10x10 SWG	SFRM	none

ASC STEEL DECK

Fire Ratings 1.4

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete		CF 1⅜	Deck[3]											Smooth Series™ Option	Note	UL Design Number
	Thickness	Type		BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36			
hr	in	pcf															
2	3¼	110 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D907
¾, 1	2½	110 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D914
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D916
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
¾ or 1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-116 LW						✓	✓	✓	✓	✓	✓	✓	Y		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2⅝	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3½	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4⁷⁄₁₆	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	3½	150-156 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y	4, 5	D918
1½	4	150-156 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4½	150-156 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	5¼	150-156 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3½	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4⁷⁄₁₆	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D919
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-116 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3½	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4⁷⁄₁₆	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	110-120 LW									✓	✓	✓	✓	Y		D920
Refer to D916 for these values.																	D922

1.4 Fire Ratings

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8]	Minimum Concrete Reinforcing	Fire Proofing[2] On	
		hr		Beam	Deck
D923	W8x28	0	6x6 10x10 SWG	SFRM	none
D924	W8x28	0	Synthetic fibers, negative reinforcing steel	SFRM	none
D925	W8x28, W8x16, 8K1 OWSJ	0	6x6 10x10 SWG or negative bending reinforcement with synthetic fibers	SFRM	none
D927	W8x28, OWSJ	0	6x6 10x10 SWG	SFRM	none
D929	W8x28	0	6x6 10x10 SWG	SFRM	none
D931	W8x28	0 or 1	6x6 10x10 SWG	SFRM	none
D949	W8x28	0	6x6 10x10 SWG	SFRM	none
D957	W12x14, W8x28, W8x24, W6x12, OWSJ	1, 1½, 2, 3	6x6 10x10 SWG		none

ASC STEEL DECK

Fire Ratings 1.4

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete		CF 1⅜	Deck[3]											Smooth Series™ Option	Note	UL Design Number
	Thickness	Type		BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36			
hr	in	pcf															
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		D923
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3¼	107-116 LW						✓	✓	✓	✓	✓	✓	✓	Y		
3	4 3/16	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
1	2⅝	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	3½	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
3	4 7/16	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Y		
2	4⅛	142-148 NW		✓	✓	✓					✓		✓		N/A	4	D924
2	4⅜	142-148 NW		✓	✓	✓					✓		✓		N/A	5	
2	3⅛	105-111 LW		✓	✓	✓					✓		✓		N/A		
3	5	142-148 NW		✓	✓	✓					✓		✓		N/A	4	
3	5⅜	142-148 NW		✓	✓	✓					✓		✓		N/A	5	
3	4	105-111 LW		✓	✓	✓					✓		✓		N/A		
Refer to D902 for these values.																	D925
Refer to D916 for these values.																	D927
Refer to D916 for these values.																	D929
Refer to D902 for these values.																	D931
Refer to D916 for these values.																	D949
1	3½	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		D957
1½	4	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3¼	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3¼	107-116 LW									✓	✓	✓	✓	Y		
3	4 3/16	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
1	2⅝	107-120 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3½	114-120 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
3	4 7/16	114-120 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		

1.4 Fire Ratings

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

UL Design Number	Minimum Beam or Joist	Unrestrained Assembly Rating[8] hr	Minimum Concrete Reinforcing	Fire Proofing[2] On	
				Beam	Deck
D967	W8x28	0	6x6 W1.4xW1.4	SFRM	none
D968	W8x28	0	6x6 W1.4xW1.4		none
D973	W8x28	0	Fiber - Ultra Fiber 500		none
D974	W8x28	1½	6x6 10x10 SWG		none
D975	W8x28, W8x24, W6x12	1, 1½, 2, 3	6x6 10x10 SWG		none
D976	W8x28 OWSJ	1, 1½, 2	6x6 8x8 SWG		none
D977	W8x28, OWSJ	1, 1½	6x6 8x8 SWG		none
D985	W8x28, 10K1	0	6x6 10x10 SWG		none
D988	W8x28, 10K1	1, 1½, 2, 3	6x6 W1.4xW1.4		none

Table Notes:
1. This table summarizes ASC Steel Deck's UL fire listings. Refer to the UL website for the most accurate and up-to-date listings.
2. SFRM = Spray-Applied Fire Resistive Material.
3. ASC Steel Deck may be used as blend deck with other manufacturers electrified cellular deck or trench.
4. Carbonate Aggregate.
5. Siliceous Aggregate.
6. BK Holding Corp. Ultra Fiber 500®
7. Syntheon Inc. Elemix® XE and Grey XE concrete additive.
8. For restrained fire ratings see UL listng for additional requirements.

ASC STEEL DECK

Fire Ratings 1.4

Figure 1.4.1: **ASC STEEL DECK- UNDERWRITERS LABORATORIES (UL) FIRE RESISTANCE**

Restrained Assembly Rating[8]	Concrete		CF 1⅜	Deck[3]											Smooth Series™ Option	Note	UL Design Number
	Thickness	Type		BH-36	BHN-36	BHN-35¼	BHF-36	NH-32	NHN-32	NHF-32	2WH-36	2WHF-36	3WxH-36	3WxHF-36			
hr	in	pcf															
¾, 1	2½	110 LW		✓	✓	✓					✓		✓		N/A		D967
1	3½	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		D968
1½	4	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	4½	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
3	5¼	147-153 NW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
1	2½	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
1½	3	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3¼	107-116 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3½	114-120 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
3	4⁷⁄₁₆	114-120 LW		✓	✓	✓	✓				✓	✓	✓	✓	Y		
2	3¾	142-148 NW									✓				N/A	6	D973
3	4½	114-120 NW						✓							N/A	7	D974
Refer to D957 for these values.																	D975
1, 1½, 2	3½	111-117 NW						✓							N/A	7	D976
1, 1½, 2	3½	112.5-106.5 LW						✓	✓						N/A	7	D977
1	3½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		D985
1½	4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
2	4½	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
3	5¼4	147-153 NW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
¾ or 1	2½	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
1½	3	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
2	3¼	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
2	3¼	107-116 LW						✓	✓	✓	✓		✓		N		
3	4³⁄₁₆	107-113 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
1	2⅝	107-120 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
2	3½	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
3	4⁷⁄₁₆	114-120 LW		✓	✓	✓	✓	✓	✓	✓	✓		✓		N		
Refer to D902 for these values.																	D988

1.5 **Steel Deck Section Properties**

ASC STEEL DECK

Section Properties

All of ASC Steel Deck's section properties are calculated in accordance with the American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members, AISI S100-2012, Section B. Section properties can be used to develop the bending capacity of the steel deck for out-of-plane loads, which are typically defined by gravity for composite decks carrying construction and fluid concrete loads.

The section properties for steel floor deck, like other cold-formed steel members such as Cee, Zee, hat-shaped purlins, studs, and track are based on post-buckling strength. Post-buckling strength is based on the concept that compression flanges and portions of webs will exhibit some local buckling prior to the load capacity of the member being reached. To account for this, the widths of the flat compression elements of the steel deck are reduced for the purpose of determining the section properties, excluding the portion that can no longer effectively carry compression loads. This reduction of the gross section properties results in the effective section properties.

Steel Thickness

The thickness of steel floor deck is typically specified by a gage designation. The design of steel deck is dependent on the specified design base steel thickness in accordance with AISI S100-2012. The base steel thickness should not be confused with the total coated thickness, which is the combined thickness of the base steel, the optional galvanizing thickness, and any factory-applied paint system thickness.

The minimum acceptable base steel thickness to be supplied shall not be less than 95% of the design base steel thickness. This is specified in Section A2.4 Delivered Minimum Thickness of AISI S100-2012.

Some standards reference non-mandatory tables that list the thickness of sheet steel by gage designation. These include the AISC Manual of Steel Construction in the Miscellaneous Information section of the appendix and AWS D1.3 in the Annex. Both references indicate that the values are non-mandatory and are for reference only. The nominal total coated thicknesses listed for each gage in these sources should not be used to determine if the cold-formed steel structural member, including steel deck, meets the minimum thickness requirement for the specified gage.

Effective Section Properties

Effective section properties for a steel deck panel are used to check for the maximum bending and axial load capacities.

The effective properties are determined at the full yield stress of the steel. As the grade of steel increases, the effective section properties decrease. The effective width of the compression elements decreases as the localized plate-like buckling increases. The bending capacity of the deck increases with the increase in the grade of steel even though the effective section properties are decreasing. The increasing strength of the steel outpaces the decrease in effective section properties leading to higher bending capacities. Steel deck cannot be compared based strictly on effective section properties without considering the grade of the steel because of the effect on the effective section properties by the grade of steel. Figure 1.5.1 demonstrates this for BH-36 steel deck.

20 Gage BH-36 Steel Deck Panel

Yield ksi	I_e^+ (in^4/ft)	I_e^- (in^4/ft)	S_e^+ (in^3/ft)	S_e^- (in^3/ft)	M_n^+ (Kip-in/ft)
33	0.193	0.237	0.235	0.251	4.65
37	0.187	0.233	0.233	0.247	5.17
40	0.187	0.233	0.232	0.244	5.56
50	0.177	0.227	0.228	0.236	6.83
55	0.177	0.227	0.227	0.233	7.34
80	0.173	0.223	0.218	0.230	7.84

Figure 1.5.1: **EFFECTIVE SECTION PROPERTIES**

Many steel deck panels are not symmetric. In most cases, the top and bottom flange widths are not equivalent. The bending stress and location of the neutral axis is therefore different for positive and negative bending, resulting in different positive and negative section properties.

Gross Section Properties

The gross section properties of the steel deck are based on the entire cross section of the panel. Determination of gross section properties assumes that there is compression buckling of the compression flanges or web elements of the steel deck, therefore there are no ineffective elements. The gross section properties are used in combination with effective section properties to determine the deflection of the steel deck under uniform out-of-plane loads and for checking axial compression and bending.

Service Load Section Properties

The service load moment of inertia is used to determine the deflection of the steel deck for out-of-plane loads. The calculated moments of inertia are determined at a working stress level of 0.6Fy. Following accepted practice, the hybrid moment of inertia is based on the sum of two times the effective moment of inertia, and the gross moment of inertia divided by three, as follows:

$$I_d = \frac{2I_e + I_g}{3}$$

ASC STEEL DECK

How to Read Section Properties Table

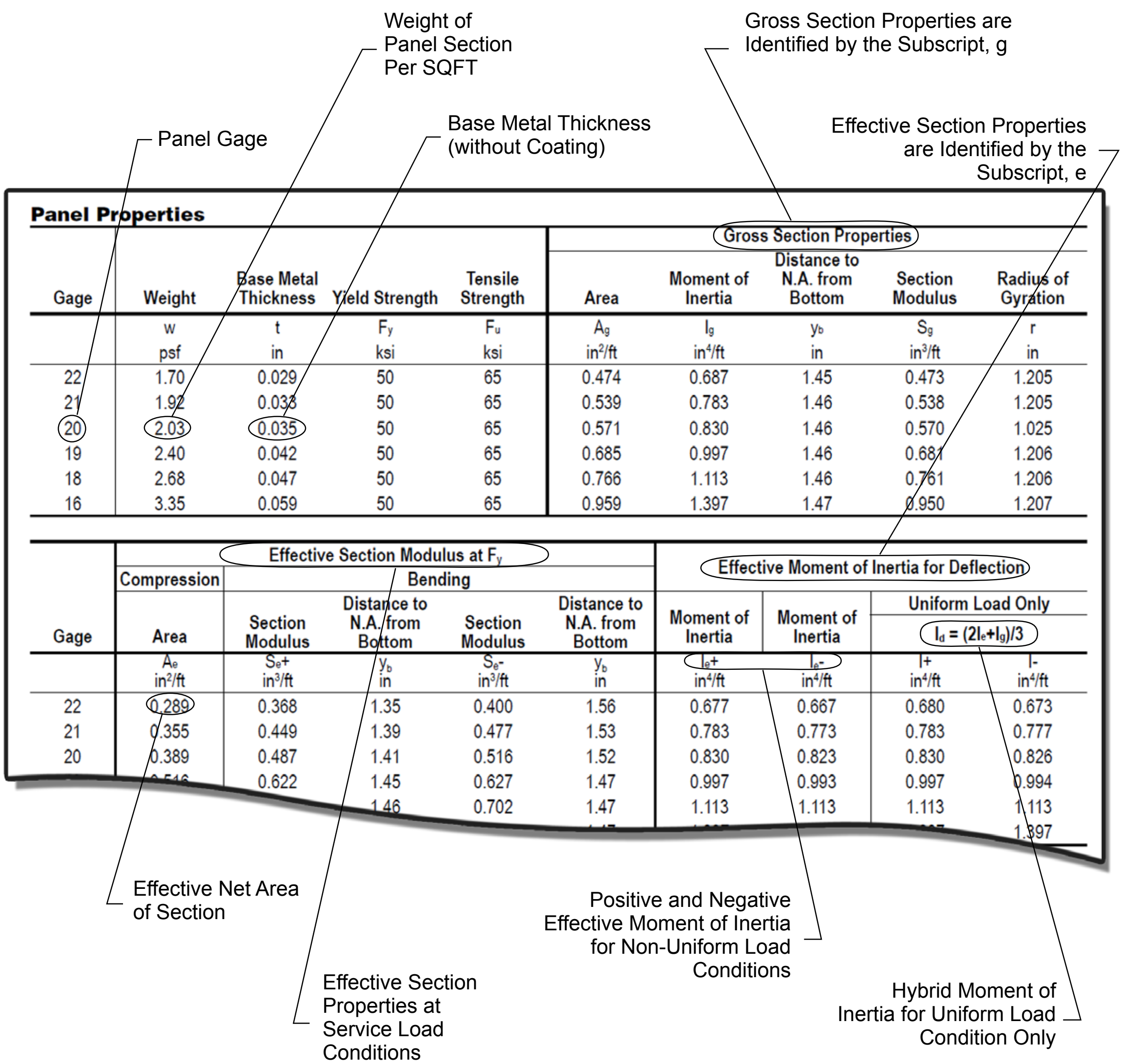


Figure 1.5.2: **SAMPLE OF PANEL PROPERTIES TABLE**

This deflection equation for uniformly distributed loads takes into account that throughout the length of the span, portions of the steel deck will have low bending stress and others will have high bending stress. The areas with low bending stress exhibit behavior based on gross section properties because the stress is below the onset of localized compression buckling. The portions with high bending stress that are at or above the onset of localized compression buckling exhibit progressively lower effective section properties as the bending stress goes up. Using the weighted average of the gross and effective section properties is an effective method to address deflections in which section properties change depending on the bending stress.

1.6 **Web Crippling**

Steel Deck Reactions at Supports

Steel deck reactions at supports are governed by the web crippling capacity of the steel deck webs on the supporting member. This is calculated in accordance with Section C3.4 of AISI S100-2012 for multi-web steel decks.

Reactions Due to Uniform Loads

The end and interior reactions listed in the tables in the IAPMO ER-329 report are for a uniformly distributed out-of-plane load applied to the deck (See figure 1.6.1 and 1.6.2).

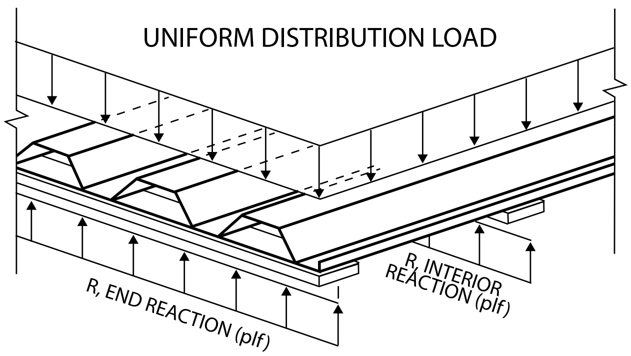


Figure 1.6.1: **UNIFORM DISTRIBUTED OUT-OF-PLANE LOAD**

The allowable R_n/Ω and factored ϕR_n reactions presented in the tables are in pounds per linear foot running axially along the support for a given deck-bearing length on the support (the support member width that the deck bears on). This is based on the web crippling capacity multiplied by the number of webs per foot. Figure 1.6.3 shows how to read the reaction tables in the IAPMO ER-329 report.

Panels must be attached to supports with fastener patterns not less than the minimum attachment patterns shown for the deck panel.

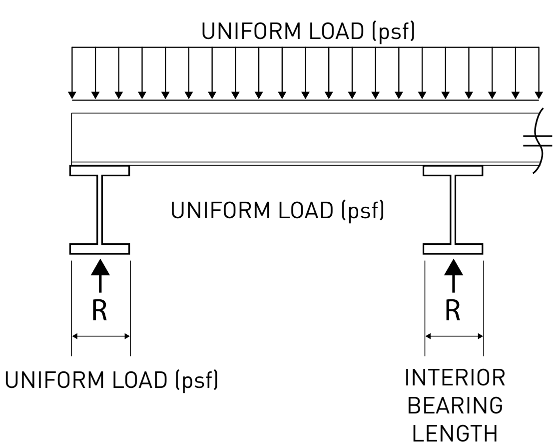
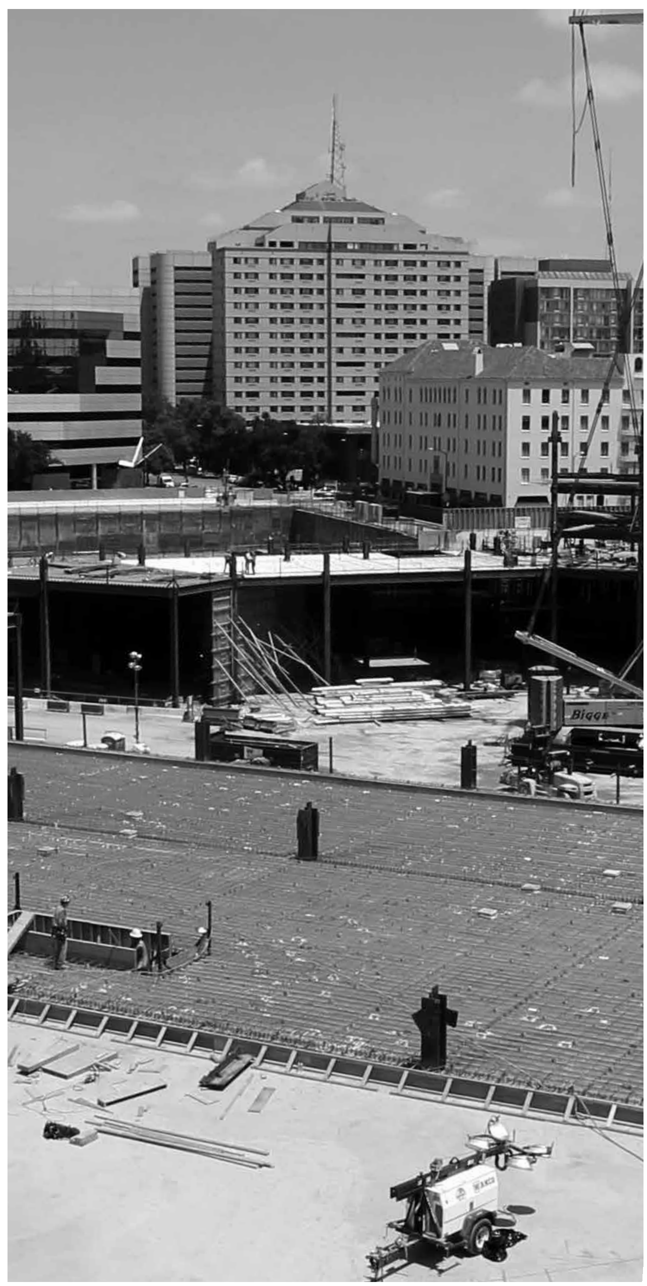


Figure 1.6.2: **SUPPORT REACTIONS**

Point or Line Load Reactions

For load conditions that exceed the uniform reaction capacity tables, including point loads and line loads on the steel deck panel, the maximum reaction capacity should be based on the web crippling capacity for the steel deck. For reactions exceeding the published values, or for conditions other than a uniformly distributed load, the maximum reaction capacity shall be determined by the designer in accordance with section C3.4 of the North American Specifications for the Design of Cold-Formed Steel Structural Members for multi-web steel panels and the geometric constants presented in the web crippling tables for the deck panel.



