

# **Introduction to SDI NC-2010 Standard for Non-Composite Steel Floor Deck**

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## **Introduction**

Steel deck products are used in buildings as part of cost effective floor and roof assemblies. Steel decks can be designed to carry not only gravity and uplift loads, but when properly detailed and installed, provide effective diaphragms to resist lateral loads due to wind and seismic events. Proper design and specification of deck products are the responsibility of the building structural engineer-of-record (SEOR). When looking for design standards and general design guidance, the engineer's best source of information is the Steel Deck Institute.

Formed in 1939, the Steel Deck Institute (SDI) provides uniform industry standards for the engineering, design, manufacture, and field usage of steel decks. The SDI is concerned with cold-formed steel products used to support finished roofing materials or to serve as a permanent form and/or positive reinforcement for concrete floor slabs.

## **Standards and Codes**

The Steel Deck Institute is an American National Standards Institute (ANSI) Accredited Standards Developer that is responsible for standards specific to the design, fabrication, and installation of steel deck products, including the ANSI/SDI-NC-2010 "Standard for Non-Composite Steel Floor Deck."

This Standard references the American Iron and Steel Institute (AISI) North American Specification for the Design of Cold-Formed Steel Structural Members [AISI, 2007] as the base standard for the calculation of member strength. The AISI standard is incorporated by reference into the 2009 and 2012 International Building Codes.

### **ANSI/SDI-NC-2010 “Standard for Non-Composite Steel Floor Deck”**

The SDI Standard for Non-Composite Steel Floor Deck [SDI NC-2010] provides criteria for the proper design, specification, and installation of non-composite steel floor deck. This standard was developed by SDI to meet a need for a standard for non-composite steel floor deck. This standard is currently included by reference in the 2012 International Building Code.

Some highlights of this standard include:

1. Criteria for design of the deck as a form prior to the curing of the concrete, including requirements for construction loading.
2. Criteria for the design of the concrete as a reinforced concrete slab in accordance with ACI 318.
3. Specification of accessories such as pour stops and end closures
4. Specification of welds and mechanical fasteners
5. Installation and anchorage criteria

Through studying the Standard, the reader will become familiar with how to properly specify non-composite steel floor deck and how to properly design concrete slabs on non-composite steel floor deck.

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**AMERICAN NATIONAL STANDARDS INSTITUTE/ STEEL DECK INSTITUTE**

NC - 2010 Standard for

# **Non-Composite Steel Floor Deck**



## 1. General

### 1.1 Scope:

- A. This Standard for Non-Composite Steel Floor Deck, hereafter referred to as the Standard, shall govern the materials, design, and erection of cold formed steel deck which is used as a form for reinforced concrete slabs in floor and roof applications in buildings and similar structures.
- B. The appendices shall be part of the Standard.
- C. The user notes and user note attachments shall not be part of the Standard.

**User Note:** User notes and user note attachments are intended to provide practical guidance in the use and application of this Standard.

- D. Where the Standard refers to “designer,” this shall mean the entity that is responsible to the Owner for the overall structural design of the project, including the steel deck. This is usually the Structural Engineer of Record.
- E. Equations that appear in this Standard are compatible with the inch-pounds system of units. However, any consistent system of units may be used. SI units or equations are shown in parenthesis in this Standard are for information only and are not part of this Standard.
- F. Terms not defined in this Standard, AISI S100 or AISI/AISC shall have the ordinary accepted meaning for the context for which they are intended.
- G. It shall be permitted to specify deck base steel thickness either by dimensional thickness, or by gage when the relationship of base steel thickness to gage has been defined by the deck manufacturer. However, for the purpose of design, the dimensional thickness shall be used.

### 1.2 Reference Codes, Standards, and Documents:

- A. Codes and Standards: The following documents or portions thereof are referenced in this Standard and shall be considered part of the requirements of this Standard
  - 1. American Iron and Steel Institute (AISI)
    - a. AISI S100-07 w/S2-10, North American Specification for the Design of Cold-Formed Steel Structural Members, Including Supplement 2 (February 2010)
    - b. AISI S905-08, Test Methods for Mechanically Fastened Cold-Formed Steel Connections
    - c. AISI S907-08, Test Standard for Cantilever Test Method for Cold-Formed Steel Diaphragms
    - d. AISI/AISC, Standard Definitions for Use in the Design of Steel Structures, 2007 edition
  - 2. American Welding Society (AWS)
    - a. AWS D1.1:2010, Structural Welding Code-Steel
    - b. AWS D1.3:2008, Structural Welding Code-Sheet Steel
  - 3. American Society for Testing and Materials (ASTM)
    - a. ASTM A653 / A653M - 08 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

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- b. ASTM A1008 / A1008M - 08a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
  - 4. American Concrete Institute (ACI)
    - a. ACI 318-08, Building Code Requirements for Structural Concrete
  - 5. American Institute of Steel Construction (AISC)
    - a. ANSI/AISC 360-10, Specification for Structural Steel Buildings
- B. Reference Documents: The following documents or portions thereof are referenced in this Standard and shall be considered part of the requirements of this Standard. Where these documents conflict with this Standard, the more stringent shall control.
- 1. Steel Deck Institute (SDI)
    - a. SDI-DDM, Diaphragm Design Manual, 3<sup>rd</sup> Edition, including Appendices I through VI

