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Steel Deck Institute Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Deck Floor Systems with Electrical Distribution

Steel Deck Institute

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STEEL DECK INSTITUTE sdi®

Our 50th 1939 1989 Anniversary Year

Steel Deck Institute Design Manual

For Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

The Steel Deck Institute

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The Steel Deck Institute reserves the right to change, revise, add to, or delete any data contained in this manual without prior notice.

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Before making use of this manual, please review special notice on page 47.

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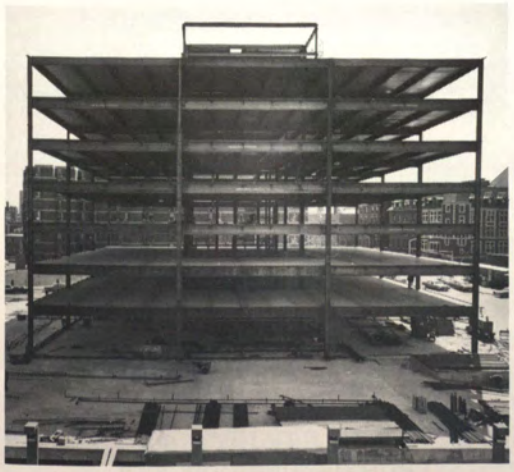
Steel Deck Applications



The Steel Deck Institute

Since 1939, the Steel Deck Institute has provided uniform industry standards for the engineering, design, manufacture, and field usage of steel decks.

The SDI is concerned with cold-formed steel products, with various configurations distinctive to individual manufacturers, used to support finished roofing materials or to serve as a permanent form and/or positive reinforcement for concrete floor slabs.

Members of the Institute are manufacturers of steel floor and roof decks. Associate members are manufacturers of fasteners, coatings, and other related components, contractors, and others in the field who share SDI interests.

The Institute is managed by an executive director who supervises the programs developed through the combined efforts of the total membership.

Continuing SDI functions include preparation, review, and distribution of literature, referral of inquiries to appropriate sources, coordination of research and testing, and liaison with other construction industry associations on matters of common interest.

The purpose of these functions is three-fold:

1. To develop steel decks that are engineered for structural soundness, that maintain consistent quality, that adapt to a wide range of designs and systems, and that are economical in both initial and life-cycle costs.
2. To initiate design and installation procedures that conform to good construction practices and that meet cost requirements.
3. To make this information readily accessible to designers and owners.

Design Manual for Composite Decks, Form Decks and Roof Decks

Since steel decks were originally used only for roof construction, the Steel Deck Institute traditionally limited its attention to roof assemblies.

For more than a decade, however, SDI members have been manufacturing steel decks for floor assemblies. These companies have developed floor deck engineering data and have established performance standards through laboratory testing and field usage.

In 1975, SDI members concluded that the Institute should expand its design manual to include floor decks used either in composite slab design or as a permanent form. In 1989, it was further expanded to include cellular metal floor deck with electrical distribution.

The result is this publication, the *Steel Deck Institute Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Decks with Electrical Distribution* definitive guide to the proper design and specification of steel decks.

Standards

- The SDI developed the following standards for steel floor decks, roof decks, and related products:
- Replaced gage with design thickness as the unit of measure in references to material thickness;
- Established manufacturing tolerances;
- Developed site storage and erection recommendations;
- Standardized accessories—sump pans, ridge and valley plates, and cant strips;
- Developed specifications for Composite Steel Floor Deck, Non-Composite Steel Form Deck and for Steel Roof Deck;
- Defined standard roof deck sections and issued standard load tables for narrow, intermediate, and wide rib decks.

Testing

Independent tests are the best guide to product performance and reliability, a philosophy to which Steel Deck Institute members subscribe. Their support for an ongoing program is indicated by the number and scope of tests already performed and by their policy of

sponsoring new tests when new products or applications are introduced by the industry.

Following are completed roof deck tests for which published results are available;

- U.L.Fire Ratings: two-hour steel deck assembly; acoustical ceiling with wide joist spacing; steel roof assembly with directly applied insulation;
- National Bureau of Standards fire tests on various steel roof deck constructions;
- Steel Deck Diaphragms.

SDI manufacturers can furnish fire ratings, load test results, and other performance test reports for their own products.

Roof Deck Certification Program

The Steel Deck Institute offers deck manufacturers (both members and non-members) certification of product design through an engineering analysis by independent consulting engineers. To receive design certification for a roof deck section, a manufacturer must submit a profile with dimensions and a load table (either his own or the SDI Standard Load Table) to the SDI.

A computer program analyzes the profile and dimensions and produces a load table. If the manufacturer's stated safe loading is verified by the computer analysis, the SDI issues a certificate which states that the product is designed in accordance with SDI Specifications and also verifies the manufacturer's load tables.

OTHER PUBLICATIONS:

The Steel Deck Institute Diaphragm Design Manual

An essential, comprehensive and practical reference for Engineers, Architects, Detailers, Draftsmen, Contractors, Building Officials and people engaging in the design and use of Steel Deck and Steel Structures.

This hard-bound manual represents a full-scale diaphragm study conducted over the past 20 years by Dr. Larry Luttrell at the Major Units Laboratory of West Virginia University.

This is publication No. DDM01 and may be purchased from the SDI.

The Steel Deck Institute Diaphragm Design Manual Second Edition

Published in November 1987, this basic, user friendly manual for practicing Engineers and Architects contains expanded and up-dated chapters on Diaphragm strength, Diaphragm stiffness, Connections and Filled Diaphragms. Includes clearly illustrated and explained design examples, organized for easy use.

Dr. Larry Luttrell, Professor Civil Engineering, West Virginia University and Advisor for the STEEL DECK INSTITUTE provides a reference source that contains the answers to all your questions. This is publication No. DDM02 and may be purchased from the SDI.

Comprehensive Steel Deck Institute Binder

A complete, hard-bound encyclopedia containing valuable, tabulated material for Composite Decks, Form, Decks, and Roof Decks.

This manual provides State-of-the-Art product catalogs of SDI Member Manufacturers, and publications of Associate Members who furnish items used in steel deck construction.

This publication is available through the SDI.

Advantages of Steel Deck:

Versatility

Steel decks complying with SDI Specifications are available from the member companies in 1½, 2, 3, 4½, 6, and 7½-inch depths; 6, 7½, 8, 9, and 12-inch rib spacings; with and without stiffening elements, with and without acoustical material, cellular and non-cellular, and in varying material thicknesses. This extensive choice makes steel deck applicable to a wide range of projects and structural designs.