How to Read Web Crippling Table

Support Condition: Deck Panel End on Supports or Deck Panel Continuous Over Supports

ASD Design Basis

Panel Gage

Bearing Length of Deck Panel Web on Support

LRFD Design Basis

Reactions at Supports (plf) Based on Web Crippling

Gage	Condition	Bearing Length of Webs: Allowable (R_n/Ω) 1"	1.5"	2"	3"	Factored (ΦR_n) 1"	1.5"	2"	3"
22	End	264	329	421	492	404	580	644	753
	Interior	473	571	710	816	704	961	1056	1214
21	End	339	420	535	624	519	739	819	954
	Interior	605	726	898	1029	900	1219	1335	1531
20	End	380	470	597	694	581	824	913	1062
	Interior	677	810	999	1144	1007	1357	1486	1701
19	End	538	661	834	967	824	1155	1276	1480
	Interior	956	1136	1390	1585	1423	1895	2068	2358
18	End	667	815	1024	1185	1021	1421	1567	1813
	Interior	1184	1399	1704	1938	1761	2327	2535	2883
16	End	1028	1244	1549	1783	1572	2156	2370	2728
	Interior	1821	2132	2571	2908	2709	3526	3825	4326

Web Crippling Constraints h=3.5" r=0.125" θ=54.4°

Deck Panel Geometry

Allowable Reaction of Deck Panel on Interior Support with 2″ of bearing

Allowable Reaction of Deck Panel on End Support with 1.5 Bearing

Figure 1.6.3: **SAMPLE OF WEB CRIPPLING TABLE**

1.7 **Steel Deck as a Concrete Form**

ASC Steel Deck

Introduction

The design of deck as a form for concrete is based on ANSI/SDI C-2011 for composite deck and ANSI/SDI NC-2010 for non-composite deck. The deck acts as a permanent form for the concrete. In addition to providing formwork for the concrete, the deck provides the tension reinforcing for composite deck-slab systems. The deck also provides a safety floor for erection and a working platform for construction trades. It is critical that the deck be designed to carry these loads to meet the expected performance.

Maximum Unshored Span Tables

The maximum unshored spans for single and uniform double or triple deck span conditions are included in the load tables for the deck in this catalog. This provides an easy to use design aid to help select the appropriate deck type and gage for a particular span. The maximum unshored spans are determined in accordance with ANSI/SDI C-2011. This design standard provides the minimum recommended loads the deck is required to support including the weight of the deck, concrete, and 20 psf uniform construction live load or 150 plf concentrated construction live load. These maximum unshored spans may not be appropriate for heavy construction live loads from concrete buggies, drive on deck laser screeds, or ride on power trowels. Maximum unshored spans for loading conditions and span conditions that exceed the load table should be determined by the designer of record for the project or the engineer responsible for the erection of the structure.

In addition to considering the loading used to develop the maximum unshored span in the tables, the definition of span and maximum reactions at supports need to be considered. It is appropriate to consider the span as clear span between supports when the supports have relatively ridged flanges as compared to the deflection of the deck. On supports without ridged flanges such as cold-formed Cees, Zees, open web steel joists, and thin ledger angles, center-to-center span is more appropriate.

The maximum spans may be governed by the maximum reaction capacity of the composite deck at supports. ASC Steel Deck does not specify a minimum bearing length of deck on a support, however, allowable and factored reaction tables are presented for each deck type. This provides the maximum reaction for the deck based on the bearing length of the deck on a support. This is limited by the web crippling capacity of the deck. The deck span may be limited by the maximum reactions for heavily loaded or long spanning deck. (See figure 1.6.2)

Design Loads for Steel Deck as a Form

Steel deck as a form should be designed to resist the anticipated construction loads applied to the steel deck. The design should meet the minimum design loads specified in ANSI/SDI C-2011 Standard for Composite Steel Floor Deck-Slabs. This standard provides the minimum recommended loads and load combinations for steel deck as a form. This includes the dead weight of concrete, and 20 psf uniform construction live load or 150 lbs concentrate load per foot width of deck. Heavy equipment loads from concrete buggies, drive on deck laser screeds, and ride-on power trowels exceed the minimum design loads. It is critical that the maximum unshored spans be checked by the designer of record or the engineer responsible for the erection for the structure for heavy equipment loads on deck used as a form.

ANSI/SDI C-2011 basic ASD combinations include the following used to develop the tables in this report.

$W_{dc}+w_{dd}+w_{lc}$	ANSI/SDI C-2011	Eq 2.4.1
$W_{dc}+w_{dd}+P_{lc}$	ANSI/SDI C-2011	Eq. 2.4.2
$W_{dd}+w_{cdl} \geq 50$psf	ANSI/SDI C-2011	Eq. 2.4.2

W_{dc} = dead weight of concrete[1]

W_{dd} = dead weight of the steel deck

W_{lc} = uniform construction live load (combined with fluid concrete) not less than 20psf

W_{cdl} = uniform construction live load (combined with bare deck) not less than 50psf

P_{lc} = concentrated construction live load per unit width of deck section; 150lbs on a one foot width

Loading Note:

1. *For form decks (non-composite), additional concrete dead load is required for single spans in accordance with ANSI/SDI NC-2010*

Design of Steel Deck as a Form

The design of deck as a form is a straight forward engineering exercise. The deck is no more than a cold–formed steel beam spanning between the support framing. The provision of AISI S100 should be used to determine the strength of the deck. The bending moment, web shear, and reactions are determined using engineering mechanics for slender beams. ANSI/SDI C-2011, Appendix 1, shows loading configurations that are typically used for steel deck as a form. These do not address unequal spans and unique loading conditions. The maximum moment, web shear, and reactions are then checked against the strength of the deck to determine the appropriate deck type and gage for a project.

The bending strength of a cold-formed steel deck should be determined in accordance with AISI S100. Allowable stress design is commonly used for determining the bending capacity of the steel deck. Combined bending and web shear is often ignored because the web shear stress is relatively small compared to the bending stress. The section properties for steel deck are provided in the IAPMO ER-329 report to aid in the design of deck exceeding the scope of the maximum unshored span tables.

Steel Deck as a Concrete Form 1.7

The reactions of the steel deck at supports should be checked to ensure that the webs of the steel deck do not buckle. The allowable web crippling of the deck may be taken directly from the web crippling tables in the IAPMO ER-329 report. For conditions exceeding the scope of the tables, the web crippling will need to be determined in accordance with AISI S100. To help the designer, the flat width of the web (h), bend radius (r), and angle relative to the support (Θ) are included in the tables.

It is important that deck used as a form does not over deflect. ANSI/SDI C-2011 limits deflection to L/180, but not to exceed ¾ inch. The deflection check is based on the weight of the deck and concrete using equations of engineering mechanics. Skip loading and constitution live loads are not considered because these loads are not present after the concrete is finished and during the curing time. For the maximum unshored span tables presented in the IAPMO ER-329 report, ASC Steel Deck allows for an additional 3 psf for normal weight concrete and 2 psf for lightweight concrete to account for added concrete due to deflection. ANSI/SDI C-2011, Appendix 1, has equations for deflection for common conditions. The actual deck deflection may vary from the predicted deflection, however, the predicted limits have proven to be reliable for the design of deck as a form.

Cantilevers

Cantilevering deck is an acceptable common solution to extending the composite deck-slab past a support and generally involves the use of a two piece pour stop as shown in figure 1.7.1. Cantilevers need to be designed by the engineer of record or the engineer responsible for the erection of the structure. The section properties included in the IAPMO ER-329 report provide the basic properties for this calculation. The cantilever should be designed in accordance with ANSI/SDI C-2011 section 2.4.

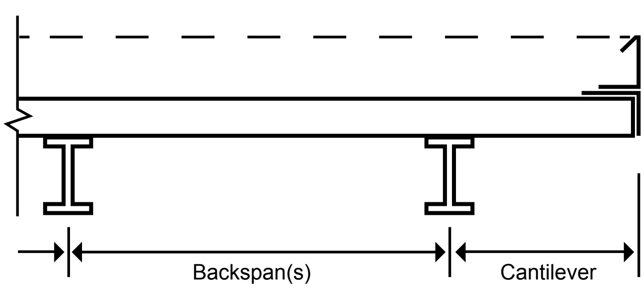


Figure 1.7.1: **Cantilevers**

1.8 **Composite Deck-Slab Design**

ASC STEEL DECK

General Design Principles

The design of composite steel deck-slab systems reflect the basic engineering concepts used to design reinforced concrete beams. The concrete acts as the compression material, and the steel deck bonded to the bottom of the concrete acts as the tension steel. In this manner, the composite deck-slab behaves like a simple reinforced concrete beam in which the deck is the rebar.

A composite deck-slab is most commonly designed as a simple span beam. The deck only provides positive bending reinforcement. The minimum temperature and shrinkage reinforcing is not adequate to develop negative bending over supports. With out any significant negative bending reinforcement over supports, the concrete is assumed to crack and the deck yield in negative bending, creating a condition in which the composite deck-slab is treated as a simple beam. (See figure 1.8.1)

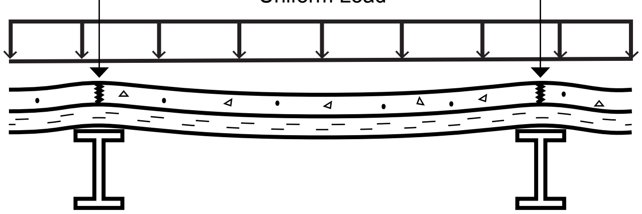


Figure 1.8.1: **Single Span**

The maximum load carrying capacity of a composite deck-slab system should be limited to the bending capacity, vertical shear, and maximum acceptable deflection. *ANSI/SDI C-2011* provides the design methods for composite steel deck-slab systems. The tables in the IAPMO ER-329 report provide an easy to use design aid following these methods.

Superimposed Load Capacity

The superimposed load that the composite deck-slab system carries are those loads that are in addition to the concrete and deck self-weight. These loads consist of out-of-plane dead and live loads. Most composite deck-slab systems are designed using Allowable Stress Design (ASD). This is a convenient method because either calculations or load tables can be developed based on service loads. ASD design does not take into account the different load factors for dead and live loads of 1.2 and 1.6 respectively. Most ASD superimposed load calculations and load tables assume that the entire superimposed load is a live load using a load factor of approximately 1.6, which heavily favors live loads and is therefore conservative for dead loads. ASD is best suited for applications for which the majority of the load is live load, which is typical for most commercial building floor applications.

Load and Resistance Factor Design (LRFD) is a more efficient method of design for superimposed loads that are primarily dead load. This method is more involved and is only warranted in conditions in which ASD is unfavorable. An example would be a case in which a large portion of the superimposed load is dead load. In these situations, a great portion of the load would use a 1.2 load factor for dead load, and a smaller portion of the load would use a 1.6 load factor for live load. In these cases, an LRFD approach will prove to be more efficient if the maximum superimposed load carrying capacity is governing the design. LRFD is a good choice for composite deck-slab systems supporting heavy loads such as equipment pads and heavy planting beds for green roof systems or patio decks.

Loading

Composite deck-slab systems are a very efficient way to support many design loads. The loads should be static or semi-static in nature. These are typical of dead loads and typical commercial building live loads. Live loads that are cyclic or vibratory in nature, however, may break down the bond between the deck and slab over time. These loads should not be applied to composite deck-slab systems without supplemental reinforcing. Loads to watch out for:

Vibratory or Cyclic Loads: Machinery that vibrates or applies a repetitive cyclic load should be avoided. This type of equipment may break down the bond between the concrete and deck due to vibration or high and localized bending and shear.

Forklift Loads: Forklifts tend to create very high localized wheel loads that apply significant localized bending and shear to the composite deck-slab system and should be avoided.

Hard Wheeled Loads: Heavily loaded hard wheeled carts may apply high localized bending and shear below the wheels that may approach the design capacity of the composite deck-slab system and should be avoided.

These types of cyclic or vibratory loads may be applied to composite deck-slab systems if supplemental reinforcing designed to carry the load is added to the concrete section. In this case, the deck is considered a stay in place form, similar to a form deck.

Parking Structures: Composite deck-slab systems have been used successfully for parking structures for many years. The combination of the relative light weight of automobiles with pneumatic tires that distribute the load and suspension, greatly reduce the effects of dynamic cyclic loading on the composite deck-slab system. For open parking structures, it is recommended that the slab be sealed to reduce possible corrosion of the steel deck from water penetrating cracks in the slab. Supplemental reinforcing in the slab is recommended in exposed conditions in which the deck could corrode over time.

Concrete

Composite steel deck utilizes structural concrete fill poured over the top of the steel deck. The design of the concrete should be in accordance with ACI 318 with a minimum compressive strength of 3000psi. ASC Steel Deck's load tables are based on either 145 pcf normal weight concrete or 110 pcf lightweight concrete. Composite deck systems can be designed with lower or higher density light weight concrete, but it is important that the effect on fire rating be considered if applicable to the project.

Temperature and Shrinkage Reinforcing

Reinforcing should be provided in the concrete to prevent temperature and shrinkage cracking. This can be accomplished with welded wire fabric, reinforcing steel, or fibers. The minimum steel reinforcing should not be less than 0.00075 times the area of the concrete, but not less than 6x6 Wl.4xWl.4 welded wire fabric. Steel fibers may be used when the concrete is designed in accordance with ASTM C1116 type I with steel fibers per ASTM A820 type I, II or V, provided at the manufactures recommended dosage, but not less than 25lbs/cy. Macro synthetic fibers may be used when the concrete is designed in accordance with ASTM C 1116 type III, with fibers in accordance with ASTM D7508 provided at the manufacturers recommended dosage, but not less than 4lbs/cy. Other types of fibers that effectively resist temperature and shrinkage cracking may be used at the fiber manufactures recommended dosage. This is appropriate because any increase in concrete strength that may result from temperature and shrinkage control using fibers is not considered when developing the load carrying capacity of the composite deck-slab.

Composite Deck-Slab Section Properties

The development of section properties for composite deck-slab assemblies follows the engineering mechanics used to develop section properties for reinforced concrete design. The convention in design of composite deck-slab systems is to use the transformed section to convert the area of steel into an equivalent area of concrete. The transformed section properties are then used to determine the nominal bending moment and predicted deflections for the composite deck-slab section.

UnCracked Section

The uncracked section for composite steel deck-slab systems is analogues to reinforced concrete design. The uncracked section properties are determined at low bending stress, in which the concrete is still effective in tension. This is the condition in which the concrete in tension, has not cracked, and still contributes to the section properties. (See figure 1.8.2) The uncracked moment of inertia is presented in the composite deck tables in this report for common slab conditions. For conditions exceeding the scope of the table, the uncracked moment of inertia should be calculated in accordance with *ANSD/SDI* C-2011 Appendix 4.

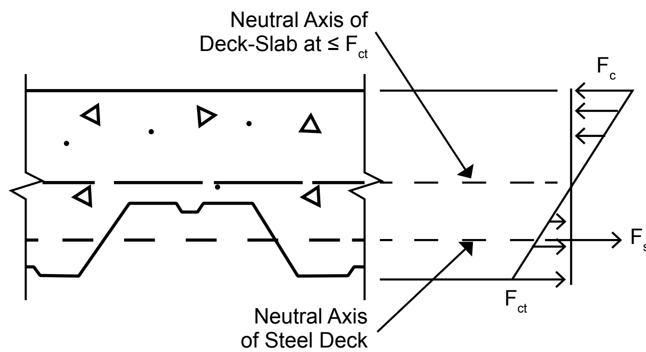


Figure 1.8.2: **Uncracked Section**

Cracked Section

The cracked section for composite deck-slab systems is determined using methods similar to reinforced concrete design. For composite deck-slab systems, this is determined at a compressive yield stress in the concrete in which the flexural stress is still assumed to be linear elastic and the concrete in tension is cracked and is no longer contributing to the section properties. (See figure 1.8.3) The cracked moment of inertia is presented in the composite deck tables in the IAPMO ER-329 report for common slab conditions. For conditions exceeding the scope of the tables, the cracked moment of inertia should be calculated in accordance with *ANSI/SDI* C-2011 Appendix 4.

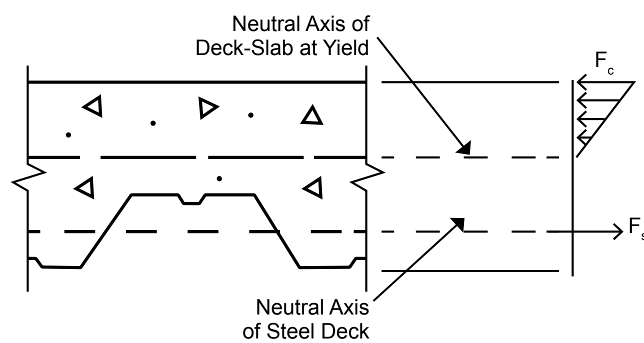


Figure 1.8.3: **Cracked Section**

Bending Capacity

The flexural capacity for composite steel deck-slab systems is determined using methods similar to reinforced concrete design. In the IAPMO ER-329 report, the nominal bending capacity for deck-slab systems that are not anchored to the structure with headed shear stud anchors are developed using the *ANSI/SDI* C-2011 prequalified method. This is referred to as the yield method in which the nominal bending moment is limited to the point at which the steel deck begins to yield. This is determined using the cracked moment of inertia and the yield strength of the steel deck. The factored and allowable bending moments for common composite steel deck-slab systems are listed in the tables in the IAPMO ER-329 report. For conditions exceeding the scope of the tables, the bending capacity should be calculated in accordance with *ANSI/SDI* C-2011 pre-qualified sections

1.8 **Composite Deck-Slab Design**

method. The embossment factor (K) for this method is presented in General Note 7 of section 1.18, Composite Deck-Slab Table General Requirements along with the embossment geometry.

Vertical Shear

The vertical shear capacity for a composite deck-slab system is the combination of the shear contribution of the concrete and the steel deck. The factored and allowable vertical shears are presented in the tables in the IAPMO ER-329 report. For conditions that exceed the tables, the shear should be determined in accordance with *ANSI/SDI* C-2011.

Deflection

The deflection of a composite deck-slab system should be checked to ensure serviceability of the system for its intended use. The superimposed load tables in the IAPMO ER-329 report have been limited to strength or L/360 deflection limit. L/360 was chosen because it is the typical live load deflection limit for floor systems. Deflection was checked using the average of the cracked and uncracked section properties.

$$I_d = \frac{I_u + I_c}{2}$$

The average moment of inertia for deflection (I_d) is presented in the tables for common conditions. This can be used to check the deflection for both lower and higher deflection limits.

Concentrated Load

Concentrated point loads and line loads should be checked using the composite deck properties including the maximum bending moment, vertical shear, and moment of inertia for the deflection check. *ANSI/SDI* C-2011 section 9 provides a general solution for concentrated loads on steel deck, including the design of load distribution reinforcing in the slab.