**User Note:** The following documents are referenced within the user notes:

- 1. American Iron and Steel Institute (AISI)
  - a. AISI S100-07 w/S2-10, North American Specification for the Design of Cold-Formed Steel Structural Members, Including Supplement 2 (February 2010)
  - b. AISI S907-08, Test Standard for Cantilever Test Method for Cold-Formed Steel Diaphragms
- 2. American Society for Testing and Materials (ASTM)
  - a. ASTM A653 / A653M - 08 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - b. ASTM A1008 / A1008M - 08a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
  - c. ASTM E119 - 08a, Standard Test Methods for Fire Tests of Building Construction and Materials
- 3. Underwriters Laboratories (UL)
  - a. Fire Resistance Directory
- 4. Steel Deck Institute (SDI)
  - a. SDI-DDM, Diaphragm Design Manual, 3<sup>rd</sup> Edition, including Appendices I through VI
  - b. SDI-MOC, Manual of Construction with Steel Deck, 2<sup>nd</sup> Edition

## 2 Products

### 2.1 Material:

- A. All sheet steel used for deck or accessories shall have a minimum specified yield stress which meets or exceeds 33 ksi (230 Mpa) and a maximum specified yield stress which shall not exceed 80 ksi (550 Mpa).

**User Note:** The 80 ksi upper limit on specified yield stress applies only to the specified limit for a particular steel grade. Steel supplied under that specified grade may have mill certificates that report yield strengths of greater than 80 ksi. In

accordance with AISI S100, this is acceptable and should not be considered to be grounds for rejection.

- B. Sheet steel for galvanized deck shall conform to ASTM A653 / A653M, Structural Steel. Other galvanized structural sheet steels or high strength low alloy steels shall be permitted in accordance with AISI S100, Section A2.
- C. Sheet steel for uncoated deck shall conform to ASTM A1008 / A1008M. Other structural sheet steels or high strength low alloy steels shall be permitted in accordance with AISI S100, Section A2.

**User Note:** Materials are offered in A653 (A653M) grade 80 steel (galvanized) or ASTM A1008 (A1008M) grade 80 steel (uncoated). This steel has a minimum yield strength of 80 ksi (550 MPa) and is generally over 90 ksi (620 MPa). Depending on the deck geometry, AISI S100 limits the maximum design yield stress to 60 ksi (415 MPa) for this material.

**User Note:** Most steel deck is manufactured from steel conforming to ASTM A1008 / A1008M, or from ASTM A653 / A653M, Structural Sheet Steel. When specifying alternative steels, certain restrictions apply, particularly as noted in AISI S100-07, Paragraph A2.3.2. Section 2.1B of this standard refers to the use of galvanized deck while Section 2.1C refers to the use of uncoated or uncoated top/painted underside deck. In most cases the designer will choose one finish or the other. However, both types of finish may be used on a project, in which case the designer must indicate on the plans and project specifications the areas in which each is used. (Refer to Section 2.3 of this Standard). Specification of painted deck in areas that require spray-on fireproofing should be avoided unless specifically permitted by the applicable fire rated assembly. This must be clearly called out in the contract documents. In general, there are three types of fire resistive assemblies; those achieving the fire resistance by membrane protection, direct applied protection, or with an unprotected assembly. Of these three, only the systems that utilize direct applied protection are concerned with the finish of the steel deck. In these systems, the finish of the steel deck can be the factor that governs the fire resistance rating that is achieved. In assemblies with direct applied fire protection the finish (paint) is critical. In the Underwriters Laboratories Fire Resistance Directory, some of the individual deck manufacturing companies have steel deck units that are classified in some of the D700, D800, and D900-series roof-ceiling designs. These classified deck units (Classified Steel Floor and Form Units) are shown as having a galvanized finish or a phosphatized/painted finish. These classified deck units have been evaluated for use in these specific designs and found acceptable.

- D. Sheet steel for accessories shall conform to ASTM A653 / A653M, Structural Steel for structural accessories, ASTM A653 / A653M, Commercial Steel for non-structural accessories, or ASTM A1008 / A1008M for either structural or non-structural accessories. Other structural sheet steels or high strength low alloy steels shall be permitted in accordance with AISI S100, Section A2.
- E. The deck type (profile) and thickness (gage) shall be as shown on the plans.
- F. Concrete:
  - 1. The specified concrete compression strength shall not be less than 3 ksi (21 MPa).
  - 2. Concrete and reinforcing steel placed on steel deck shall conform to ACI 318, Chapters 3, 4, and 5, except as modified in this standard.

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3. Admixtures containing chloride salts or other substances that are deleterious to the steel deck shall not be permitted.

**User Note:** The use of admixtures containing chloride salts is not allowed because the salts will corrode the steel deck. Other admixtures may also have corrosive effects.

## 2.2 Tolerance:

- A. The minimum uncoated steel thickness as delivered to the job site shall not at any location be less than 95% of the design thickness, however lesser thicknesses shall be permitted at bends, such as corners, due to cold-forming effects.

**User Note:** The minimum delivered thickness is as permitted by AISI S100.

- B. Panel length shall be no less than ½ inch (13 mm) shorter than the specified length nor greater than ½ inch (13 mm) longer than the specified length for single span or butted end deck. Panel length shall be no less than ½ inch (13 mm) shorter than the specified length for lapped end deck.