Structural Strength with Less Weight

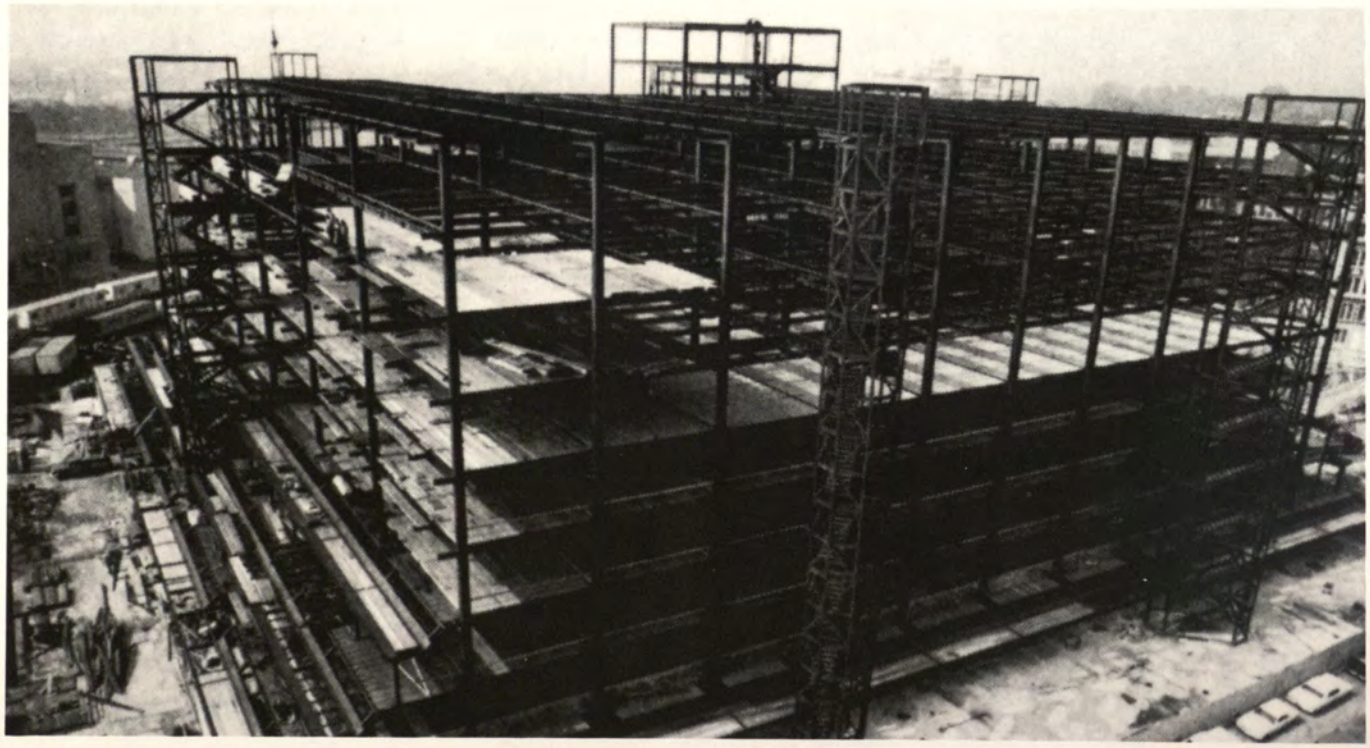
The properties of steel are used with maximum efficiency in the design and fabrication of steel decks, resulting in products with a high strength-to-weight ratio. As a result, delivery, erection, and structural framing costs can be lower than with other systems.

Attractive Appearance

Although steel deck is primarily a structural component, it is visually attractive when left exposed in other applications. With the properly specified factory and field coatings, steel deck is easy to maintain, durable, and esthetically pleasing.

All-Weather Construction

Steel deck can be erected in most weather conditions, eliminating the costly delays that can occur with other types of roof systems.



Required Fire Ratings

U.L. fire resistance ratings on standard roof assemblies have been obtained by the Steel Deck Institute. Individual SDI manufacturers have ratings on their own products. Most fire resistance requirements can be met with products manufactured by SDI members.

Uniform Quality

Through engineering and continuously refined production techniques, SDI manufacturers produce decks that conform to specified standards.

Proven Durability

Steel deck in place and performing satisfactorily for more than a half-century is indicative of the product's durability.

Economy and Value

Value is determined by combining initial costs, life-cycle costs, and overall performance. Steel deck assemblies are the best value in roofing designs. They combine low cost with top performance.

Code of Recommended Standard Practice

For Composite Deck, Form Deck, and Roof Deck Construction

1. General

1.1 Scope: This code is intended to promote safety and quality construction in accordance with good engineering practice. It is designed to assist in the preparation of the sales contract by providing contract details which can be adopted by reference.

1.2 Application: This code shall govern where building codes, architects' and engineers' plans and specifications, or contracts are not complete or clear. There shall be no conflict between this code and any legal building regulation; it shall only supplement and amplify such laws.

1.3 Design: In the absence of ordinances or specifications to the contrary, design shall be in accordance with the current Specifications of the Steel Deck Institute. Steel roof deck and floor deck, both composite and non-composite, may be used in a variety of ways, some of which do not lend themselves to a standard ''steel deck'' analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

1.4 Plans and Specifications for Bidding: Plans and specifications shall clearly show details and shall be complete as to extent of deck and accessories to be furnished by the seller.

1.5 Responsibility for Design: When details of design are specified, the seller shall assume no responsibility other than to furnish materials as specified. When details of design are not specified, the seller shall furnish all materials required in accordance with Section 1.3 of this code.

2. Bidding

2.1 Base Bids:

2.1.1 Roof Deck: Base bids shall include roof deck, ridge and valley plates, and sump pans per architects plans and specifications. No other accessories shall be included unless specified.

2.1.2 Composite Floor Deck and non Composite Form Deck: Base bids shall include deck and only those accessories specifically designated on the plans and called for in the appropriate division of the specifications.

2.2 Incomplete Plans and Specifications: Incomplete plans and specifications shall be bid on the basis that the seller shall provide material in agreement with the provisions of this code.

2.3 Special Details: Any material required to support the steel deck shall not be included.

3. Drawings and Specifications

3.1 Furnished by Buyer: The buyer shall furnish complete architectural plans and specifications, structural steel drawings, and purlin placing plans, all correctly dimensioned.

3.2 Furnished by Seller: The seller shall furnish erection layouts clearly showing the location of all sheets. The seller shall also furnish as many prints as may be reasonably necessary, but the tracing shall remain the property of the seller.

3.3 Discrepancies: The architect's plans shall be assumed to be correct in the absence of written notice from the buyer to the contrary. When structural steel or purlin placing plans do not agree with the architect's plans, the structural plans shall be considered as a written notice of change of plans.

3.4 Approval: The erection layouts shall be submitted to the buyer for approval unless the buyer instructs the seller to submit same directly to the architect or waives his right of approval. The buyer (or architect) shall return one

copy marked with his approval or with such corrections as he may deem necessary. The seller shall not start shop work prior to final approval of his drawings unless such approval is waived.

3.5 Changes by Buyer After Approval: When any changes are made by the buyer after approval or when any extra materials are required, the cost of such changes and extra materials shall be paid by the buyer at a price agreed upon between the buyer and seller.

4. Collateral Material

Although certain collateral materials are not supplied by the steel deck manufacturer, it is the desire of the Steel Deck Institute to have certain principles followed in specifying and furnishing these collateral materials in order to provide a satisfactory deck assembly. This code is not intended to encroach upon the standard practices of the related industries, but is intended to supplement and amplify specifications pertaining to their products.

4.1 Insulation: All steel roof decks shall be covered with a material of sufficient insulating value to prevent condensation under normal occupancy conditions. Insulation shall be adequately attached to the steel roof deck by adhesives or mechanical fasteners. Insulation materials shall be protected from the elements at all times during the storage and installation.

4.2 Acoustical Batts: When acoustical deck is provided, sound absorbing acoustical glass fiber batts shall be installed in the field. Batts shall be shipped and stored at the jobsite in such a manner as to ensure protection until installation. If acoustical batts become wet, they shall be allowed to thoroughly dry without being compressed before installation.

4.3 Roof Coverings: A suitable roof covering shall be applied over the insulation.

4.4 Sheet Metal Work: All closures, flashing, etc., used in roof deck construction, unless otherwise specified, shall be detailed and furnished by the sheet metal contractor.

4.5 Field Painting: Any field painting or touch-up of abrasions or deterioration of the primer coat or other protective finishes shall be the responsibility of the buyer.

4.6 Shear Connectors: The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer.

5. Construction Practice

The Steel Deck Institute recommendations for site storage, installation, and construction practices are addressed specifically in the appropriate deck specifications in this design manual and are an integral part of this Code of Recommended Standard Practice.