Non-Composite Deck-Slab Design 1.9

General

Non-composite steel deck design assumes that the steel deck and concrete do not interact to develop composite sections for bending. The design of non-composite deck should be done in accordance with ANSI/SDI NC-2010 Standard for Non-Composite Steel Floor Deck. The most common non-composite deck design is to use the deck as a permanent form and to design the reinforced concrete in accordance with ACI 318. Another less common option is to design the deck to carry all the design loads, including the weight of the unreinforced concrete. For this option, the design of the deck should follow the provisions of AISI S100 Specification for the Design of Cold-Formed Steel Structural Members.

Deck as a Form

The design of deck as a form shall be in accordance with ANSI/SDI NC-2010. Section 1.7 of this design guide discusses the design of deck as a form.

Concrete Slab Design

The design of a concrete slab above a non-composite deck should be in accordance with ACI 318. This includes bending capacity, vertical shear, and diaphragm shear. It is acceptable to ignore the contribution of the concrete in the flutes of the deck when designing the concrete section. For this method of design, the minimum thickness of concrete above the steel deck is 1½ inches.

Temperature and Shrinkage Reinforcement

The minimum reinforcing for temperature and shrinkage control should be in accordance with ACI 318.

Non-Composite Deck Load Tables

Non-composite deck uniform load tables are provided in the IAPMO ER-329 report. The tables include the maximum unshored span and the maximum uniform load capacity of the non-composite deck.

1.10 **Penetrations and Openings**

General

Openings and penetrations in composite deck-slab floor and roof structures are a normal part of every building. These can range from small pipe and conduit penetrations, to mid-sized openings for mechanical ductwork, to large openings for stair wells or elevator shafts. Small penetrations less than 12 inches across may not require much, if any, structural design consideration unless several are grouped closely together. Mid-sized openings up to 2 to 3 feet across most likely require design consideration to address the appropriate distribution of load around the opening for both deck as a form and the composite deck-slab system. Large openings are generally designed with support framing around the openings which is part of the overall framing for the composite deck-slab floor or roof system. It is difficult to have a "rule-of-thumb" for unscheduled openings because of the wide variety of building conditions. The information in this section should provide guidance toward addressing a wide range of penetrations and openings in the composite steel deck-slab system.

Deck-Over or Cut-Out?

The one major consideration which determines the complexity of designing penetrations or openings in the steel deck is whether to *Deck-Over* or *Cut-Out* the deck. This impacts how the penetration affects the deck as a form and what type of deck stiffeners or opening frames should be considered. For purposes of the design guide, when *Decked-Over* or *Cut-Out* are italicized they shall have the following definitions.

> *Decked-Over:* an opening or penetration through the deck-slab system in which the deck is placed, the penetration or opening is blocked out with formwork, Styrofoam, or edge form flashings without cutting the deck, the concrete is poured and allowed to adequately cure, then the deck is cut out when the opening is needed. (See figure 1.10.1)

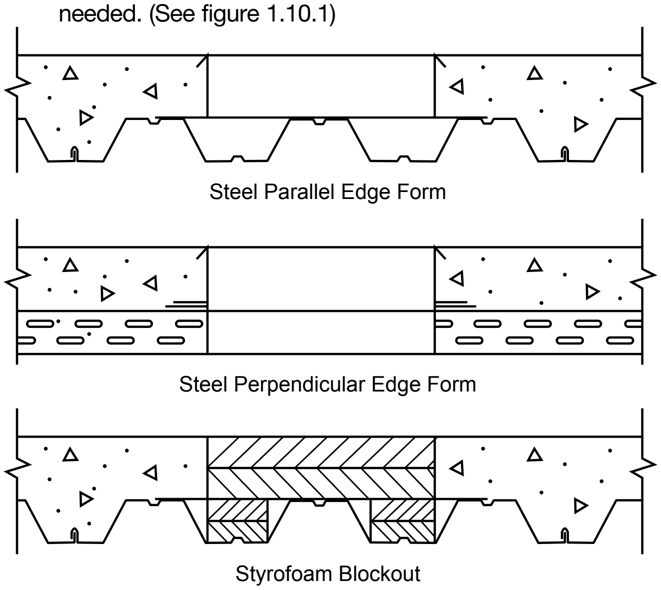


Figure 1.10.1: **DECKED-OVER OPENINGS**

> *Cut-Out:* an opening or penetration through the deck-slab system in which the deck is placed, the penetration or opening cut out, deck stiffeners or support frames are installed (if required), the opening is flashed with edge form or sleeving cans, then concrete is poured and allowed to cure.

Penetrations or openings that are *Decked-Over* have several key advantages, including simplifying the design of the deck as a form and providing fall-protection safety for mid-size and large openings. When the *Decked-Over* approach is used, the steel deck bending capacity and vertical shear capacity is not reduced from an opening being cut in the deck. In the *Decked-Over* case, no additional design effort needs to be considered because unshored spans do not change as the bending capacity and vertical shear capacity have not been reduced. Another advantage for mid-sized and larger openings is that the deck provides the fall protection, eliminating the need to plank over or put up handrails around the openings in accordance with OSHA regulations. The primary disadvantage of *Decked-Over* openings is that they cannot be cut out and utilized until after the concrete slab has been poured and had adequate time to cure.

Penetrations or openings that are *Cut-Out* have the advantage of being immediately available for use. The disadvantage of *Cut-Out* openings is that the opening in the deck is cut out, therefore compromising the bending capacity and the vertical shear of the deck in the area of the opening. For small openings in most common conditions, the amount the deck is compromised is insignificant and can typically be ignored. For mid-size openings, the amount the deck is compromised is significant and will most likely require stiffening or a structural support frame. Another disadvantage is that *Cut-Out* openings also require fall protection planking or hand rails to prevent injuries in accordance with OSHA regulations.

Small Size Penetrations

Small size penetrations of 12 inches or less often do not require any structural design or detailing. These penetrations are typically for pipes, conduits, or small ductwork. It is up to the designer of record to determine whether specific design and detailing is required for small size penetrations. The following are common examples of methods to stiffen the deck around small openings and penetrations which may be considered by the designer.

Decked-Over small penetrations is the recommended method because the designer does not need to consider whether the penetration will affect the capacity of the deck as a form, because the deck is not cut out. The only issue which may need to be considered is load distribution around the opening. If required, this can be accomplished by placing rebar to distribute the loads around the opening. For most common floor applications, this is not necessary for openings less than 12 inches unless several are grouped together.

Penetrations and Openings 1.10

Cut-Out small penetrations may require the stiffening of the deck. Most small openings less than 6 inches which do not cut through more than 1 web of the deck does not require any reinforcing. Small *Cut-Out* penetrations less than 24 inches can be reinforced with stiffening angles, tube steel, or channels attached to the deck. (See figure 1.10.2) These details rely on the adjacent deck's reserve capacity to support the load distributed to those flutes due to the penetration *Cut-Out*. These distribution angles are an effective way to control localized deck deflection around the penetration *Cut-Out*. They do not, however, address possible overstress or over deflection of the adjacent flutes of the deck now carrying the load. Historically this type of detail has been demonstrated to be an effective solution for small penetrations.

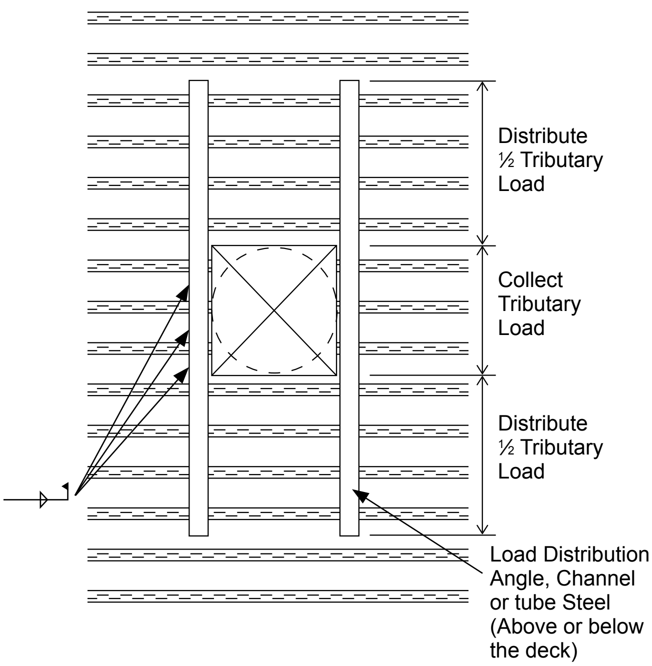


Figure 1.10.2: **DECK SUPPORT ANGLES**

Mid-Size Openings

Mid-sized openings typically require some structural design and detailing consideration. These openings are typically for ductwork or other mechanical shafts. Mid-sized openings range from 1 foot to approximately 4 feet and cut through multiple webs of the composite steel deck. The following are common examples of how the design professional may address mid-size penetrations in their designs.

Decked-Over mid-sized openings require less structural design and detailing than *Cut-Out*. If the opening is *Decked-Over*, the deck as a form is not compromised therefore no stiffening angles or support frames are required. The design should consider the effect of load transfer around mid-size openings for the composite steel deck-slab design. The superimposed load and dead load of the deck-slab needs to be distributed around the opening. This can be accomplished by using rebar to distribute to the deck-slab adjacent to the openings. (See figure 1.10.3) Reinforced concrete design to distribute these loads perpendicular to the deck span should be done in accordance with ACI 318.

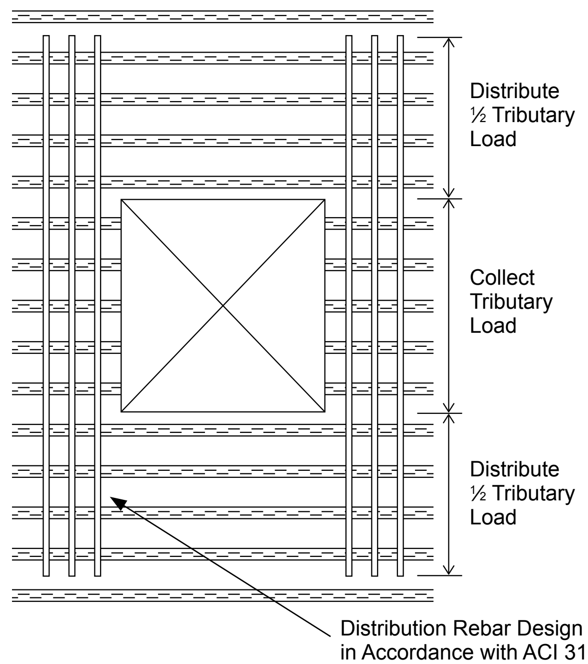


Figure 1.10.3: **REBAR DISTRIBUTION**

Cut-Out mid-sized openings require structural design and detailing of the deck as a form and the composite deck steel deck-slab. *Cut-Out* openings compromise the deck bending and shear capacity. For openings less than 2 feet, stiffener angles may be an acceptable solution similar to those used for small penetrations. The designer of record should verify the size of the stiffener and that the adjacent deck can support the concrete and construction loads. For all mid-sized openings, deck support frames may be a good option to support the deck for the concrete and construction loads. The designer of record should design and detail these frames around the mid-sized openings to transfer the loads back to the primary framing members supporting the composite steel deck. (See figure 1.10.4) Steel angles or channels are common framing materials for mid-sized openings.

1.10 **Penetrations and Openings**

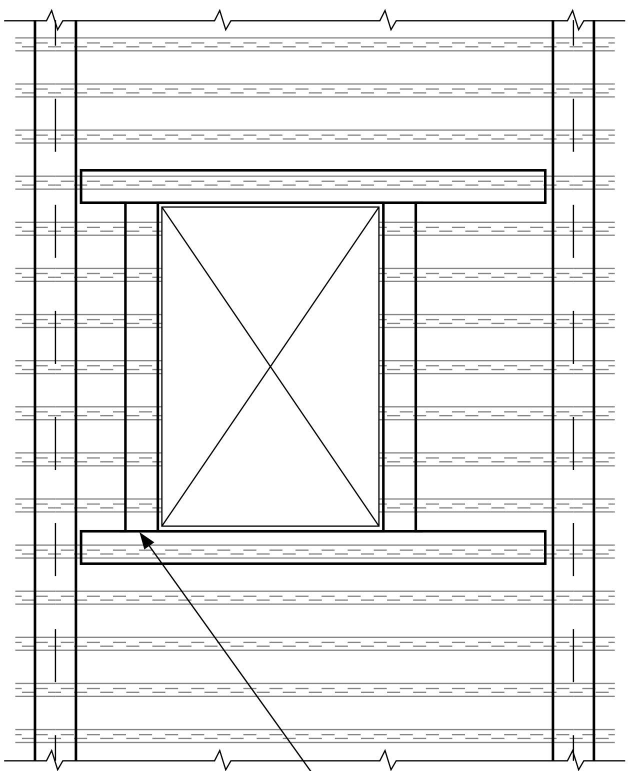


Figure 1.10.4: **DBL H OPENING FRAME**

Large Openings

Large openings for stair wells, elevator shafts, or large mechanical shafts are typically supported by framing which is part of the primary building framing system supporting the composite steel deck-slab system. *Decked-Over* large openings are often not practical due to the large size of the opening. Most large openings do not fall into the *Cut-Out* category because the deck will be detailed around the opening with pour stops similar to edge of slab conditions.

Consideration for Groups of Openings

When small sized *Cut-Out* penetrations are grouped together, the effect of the grouping may need to be treated as a mid-sized or large sized opening. Groups of small penetrations running along the edge of a support beam can compromise a large portion of the vertical shear capacity of both the deck as a form and the composite steel deck-slab system. (See figure 1.10.5)

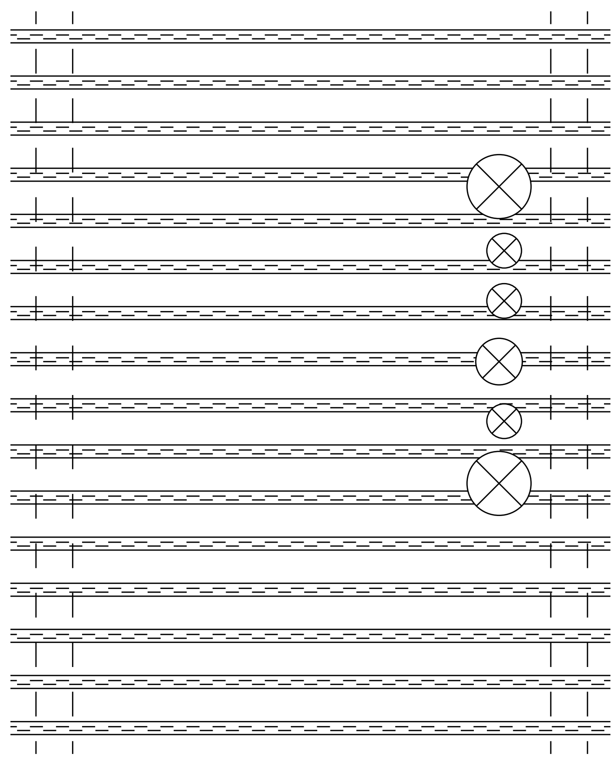


Figure 1.10.5: **ROW OF SMALL HOLES**

Penetrations and Openings 1.10

The effect of several small openings with stiffeners in proximity to each other may affect the overall capacity of the deck as a form or capacity of the composite deck-slab system. This may be an issue when the stiffening angles or penetrations overlap in a given span. The designer should consider the overlapping distribution of the load on the deck between openings to ensure the bending capacity of the deck is not exceeded (See figure 1.10.6)

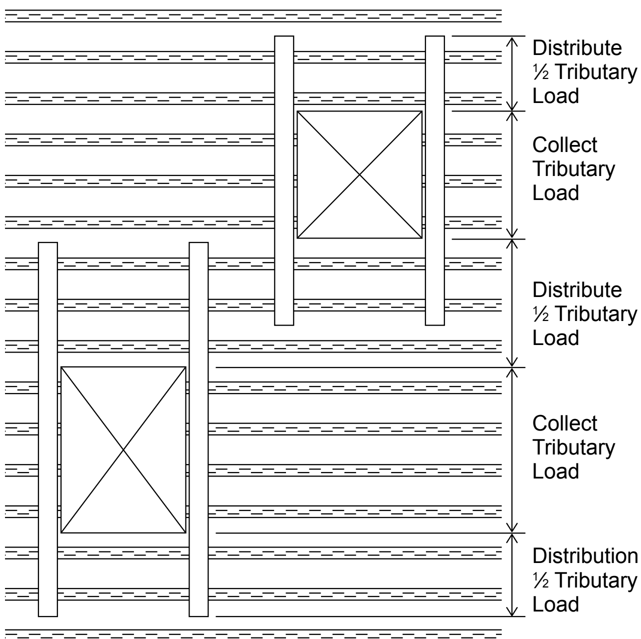


Figure 1.10.6: **OVERLAPPING HOLES**

The effect of two small holes in the same flute(s) of the deck panel may need no more consideration than a single penetration. The load from the flutes with the penetrations is distributed to the adjacent webs and is similar in magnitude to a single penetration. (See figure 1.10.7)

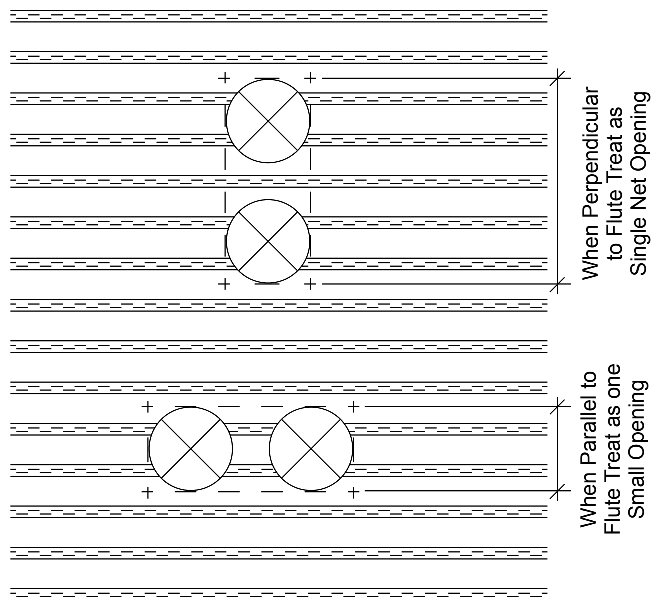


Figure 1.10.7: **SINGLE VS 2 PENETRATIONS**

1.11 Composite and Non-Composite Diaphragm Shear

General

A composite steel deck-slab is an integral part of a building's horizontal diaphragm system. The composite deck-slab acts as a shear resistant membrane supported by the steel framing supporting the diaphragm and providing the perimeter cords and collectors. The composite deck-slab tables in the IAPMO ER-329 report provide an easy to use design aid with factored diaphragm shears for common attachment types.

Shear Design of Diaphragms without Welded Shear Studs

The diaphragm shear design of composite deck-slab systems may be performed in accordance with the SDI Diaphragm Design Manual. This method is used for deck which is not attached with headed shear stud anchors. Common attachment methods include arc spot welds, power actuated fasteners, and self-drilling screws. The side laps of the steel deck should be connected together to prevent concrete leakage and provide some shear contribution. The minimum side lap connection should be button punches at 36 inches on center.

Diaphragm Boundary Fasteners to Supports

The diaphragm boundary connections to supports, perpendicular to the deck, should be the specified attachment pattern in the composite tables for the given deck gage, concrete type, and slab thickness.