**User Note:** No restriction is placed on over length panels in lapped applications because there is no adverse consequence in this application.

- C. Panel cover width shall be no less than 3/8 inch (10 mm) less than the specified panel width, nor more than 3/4 inch (19 mm) greater than the specified width.
- D. Panel camber and/or sweep shall not be greater than 1/4 inch in a 10 foot length (6 mm in 3 m).
- E. Panel end out of square shall not exceed 1/8 inch per foot of panel width (10 mm per m).

## 2.3 Finish:

- A. Galvanizing shall conform to ASTM A653 / A653M.
- B. A shop coat of primer paint (one or both sides) shall be applied to steel sheet if specified by the designer.

**User Note:** Although deck painted on the top may be used as a form, uncoated steel or a galvanized surface is typically used in contact with concrete to achieve better chemical bond.

- C. The finish on the steel deck shall be compatible for the environment to which the deck is exposed within the finished structure, and shall be specified by the designer.

**User Note:** When galvanized material is used to support a reinforced concrete slab, the slab dead load is considered to be permanently carried by the deck. For any permanent load carrying function, a minimum galvanized coating conforming to ASTM A924 (A924M), G30 (Z090) is recommended.

**User Note:** The finish on the steel deck should be as specified by the designer and be suitable for the environment to which the deck is exposed within the finished structure. When non-composite deck with a painted bottom is used, the primer coat is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions and shall be considered an impermanent and provisional

coating. In highly corrosive or chemical atmospheres or where reactive materials could be in contact with the steel deck, special care in specifying the finish should be used, which could include specialized coatings or materials. In highly corrosive environments, consideration should be given to designing the slab to resist all service loads.

**User Note:** The uncoated finish is by custom referred to as “black” by some users and manufacturers; the use of the word “black” does not refer to paint color on the product.

**2.4 Design:**

A. Deck used as a form:

1. Design by either Allowable Strength Design (ASD) or Load and Resistance Factor Design (LRFD) shall be permitted. The section properties and allowable strength (ASD) or design strength (LRFD) for the steel deck shall be computed in accordance with AISI S100.

2. Deck shall be evaluated for strength under the following load combinations:

a. Allowable Strength Design

$$W_{dc} + W_{dd} + W_{lc} \quad (\text{Eq. 2.4.1})$$

$$W_{dc} + W_{dd} + P_{lc} \quad (\text{Eq. 2.4.2})$$

$$W_{dd} + W_{cdl} \quad (\text{Eq. 2.4.3})$$

Where:

$W_{dc}$  = weight of the fresh concrete

$W_{dd}$  = weight of the steel deck

$W_{lc}$  = uniform construction live load, 20 psf (0.96 kPa)

$W_{cdl}$  = uniform combined distributed construction live load, 50 psf (2.40 kPa)

$P_{lc}$  = concentrated construction live load per unit width of deck section; 150 pounds on a 1 foot width (2.19 kN on a 1 meter width)

b. Load and Resistance Factor Design

$$1.6W_{dc} + 1.2W_{dd} + 1.4W_{lc} \quad (\text{Eq. 2.4.4})$$

$$1.6W_{dc} + 1.2W_{dd} + 1.4P_{lc} \quad (\text{Eq. 2.4.5})$$

$$1.2W_{dd} + 1.4(W_{cdl}) \quad (\text{Eq. 2.4.6})$$

**User Note:** The load factor used for the weight of the fresh concrete is 1.6 because of delivering methods and an individual sheet can be subjected to this load. The use of a load factor of 1.4 for the construction load in LRFD design is calibrated to provide equivalent design results in ASD design. Refer to the commentary of AISI S100 for additional information.

3. Cantilever spans shall be evaluated for strength under the following load combinations:

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- a. Allowable Strength Design: Equations 2.4.1 and 2.4.2 shall be applied to both the cantilever span and the adjacent span. The concentrated construction live load ( $P_{lc}$ ) shall be applied at the end of the cantilever.
  - b. Load and Resistance Factor Design: Equations 2.4.4 and 2.4.5 shall be applied to both the cantilever span and the adjacent span. The concentrated construction live load ( $P_{lc}$ ) shall be applied at the end of the cantilever.
4. Special loading considerations:
- a. For single span deck conditions,  $w_{dc}$  shall be increased by 50%, the increase not to exceed 30 psf (1.44 kPa).
  - b. The specified construction live loads shall be increased when required by construction operations.
  - c. Loads shall be applied in a sequence that simulates the placement of the concrete, as indicated in Appendix 1. Rational analysis shall be permitted to be used for developing shear and moment diagrams and calculating deflections for non-uniform spans.

**User Note:** The loading shown in Figure 1 of Appendix 1 is representative of the sequential loading of fresh concrete on the deck. The 150 pound load (per foot of width) is the result of distributing a 300 pound (1.33 kN) worker over a 2 foot (600 mm) width. Experience has shown this to be a conservative distribution. The SI equivalent of the 150 pound load per foot is 2.19 kN per 1 m of width. For single span deck conditions, the ability to control the concrete placement may be restricted and an amplification factor of 1.5 is applied to the concrete load to address this condition; however, in order to keep this 50% load increase within a reasonable limit, the increase is not to exceed 30 psf (1.44 kPa). In LRFD, a load factor for construction of 1.4 is applied to this load. Whenever possible, the deck shall be multi-span and not require shoring during concrete placement.