Advantages

Of Composite Steel Floor Deck

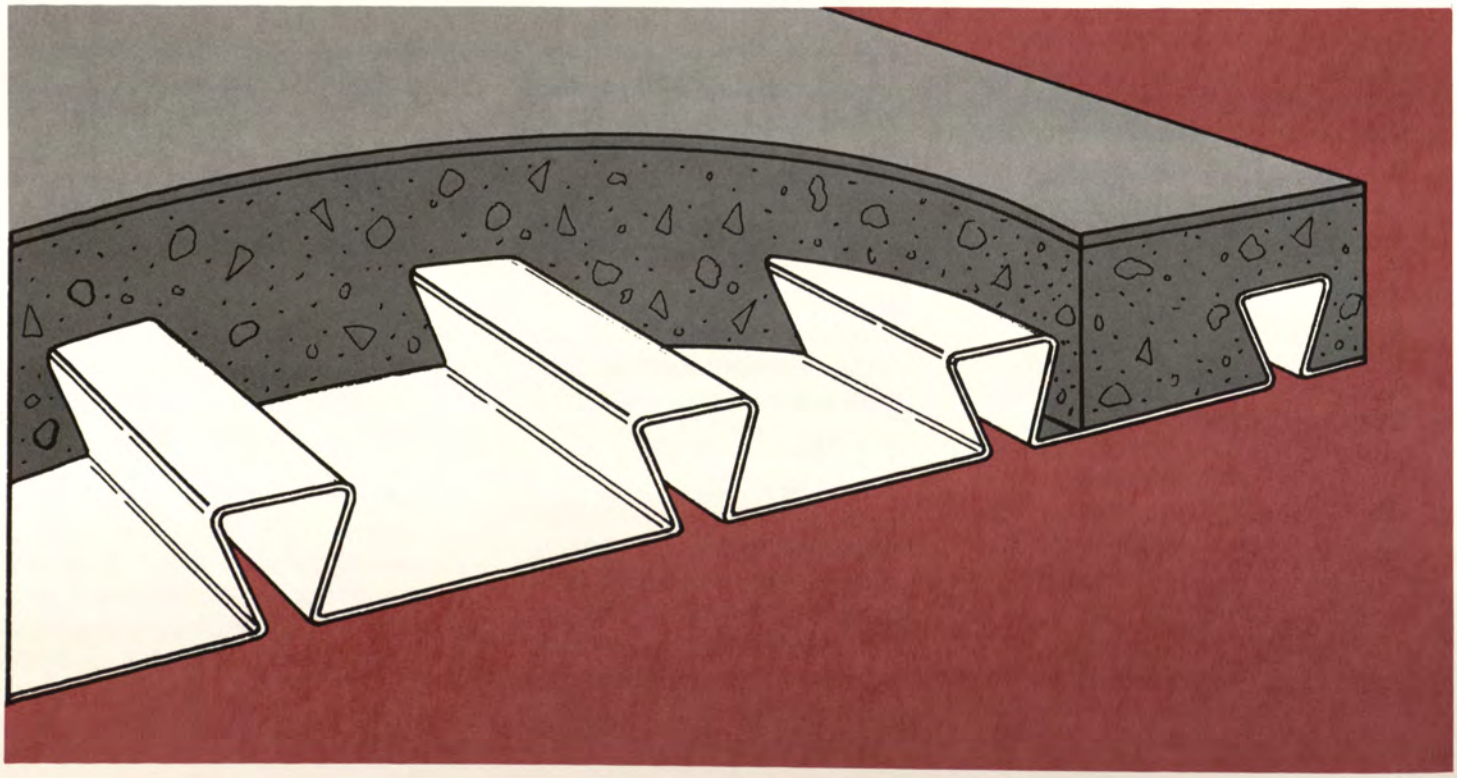
Composite Action: Steel floor decks, engineered for use in composite slab design, furnish positive reinforcement for the concrete slab and can eliminate the need for any additional positive reinforcing. Composite floor decks are designed to interlock positively with the overlying concrete fill, resulting in unit action. The interlocking process is achieved by mechanical means, deck profile and surface bond, or a combination.

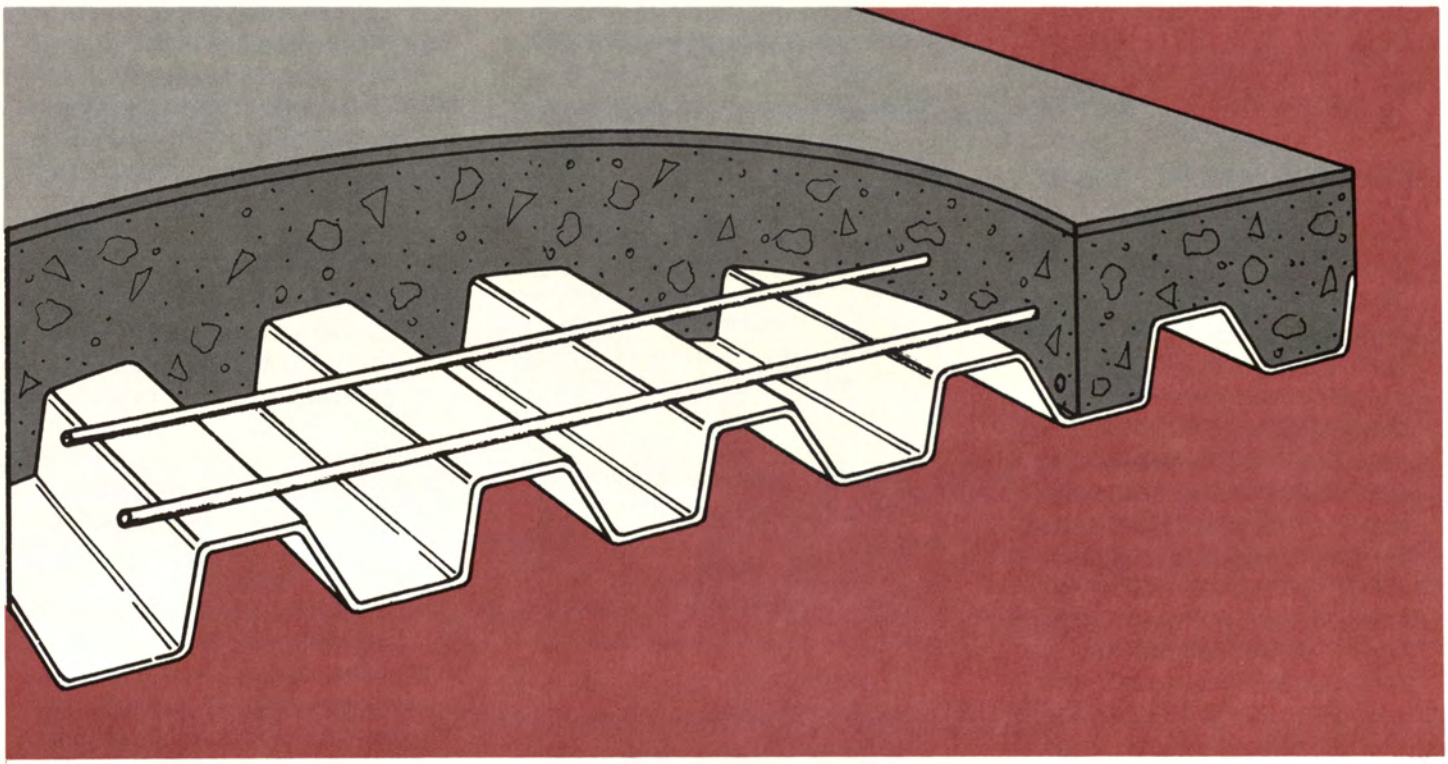
Improved Composite Beam Construction: In a composite beam assembly, a composite floor slab and a steel beam are joined by shear connectors to create one structural unit which has greater strength than a separate slab and beam. Floor decks engineered for composite beam design simplify connector installations and enhance concrete coverage around shear connectors. In some cases, full AISC shear connector values and solid slab design can be applied.