Diaphragm boundary fastener spacing, parallel with the ribs of the deck, shall not exceed the spacing determined by: dividing the fastener shear strength by the required shear demand. Connector shear strengths are presented in figures 1.13.11 and 1.13.12

$$Spacing(in) = \frac{Q_{fa}}{s_a}\left(\frac{12in}{ft}\right)$$

$$Spacing(in) = \frac{Q_{ff}}{s_f}\left(\frac{12in}{ft}\right)$$

Q_{fa} = Allowable fastener strength using the safety factor, $\Omega = 3.25$, for composite deck-slab diaphragm shear in accordance with ANSI/SDI C-2011, lbs

Q_{ff} = Factored fastener strength using the safety factor, $\Phi = 0.5$, for composite deck-slab diaphragm shear in accordance with *ANSI/SDI C-2011*, lbs

S_a = Allowable shear demand, lbs/ft

S_f = Factored shear demand, lbs/ft

Skew Cut Diaphragm

At skew cut conditions, the minimum number of fasteners is determined based on the location of the fasteners in the ribs per the perpendicular attachment schedule. The average spacing of the fasteners per sheet shall not be greater than the spacing of the parallel boundary fasteners. Fasteners may need to be doubled up in some flutes to achieve this.

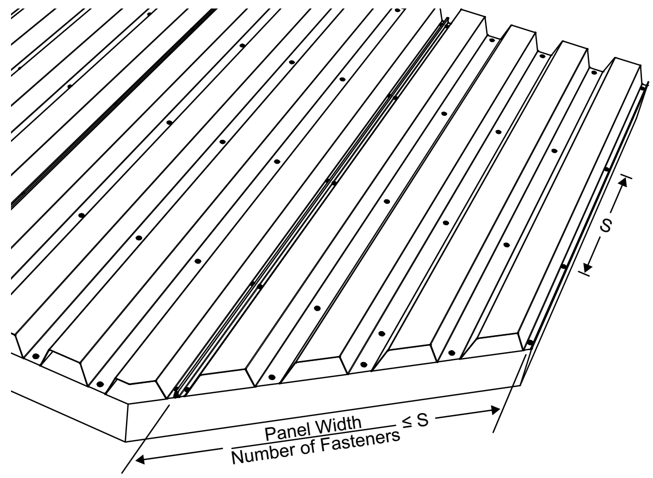


Figure 1.11.1: **SKEW DIAPHRAGM**

Diaphragm Deflection

Composite deck-slab diaphragms are very stiff with a flexibility factor, f<0.5micro inches/lbs (Shear stiffness, G' > 2000 kip/inch). The specific predicted shear stiffness (G') for a given composite deck-slab condition can be determined in accordance with the methods in ANSI/SDI C-2011. Due to the very stiff nature of these systems, checking the shear deflection of the diaphragm is often not necessary. There may be occasions, however, to check diaphragm shear deflections for diaphragms with large length to depth ratios. For these conditions, the methods and equations of engineering mechanics presented for diaphragm deflections in the ASC Steel Deck Roof Deck Design Guide may be used.

Diaphragm Shear With Headed Shear Stud Anchors

Diaphragms requiring diaphragm shears that exceed the limits of the arc spot welds, power actuated fasteners, or self-drilling screws may be developed using headed shear stud anchors and supplemental shear reinforcing in the concrete slab above the deck. This design is based on the transfer of shear from the collector into the reinforced concrete slab above the deck using headed shear stud anchors. The capacity of the diaphragm is limited by this shear transfer, or the capacity of the reinforced concrete diaphragm above the deck. The capacity of the headed shear stud anchors should be determined in accordance with AISC 360 requirements for composite beam design. The in-plane shear capacity for the reinforced concrete diaphragm above the deck should be determined in accordance with ACI 318 requirements for reinforced concrete design. The composite deck-slab tables in the IAPMO ER-329 report provide factored diaphragm shear capacities for common reinforcing schedules with ¾ inch diameter headed stud anchors.

1.12 Composite Deck-Slab Tables

ASC STEEL DECK

General
The composite deck-slab load tables are intended to provide a designer with easy to use design aids for common composite deck-slab conditions. The tables provide uniform load in both allowable and factored superimposed loads. Factored diaphragm shears are provided for composite deck-slab systems for lateral design. Diaphragms may be attached with a variety of attachments to supports including traditional arc spot welds, power actuated fasteners (PAF), and self-drilling screws. Factored shear tables for diaphragms with steel reinforcing and headed shear stud anchors are provided for high shear diaphragms. All of these tables are supported with complete composite deck-slab properties including bending moment, vertical shear, and section properties to aid in the design of conditions exceeding the scope of the tables.

Superimposed Uniform Load Tables
Uniform superimposed load is the load which the composite deck-slab can carry in addition to its self-weight. Both allowable and factored superimposed loads are provided. The superimposed load tables assume that the minimum temperature and shrinkage reinforcement is not adequate to develop negative bending resistance at supports, therefore all spans are treated as simple spans.

Most floor systems are designed using allowable stress design (ASD). The allowable superimposed load tables present the maximum uniform load based on the allowable bending strength, allowable vertical shear, and a deflection limit of L/360. ASD assumes that the superimposed load is primarily live load and is conservative for dead loads.

Load and Resistance Factor Design (LRFD) is recommended for conditions in which the majority of the superimposed load is dead load, and the maximum superimposed load is the limiting design criteria. The factored superimposed loads in the tables do not include a deflection check. The designer will have to check the service load deflection to ensure that the deflection meets the projects deflection serviceability requirements when using an LRFD approach.

Composite Deck-Slab Properties
For conditions exceeding the scope of the uniform load tables, composite deck-slab properties are provided in the tables. The properties can be utilized as part of the solution for concentrated loads, deflection limits, or spans not included in the superimposed load tables. The properties include both allowable and factored moments, and vertical shear for determining the capacity of the composite deck-slab system. Cracked, uncracked, and the average of cracked and uncracked moment of inertia are provided to assist in determining the deflection of the deck-slab system.

Factored Diaphragm Shear
The IAPMO ER-329 report presents composite steel deck-slab diaphragm shears using a load and resistance factor basis. The diaphragm shears presented are factored shears. Composite steel deck-slab systems have traditionally been designed using allowable stress design (ASD), in part because manufactures have presented allowable shears. These shears were based on research and engineering studies dating back to before LRFD was commonly used for steel design. The factored shears presented in the IAPMO ER-329 report work seamlessly with the design of the lateral force resting system for steel and concrete buildings designed using the LRFD approach. The designer does not have to convert the lateral forces to ASD when selecting a factored diaphragm from the shear tables.

Factored shears are provided for a variety of fastener types to supports. This range of fasteners reflects a full range of building types that composite deck-slab systems are used in.

Wide Flange Multi-Story Steel Construction: Arc spot welds are the traditional method for attaching composite deck to structural steel support members. This method provides good shear performance and is applicable to a wide variety of support steel, from heavy wide flange beams to light weight open web steel joists. Welded steel headed stud anchors are commonly used for composite beam design. They are also a good choice to transfer large diaphragm forces into the composite deck-slab system. This system is ideal for high shear diaphragms on wide flange beams and requires the use of welded wire fabric or reinforcing bars in the slab.

Open Web Steel Joist Mezzanine and Floor Systems: Composite steel deck-slab systems can be attached with arc spot welds, however, power actuated fasteners (PAF) are an ideal cost effective method of attachment to light structural angles used for open web steel joist framing. PAF selection is dependent on the support steel thickness. (See figure 1.13.12)

Cold-Formed Steel Mezzanine and Floor Systems: Self-drilling screws are the best choice for attaching composite steel deck to cold-formed steel framing. Common examples of this application include: cold-formed steel framed multi-story mini-storage buildings, mezzanines, and conventional cold-formed steel stud, and joist framed buildings.

Composite Deck-Slab with Cellular Deck
Cellular composite deck panels can be conservatively designed using the non-cellular deck-slab tables. The superimposed loads, vertical shear, and moment of inertia can be conservatively used for the design, based on the gage of the beam section of the cellular profile. This ignores the contribution of the steel used for the bottom pan of the cellular deck. Maximum unshored spans for cellular deck-slab system are listed with the cellular deck section properties.

Allowable Stress Design
Historically, most composite steel deck-slab systems diaphragm shear tables have been presented using an allowable stress design basis. To compare composite steel deck-slabs designed using ASD basis, it is recommended that the ASD shear demand be converted back to an LRFD basis. This can be accomplished by dividing the required allowable shear by 0.7 ASD seismic factor, for seismic controlled designs, or 0.6 ASD wind factor for wind controlled designs.

How to Read Tables

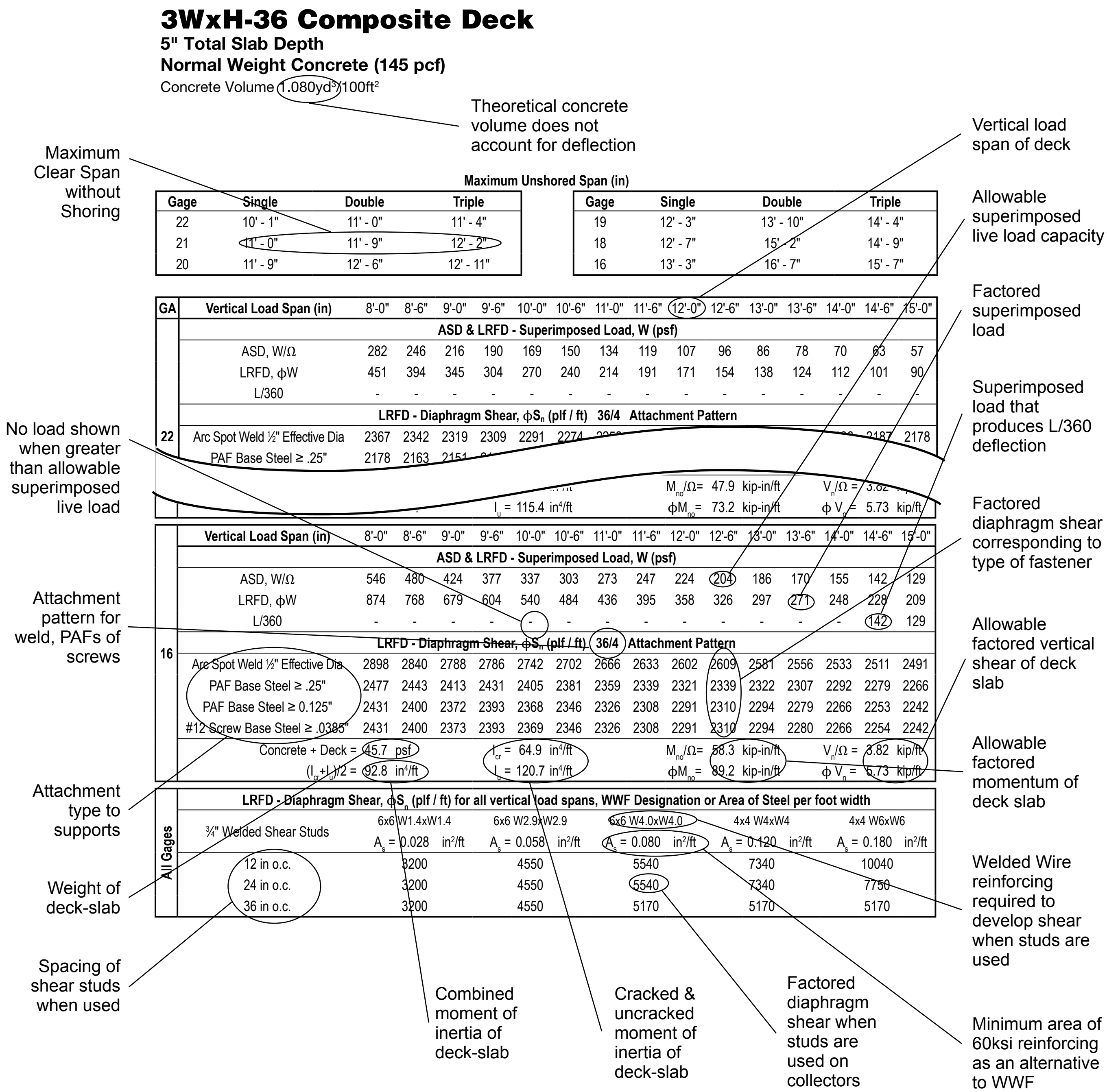


Figure 1.12.1: **SAMPLE OF COMPOSITE DECK TABLE**

1.13 **Support Fastening**

Support Fastening

A variety of fastening systems may be used to connect steel deck to the supporting steel members. The type of fastening system used depends on the required diaphragm shear capacity, uplift capacity, and the thickness of the supporting steel members. These fastening systems include arc spot welds, arc seam welds, headed stud anchors, self-drilling screws, and power-actuated fasteners (PAF). The strength of each fastener type is mathematically derived from specified standards and testing.

The shear strength for arc spot and arc seam welds is derived from the equations in Section E2.6 of AISI S100-2012. The strength for self-drilling screws and PAF is determined in accordance with the Steel Deck Institute Diaphragm Design Manual DDM03. The strengths for these fasteners are listed in the Weld and Shear Capacities Table (See figure 1.13.11 and Figure 1.13.12). The shear strength of steel headed stud anchors is determined in accordance with ASIC 360 Specification for Structural Steel Buildings.

The pull-out and pull-over capacities for fasteners are in accordance with Sections E4.4.1 and E4.4.2 of AISI S100-2012. The pull-out for PAF's should be obtained from the manufacturer's data for the selected fastener.

Fastener Selection

To ensure quality fastening to supports, the fastener (weld, screw, or PAF) must be compatible with the thickness of the steel support member. (See figure 1.13.1)

Arc spot and arc seam welds do not have a mandatory minimum support member thickness. Experience has shown that a support thickness as thin as 10 gage is reasonable. Welders with light gage welding experience can weld steel deck to thinner gage supports.

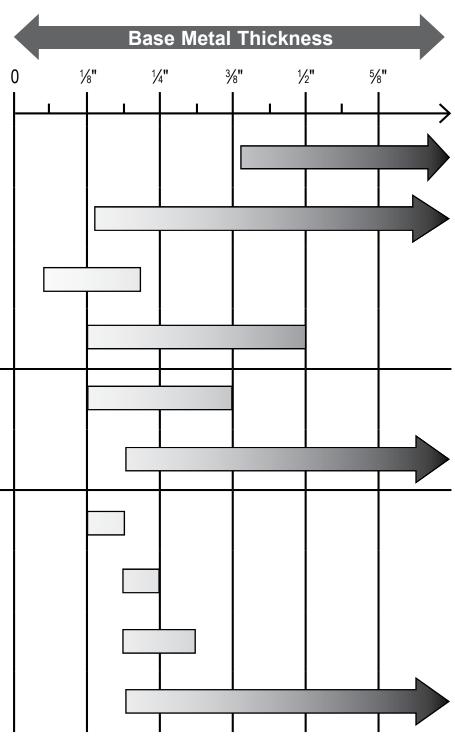
Steel headed stud anchors are subject to a minimum support member thickness in accordance with AISC 360. This requires that the headed stud anchor be a minimum of 2.5 times the thickness of the supporting beam flange unless the headed studs anchor is placed directly over the web. For ¾" diameter stud, the minimum flange thickness when the stud is not directly over the web is 0.3 inches.

Self-drilling screws are suitable for use with supporting members from 0.0385 inches to ½", depending on thread pitch and drill point configuration. The fastener manufacturer should be consulted to determine which screw is appropriate.

Power Actuated Fasteners (PAF) are selected based on a range of support thickness for a given fastener. Follow the PAF manufacturer's support thickness recommendations. The fastener selection chart (See figure 1.13.1) provides a quick and easy guide to help select the appropriate fastening system for the support member thickness.

Figure 1.13.1: **FASTENER SELECTION CHART**

Fastener	Base Metal Thickness Minimum	Base Metal Thickness Maximum
¾" ϕ Shear Stud	0.400" min when not over web	unlimited
Arc Spot Weld*	0.135"	unlimited
12-14 Self Drilling Screw**	0.0385"	0.210"
12-24 Self Drilling Screw**	0.125"*	0.500"
Hilti X-HSN-24 High Shear Nail	⅛"	⅜"
Hilti ENP19 L15 High Shear Nail	¼"	unlimited
Pneutek SDK61075 Fastener	0.113"	0.155"
Pneutex SDK63075 Fastener	0.155"	0.250"
Pneutek K64062 and K64075 Fastener	0.187"	0.312"
Pneutek K66062 and K66075 Fastener	0.312"	unlimited



*Below 10 gage is not recommended due to the difficulty of producing a good quality weld. **Correct drill point must be selected for the base material thickness.

Minimum Fastener Edge Distance

The minimum edge distance for fasteners used with ASC Steel Deck profiles has been verified through full-scale diaphragm shear testing. The minimum edge distance for self-drilling screws and PAFs is ½". The minimum edge distance for arc spot and arc seam welds is ¾". Edge distance is measured from the center of the fastener or the center of the radius of an arc spot or seam weld. (See figure 1.13.2)

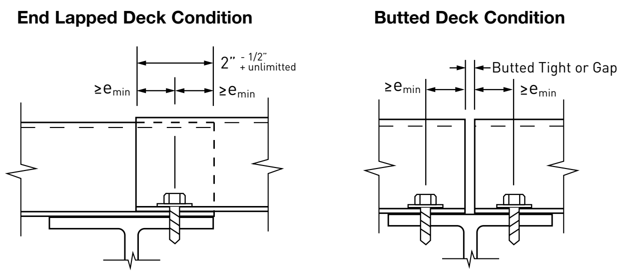


Figure 1.13.2: **END LAP AND BUTTED DECK**

Arc Spot and Arc Seam Welds

Traditionally, arc spot welds and arc seam welds are used to attach steel deck to supports. (See figures 1.13.3 and 1.13.4) Arc welds have high shear capacity, resulting in diaphragms with higher shear capacities than screws or power actuated fasteners (PAF).

Welded connections have some drawbacks compared to screws and PAF. Welds require skilled labor and have a relatively slow production rate. Additionally, welding cannot be performed in the rain or if standing water is present on the deck. Welding often results in burn marks visible from the underside of the deck and supporting members, which may be objectionable for some exposed deck conditions. Jobsite safety is of great concern as welding also creates a fire risk.

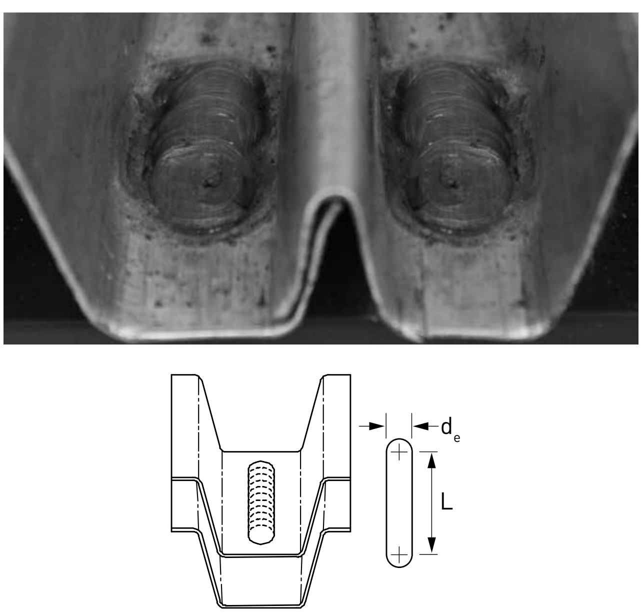


Figure 1.13.3: **ARC SEAM WELD** (weld to support)

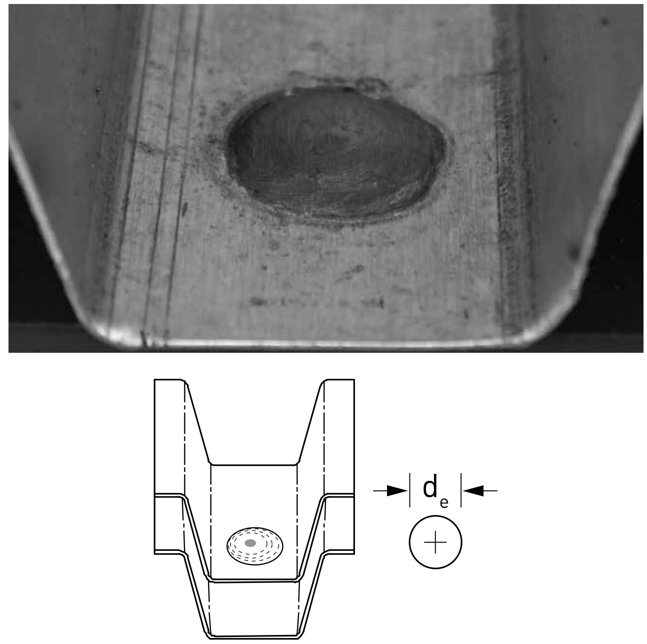


Figure 1.13.4: **ARC SPOT WELD** (weld to support)

Welds used for composite deck-slab or non-composite deck-slab applications do not require touch up painting. Specifications should not require the weld to receive touch-up paint for decks with concrete fill.