The specified construction live loads reflect nominal loads of workers and tools and do not include loads of equipment such as laser screeds or power trowels. If anticipated construction activities include additional loads, they should be considered in the design.

5. Deck Deflection
- a. Calculated deflections of the deck as a form shall be based on the load of the fresh concrete as determined by the design slab thickness and the self-weight of the steel deck, uniformly loaded on all spans, shall be limited to the lesser of 1/180 of the clear span or 3/4 inch (19 mm). Calculated deflections shall be relative to supporting members.
  - b. The deflection of cantilevered deck as a form, as determined by slab thickness and self-weight of the steel deck, shall not exceed  $a/90$ , where “a” is the cantilever length, nor 3/4 inches (19 mm).

**User Note:** The deflection calculations do not take into account construction loads because these are considered to be temporary loads. The deck is designed to always be in the elastic range, so removal of temporary loads will allow the deck to recover. The supporting structural steel also deflects under the loading of the fresh concrete.

The designer is urged to check the deflection of the total system, especially if composite beams and girders are being used. The basic load tables are based on uniform slab thickness. If the designer wants to include additional concrete loading

on the deck because of frame deflection, the additional load should be shown on the design drawings or stated in the deck section of the project specifications.

6. Minimum Bearing and Edge Distance: Minimum bearing lengths and fastener edge distances shall be determined in accordance with AISI S100.

**User Note:** Figure 2 in Appendix 1 indicates support reactions. Experience has shown that 1-1/2 inches (38 mm) of bearing is sufficient for non-composite floor decks. If less than 1-1/2 inches (38 mm) of end bearing is available, or if high support reactions are expected, the design professional should check the deck web crippling capacity. The deck must be adequately attached to the structure to prevent the deck from slipping off the supporting structure.

7. Diaphragm Shear Capacity: Diaphragm strength and stiffness shall be determined either: (1.) in accordance with SDI-DDM, (2.) from tests conducted in accordance with AISI S907, or (3.) by other methods approved by the building official.
    - a. Safety factors and resistance factors shall be as shown in Table D5 of AISI S100 for bare steel deck diaphragms.
    - b. When SDI-DDM is the basis of diaphragm design, fasteners and welds which do not have flexibility and strength properties listed in SDI-DDM Section 4 shall demonstrate flexibility and strength properties through testing in accordance with AISI S905 or other equivalent testing methods approved by the building official. Fastener or weld strength defined in AISI S100 or other equivalent methods approved by the building official shall be permitted. Alternately, it shall be permitted to neglect the contribution of sidelap connections to diaphragm strength and stiffness.
      - i. Sidelap fillet welds and side seam welds shall be permitted to have flexibility calculated in accordance with SDI-DDM Section 4.4 and strength calculated in accordance with AISI S100.
  8. Connections: Deck shall be attached to supports to resist loads and to provide structural stability for the supporting joist or beam. Connections shall be designed in accordance with AISI S100 or strengths shall be determined by test in accordance with AISI S905. Tests shall be representative of the design. When tests are used and the design allows either end laps or single thickness conditions, both conditions shall be tested.
- B. Concrete Slab Design:
1. The concrete slab shall be designed by the designer in accordance with ACI 318.
    - a. At cantilever slabs and regions of negative moment, provide negative steel unless the form is capable of resisting all loads and the concrete is considered to be a wearing surface only.
    - b. Concentrated loads or combinations of concentrated loads with uniform loads shall be considered.
  2. Temperature and shrinkage effects in the concrete shall be controlled by methods permitted by ACI 318.

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- a. The designer shall be permitted to disregard the area of concrete that is displaced by the deck ribs.
- 3. Concrete Thickness:
  - a. The minimum concrete thickness above the top of the deck shall be 1-1/2 inches (38 mm).

**User Note:** The minimum concrete coverage of 1-1/2 inches is for structural design only. Decks that have wide top flanges may require thicker concrete cover to reduce the potential for cracking over the deck flange.

- 4. Calculation of Slab Superimposed Load Capacity:
  - a. If uncoated or painted deck is used, the weight of the concrete slab shall be deducted from the calculated capacity of the reinforced concrete slab.
  - b. If galvanized deck is used, the weight of the concrete slab shall be permitted to be permanently carried by the steel deck and need not be deducted from the calculated live load.

**User Note:** When uncoated or painted deck is used, it is considered to be an impermanent component and the concrete must be designed to carry the complete load, including the weight of the slab. When galvanized deck is used, it is considered to be a permanent component, and the dead weight of the concrete may be considered to be carried by the deck.

- c. If temporary shoring is used, the weight of the concrete slab shall be deducted from the calculated capacity of the reinforced concrete slab, regardless of the deck finish.

**User Note:** Except for some tested diaphragm values, the deck should not be assumed to act compositely with the concrete even though strong chemical bonds can, and do, develop.