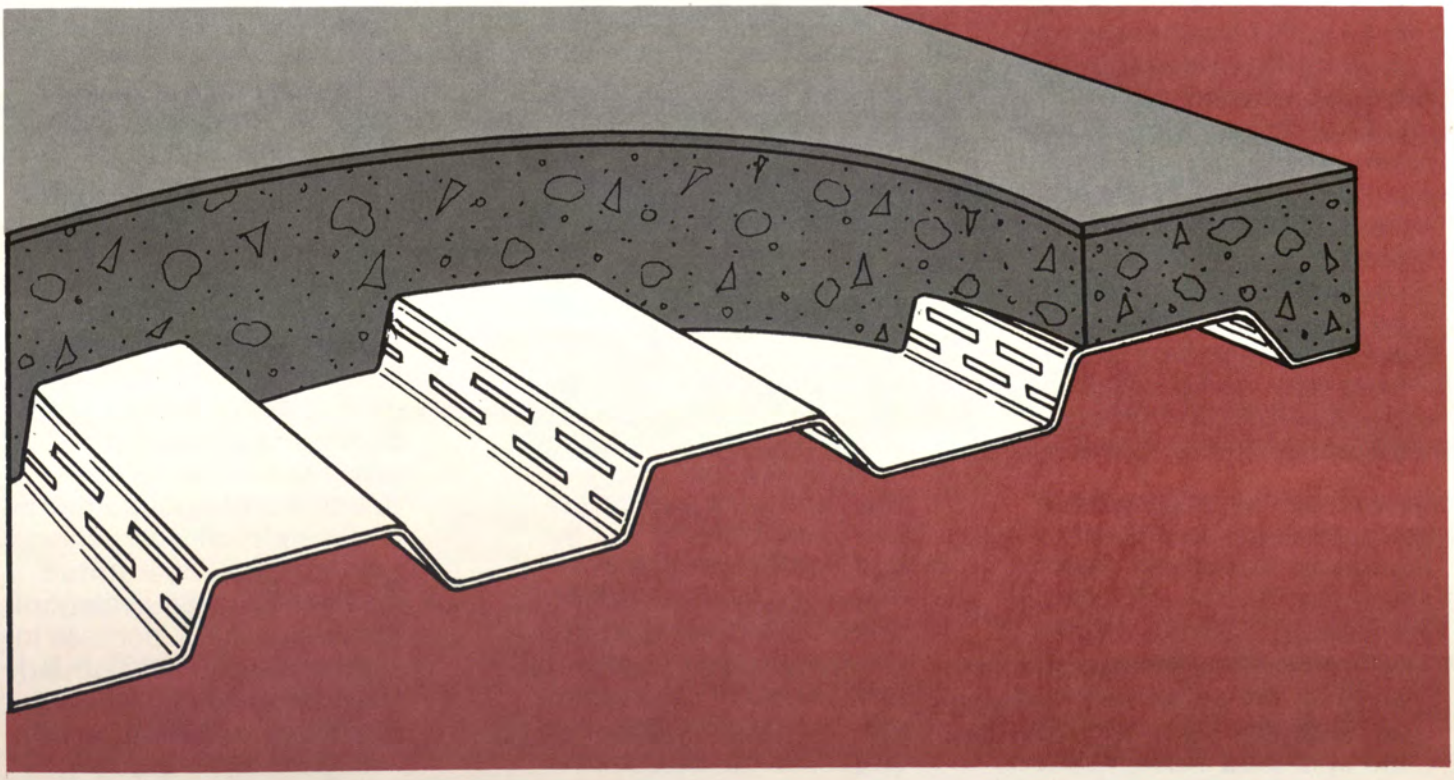
Working Platform: Where many floor designs require temporary safety floors for tradesmen, floor deck with appropriate design and installation can be a safe working platform.

Permanent Forms: Steel floor decks eliminate the need for erection and removal of temporary forms.

Required Fire Ratings: UL fire resistance ratings for floor deck assemblies have been obtained by SDI manufacturers for their own products. Ratings are available for steel deck both with and without spray-applied fireproofing and with regular weight, lightweight, and semi-lightweight concrete.







SDI Specifications and Commentary

For Composite Steel Floor Deck

1. Scope

This specification pertains to composite steel floor deck.

Commentary: Composite steel floor deck is cold-formed steel deck which acts as a permanent form and as the positive bending reinforcement for the structural concrete. When suitably fastened the steel deck also acts as a working platform for the various trades. After the concrete hardens the steel deck and the concrete are interlocked by the shape of the deck, mechanical means, surface bond, or by a combination of these means.

2. Materials

2.1 Composite Steel Deck: Composite steel floor deck shall be fabricated from steel conforming to Section 1.2 of the latest edition (1980), of the American Iron and Steel Institute, Specification for the Design and Cold-Formed Steel Structural Members. The steel used shall have a minimum yield point of 33 ksi. The delivered thickness of the uncoated steel shall not be less than 95% of the design thickness.

Commentary: Most of the composite steel floor deck is manufactured from steel conforming to ASTM Designation A611, Grades C and D or from A446 Grades A, C, and E. If the published product literature does not show the uncoated steel thickness in decimal inches (or millimeters) but lists gage or type numbers, then the thickness of steel before coating with paint or metal shall be in conformance with the following table:

Type No.	Design Thickness Inches	Minimum Thickness Inches
22	0.0295	0.028
21	0.0329	0.031
20	0.0358	0.034
19	0.0418	0.040
18	0.0474	0.045
17	0.0538	0.051
16	0.0598	0.057

2.1a. Finish: The finish on the steel composite deck shall be as specified by the designer and be suitable for the environment of the structure.

Commentary: Since the composite deck is the positive bending reinforcement for the slab it must be designed to last the life of the structure; a minimum recommended finish is galvanized coating conforming to ASTM A 525 G60.

2.2 Concrete: Concrete shall be in accordance with the applicable sections of chapters 3, 4 and 5 of the ACI 318 Building Code Requirements for Reinforced Concrete. Minimum compressive strength (f'c) shall be 3000 psi. Admixtures containing chloride salts shall not be used.

Commentary: The use of admixtures containing chloride salts is not allowed because the salts may corrode the steel deck which has been designed as the slab reinforcement.

3. Design (Deck as a Form)

3.1 The section properties of the steel floor deck (as a form in bending) shall be computed in accordance with the American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members, 1980 edition.

3.2 Stress in the deck shall not exceed 0.6 times the yield strength with a maximum of 36 ksi under the combined weights of wet concrete, deck, and the following construction live loads: 20 pounds per square foot uniform load or 150 pound concentrated load on a 1'-0" section of deck. **See Figure 1.**

Commentary: The loading shown in Figure 1 is representative of the sequential loading of wet concrete on the form. The 150 pound load is the arithmetic result of 200 lb. (man's weight) x ¾. The philosophy here is to allow a ⅓ increase in stress due to the temporary nature of a man load. Decreasing the load by 25% is the mathematical equivalent of allowing a 33% increase in stress. Also the 150 pound load is considered to be applied to a one foot width —experience has shown

that a greater distribution really occurs. In the past, many manufacturers have recommended using a 20 psf construction load simultaneously applied over all spans; the loading situations of Figure 1 are more severe than the old uniform load method. It is recommended that clear spans be used in the equations of Figure 1.

3.3 Calculated theoretical deflections of the deck, as a form, shall be based on the weight of the concrete (as determined by the design slab thickness) and the weight of the steel deck, uniformly loaded on all spans and shall be limited to L/180 or ¾ inch, whichever is smaller. Deflections shall be relative to supporting members. **See Figure 2.**

Commentary: The deflection calculations do not take into account construction loads as these are considered to be temporary loads; the deck is designed to always be in the elastic range so removal of temporary loads should allow the deck to recover. The structural steel also deflects under the loading of the wet concrete. The designer is urged to check the deflection of the total system especially if composite beams and girders are being used.

3.4 The bearing lengths shall be determined in accordance with the AISI specification; a uniform loading case of wet concrete plus deck weight plus 20 psf construction load shall be used. **See Figure 3.**

Commentary: In the past, 1½ inches of end bearing was the minimum; this is still a good ''rule of thumb'' that will, in general, prevent slip off. If less than 1½ inches of end bearing is available, or if high support reactions are expected, then the design engineer should ask the deck manufacturer to check the deck web stress. In any case, the deck must be adequately attached to the structure to prevent slip off.