Arc spot and seam welds for ASC Steel Deck products are specified based on the effective diameter or length and width. This is approximately the diameter or width and length of a weld at the interface between the deck and supporting member. The effective weld size is less than the visible weld size and is verified through the development of weld qualifications and procedures. See AISI S100-2012 Section E2 for more information regarding weld design. Weld inspection, procedures, and qualifications should be in accordance with AWS D1.3

Arc spot welds connecting deck less than 0.028 inches thick require weld washers in accordance with AWS D1.3. Weld washers are not recommended for thicker decks. (See figure 1.13.5)

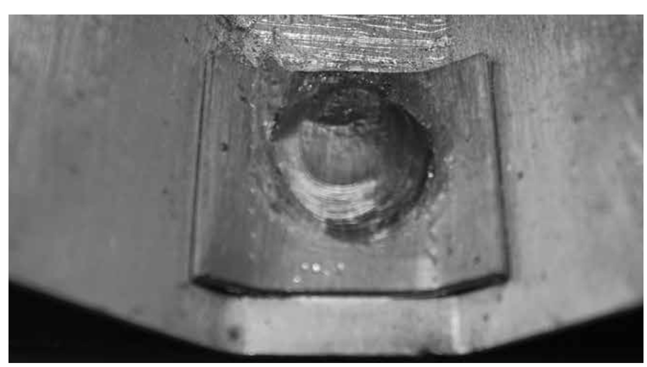


Figure 1.13.5: **WELD WASHER**

1.13 **Support Fastening**

ASC STEEL DECK

Power-Actuated Fasteners, PAF

Power-actuated fasteners (PAF) are an excellent fastening system. Commonly referred to as high shear nails or pins, they can be used to achieve mid to high range diaphragm shear capacities, depending on the fastener selected and the support thickness. The benefits of using PAFs is that they can be installed without skilled qualified welders, are efficient to install, do not pose a jobsite fire risk, and do not leave any burn marks associated with welding. This makes PAFs an attractive option for architecturally exposed steel deck.

A drawback of PAF systems is that it may be difficult for the design engineer to select the fastener size when designing with open-web steel joists because the thickness of the top chord may be unknown. Good practice would be to design the diaphragm with the minimum expected substrate steel thickness, and indicate a range of acceptable fasteners based on the thickness of the supporting steel member. The inspection process on the jobsite should be tasked with ensuring that the correct fastener is used based on the substrate thickness.

Pneutek

Pneutek's PAF system uses a pneumatic actuated tool. This system does not use a powder charge to drive the fastener. Contact Pneutek for fastener installation instructions and for additional technical support relating to their fastening systems. (See figure 1.13.6)
www.pneutek.com 800-431-8665

Pneutek Fasteners

SDK61075, SDK63075, K64062, K66075, K66056, K66062, K66075

Hilti, Inc.

Hilti, Inc.'s PAF system includes powder fired tools to install their high shear nails (HSN) and ENP fasteners. The operator of the powder-fired tools must have OSHA compliant safety training. Contact Hilti, Inc. for fastener installation instructions and for additional technical support relating to their fastening systems. (See figure 1.13.7 and 1.13.8)
www.us.hilti.com 800-879-8000

Hilti Inc. Fasteners

X-ENP-19 L15, X-HSN 24

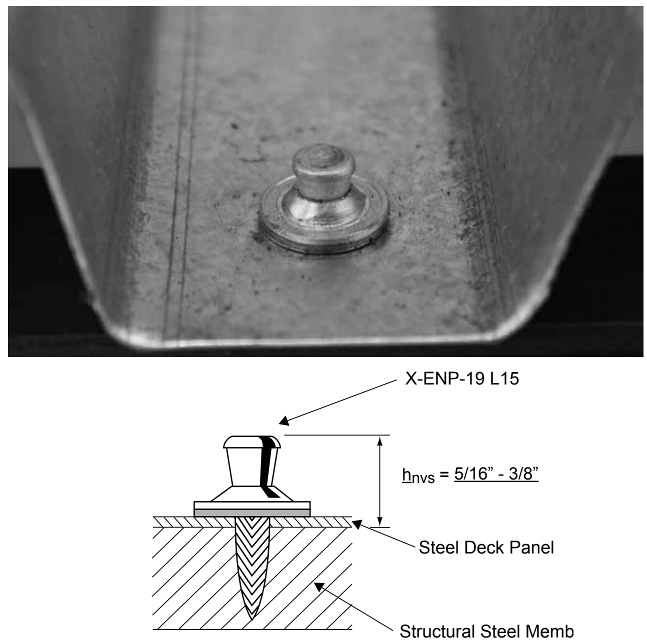


Figure 1.13.7: **HILTI X-ENP-19**

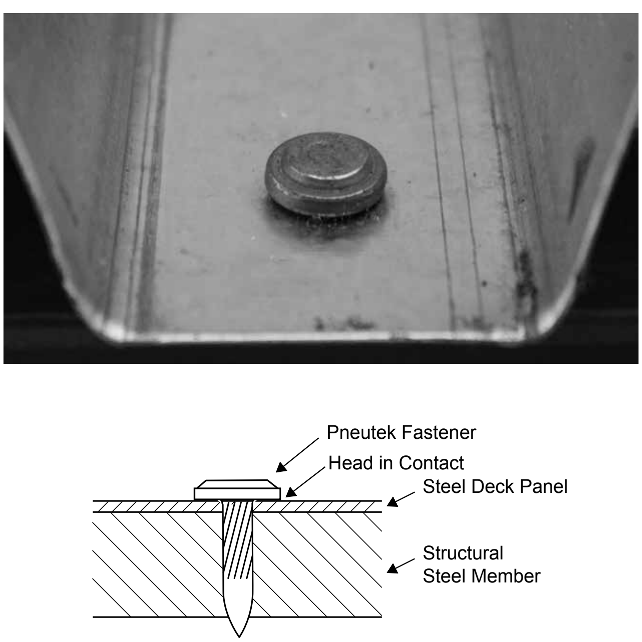


Figure 1.13.6: **PNEUTEK K64062**

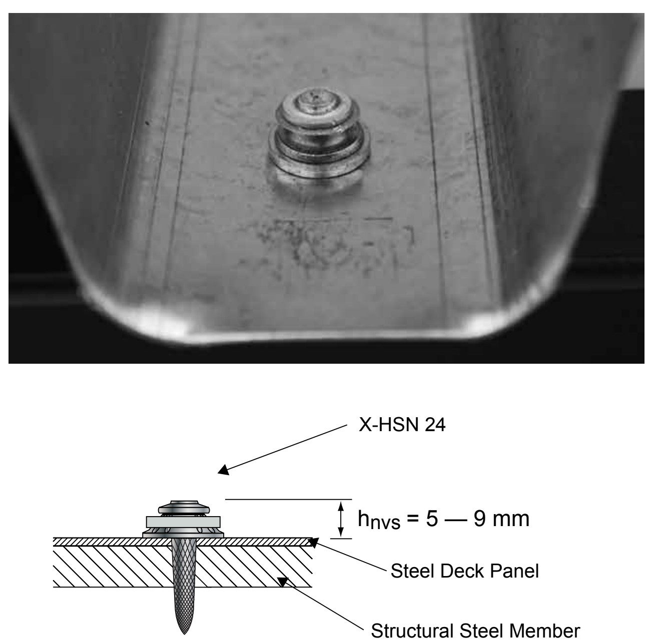


Figure 1.13.8: **HILTI X-HSN 24**

Headed Stud Anchor

The headed shear stud anchor is a traditional method of attaching metal deck to supporting steel beams. (See figure 1.13.9) Shear studs are commonly used to develop composite steel beams. Headed shear stud anchors are an excellent way of transferring diaphragm shear forces from a collector beam into the composite deck-slab system. Shear studs replace an arc spot weld, PAF, or screws on a one to one basis.

Figure 1.13.9: **HEADED STUD ANCHOR**

Self-Drilling Screws

Self-drilling screws are an excellent option for attaching deck to thin-gage metal supporting members. (See figure 1.13.10) Although diaphragms which are attached with screws tend to have a lower shear capacity than other support fastening systems, screws install quickly with lower skilled labor and do not leave any burn marks on the deck or supporting members. This makes them an attractive option for architecturally exposed steel deck. Self drilling screws may not be practical on heavier structural steel support members because it can be time consuming to drill through the steel deck panel into the supporting member. When installed, the driven screw penetrates both the steel deck panel and the supporting member; as a result, the screw points are visible from the underside of the supporting structure.

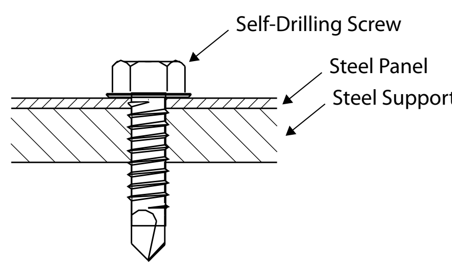


Figure 1.13.10: **#12-24R1-1/4 SCREW**

1.13 **Support Fastening**

ASC STEEL DECK

Figure 1.13.11

Nominal Strength **WELDING CAPACITIES**

Deck Panel	Gage	Arc Spot (puddle) Weld (½ in effective diameter)		Arc Seam Weld (⅜ in x 1 in effective width & length)
		Shear (lbs)	Tensile (lbs)	Shear (lbs)
BH, NH	22	2416	2310	3873
	20	3364	2755	4688
	18	5701	3618	6344
	16	7263	4463	8065
2WH, 3WxH	22	2323	2243	3752
	21	2886	2541	4293
	20	3212	2689	4565
	19	4486	3200	5531
	18	5525	3561	6231
	16	7172	4408	7948
BHF, NHF	20/20	8608	5290	9851
	20/18	8836	6019	11521
	20/16	8836	6862	13392
	18/20	8836	6078	11660
	18/18	8836	6853	13376
	18/16	8836	7850	15298
	16/20	8836	6935	13534
	16/18	8836	7850	15298
	16/16	8836	8875	17271
2WHF, 3WxHF	20/20	8509	5229	9717
	20/18	8836	5960	11383
	20/16	8836	6788	13250
	18/20	8836	6026	11537
	18/18	8836	6788	13250
	18/16	8836	7782	15168
	16/20	8836	6870	13408
	16/18	8836	7782	15168
	16/16	8836	8805	17138

Safety and Resistance Factors for Welds
for Conditions other than Diaphragm Shear

	Shear		Tension	
	Ω	Φ	Ω	Φ
Arc Spot Weld	2.80	0.55	2.50	0.60
Arc Spot Weld	3.05	0.50		
Arc Spot Weld	2.55	0.60		
Arc Spot Weld	2.20	0.70		
Arc Seam Weld	2.55	0.60		

Calculated in Accordance with AISI S100-2012

Figure 1.13.12

Nominal Strength **MECHANICAL FASTENER CAPACITIES**

		Nominal Shear Strength (lbs)							
		Screws	Hilti			Pneutek			
Supporting Framing Steel Thickness (in)	Min	0.0385	0.250	0.125	0.125	0.125	0.312	0.232	0.155
	Max	unlimited	unlimited	0.375	0.375	0.250	unlimited	0.312	0.232
Deck Profile	Deck Gage	# 12, #14 Self Drill	X-ENP-19 L15	X-HSN 24	X-EDNK22 THQ12	K66062 K66075	K64062 K64075	SDK63075	SDK61075
BH, NH	22	1402	1624	1508	1508	1841	1735	1728	1546
	20	1683	1938	1800	1800	2258	2216	1977	1833
	18	2241	2549	2367	2367	3132	3009	2417	2378
	16	2803	3149	2924	2924	4076	3686	2812	2896
2WH, 3WxH	22	1359	1577	1464	1464	1780	1655	1689	1502
	21	1547	1787	1659	1659	2055	1993	1860	1695
	20	1641	1891	1756	1756	2195	2149	1941	1790
	19	1969	2253	2092	2092	2698	2642	2210	2116
	18	2203	2508	2329	2329	3071	2960	2389	2342
	16	2766	3109	2887	2887	4011	3644	2787	2862
BHF, NHF	20/20	3370	3737	3470	3470	5092	4294	3176	3386
	20/18	3886	4258	3953	3953	6071	4800	3485	3804
	20/16	4448	4810	4466	4466	7201	5314	3801	4229
	18/20	3928	4300	3992	3992	6154	4840	3509	3837
	18/18	4444	4806	4462	4462	7191	5310	3799	4225
	18/16	5006	5342	4960	4960	8383	5793	4099	4619
	16/20	4491	4851	4504	4504	7288	5351	3824	4259
	16/18	5006	5342	4960	4960	8383	5793	4099	4619
	16/16	5569	5862	5444	5444	9639	6251	4385	4982
2WHF, 3WxHF	20/20	3328	3694	3430	3430	5014	4250	3150	3350
	20/18	3844	4215	3914	3914	5989	4760	3460	3770
	20/16	4406	4769	4429	4429	7114	5277	3778	4198
	18/20	3891	4262	3958	3958	6081	4804	3487	3807
	18/18	4406	4769	4429	4429	7114	5277	3778	4198
	18/16	4969	5307	4928	4928	8302	5762	4079	4594
	16/20	4453	4815	4471	4471	7211	5318	3804	4232
	16/18	4969	5307	4928	4928	8302	5762	4079	4594
	16/16	5531	5828	5412	5412	9553	6221	4367	4958

Calculated in Accordance with the SDI DDM03

1.14 **Side Seam Fastening**

Side Seam Attachment

The side seam attachment for composite floor deck has a small influence on diaphragm shear capacity, but is critical for holding the seam together during the concrete pour. The side seam attachment creates a positive connection, limiting differential movement between the sheets of deck under out-of-plane loads during concrete placement. The common side seam attachment systems are the Triple Button Punch™, traditional button punch, top seam weld, and DeltaGrip® system for standing seam interlock side seams. Self-drilling screws are used for nestable side seams. The two common types of side seams are the standing seam interlock and the nestable side seam (See figure 1.14.1).

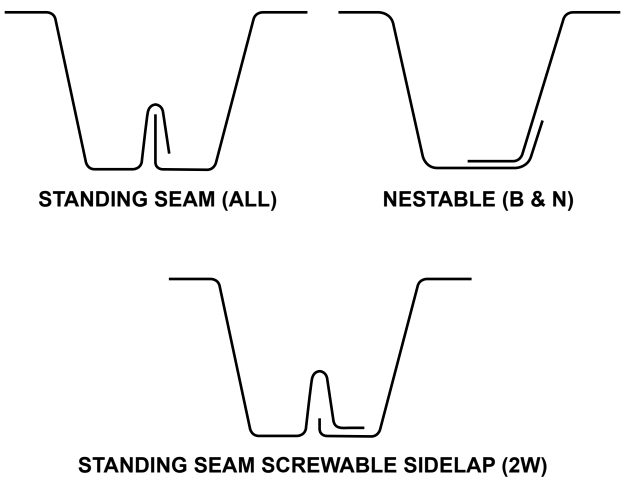


Figure 1.14.1: **STANDING SEAM AND NESTABLE DIAGRAM**

SAMPLE BUTTON PUNCH TOOL

Triple Button Punch

The Triple Button Punch™ is the latest innovation in reliable side seam connections for standing seam side laps for composite steel deck. (See figure 1.14.2) For architecturally exposed deck, the Triple Button Punch system is the best option because there are no penetrating holes that can leak concrete, and no unsightly burn marks typically associated with welded connections. This connection is installed using ASC Steel Deck's DeltaGrip tool with the triple button punch die set. The triple button punch is more effective than a traditional button punch because the three dimpled connections are tightly seated using the DeltaGrip pneumatic tool. The DelatGrip tool produces consistent, repeatable punches that are not subject to operator fatigue or punch depth settings that cause quality problems with traditional hand operated button punch tools.

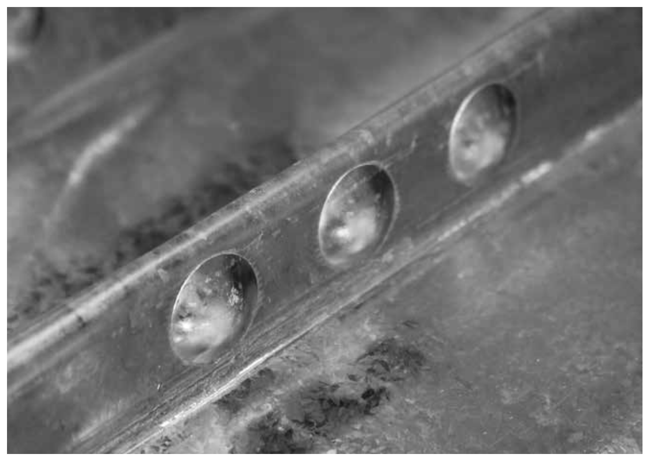


Figure 1.14.2: **TRIPLE BUTTON PUNCH**

Traditional Button Punch

The traditional button punch attachment is used to connect standing seam side seams by creating a single dimpled clinch connection. (See figure 1.14.3) The quality of a button punch which has been installed with a hand-operated tool is dependent on the operator and the depth of the particular punching tool. A "good" button punch should not become disengaged when a person modestly jumps on the adjacent sheet of deck.

Figure 1.14.3: **BUTTON PUNCH SIDE LAPS**

Self-Drilling Screws

Self-drilling screws are used to attach standing seam screwable sidelap steel deck. (See figure 1.14.4) Screws can be easily installed with low-skill labor using screw guns that are readily available. Screws do not leave burn marks associated with welding, but the screw points do protrude through the underside of the steel deck. As a result, screws may not be acceptable for some architecturally exposed steel deck.

Figure 1.14.4: **SIDE SEAM SELF-DRILLING SCREW (Nestable Sidelap)**

Top Seam Weld

Top seam welds are the least desirable method to connect standing seam composite deck together. (See figure 1.14.5) The top seam welds are slow to install, require skilled welders, and contribute very little to the strength of the composite deck system. Top seam welds connect the standing seam deck side seams by welding the three layers of steel deck together. This is done after the hem is crimped using a hand or pneumatically operated crimping tool. Top seam welding is a slow process requiring skilled welders, leading to increased installation cost. The welding creates burn marks on the underside of the deck and occasional burn-through holes. Top seam welds are not recommended for architecturally exposed steel deck. Weld inspection, procedures, and qualifications should be in accordance with AWS D1.3.