- 5. Diaphragm Shear Capacity: Diaphragm strength and stiffness shall be determined either: (1.) in accordance with SDI-DDM, (2.) from tests conducted in accordance with AISI S907, or (3.) by other methods approved by the building official.
  - a. Safety factors and resistance factors shall be as follows for deck with fill:
    - i. When the analytical method of SDI-DDM is used:  
ASD: Safety Factor ( $\Omega$ ) = 3.25  
LRFD: Resistance Factor ( $\Phi$ ) = 0.50
    - ii. When strength is based on test:  
Safety and Resistance Factors shall be determined in accordance with AISI S100 Chapter F, but for structural concrete fill, shall not be less critical than those for concrete diaphragms contained in ACI 318, Section 9.3.
  - b. When SDI-DDM is the basis of diaphragm design, fasteners and welds which do not have flexibility and strength properties listed in SDI-DDM Section 4 shall demonstrate flexibility and strength properties through testing in accordance with AISI

S905 or other equivalent testing methods approved by the building official. Fastener or weld strength defined in AISI S100 or other equivalent methods approved by the building official shall be permitted. Alternately, it shall be permitted to neglect the contribution of sidelap connections to diaphragm strength and stiffness.

- i. Sidelap fillet welds and side seam welds shall be permitted to have flexibility calculated in accordance with SDI-DDM Section 4.4 and strength calculated in accordance with AISI S100.

- 6. Fire Resistance: The designer shall consider required fire resistance ratings in the design of the slab.

**User Note:** Fire rating requirements may dictate the minimum concrete strength. Many fire rated assemblies that use steel floor decks are available. In the Underwriters Laboratories *Fire Resistance Directory*, the deck constructions show hourly ratings for restrained and unrestrained assemblies. ASTM E119 provides information in appendix X3 titled “Guide for Determining Conditions of Restraint for Floor and Roof Assemblies and for Individual Beams”. It is generally acknowledged that all interior and exterior spans of multispan deck that are properly attached to bearing walls are restrained.

## 2.5 Accessories:

- A. Accessories for structural applications shall be of dimensions and thickness suitable for the application, and shall be designed in accordance with AISI S100 or AISC 360, as may be appropriate.

**User Note:** For convenience, minimum acceptable pour stop thicknesses (gages) are shown in User Note Attachment 1. For applications that exceed the scope of the attachment, alternate designs in accordance with AISI S100 and AISC 360 are acceptable.

## 3. Execution

### 3.1 Installation/General:

- A. Temporary shoring, if required, shall be installed before placing deck panels and shall be designed to resist a minimum uniform load of 50 psf (2.4 kPa), and the loading criteria indicated in Section 2.4.A.2. Shoring shall be securely in place before floor deck erection begins. The shoring shall be designed and installed in accordance with standards applicable to the specific shoring system and shall be left in place until the concrete attains 75% of its specified design strength, but not less than seven (7) days.
- B. Steel deck shall be anchored to steel supporting members including perimeter support steel and/or bearing walls by arc spot welds, fillet welds, or mechanical fasteners.
- C. Deck and accessories shall be cut and neatly fitted around scheduled openings and other work projecting through or adjacent to the decking.
- D. Edge ribs of panels shall be fastened to each point of support. Additional fasteners between edge ribs shall be spaced an average of 12 inches (300 mm) apart but not more than 18 inches (460 mm).

**User Note:** The edge rib is the bottom flange of the last rib of a deck panel.

- E. For deck with spans greater than 5 feet (1.5 m), side laps shall be fastened at intervals not to exceed 36 inches (1 m) on center, using one of the following methods:
1. Screws with a minimum diameter of 0.190 inches (4.83 mm) (#10 diameter)
  2. Crimp or button punch
  3. Arc spot welds 5/8 inch (16 mm) minimum visible diameter, or minimum 1-1/2 inch (38 mm) long fillet weld, or other weld shown to be substantially equivalent through testing in accordance with AISI S905, or by calculation in accordance with AISI S100, or other equivalent method approved by the building official.
  4. Side lap fasteners whose strength and flexibilities are determined in accordance with Sections 2.4.A.7.b and 2.4.B.5.b shall be permitted.

**User Note:** The above side lap spacing is a minimum. Service loads or diaphragm design may require closer spacing or larger side lap welds. Good metal to metal contact is necessary for a good side lap weld. When welding, burn holes are to be expected and are not grounds for rejection. Welds with fusion around 75% of the weld perimeter are considered acceptable. The SDI does not recommend welded sidelaps for deck that is thinner than 0.0358 inch design thickness (20 gage) due to difficulty in welding thinner material.

- F. For deck with spans greater than 5 feet (1.5 m), perimeter edges of units between span supports shall be fastened at intervals not to exceed 36 inches (1 m) on center, using one of the following methods:
1. Screws with a minimum diameter of 0.190 inches (4.83 mm) (#10 diameter)
  2. Arc spot welds with a minimum 5/8 inch (16 mm) minimum visible diameter, or minimum 1-1/2 inch (38 mm) long fillet weld.
  3. Powder actuated or pneumatically driven fasteners.

**User Note:** Number 10 screws may not be adequate at thicker edge supports and may fracture due to driving torque resistance. A minimum of a Number 12 screw is recommended at parallel edge supports thicker than 14 gage (0.0747 inch) and a Number 14 screw may be required for thicker and harder steels.