4. Installation

4.1 Welding: Floor deck units shall be anchored to supporting members, including bearing walls, with nominal 5/8 inch diameter puddle welds or equivalent at all edge ribs plus a sufficient number of interior ribs to provide a maximum average spacing of 12 inches. The maximum spacing between adjacent points of attachment shall not exceed 18 inches.

Welding washers shall be used when welding steel floor deck of less than 0.028 inch thickness.

Commentary: The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer. If studs are being applied through the deck onto the structural steel the stud welds can be used to replace the puddle welds. (The deck should be welded to act as a working platform and to prevent blow off.

In general, stronger welds are obtained on 0.028 inches or thicker deck without weld washers. Welds on decks less than 0.028 inches are stronger with washers.

4.2 Mechanical Fasteners: Mechanical fasteners (powder-actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, providing the type and spacing of the fasteners 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. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of any unfastened ribs.

4.3 Lapped and Butted Ends: Deck ends may be either butted or lapped over supports. Standard tolerance for ordered length is plus or minus 1/2 inch.

Commentary: If stud shear connectors are used, deck units should be butted and not lapped. Gaps are acceptable at butted ends. If the

(CONTINUED)

Figures 1, 2, and 3, are found on page 19.

tape or taping of butted ends is requested, it is not the responsibility of the deck manufacturer.

Staggering floor deck end laps is not a recommended practice. The deck capacity as a form and the load capacity of the composite deck/slab system are not increased by staggering the end laps; layout and erection costs are increased.

4.4 Differential Deflection: Shall be controlled by fastening together sidelaps of floor deck units as recommended by the steel deck manufacturer.

5. Design Deck and Concrete As A Composite Unit

5.1 General:
The composite slab shall be designed as a reinforced concrete slab with the steel deck acting as the positive reinforcement. Slabs shall be designed as simple or continuous spans under uniform loads.

Commentary: High concentrated loads, diaphragm loads, etc. require additional analysis. Horizontal load capacities can be checked by referring to the Steel Deck Institute *Diaphragm Design Manual,* Second Edition.

Most published live load tables are based on simple span analysis of the composite systems; that is, the slab is assumed to crack over each support. If the designer wants a continuous slab, then the negative reinforcing should be designed using conventional reinforced concrete design techniques—the welded wire mesh, chosen for temperature reinforcing (Section 5.5), does not usually supply enough area for continuity. The deck is not considered to be compression reinforcing.

Care should be used during the placement of loads on rolled in hanger tabs for the support of ceilings so that approximate uniform loading is maintained. The individual manufacturer should be consulted for allowable loading on single rolled in hanger tabs. Improper use of rolled in hanger tabs could result in the over stressing of such tabs and/or the over loading of the composite deck slab.

5.2 Testing: The deck manufacturer shall have performed or witnessed by a licensed engineer, a sufficient number of tests on the composite deck/slab system to have determined load/deflection characteristics and the mode of failure under uniform or symmetrically placed point loads. Based on the test information the design load rationale shall be established by:

1.) Elastic flexural analysis or
2.) Ultimate strength analysis based on shear bond failure or flexural failure.

5.2a Elastic Flexural (working stress) analysis for unshored construction.

Under the superimposed (live) load the tensile stress of the deck, between supports, shall not exceed 0.6 times the yield strength of the steel. Under the combination of superimposed (live) load, the weight of the concrete and the weight of the deck, the tensile stress of the deck, between supports, shall not exceed 0.8 times the yield strength of the steel.

5.2b Elastic Flexural (working stress) stress analysis for shored construction.

Under the total loading, the tensile stress of the deck, between supports, shall not exceed 0.6 times the yield strength of the steel with a maximum of 36 ksi.

5.2c Ultimate Strength analysis based on flexural or shear bond failure shall be based on a minimum safety factor of 2.

Commentary: By using one of the appropriate anaylsis techniques (either working stress or ultimate strength) the deck manufacturer determines the uniformly applied live loads that can be applied to the deck/slab combination.

For most applications the deck thickness and profile is selected so that shoring is not required; the live load capacity of the composite system is then usually more than adequate for the superimposed (live) loads. In calculating the section

properties of the deck (under section 3.1 of these specifications) the AISI provisions may require that the compression flange be reduced to an effective width, but when used as tensile reinforcement the total area of the cross section may be used.

5.3 Concrete: (Working Stress Analysis).

5.3a For unshored construction the compressive stress in concrete shall not exceed 0.45 f'c under the applied live load. For shored construction the compressive stress in the concrete shall not exceed 0.45 f'c under the total dead and live loads.

5.3b The allowable shear stress shall conform to ACI specifications.

5.3c Minimum Cover of Concrete above the top of the floor deck shall be 2 inches. When additional (negative bending) reinforcement is placed over the deck, the minimum cover of concrete above the reinforcement shall be ¾ inch.

5.4 Deflection: Deflection of the composite slab shall not exceed L/360 under the superimposed load.

Commentary: Live load deflections are seldom a design factor. The deflection of the slab/deck combination can best be predicted by using the average of the cracked and uncracked moment of inertia as determined by the transformed section method of analysis.

5.5 Temperature and Shrinkage reinforcement, consisting of welded wire fabric or reinforcing bars, shall have a minimum area of 0.00075 times the area of concrete above the deck, but shall not be less than the area provided by 6 x 6-10/10 (6 x 6-W1.4 x W1.4) welded wire fabric. For those products so manufactured, shear transfer wires welded to the top of the deck may be considered to act as shrinkage or temperature reinforcement.

Commentary: If welded wire mesh is used with a steel area given by the above formula, it will generally not be sufficient to be the total negative reinforcement: however, the mesh has shown that it does a good job of crack control especially if kept near the top of the slab (¾ inch to 1 inch cover).

6.0 Construction Practice

The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI code and shall be left in place until the slab attains 75% of its specified compressive strength.

Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale or coating, and all other foreign matter. Care must be exercised when placing concrete so that the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed in a uniform manner over the supporting structure and spread towards the center of the deck span. If buggies are used to place the concrete, runways shall be planked and the buggies shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

6.1 All deck sheets shall have adequate bearing and fastening to all supports so as not to lose support during construction. Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage. Damaged deck (sheets containing distortions or deformations caused by construction practices) shall be repaired, replaced, or shored to the satisfaction of the architect before placing concrete. The cost of repairing, replacing, or shoring of damaged units shall be the liability of the trade contractor responsible for the damage.

Commentary: For temporary construction loads prior to concreting, it should be safe to assume that the deck will

(CONTINUED)

For Composite Steel Floor Deck

(CONTINUED)

support a minimum uniform load of 50 psf without further investigation.

6.2 The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI code and shall be left in place until the slab attains 75% of its specified compressive strength.

6.3 Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale and all other foreign matter.

6.4 Care must be exercised when placing concrete so that the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed from a low level to avoid impact in a uniform manner over the supporting structure and spread toward the center of the deck span. If buggies are used to place the concrete, runways shall be planked and the buggies shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

7. Additional Information and Comments:

7.1 Parking Garages; Composite floor deck has been used successfully in many parking structures around the country; however, the following precautions should be observed:

1. slabs should be designed as continuous spans with negative bending reinforcing over the supports;
2. additional reinforcing should be included to deter cracking caused by large temperature differences and to provide load distribution; and,
3. in areas where salt water, either brought into the structure by cars in winter or carried by the wind in coastal areas, may deteriorate the deck, protective measures must be taken. The top surface of the slab must be effectively sealed so that the salt water cannot migrate through the slab to the steel deck; a minimum G90 galvanizing is recommended, and, the exposed bottom surface of the deck should be protected with a durable paint.

The protective measures must be maintained for the life of the building. If the protective measures cannot be assured, the steel deck can be used as a stay in place form and the concrete can be reinforced with mesh or bars as required.