Figure 1.14.5: **TOP SEAM WELD**

Screwable Sidelap

Self-drilling screws are used to attach standing seam screwable sidelap composite deck. (See figure 1.14.6) The screws can be easily installed with low-skill labor using screw guns that are readily available. The screws do not leave burn marks associated with welding, but the screw points do protrude through the underside of the steel deck. As a result, screws may not be acceptable for some architecturally exposed steel deck.

Figure 1.14.6: **SIDE SEAM SELF-DRILLING SCREW (Screwable Sidelap)**

DeltaGrip®

The DeltaGrip system was developed in 2003 to reduce the installed costs of high shear roof deck diaphragms by eliminating the costly top seam weld. The DeltaGrip connection has also been proven to be an effective side seam connection for composite steel deck, keeping the deck from separating during concrete placement. This revolutionary clinching system punches three triangular tabs though the standing seam interlock side seam. This interlock creates the equivalent strength of a time consuming top seam weld with the rapid action of a pneumatically powered DeltaGrip tool. High-quality DeltaGrip connections can be installed with low-skill labor compared to the skilled welders required to make top seam welds.

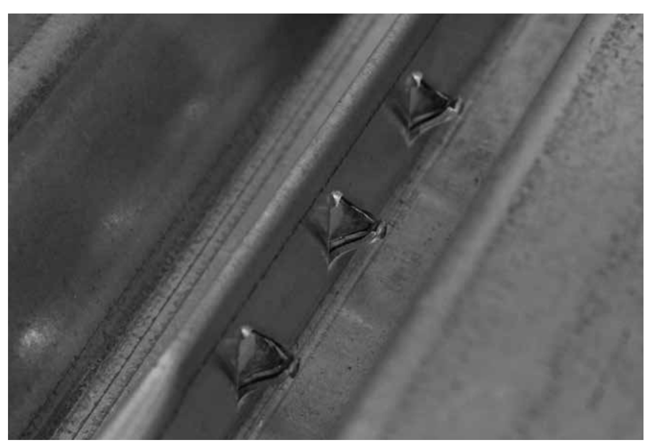


Figure 1.14.7: **DELTAGRIP PUNCH**

1.15 **Edge Form**

Edge Form

Edge form is an integral part of a composite or non-composite deck installation. The edge form provides containment of the concrete at the perimeter of the composite deck-slab system and around openings. Edge form also provides a screed at the edge to help maintain slab thickness. Edge forms may be manufactured from bent plate, cold-formed sheet steel, and hot roll steel angles or channels. ASC Steel Deck manufactures cold-formed sheet steel flashings used for edge forms and other flashing conditions. Section 1.17 shows typical installation conditions for common flashing types.

Edge Form Flashings

Galvanized steel edge form flashings are custom manufactured by ASC Steel Deck to meet project requirements. The flashings are formed from ASTM A653 SS Grade 33 minimum galvanized steel sheets. Flashings are available in most common structural shapes in 7 gages. (See figures 1.15.1 and 1.15.2) The standard length flashing is 10'-0", shorter lengths available upon request. The minimum width of any stiffener or flat cross section is ¾". For Hat and Channel shapes, the web width must be at least ¾" wider than the flange width.

Design of Edge Form

Edge forms may be rationally designed to support concrete and construction loads using the methods in the SDI Floor Deck Design Manual based on engineering mechanics and confirmatory testing. The SDI edge form table provided in figure 1.15.3 provides an easy to use design aid without the need to detailed calculations for common edge form conditions.

FLASHING THICKNESS BY GAGE	
Gage	**Base Steel Thickness**
22	0.0290
20	0.0350
18	0.0470
16	0.0590
14	0.0700
12	0.1050
10	0.1350

Figure 1.15.1

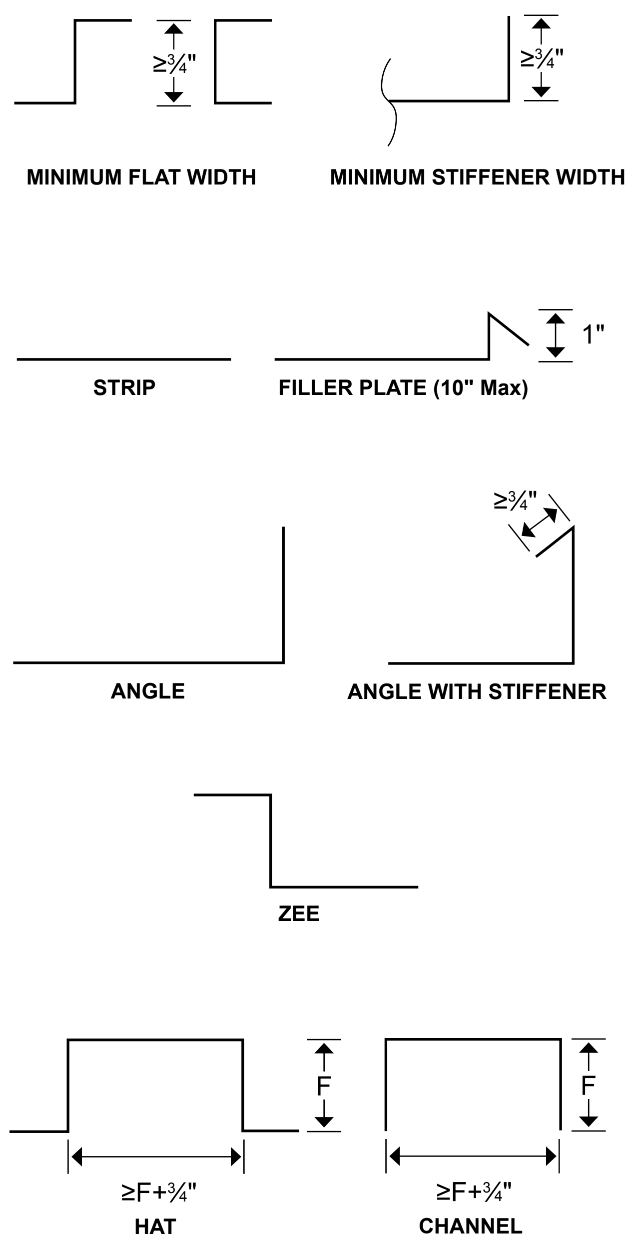
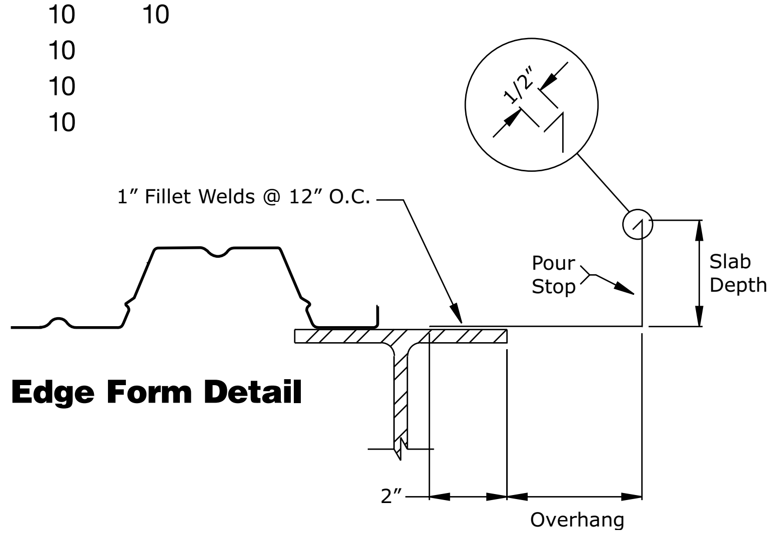


Figure 1.15.2

Figure 1.15.3: **Pour stop gage selection table, based on overhang and slab depth. (as published in ANSI/SDI C-2011)**

Slab Depth	Pour Stop Overhang 0"	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"	11"	12"
4.00	20	20	20	20	18	18	16	14	12	12	12	10	10
4.25	20	20	20	18	18	16	16	14	12	12	12	10	10
4.50	20	20	20	18	18	16	16	14	12	12	12	10	10
4.75	20	20	18	18	16	16	14	14	12	12	10	10	10
5.00	20	20	18	18	16	16	14	14	12	12	10	10	
5.25	20	18	18	16	16	14	14	12	12	12	10	10	
5.50	20	18	18	16	16	14	14	12	12	12	10	10	
5.75	20	18	16	16	14	14	12	12	12	12	10	10	
6.00	18	18	16	16	14	14	12	12	12	10	10	10	
6.25	18	18	16	14	14	12	12	12	12	10	10		
6.50	18	16	16	14	14	12	12	12	12	10	10		
6.75	18	16	14	14	14	12	12	12	10	10	10		
7.00	18	16	14	14	12	12	12	12	10	10	10		
7.25	16	16	14	14	12	12	12	10	10	10			
7.50	16	14	14	12	12	12	12	10	10	10			
7.75	16	14	14	12	12	12	10	10	10	10			
8.00	14	14	12	12	12	12	10	10	10				
8.25	14	14	12	12	12	10	10	10	10				
8.50	14	12	12	12	12	10	10	10					
8.75	14	12	12	12	12	10	10	10					
9.00	14	12	12	12	10	10	10						
9.25	12	12	12	12	10	10	10						
9.50	12	12	12	10	10	10							
9.75	12	12	12	10	10	10							
10.00	12	12	10	10	10	10							
10.25	12	12	10	10	10								
10.50	12	12	10	10	10								
10.75	12	10	10	10									
11.00	12	10	10	10									
11.25	12	10	10										
11.50	10	10	10										
11.75	10	10											
12.00	10	10											



Edge Form Detail

The above Selection Table is based on the following criteria:

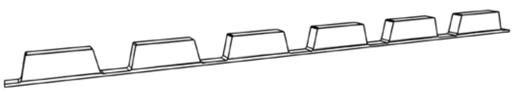
1. Normal weight concrete (150 pcf).
2. Horizontal and vertical Deflection is limited to ¼" maximum for concrete dead load.
3. Design stress is limited to 20 ksi for concrete dead load temporarily increased by one-third for the construction live load of 20 psf.
4. Pour Stop Selection Table does not consider the effect of the performance, deflection, or rotation of the pour stop support which may include both the supporting composite deck and/or the frame.
5. Vertical leg return lip is recommended for all types (gages).
6. This selection is not meant to replace the judgement of experienced Structural Engineers and shall be considered as a reference only.
7. SDI reserves the right to change any information in this section without notice.

1.16 **Accessories**

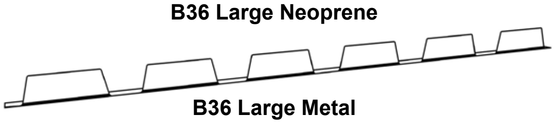
ASC Steel Deck offers a variety of accessories to complement our steel deck offer. These include flashings, sump pans, weld washers, profile cut top (small void) and bottom (large void) neoprene foam, and galvanized steel closures.

When accessories are called for in the specifications, the location must be clearly shown on the structural and architectural drawings. Specifications which call for the use of profile cut closures where walls meet the metal deck may lead to unnecessary construction costs if they are only needed at exterior walls or specific interior locations.

B36 DECK NEOPRENE AND METAL CLOSURES



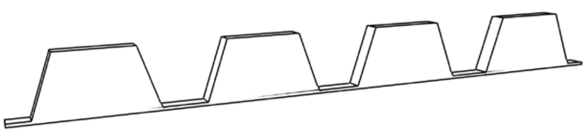
B36 Large Neoprene



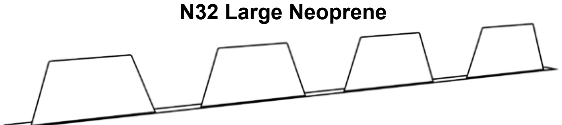
B36 Large Metal

Figure 1.16.1

N32 DECK NEOPRENE AND METAL CLOSURES



N32 Large Neoprene

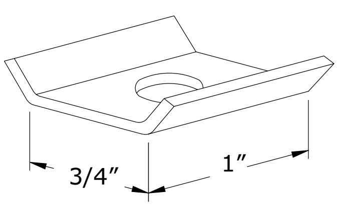


N32 Large Metal

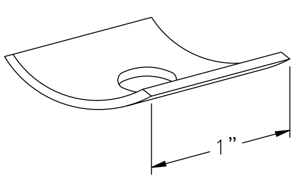
Figure 1.16.2

Weld Washers

14 gauge x ⅜" diameter hole for welded attachment of C1.4-32. Variable Gauge x ⅜" diameter hole for welded attachment of C0.9-32. Weld washers are for use with 26 and 24 gage C1.4-32 and C0.9-32 only. Do not use weld washers on 22 gage or heavier steel decks.



14 Gage x ⅜" dia. hole for welded attachment of C1.4-32 (CF1⅜)



14 Gage x ⅜" dia. hole for welded attachment of C0.9-32 (CF⅞)

Figure 1.16.3

Profile Cut Neoprene Closures

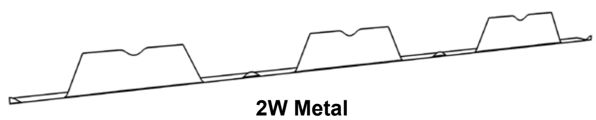
Neoprene closures may be used on the top and bottom of the steel deck to reduce vapor, moisture, and air from infiltrating into the building roof or floor assembly. These are die-cut from black closed cell neoprene foam. The foam is manufactured in accordance with ASTM D-1056 and passes the FM-VSS No. 302, UL 94HBF, and UL 94 HF1 flammability tests.

Profile Cut Metal Closures

Metal closures may be used to control animal nesting within the building structure. Metal closures may be used in combination with neoprene closures. Metal closures with calking can also be used to reduce noise infiltration as part of an acoustically engineered system. The metal closures are stamped out of minimum 22 gage galvanized sheet steel.

2WH NEOPRENE AND METAL CLOSURES

2W Neoprene

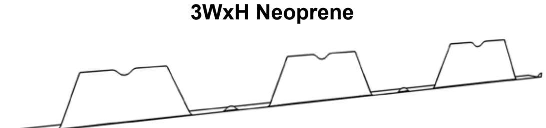


2W Metal

Figure 1.16.4

3WxH NEOPRENE AND METAL CLOSURES

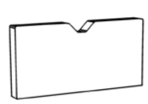
3WxH Neoprene



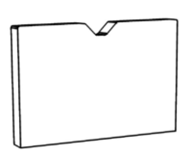
3WxH Metal

Figure 1.16.5

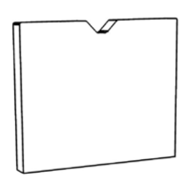
DEEP DECK NEOPRENE CLOSURES



4.5D Neoprene



6D Neoprene



7.5D Neoprene

Figure 1.16.6

ASC STEEL DECK

Typical Details 1.17

Details
Composite deck-slab systems are not complete without edge form and flashings to contain the concrete during the pour. These common details are an important part of the system. Edge forms provide both concrete containment and establish one point of depth control for the concrete.