- G. Support shall be designed and specified by the designer at the perimeter of the floor.
- H. For cantilevers, side laps shall be attached at the end of the cantilever and at a maximum spacing of 12 inches (300 mm) on center from the cantilever end at each support. Each corrugation shall be fastened at both the perimeter support and the first interior support. The deck shall be completely attached to the supports and at the side laps before any load is applied to the cantilever. Concrete shall not be placed on the cantilever span before concrete is placed on the adjacent span.
- I. Fastener edge distance shall be as required by the applicable fastener design standard.
- J. Deck bearing surfaces shall be permitted to deviate from parallel a maximum of 1:24, but not to exceed 1/16 inch (1.6 mm).

**User Note:** Out of plane support flanges can create knife-edge supports and air gaps between the deck and support. This makes welding more difficult and allows distortion under screw or power actuated fastener washers or heads.

### 3.2 Welding

- A. All welding of deck shall be in accordance with AWS D1.3. Each welder shall demonstrate an ability to produce satisfactory welds using a procedure as described in ANSI/AWS D1.3.
 

**User Note:** SDI-MOC describes a weld quality control test procedure that can be used as a preliminary check for welding machine settings under ambient conditions.
- B. For connection of the deck to the supporting structure, weld washers shall be used with arc spot welds on all deck units with metal thickness less than 0.028 inches (22 gage) (0.71 mm). Weld washers shall be a minimum thickness of 0.050 inches (1.27 mm) and have a nominal 3/8 inch (10 mm) diameter hole. Weld washers shall not be used between supports along the sidelaps.
- C. Where weld washers are not required, a minimum visible 5/8 inch (16 mm) diameter arc spot weld or arc seam weld of equal perimeter shall be used. Weld metal shall penetrate all layers of deck material at end laps and shall have good fusion to the supporting members.
- D. When used, fillet welds to support structure shall be at least 1-1/2 inches (38 mm) long.
- E. When shear studs are installed to develop composite action between the beam or joist and the concrete slab, the shear stud shall be permitted as a substitute for an arc spot weld to the supporting structure. Shear studs shall be installed in accordance with AWS D1.1.

### 3.3 Mechanical Fasteners

- A. Mechanical fasteners, either powder actuated, pneumatically driven, or screws, shall be permitted in lieu of welding to fasten deck to supporting framing if fasteners meet all project strength and service requirements.
- B. When the fasteners are powder actuated or pneumatically driven, the strength per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than 1/8 inch (3mm) and on the fastener providing a minimum 5/16 inch (8mm) diameter bearing surface (fastener head size). Fasteners shall not be installed into structural supports which are outside the acceptable limits of the manufacturers applicable test report or other documentation.
- C. When the structural support thickness is less than 1/8 inch (3mm), powder actuated or pneumatically driven fasteners shall not be used unless lesser support thicknesses are permitted by applicable fastener test report or other documentation acceptable to the designer. Screws shall be acceptable for use without restriction on structural support thickness, however, the screw selected shall have a grip range compatible with the combined thickness of the deck and supporting member.

**User Note:** Mechanical fasteners (screws, powder or pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, provided the type and spacing of the fastener satisfies the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer as the basis for obtaining approval. Strength of mechanically fastened connections are dependent upon both deck and support thickness.

### 3.4 Accessory Attachment:

- A. Structural accessories shall be attached to supporting structure or deck as required for transfer of forces, but not to exceed 12 inches (300 mm) on center. Non-structural

accessories shall be attached to supporting structure or deck as required for serviceability, but not to exceed 24 inches (600 mm) on center.

- B. Mechanical fasteners or welds shall be permitted for accessory attachment.

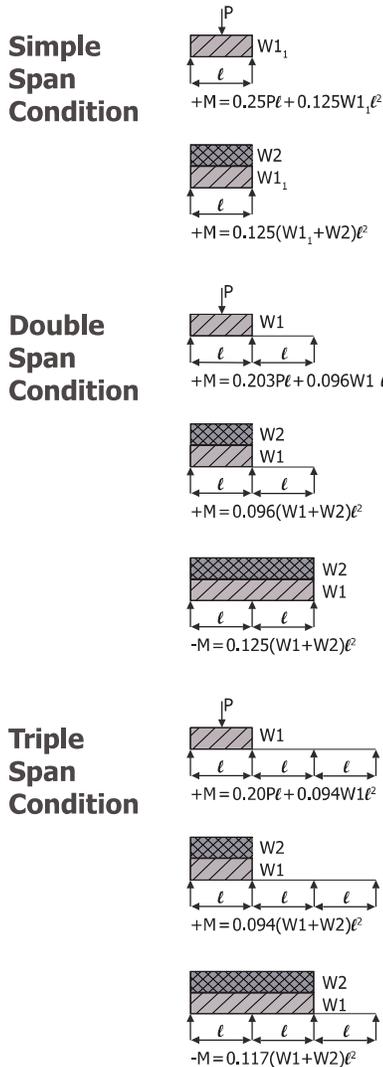
### **3.5 Cleaning Prior to Concrete Placement:**

- A. Surfaces shall be cleaned of debris, including but not limited to, welding rods, stud ferrules which are broken free from the stud, and excess fasteners, prior to concrete placement.