7.2 Cantilevers: When cantilevers are encountered, the deck acts only as a permanent form; top reinforcing steel must be designed by the structural engineer.

7.3 Composite Beams and Girders: Most composite floor deck sections are suitable for use with composite beams. The new (1980) AISC Specification has specifically provided for the use of deck in this type of construction.

7.4 Fire Ratings: Many different fire rated assemblies that use composite floor deck are available. Consult each manufacturer for a list of ratings.

7.5 Fireproofing: The metal deck manufacturer shall not be responsible for the cleaning of the underside of metal deck to ensure bond of fireproofing. Adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

7.6 Dynamic Loads: Dynamic loading, e.g., fork lifts, can, over a long period of time, interfere with the mechanical bond between the concrete and deck which achieves its composite action via web indents. Reinforcing steel running perpendicular to the deck span and placed on top of the deck ribs is often used with this type of loading to distribute concentrated loads.

7.7 Other Criteria: Composite Steel floor deck, may

be used in a variety of ways, some of which do not lend themselves to a standard "steel deck" analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

FIGURE 1 Loading Diagrams and Bending Moments

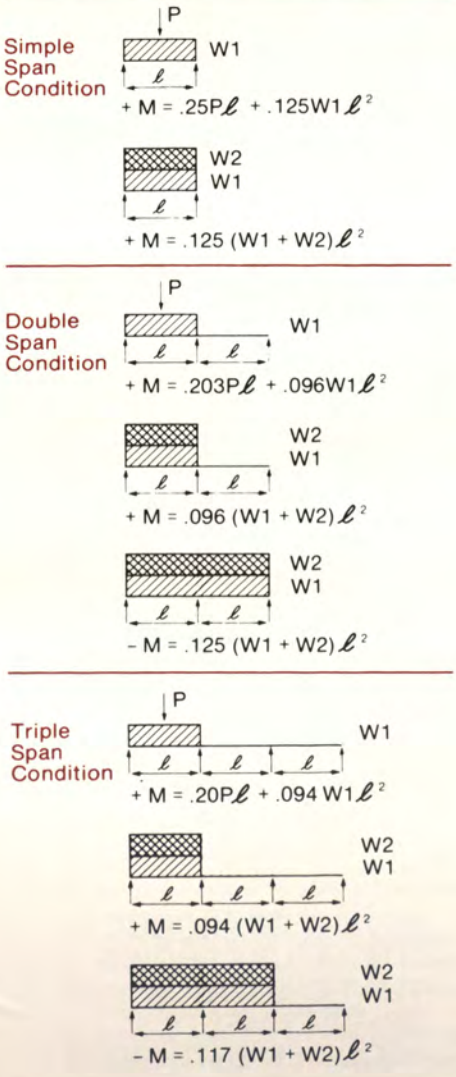


FIGURE 2 Loading Diagrams and Deflections

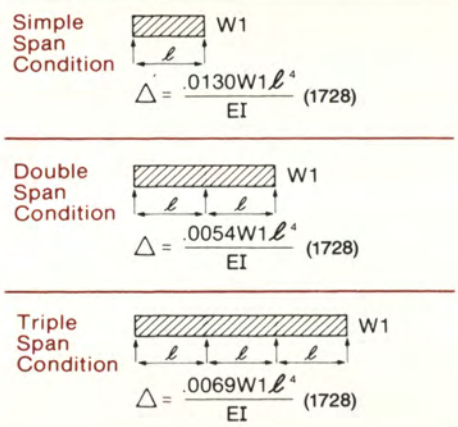
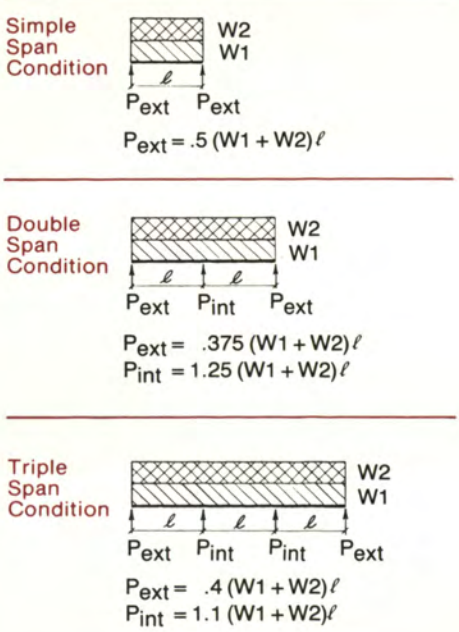


FIGURE 3 Loading Diagrams and Support Reactions



Note for Figures 1, 2 and 3

P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

Composite Steel Floor Deck

Design Example

GIVEN

A. Bay Size = 26′ x 26′
B. Superimposed load = 155 psf.
C. Fire rating required = 2 hour.
D. Concrete cover required on deck = 3¼″ lightweight.
E. Composite beam construction.
F. Temporary shoring not preferred.

1. Review deck manufacturer's literature for available deck types.

In shoring tables, choose deck that will not require temporary shoring during construction.

Check the allowable superimposed load tables for the required loading.

2. Review deck manufacturer's literature for combinations that meet requirements.

13′-0″ Beam Spacing

Embossed Deck: Formed and reinforced with 3″ x 0.0474″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement. Multi-span sheets require no temporary shoring.

8′-8″ Beam Spacing

Embossed Deck: Formed and reinforced with 2″ x 0.0358″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement.

Deck with Wires: Formed and reinforced with 2″ x 0.024″ design thickness composite steel deck with wires welded to top of deck at 6″ c. to c.

Multi-span sheets in both deck types require no temporary shoring.

6″-6″ Beam Spacing

Embossed Deck: Formed and reinforced with 1½″ x 0.0295″ design thickness composite steel deck. Determine required shrinkage and temperature reinforcement.

Deck with Wires; Formed and reinforced with 1¼″ x 0.024″ design thickness composite steel deck with wires welded to top of deck at 7″ c. to c.

Multi-span sheets in both deck types require no temporary shoring.

Note: For all of the above, **no spray-applied fireproofing** of the deck is required for a 2-hour rating.

3. Factors that should be considered in selecting a composite floor deck systems:

Compatibility of deck to total structure.

Hanging requirements.

Composite beams and studs.

Rib width-to-height ratio to determine stud values.

Compatibility of coating to stud welding.

Electrical requirements.

Future flexibility.

Deck material and erection costs. (Obtain from Steel Deck Institute member companies.)

Overall floor depth.

Cost of temporary shoring if shored forming is selected.

Deck fireproofing cost if protected deck is selected.

Concrete availability and cost: (lightweight) (semi-lightweight) (regular weight).

Concrete volume required.

Various beam spacings.

Total material cost.

Steel erection cost.

Steel fireproofing cost.

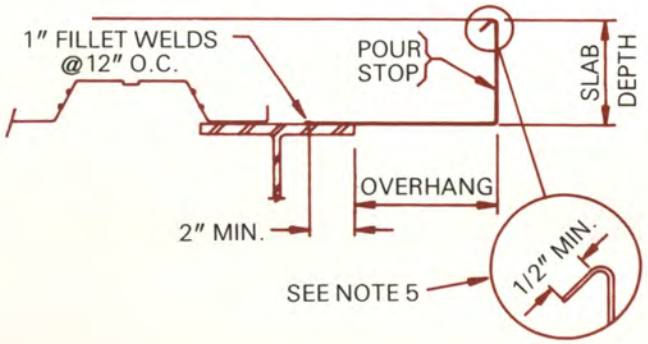
REVIEW OF PRODUCT LITERATURE SHOWS THAT 8′-8″ BEAM SPACING MEETS REQUIREMENTS MOST EFFICIENTLY.