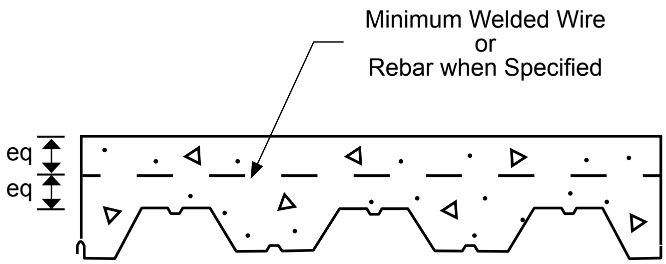


Figure 1.17.1: **TYPICAL PLACEMENT OF TEMPERATURE & SHRINKAGE REINFORCEMENT**

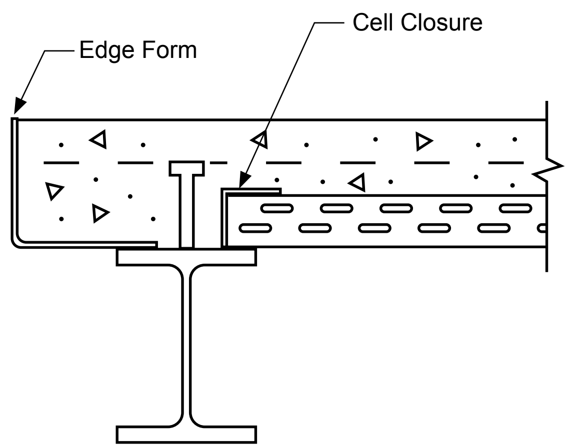


Figure 1.17.3: **SINGLE PIECE EDGE FROM PERPENDICULAR TO DECK ON WIDE FLANGE BEAM**

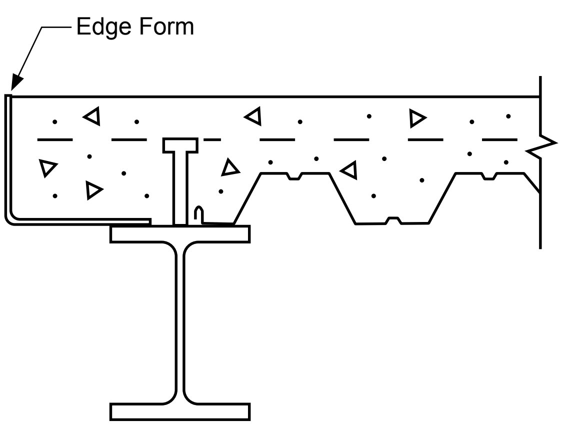


Figure 1.17.2: **SINGLE PIECE EDGE FROM PARALLEL TO DECK ON WIDE FLANGE BEAM**

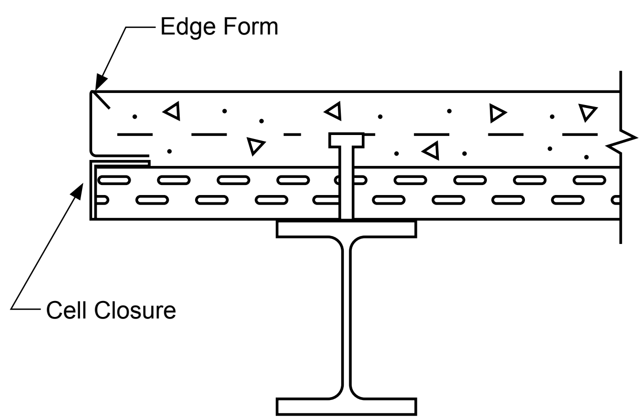


Figure 1.17.4: **TWO PIECE EDGE FORM WITH DECK CANTILEVER ON WIDE FLANGE BEAM**

1.17 **Typical Details**

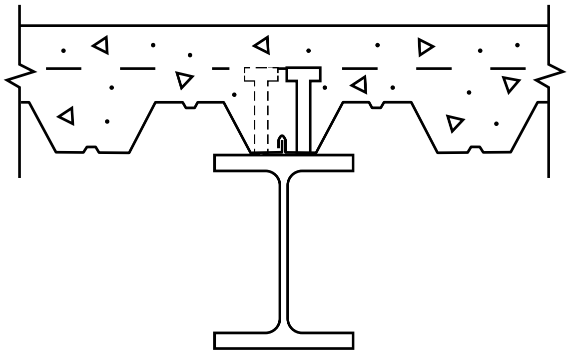


Figure 1.17.5: **DECK PARALLEL TO WIDE FLANGE BEAM**

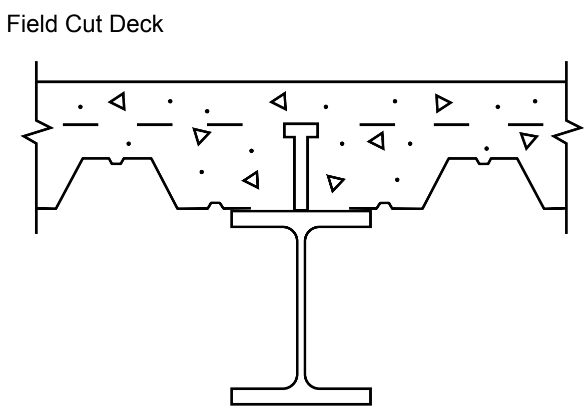


Figure 1.17.6: **DECK PARALLEL TO WIDE FLANGE BEAM CUT TO ACCOMMODATE DECK MODULE**

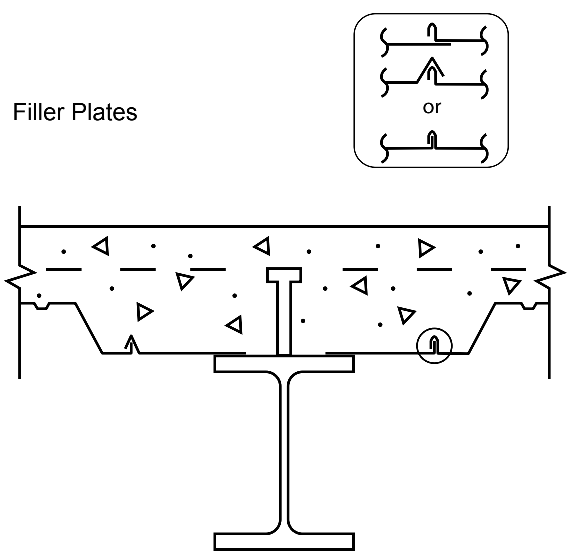


Figure 1.17.7: **DECK PARALLEL TO WIDE FLANGE BEAM WITH FILLER PLATES**

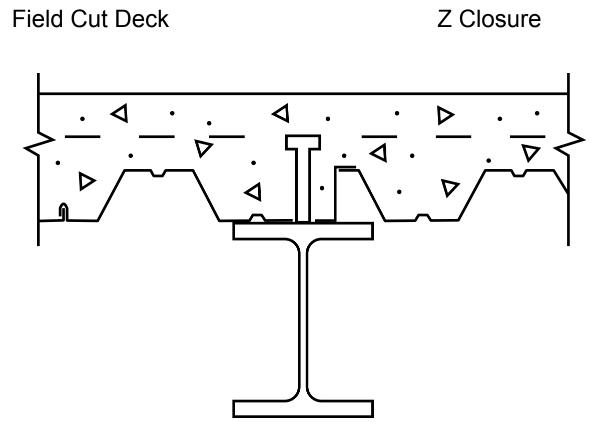


Figure 1.17.8: **DECK PARALLEL TO WIDE FLANGE BEAM CUT WITH ZEE FLASHING TO ACCOMMODATE DECK MODULE**

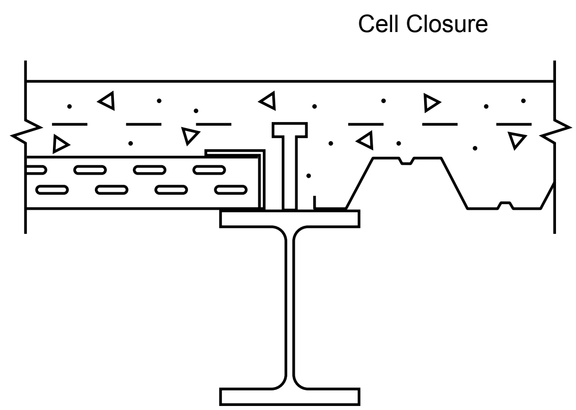


Figure 1.17.9: **DECK TRANSITION ON WIDE FLANGE BEAM**

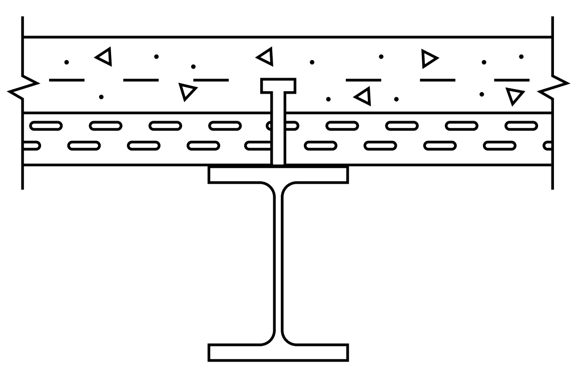


Figure 1.17.10: **DECK PERPENDICULAR TO WIDE FLANGE BEAM**

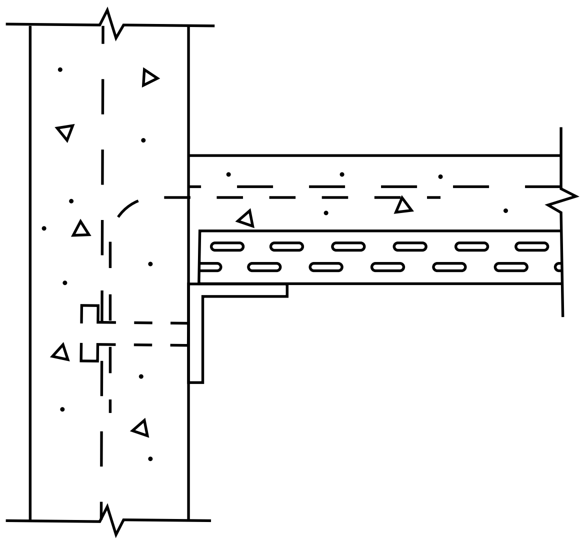


Figure 1.17.11: **CONCRETE OR CMU WALL LEGER DECK PERPENDICULAR**

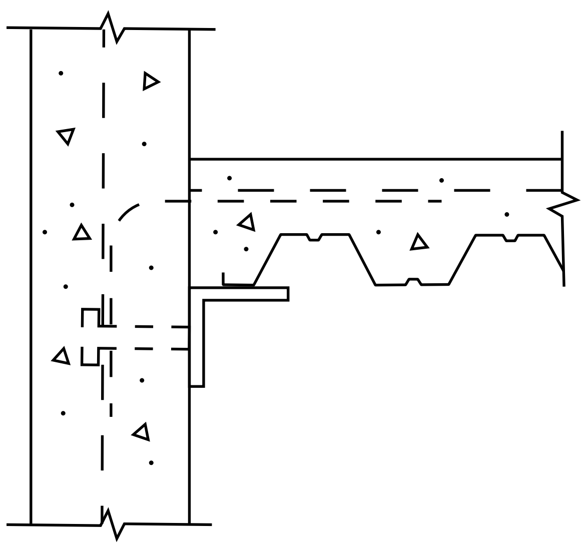


Figure 1.17.12: **CONCRETE OR CMU WALL LEGER DECK PARALLEL**

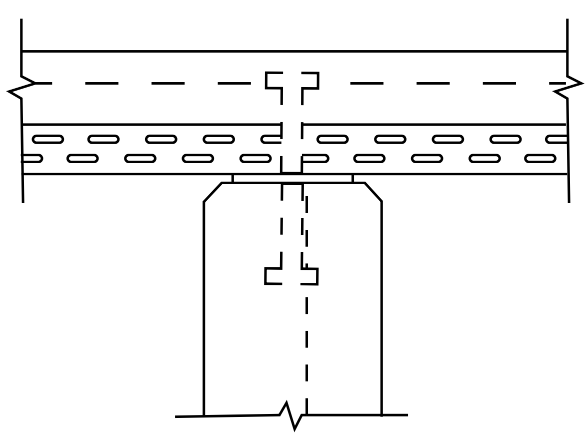


Figure 1.17.13: **CONCRETE OR CMU WALL WITH EMBED PERPENDICULAR**

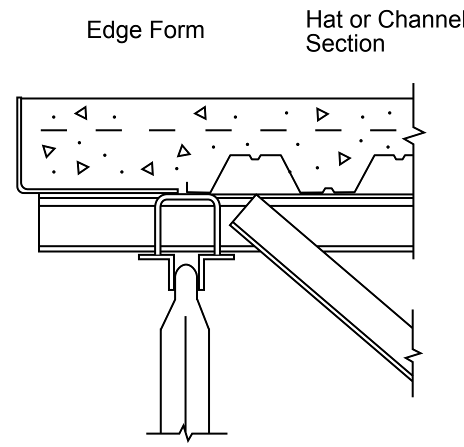


Figure 1.17.14: **SINGLE PIECE EDGE FROM PARALLEL TO DECK ON OPEN WEB JOIST GIRDER**

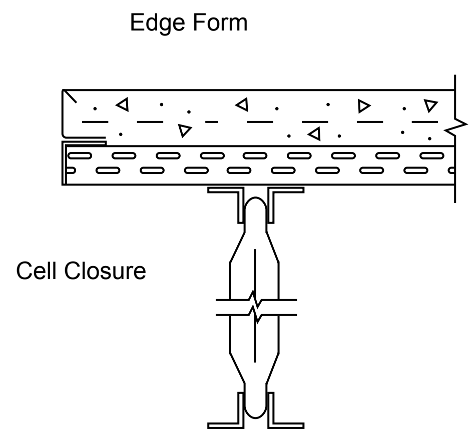


Figure 1.17.15: **TWO PIECE EDGE FORM WITH DECK CANTILEVER ON WIDE FLANGE BEAM**

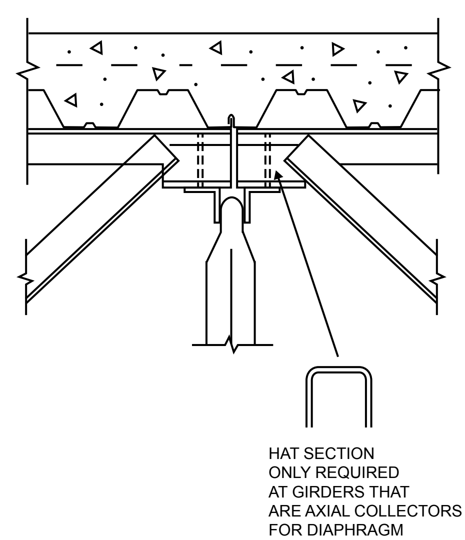


Figure 1.17.16: **DECK ON OPEN WEB STEEL JOISTS AND OPEN WEB STEEL JOIST GIRDER**

1.17 **Typical Details**

Column Flashings

Columns may require deck support angles depending on web support. Smaller columns often do not require deck support angles because there are no unsupported webs as shown in Figure 1.17.17. Large columns will create a condition in which one or more webs are unsupported, as shown in Figure 1.17.18. When the webs are unsupported, deck support angles are required to limit localized deflections during concrete placement. The Detail in Figure 1.17.18 is a common example of how deck may be supported when required. Using the thinnest support angles practical, when installed as shown, makes fitting and attaching the deck easier.

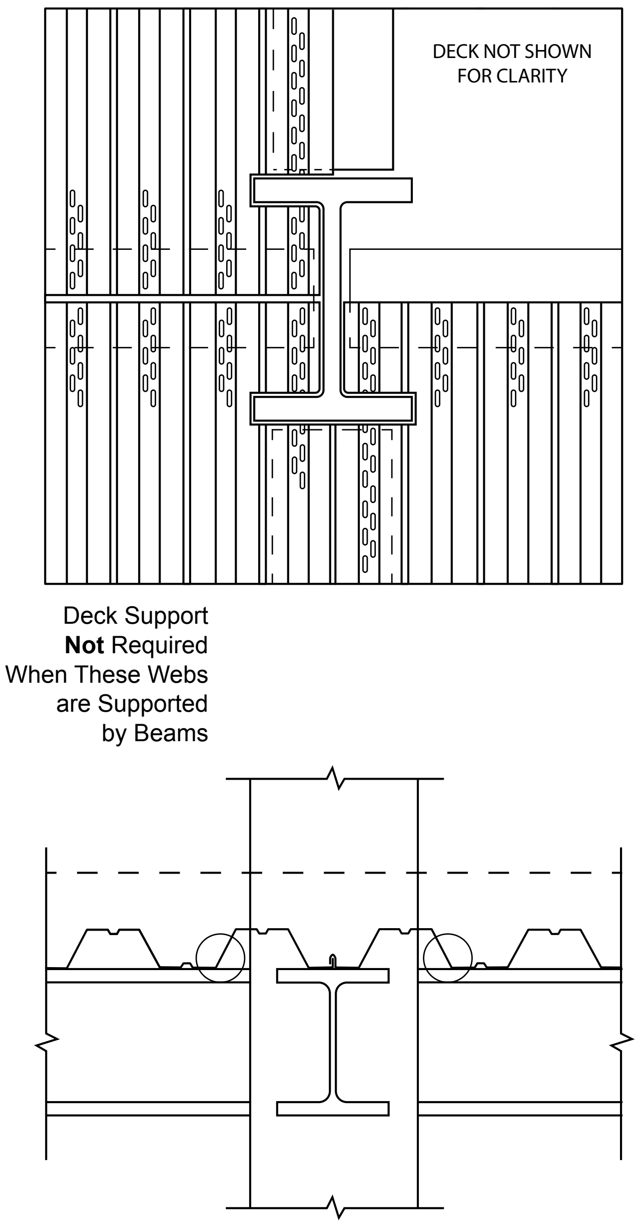


Figure 1.17.17: **COLUMN DETAIL NOT REQUIRING DECK SUPPORT ANGLES**

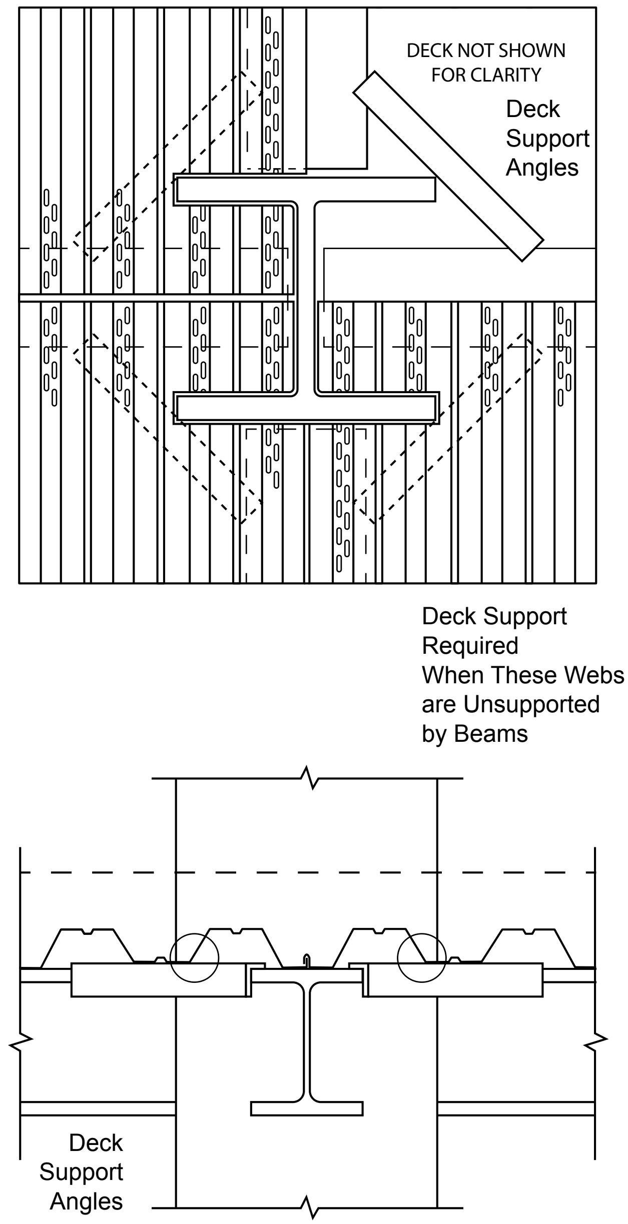


Figure 1.17.18: **COLUMN DETAIL REQUIRING DECK SUPPORT ANGLES**

ASC STEEL DECK

Composite Deck-Slab 1.18 Tables General Requirements

General Notes

1. The general notes apply to the entire design guide and IAPMO ER-329 report.
2. Composite steel deck is manufactured from galvanized steel conforming to ASTM A653 SS grade 50 or bare steel conforming to ASTM A1008 SS grade 50.
3. The concrete slabs depth in the tables is measured for the bottom of deck to the top of concrete.
4. The vertical load span is the clear span between supporting members.
5. Superimposed load is the load which can be applied to the composite deck in addition to the weight of the steel deck and concrete.
6. No uniform service load, based on an L/360 deflection limit, is shown when the load is greater than the allowable superimposed load.
7. For composite steel deck assemblies which exceed the scope of the table, the performance may be determined in accordance with *ANSI/SDI C-2011*.
   a. For 2WH-36 and 2WHF-36 the embossment shape is Type 1 with an embossment factor, K = 1.0, reference Eq. A2-8 in *ANSI/SDI C-2011*
   b. For 3WxH-36 and 3WxHF-36 the embossment shape is Type 2 with an embossment factor, K = 1.0, reference Eq. A2-8 in *ANSI/SDI C-2011*
   c. For BH-36 and BHF-36 the embossment shape is Type 1 with an embossment factor, K = 1.0, reference Eq. A2-8 in *ANSI/SDI C-2011*
   d. For NH-32 and NHF-32 the embossment shape is Type 2 with an embossment factor, K = 1.0, reference Eq. A2-8 in *ANSI/SDI C-2011*
8. Load tables are based on non-cellular version of profile. The addition of the pan (bottom plate) of cellular deck increases steel area and inherently increases the performance of the composite deck assembly. Using non-cellular design values in tables is therefore conservative.
9. Definition of symbols for composite deck

A_s	Area of reinforcing steel
I_{cr}	Cracked moment of inertia
I_u	Un-cracked moment of inertia
$(I_{cr}+I_u)/2$	Moment of inertia for determining deflection under service load
L	Vertical load clear span
M_{no}/Ω	ASD available flexural moment
V_n/Ω	ASD available vertical shear
ϕM_{no}	LRFD available flexural moment
ϕV_n	LRFD available vertical shear
ϕS_n	LRFD available diaphragm shear
PAF	Power actuated fastener
W/Ω	ASD available superimposed load capacity
ϕW	LRFD available superimposed load capacity

10. Definition of symbols for panel properties

A_g	Gross Area of steel deck
t	Design base steel thickness of steel deck
F_y	Yield strength of steel
F_u	Tensile strength of steel
I_g	Moment of inertia of gross section
y_b	Distance form extreme bottom fiber to neutral axis of gross or effective section
s_g	Minimum section modulus for gross section
r	radius of gyration
A_e	Effective are for compression
s_e-	Negative effective section modulus
s_e+	Positive effective section modulus
I_e+	Positive effective moment of inertia
I_e-	Negative effective moment of inertia
I+	Positive effective moment of inertia for determining deflection
I-	Negative effective moment of inertia for determining deflection

11. Definition of symbols for reactions

h	Flat width of web
R/Ω	ASD available reaction capacity at support based on web crippling
ϕR	LRFD available reaction capacity at support based on web crippling
r	bend radius of web/flange transition
θ	angle relative to the support of the web

12. Definition for headed shear stud anchors

Q_n	Nominal shear capacity for one welded headed shear studs anchor
Q_n/Ω	ASD available shear capacity for one welded headed shear studs anchor
ϕQ_n	LRFD available shear capacity for one welded headed shear studs anchor

Deck as a form

1. Shoring spans are based on the load combinations and bending strength requirements of *ANSI/SDI C-2011,* which include the weight of the deck. The loading includes the weight of the deck, concrete and 20psf uniform construction load, or 150 lbs/ft line load at mid span. In addition to the loads in accordance with *ANSI/SDI C-2011*, 3psf is added for normal weight concrete, and 2 psf is added for light weight concrete to account for pounding due to deck deflection between supporting members.
2. The theoretical deflection is limited to L/180, but not to exceed ¾ inch for the weight of concrete and steel deck only.
3. Reactions at supports shall not be exceeded. The shoring span may be limited by the reactions at supports in some conditions. For support reactions exceeding the reaction tables, the reactions shall be based on the web crippling of the steel deck using the flat width (h), angle to support (θ) and bend radius (r) presented in the reactions tables in accordance with the provisions of AISI S100-2012.
4. Conditions exceeding the scope of the tables, such as cantilever spans, may be determined in accordance with *ANSI/SDI C-2011* and submitted to the building official for approval.