# Non-Composite Deck Construction Loading Diagrams

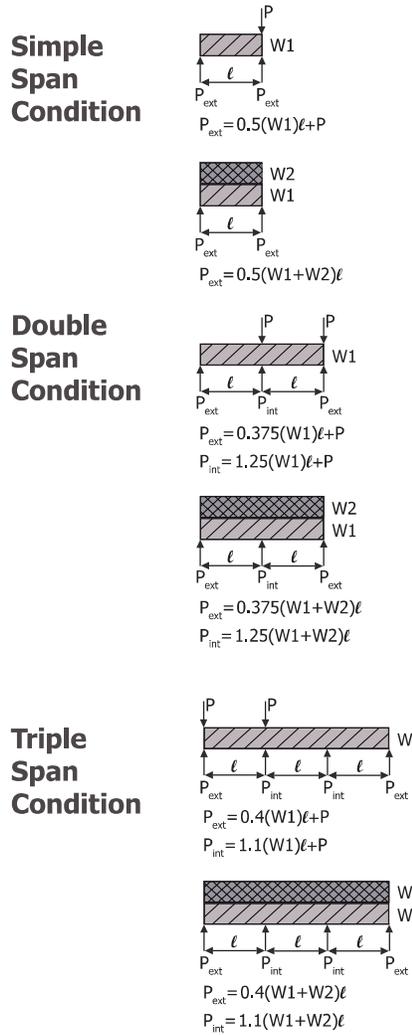
**FIGURE 1**

**Loading Diagrams and Bending Moments**



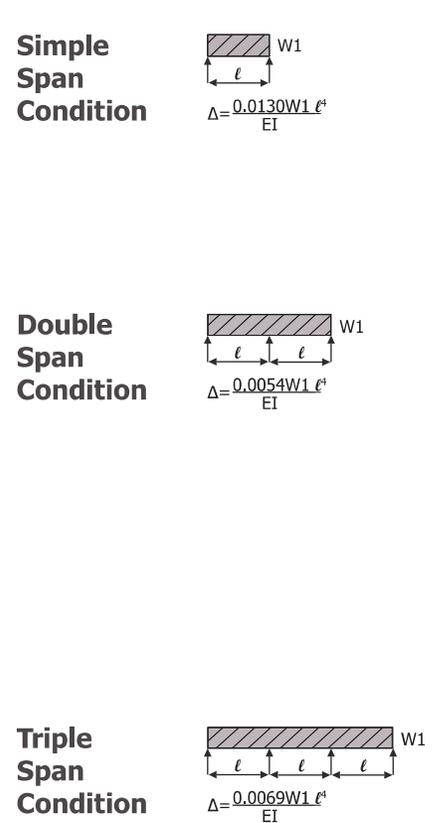
**FIGURE 2**

**Loading Diagrams and Support Reactions**



**FIGURE 3**

**Loading Diagrams and Deflections**



**Notes for Figures 1, 2, and 3**

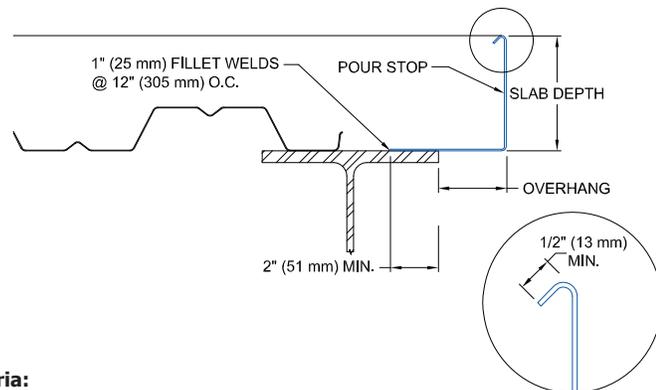
- P = concentrated construction live load
- I = in<sup>4</sup>/ft. (mm<sup>4</sup>/m) - deck moment of inertia
- W1 = slab weight + deck weight
- W2 = uniform construction live load
- E = 29.5 x 10<sup>6</sup> psi (203,000 MPa)
- ℓ = clear span length (ft.) (m)
- W1<sub>1</sub> = 1.5 x slab weight + deck weight ≤ slab weight + 30 psf (1.44 kPa) + deck weight

Dimensional consistency requires consistent units when calculating deflections.