SDI Pour Stop

Selection Table

SLAB DEPTH (Inches)	OVERHANG (INCHES)												
	0	1	2	3	4	5	6	7	8	9	10	11	12
	POUR STOP TYPES												
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	16	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											

TYPES	DESIGN THICKNESS
20	0.0358
18	0.0474
16	0.0598
14	0.0747
12	0.1046
10	0.1345



NOTES: The above Selection Table is based on following criteria:

1. Normal weight concrete (150PCF).
2. Horizontal and vertical deflection is limited to 1/4" 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 type 16 and lighter.
6. This selection is not meant to replace the judgement of experienced Structural Engineers and shall be considered as a reference only.

SDI reserves the right to change any information in this selection without notice.

SDI Specifications and Commentary

For Non-Composite Steel Form Deck

1. Scope

This specification and commentary pertains to the use of non-composite steel deck as a form for reinforced concrete slabs.

Commentary: This specification is not intended to cover highway bridges (where AASHTO specifications may govern), siding applications, or exposed roofs. In the past, most of the steel decking used in the manner that this specification covers, was referred to as "centering", however, various roof deck units have successfully been used as non-composite forms and the specification is intended to also include these applications.

2. Materials

2.1 The steel deck units shall be manufactured from steel conforming to ASTM designation A611 Grades C, D, or E, or A446 A, B, C, D, or E; or equal having a minimum yield strength of 33 ksi. The unit design stress shall not exceed the yield strength multiplied by 0.60, with a maximum of 36 ksi.

Commentary: Most of the "centering" materials are offered in grade E steel (ASTM A611 or A446); this steel has a minimum yield strength of 80 ksi and is generally over 90 ksi. In the past, 30 ksi design stress was used for grade E material; however, the AISI specifications now allow a design stress of 36 ksi.

2.2 The delivered thickness of the uncoated steel shall not be less than 95% of the design thickness.

Type No.	Design Thickness Inches	Minimum Thickness Inches
28	0.0149	0.014
26	0.0179	0.017
24	0.0238	0.023
22	0.0295	0.028
20	0.0358	0.034
18	0.0474	0.045
16	0.0598	0.057

Commentary: Finishes available are:

1. Galvanized (Conforming to ASTM A525);
2. Uncoated (Black);
3. Painted with a shop coat of primer paint (one or both sides).

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 a paint color on the product.

Centering materials are usually available galvanized or uncoated. When unshored galvanized material is used to support a reinforced concrete slab, the weight of the slab is considered to be permanently carried by the deck; when uncoated or painted deck is used to support a reinforced concrete slab the form is considered impermanent and the weight of the concrete should be deducted from the load capacity of the reinforced slab.

For any permanent load carrying function, a minimum galvanized coating conforming to ASTM A525, G60 is recommended.

3. Design

3.1 The section properties of the steel deck unit shall be computed in accordance with American Iron and Steel Institute, Specification for the Design of Cold-Formed Steel Structural Members, 1980 edition.

3.2 Deck used as a form for structural (reinforced) concrete slab:

3.2a Stress shall not exceed 0.60 times the yield strength with a maximum of 36 ksi under the combined weights of wet concrete,

deck and the following construction live loads:

20 pounds per square foot uniform load or 150 pound concentrated load on a 1'-0" wide section of deck. Loads shall be applied in a manner which simulates the sequence of concrete placement. **See Figure 1.**

3.2b Calculated Form Deflection shall be based on the weight of the wet concrete (as determined by the design slab thickness) and on the weight of the steel deck, uniformly loaded on all spans, and shall be limited to L/180 or ¾ inch, whichever is smaller. Deflection shall be relative to supporting members. **See Figure 2.**

Commentary: The deflection limitation of L/180 or ¾ inches are intended to be minimum requirements. Architectural or other considerations may influence the designer to use a more stringent limitation.

3.2c The bearing length of applicable profiles shall be determined in accordance with the AISI specification; the uniform loading case of wet concrete plus deck weight plus 20 pounds per square foot construction load shall be used. Minimum bearing shall be 1½" unless otherwise shown.

Commentary: Form decks made of grade E steel may have a radius to thickness ratio not covered by the AISI specification. Experience has shown that 1½" of bearing is sufficient for these decks. If less than 1½" is available for any form deck, or if high support reactions are expected, the designer should ask the deck manufacturer to check the deck web stress. In any case, the deck must be adequately attached to the structure to prevent slip off.

3.2d Design of the concrete slabs shall be done in accordance with the ACI 318 Building Code. Either Working Stress Design or Ultimate Strength Design may be used. The cover over the top of the deck shall not be less than 1½".

Commentary: In following the AC1 318 requirements for temperature reinforcement, the designer may eliminate the concrete area that is displaced by the deck rib.

For slabs with total depth of 3" or less, the reinforcing mesh may be considered to be at the center of the concrete above the deck. **See figure 3.** If uncoated or painted deck is used as the form, the weight of the concrete slab must be deducted from the allowable live load of the reinforced concrete slab. If galvanized form is used, the weight of the slab is considered to be permanently carried by the deck and need not be deducted from the live load. It temporary shoring is used, the weight of the slab must be deducted from the allowable live load of the reinforced slab regardless of the deck finish.

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

4. Installation and Site Storage

4.1 Site Storage: Steel Deck shall be stored off the ground with one (1) end elevated to provide drainage and shall be protected from the elements with a waterproof covering, ventilated to avoid condensation.

(CONTINUED)

Figures 1, 2, 3, and 4 are found on page 26.

For Non-Composite Steel Form Deck

(CONTINUED)

4.2 Fastening

4.2a Deck sheets shall be welded to supporting steel immediately after alignment. Welding washers shall be used on all deck units with metal thickness less than 0.028 inches thick; welding washers shall be a minimum thickness of 0.0568 inches (16 gage) and have a nominal 3/8" diameter hole. Where welding washers are not used, a nominal 0.625 inch (5/8") diameter arc puddle weld shall be used.

Commentary: Steel deck, when adequately attached, provides lateral support to the compression flanges of supporting structural steel sections.

4.2b Deck units with spans greater than five feet shall have side laps fastened at midspan or 36" intervals—whichever is smaller.

4.2c Laps and Butted Ends: Deck ends may be either butted or lapped over supports. Standard tolerance for ordered length is plus or minus 1/2 inch.

Commentary: See figure 4 for minimum frame fastening patterns. Side lap fasteners can be welds, screws, crimps (button punching), or other method approved by the designer. The frame fastening shown in figure 4 and the side lap fastening of 4.2b ARE MINIMUM REQUIREMENTS. The SDI *Diaphragm Design Manual,* Second Edition, should be used to determine fastening requirements. When the deck will be designed to resist horizontal loads, the most stringent fastening requirements, of this specification or the *Diaphragm Design Manual,* should be used. One objective of side lap fastening is to prevent differential sheet deflection (opening of side lap) during concrete loading. The five foot span limitation on side lap fastener spacing is based on experience. Welding steel deck side laps with base metal thickness less than 0.028 inches may cause large burn holes and is not recommended.

The deck contractor should not leave loose deck at the end of the day as the wind may displace the sheets and cause injury to persons or property. If studs are being welded to the top flange of the beams, then deck sheets should be butted over the supports. Gaps are acceptable at butted ends.

Staggering floor deck end laps is not a recommended practice. The deck capacity as a form is not increased by staggering the end laps; layout and erection costs are increased.

4.3 Mechanical Fasteners:

(Powder-actuated, screws, pneumatically-driven fasteners, etc.) are recognized as viable anchoring methods, providing the type and spacing of said fastener satisfies the design criteria. Documentation in the form of test data, design calculations, or design charts should be submitted by the fastener manufacturer on the basis for obtaining approval. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of any unfastened ribs.