1.18 Composite Deck-Slab Tables General Requirements

Concrete and minimum reinforcing

1. The minimum 28-day compressive strength for structural concrete shall be 3,000 psi (20.68 MPa). The appropriate concrete density (normal weight or structural lightweight) is indicated in the tables.
2. Minimum reinforcing may be provided by reinforcing steel, welded wire fabric, or fibers in accordance with of the following:
    a. Minimum steel reinforcing shall be equal to 0.00075 times the area of the concrete above the steel deck, but not less than 6 x 6 W1.4 x W1.4 welded wire fabric with a 60,000psi minimum tensile strength complying with ASTM A1064.
    b. Concrete fibers in accordance with ANSI/SDI C-2011 section 13.a.1 or 13.a.2.

Attachment of composite steel deck to supports

1. To develop the shear capacity in the tables, the deck shall be attached to the supports with the specified fastener pattern.
2. Spacing of welds or fasteners running parallel with the deck shall not exceed 36 inches on center.
3. Power actuated fasteners shall be installed per manufacture's instructions.
4. Welds and fasteners to the supports shall be as follows:
    a. Welds:
        i. Welds shall be have a minimum of 60ksi filler metal. For shielded metal arc welding, a minimum E60xx electrode should be used.
        ii. Arc spot welds shall have a minimum ½ inch effective diameter and not less than a ⅝ inch visible diameter.
        iii. Arc seam welds shall have a minimum ⅜ inch x 1 inch effective size, and may be substituted for ½ inch effective diameter arc spot welds.
    b. Power actuated fasteners (PAF) in support steel ≥ .25 inch thick shall be:
        i. Hilti X-ENP19
        ii. Pneutek K64
        iii. Pneutek K66
    c. Power actuated fasteners (PAF) in support steel ≥ 0.109 inch thick shall be:
        i. Hilti X-HSN 24
        ii. Pneutek K63
        iii. Pneutek K61
    d. Self-drilling screws in support steel ≥ .034 inch thick shall be:
        i. #12 Self Drilling-Screw in accordance with SAE J78.
    e. Minimum Edge Distance
        i. Steel deck may be butted at supports or end lapped. The standard end lap is a 2 inch overlap with a tolerance of +/- ½ inch. The minimum 1½ inch overlap (2 inch standard less ½ inch tolerance) is required. Overlaps greater than 2½ inches do not affect diaphragm performance, but is more difficult to install.
        ii. The minimum edge distance for self-drilling screws and power driven fasteners (pins/nails) is ½ inch.
5. The minimum edge distance for welds is ¾ inch measured from the center of the arc spot weld and the center of the end radius of the arc seam weld.

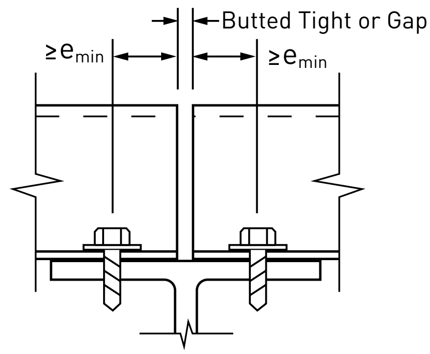


Figure 1.18.1: **BUTTED DECK CONDITION**

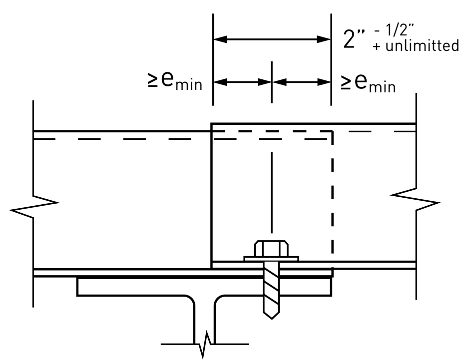


Figure 1.18.2: **END LAPPED DECK CONDITION**

Side seam attachment between deck panels

1. The minimum side seam attachment is a button punch at 36 inches on center.
2. Triple Button Punches, DeltaGrip side seam connections, arc top seam welds, or self-drilling screws may be substituted on a one to one basis for button punches.
3. The minimum edge distance for side lap screws is 1.5 times the nominal diameter of the screw.

Diaphragm shear attached with arc spot welds, power actuated fasteners, or self-drilling screws.

1. For composite steel deck assemblies which exceed the scope of the tables, the diaphragm shear performance may be determined in accordance with the SDI DDM03 referenced in *ANSI/SDI C-2011.*
2. Diaphragms with concrete fill have a flexibility factor, f < 0.5 micro inches per lb equal to a shear stiffness, G'

> 2000kip/inch.

3. Spacing of welds or fasteners transferring shear between the composite steel deck and supporting structures shall be based on the shear demand and the weld or fastener shear resistance.
   fastener spacing (ft) = weld or fastener capacity (lbs) / shear demand (lbs/ft)
4. Resistance and safety factors for diaphragm shear, $\phi = 0.5$

Diaphragm shear with welded headed shear stud anchors

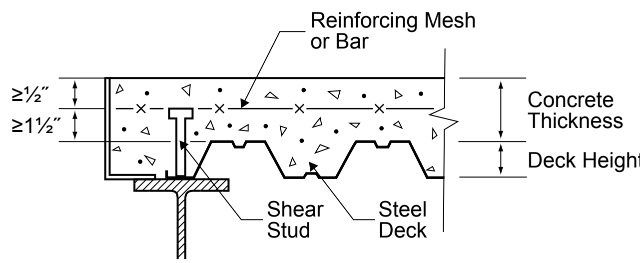
1. Concrete shear reinforcing steel shall be provided that meets the minimum specified reinforcing area, (A_s), in the table based on suggested welded wire reinforcing size. Reinforcing shall have minimum yield strength of 60,000psi and meet the requirements of ACI 318 for standard reinforcing bars or WRI standard welded wire reinforcement.
2. To achieve tabulated diaphragm shears, the welded stud shear connectors are only required at locations in which diaphragm shear is being transferred between the composite deck slab and supporting members. Intermediate support members may be attached with welds, screws or PAF's (power actuated fasteners).
3. Intermediate ribs of the steel deck not attached with welded stud shear connectors shall be fastened to the supporting member with arc spot welds, self-drilling screws, or power actuated fasteners.
4. The welded stud shear connector strength assumes the weak position in the deck flute. Reference AISC 360-10 Commentary and Figure C-I8.1.
5. Tabular values for shear strength of concrete diaphragm above deck is in accordance with ACI 318-14 based on a resistance factor $\phi = 0.75$. Refer to ACI 318 for additional requirements to be considered in seismic design.
6. Welded stud shear connectors shall extend 1½" above the top of the steel deck and shall have a minimum of ½" concrete cover above the top of the installed connector. Reference AISC 360-10 Section I3.2c.
7. The supporting member flange shall not be less than 0.3 inches thick unless the welded stud shear connector is welded over the web of the supporting member. Reference AISC 360-10 Section I8.1.
8. The maximum center-to-center spacing of welded stud shear connectors shall not exceed 8 times the depth of concrete above the deck or 36" per AISC 360-10 Section I8.2d.
9. Concrete reinforcement details shall be in accordance with ACI318.
10. For local shear transfer in the field of the diaphragm, ¾ inch diameter welded stud shear connectors shall be determined in accordance with AISC 360. The following shear capacities are for 2 inches of concrete cover above the steel deck and may be used conservatively for all thicknesses greater than 2 inches.

¾" Steel Headed Stud Anchors

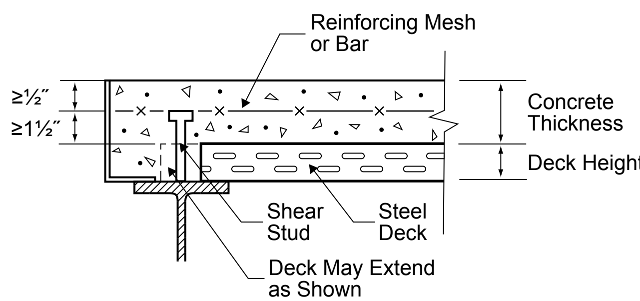
DECK TYPES	Shear Capacity[1]	
	ASD Q_n/R	LRFD ϕQ_n
2WH-36, 2WHF-36, & 2WHF-36A, 3WxH-36, 3WxHF-36, & 3WxHF-36A	10.3 kips	15.5 kips
BH-36, BHF-36, & BHF-36A NH-32, NHF-32, & NHF-32A	8.8 kips	13.2 kips

[1]145 pcf Normal Weight Concrete and 110 pcf Light Weight Concrete

Figure 1.18.3



Deck Parallel to Beam



Deck Perpendicular to Beam

Figure 1.18.4

11. See figure 1.18.4 for typical details.
12. For diaphragm shear of composite steel deck assemblies attached with welded shear studs which exceed the scope of the tables, the diaphragm shear may be determined in accordance with the provision of ACI 318 and AISC 360 as follows.
    a. The diaphragm shear shall be the lesser of the capacity of the reinforced concrete and the capacity of the welded shear studs to transfer the shear from the supporting member to the reinforced concrete section.
    b. Reinforced concrete shear shall be determined in accordance with the requirements of ACI 318 using the concrete thickness above the steel deck.
    c. The welded shear stud strength shall be determined in accordance with AISC 360.

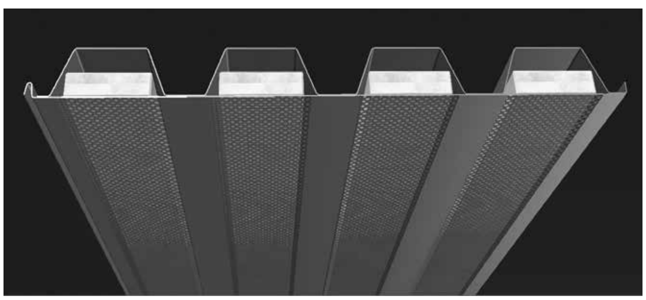
2.1 Acustadek®

Acustadek®

Acustadek provides the extraordinary beauty of exposed steel, while providing the same noise reduction performance of common Mineral Fiber, Fiberglass, and Bio Acoustic ceiling tile systems. It is an excellent option for reducing noise inside buildings, increasing the comfort for the occupants. Acustadek is a dual-purpose panel which helps lower costs by providing an interior finish while contributing to the structural performance of the building. This is accomplished by perforating the structural steel deck and adding fiberglass batt acoustic media in the webs or in the cells of cellular deck, turning the profile into Acustadek. Our new Smooth Series™ rivets offer a clean attachment solution for the Acustadek cellular deck system.

Cellular Acustadek®

Cellular Acustadek has 0.157" diameter holes spaced 0.433" inches on center in the sections of the pan below the top flutes of the steel deck. Fiberglass batts are factory inserted in the cells of the deck before shipping to the project locations. Any roof system utilizing structural or insulating concrete fill, rigid insulation board, or other roof substrate material suitable for installation on a steel roof deck may be applied to the cellular Acustadek.



Fiberglass Batts

Fiberglass batts are used to absorb sound in the Acustadek assemblies. ASC Steel Deck supplies the fiberglass batts which are cut to size for the specified profile. The standard batts are unfaced. Optional batts encapsulated with 0.75 mil clear pvc plastic can be specified.

Acoustical Performance

All Acustadeks have been tested for the sound absorption characteristics of the assemblies. This is commonly presented as a Noise Reduction Coefficient (NRC). The NRC is the average of the 250, 500, 1000, and 2000 hertz sound absorption coefficients. Acustadeks have between a 0.6 and 1.0 NRC, which can meet LEED v4 EQ Credit Acoustic Performance Option 2.

Acustadek should be a portion of a holistic approach to reducing the noise level in a building. Simply specifying an NRC rating for a single material may not get the level of sound control you require. In general, steel deck tend to have better sound absorption coefficients in the higher audible range. Other materials such as fabric wall treatments and carpet tend to have better sound absorption coefficients in the lower audible frequency ranges. The use of Acustadek in combination with other materials may create the best overall quiet environment. An experienced acoustic designer is key to developing the best overall performance using ASC Steel Deck Acustadek products.

The sound absorption coefficient varies across the spectrum of audible sound. In buildings with equipment which creates a specific frequency, the sound absorption coefficient for that frequency range should determine the type of deck rather than the overall NRC rating.

The NRC should not be confused with the Sound Transmission Coefficient (STC). STCs measure the blocking of sound through an assembly as it relates to the decibel drop in the intensity of the sound. Acustadek may not be a good choice if a high STC is required. As an example, consider a room with noisy equipment. The Acustadek may be a good solution to reduce the noise level in the room for the occupants, but may not be a good material to block the noise from escaping the room. The holes in the perforated Acustadek may in fact let more sound escape the room than a conventional deck.

Detailing and Installation of Acustadek®

Acustadek provides an exposed finish in the building. Steel deck is a structural element in the building and is subject to incidental dents in the handling and steel erection process. To minimize the potential damage use 20 gage or heavier. 22 gage may be an economical option when minor dents can be tolerated; dark paint finishes or high roof structures can mask these types of minor blemishes.

Acustadek can be specified with a galvanized finish or factory prime painted over galvanized steel. Most Acustadeks will receive finish paint to meet the aesthetic requirements of the building. The galvanized steel can be field painted following the paint manufacturer's preparation and application recommendations. As an option, factory-applied primer can be specified, which may reduce the surface preparation of the deck.

Attaching the Acustadek to the structure and connection of the side laps of the deck can impact the appearance of the installed product. Side lap top seam welds will leave burn marks on the galvanized finish and an occasional burn through should be expected. This may be unsightly if the galvanized finish is intended to be left exposed. The burns can be easily cleaned up prior to prime painting the deck after installation. A better solution, however, is to use the DeltaGrip® side lap connection. This mechanical interlock connection provides high strength similar to a weld without any thermal damage to the deck or galvanized coating, and is not visible from the underside of the deck. Arc spot and arc seam welds may also leave visible burn marks on the deck near the support or on the underside of the supporting steel. A good alternative to welding the deck to supports is to attach the deck with self-drilling screws or power-actuated fasteners (PAF), such as the high shear nails manufactured by Hilti, Inc. or fasteners manufactured by Pneutek Inc. which are intended for decking applications.

Structural Performance of Acustadek®

The Acustadek perforations have a small impact on the structural performance of the deck profiles. Section properties are reduced from the non-Acustadek version of the profiles leading to reduced vertical load capacity. The reactions at supports are unaffected by the perforations in the Acustadek.

Sound Absorption Data

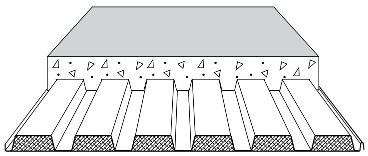
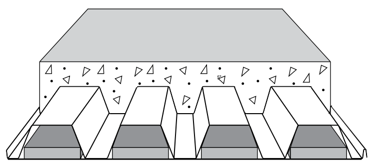
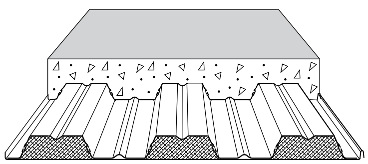
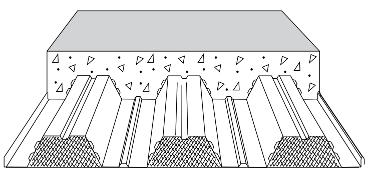
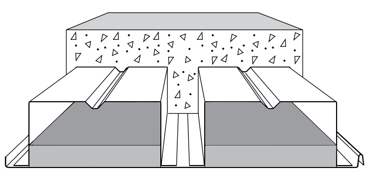
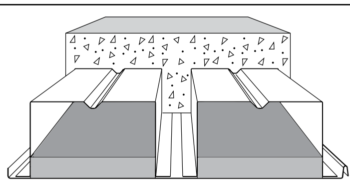
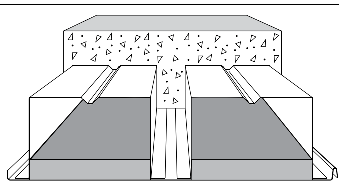
Acustadek® Profile (Perforation Type)	Batt[2]	Absorption Coefficient[1] 125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	Noise Reduction Coefficient[1]
 BHF-36A	Unfaced	0.20	0.45	0.77	1.09	0.84	0.56	0.80
	Encapsulated	0.16	0.37	0.70	1.01	0.64	0.49	0.70
 NHF-32A	Unfaced	0.44	0.57	1.08	1.00	0.82	0.63	0.85
	Encapsulated	0.49	0.63	1.17	0.93	0.72	0.48	0.85
 2WHF-36A	Unfaced	0.43	0.49	0.80	0.86	0.67	0.56	0.70
	Encapsulated	0.38	0.42	0.79	0.79	0.48	0.41	0.60
 3WxHF-36A	Unfaced	0.58	0.53	0.98	0.85	0.66	0.52	0.75
	Encapsulated	0.60	0.79	0.66	0.50	0.46	0.46	0.60
 4.5DF-24A	Unfaced	0.40	0.75	0.83	0.68	0.70	0.54	0.75
	Encapsulated	0.58	0.91	0.93	0.68	0.59	0.46	0.80
 6DF-24A	Unfaced	0.40	0.89	0.85	0.72	0.70	0.53	0.80
	Encapsulated	0.53	0.88	0.82	0.70	0.63	0.52	0.75
 7.5DF-24A	Unfaced	0.78	0.99	0.86	0.79	0.72	0.52	0.85
	Encapsulated	0.84	0.93	0.79	0.75	0.65	0.93	0.80

Table Notes:

1. Noise reduction coefficient testing was conducted in accordance with ASTM C423 and ASTM E795.
2. Unfaced or encapsulated fiberglass batts wrapped with clear plastic film.

Metric Conversion Chart

Metric Conversions

	Multiply	By	To Obtain
Spans, length & thickness	Inches	25.4	Millimeters
	Feet	304.8	Millimeters
	Inches	0.0254	Metres
	Feet	0.3048	Metres
Vertical Load & Superimposed Load	psf	0.0479	kPa
	psi	6.8948	kPa
Area	Square feet	0.0929	Square Metre
	Square	9.2903	Square Metre
Diaphragm Shear	plf	0.0146	KN/m
Section Properties	in^3/ft	53,763	mm^3/m
	in^4/ft	1,365,588	mm^4/m
	in^3/ft	53.763	cm^3/m
	in^4/ft	136.559	cm^4/m
Weight	Pounds	0.00445	kN
	psf	4.8824	kg/m^2
Volume	pcf	16.018	kg/m^3

ASC
STEEL DECK

Manufacturing Facilities

ASC Steel Deck • Sacramento, CA
2110 Enterprise Boulevard
West Sacramento, CA 95691
916-372-6851
800-726-2727

ASC Steel Deck • Fontana, CA
10905 Beech Avenue
Fontana, CA 92337

Visit us at:
www.ascsd.com