# SDI Pour Stop Selection Table

SLAB DEPTH (INCHES)	SLAB DEPTH (mm)	OVERHANG - INCHES (mm)													
		0	1	2	3	4	5	6	7	8	9	10	11	12	
		0	25	51	76	102	127	152	178	203	229	254	279	305	
<b>POUR STOP TYPES</b>															
4.00	102	20	20	20	20	18	18	16	14	12	12	12	10	10	
4.25	108	20	20	20	18	18	16	16	14	12	12	12	10	10	
4.50	114	20	20	20	18	18	16	16	14	12	12	12	10	10	
4.75	121	20	20	18	18	16	16	14	14	12	12	10	10	10	
5.00	127	20	20	18	18	16	16	14	14	12	12	10	10		
5.25	133	20	18	18	16	16	14	14	12	12	12	10	10		
5.50	140	20	18	18	16	16	14	14	12	12	12	10	10		
5.75	146	20	18	16	16	14	14	12	12	12	12	10	10		
6.00	152	18	18	16	16	14	14	12	12	12	10	10	10		
6.25	159	18	18	16	14	14	12	12	12	12	10	10			
6.50	165	18	16	16	14	14	12	12	12	12	10	10			
6.75	171	18	16	14	14	14	12	12	12	10	10	10			
7.00	178	18	16	14	14	12	12	12	12	10	10	10			
7.25	184	16	16	14	14	12	12	12	10	10	10				
7.50	191	16	14	14	12	12	12	12	10	10	10				
7.75	197	16	14	14	12	12	12	10	10	10	10				
8.00	203	14	14	12	12	12	12	10	10	10					
8.25	210	14	14	12	12	12	10	10	10	10					
8.50	216	14	12	12	12	12	10	10	10						
8.75	222	14	12	12	12	12	10	10	10						
9.00	229	14	12	12	12	10	10	10							
9.25	235	12	12	12	12	10	10	10							
9.50	241	12	12	12	10	10	10								
9.75	248	12	12	12	10	10	10								
10.00	254	12	12	10	10	10	10								
10.25	260	12	12	10	10	10									
10.50	267	12	12	10	10	10									
10.75	273	12	10	10	10										
11.00	279	12	10	10	10										
11.25	286	12	10	10											
11.50	292	10	10	10											
11.75	298	10	10												
12.00	305	10	10												

TYPES	DESIGN THICKNESS (INCHES)	DESIGN THICKNESS (mm)
20	0.0358	0.91
18	0.0474	1.20
16	0.0598	1.52
14	0.0747	1.90
12	0.1046	2.66
10	0.1345	3.42



**NOTES: This Selection Chart is based on the following criteria:**

1. Normal weight concrete 150 PCF (2,400 kg/m<sup>3</sup>).
2. Horizontal and vertical deflection is limited to 1/4" (6.3mm) maximum for concrete dead load.
3. Design stress is limited to 20 KSI (138 MPa) for concrete dead load temporarily increased by one-third for the construction live load of 20 PSF (0.96 kPa).
4. Pour Stop Selection Chart does not consider the effect of the performance, deflection, or rotation of the pour stop support which may include both the supporting deck and/or the frame.
5. Vertical leg return lip is recommended for all types (gages).
6. This selection table is not meant to replace the judgment of experienced structural engineers and should be considered as a reference only.

# QUIZ

## Introduction to SDI NC-2010 Standard for Non-Composite Steel Floor Deck

1. All sheet steel used for the manufacture of non-composite steel floor deck shall have a minimum specified yield stress which meets or exceeds \_\_\_\_\_ ksi and a maximum specified yield stress which shall not exceed \_\_\_\_\_ ksi.

- a. 36 and 50
- b. 50 and 65
- c. 33 and 80
- d. None of the above

2. The minimum concrete compression strength used on non-composite steel deck is \_\_\_\_\_ ksi:

- a. 2.5
- b. 3.0
- c. 4.0
- d. 5.0

3. The minimum uncoated steel thickness as delivered to the job site shall not at any location be less than \_\_\_\_\_ of the design thickness:

- a. 90%
- b. 95%
- c. 98%
- d. 100%

4. The finish on the steel deck shall be compatible for the environment to which the deck is exposed within the finished structure, and shall be specified by the \_\_\_\_\_.

- a. Designer
- b. Deck Manufacturer
- c. Building Official
- d. Steel Fabricator

5. The section properties and allowable strength (ASD) or design strength (LRFD) for the steel deck shall be computed in accordance with \_\_\_\_\_.

- a. *AISC Specification for Structural Steel Buildings*
- b. *AISI North American Specification for the Design of Cold-Formed Steel Structural Members*
- c. *Steel Deck Institute Diaphragm Design Manual*
- d. ACI 318 Building Code Requirements for Structural Concrete

6. For deck designed as a form, the “uniform construction live load” used for design is \_\_\_\_\_ psf.

- a. 20
- b. 30
- c. 50
- d. 75

7. Calculated deflections of the deck as a form shall be based on the load of the fresh concrete as determined by the design slab thickness and the self-weight of the steel deck, uniformly loaded on all spans, shall be limited to the lesser of \_\_\_\_\_ of the clear span or \_\_\_\_\_ inch.

- a.  $L/180$  and  $\frac{3}{4}$ ”
- b.  $L/120$  and  $\frac{1}{2}$ ”
- c.  $L/360$  and  $\frac{1}{4}$ ”
- d.  $L/480$  and  $\frac{1}{8}$ ”

8. Diaphragm strength and stiffness are permitted to be determined in accordance with:

- a. SDI-DDM
- b. AISI S907
- c. Methods approved by the building official
- d. a, b, and c

9 The concrete slab shall be designed by the designer in accordance with \_\_\_\_\_.

- a. ACI 318
- b. SDI DDM
- c. AISI S100
- d. AISI S907

10 The minimum concrete thickness above the top of the deck shall be \_\_\_\_\_ inches

- a. 1
- b. 1-1/2
- c. 2
- d. 3

11 If galvanized deck is used, the weight of the concrete slab shall be permitted to be permanently carried by the steel deck and need not be deducted from the calculated live load

- a. True
- b. False
- c. Only for 22 gage or thicker deck
- d. When permitted by the building official

12 Sidelaps shall be fastened using

- a. Screws
- b. Button punches
- c. Welds
- d. All of the above