4.4 Construction Practice

The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI Code and shall be left in place until the slab attains 75% of its specified compressive strength. Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale or coating, and all other foreign matter. Care must be exercised when placing concrete so that the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed in a uniform manner over the supporting structure and spread towards the center of the deck span. If buggies are used they shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

4.4a All deck sheets shall have adequate bearing and fastening to all supports so as not to lose support during construction. Deck areas subject to heavy or repeated traffic, concentrated loads, impact loads, wheel loads, etc. shall be adequately protected by planking or other approved means to avoid overloading and/or damage. Damaged deck (sheets containing distortions or deformations caused by construction practices) shall be repaired, replaced, or shored to the satisfaction of the architect before placing concrete. The cost of repairing, replacing, or shoring of damaged units shall be the liability of the trade contractor responsible for the damage.

Commentary: For temporary construction loads prior to concreting, it should be safe to assume that the deck will support a minimum uniform load of 50 psf without further investigation.

4.4b The need for temporary shoring shall be investigated and, if required, it shall be designed and installed in accordance with the applicable ACI code and shall be left in place until the slab attains 75% of its specified compressive strength.

4.4c Prior to concrete placement, the steel deck shall be free of soil, debris, standing water, loose mill scale and all other foreign matter.

4.4d Care must be exercised when placing concrete so that the deck will not be subjected to any impact that exceeds the design capacity of the deck. Concrete shall be placed from a low level to avoid impact in a uniform manner over the supporting structure and spread toward the center of the deck span. If buggies are used to place the concrete, runways shall be planked and the buggies shall only operate on planking. Planks shall be of adequate stiffness to transfer loads to the steel deck without damaging the deck. Deck damage caused by roll bars or careless placement must be avoided.

4.5 Information:

Commentary: Fire ratings, diaphragm design information and reinforced concrete slab capacities are available from most form deck manufacturers.

Steel form deck may be used in a variety of ways, some which do not lend themselves to a standard ''steel deck'' analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck

For Non-Composite Steel Form Deck

(CONTINUED)

Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

4.6 Fireproofing: The metal deck manufacturer shall not be responsible for the cleaning of the underside of metal deck to ensure bond of fireproofing. Adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

FIGURE 1 Loading Diagrams and Bending Moments

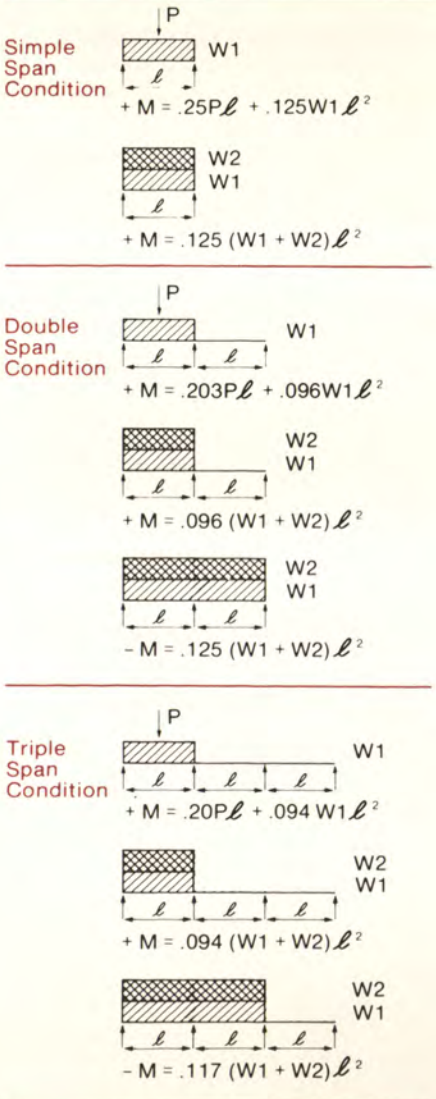
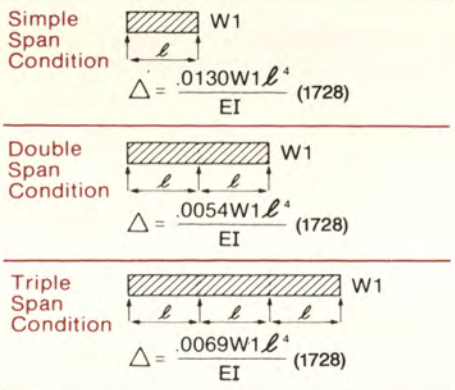


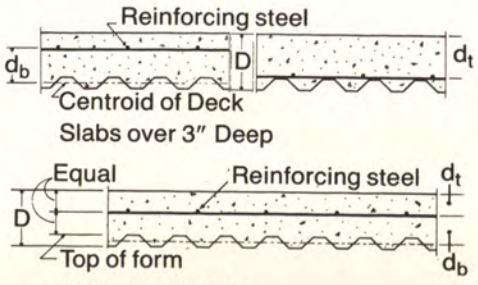
FIGURE 2 Loading Diagrams and Deflections



Note for Figures 1 and 2

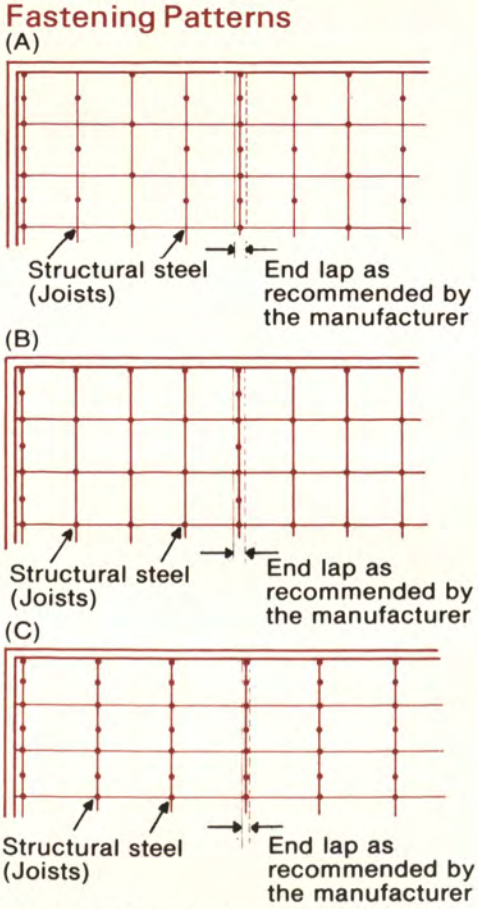
P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

FIGURE 3 Form Deck Typical Slabs



D = Depth of Slab
d_t = Distance from reinforcing steel to top of concrete.
d_b = Distance from reinforcing steel to centroid of deck.

FIGURE 4 Minimum Fastening Patterns



Intermediate side lap attachments not shown. See Section 4.2 Welding non-composite steel form deck.

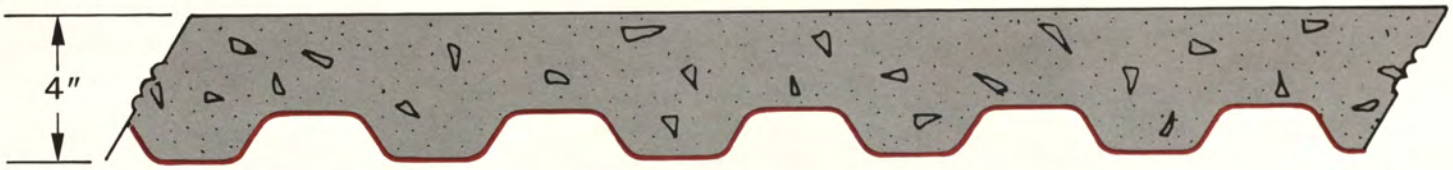
Note:
Fastener patterns A and B are for deck spans up to 4'6". Fastener pattern C is for deck spans from 4'6" to 8'0". If spans exceed 8'0", fastener should be placed so that the average spacing (at supports) is not more than 12".

Non-Composite Steel Form Deck

Design Example

Steel Deck Institute

1. Deck is to be used as a permanent form for a reinforced concrete slab. Specify the form section properties based on the following conditions:



1.1 Concrete slab is 4" total thickness — 150 pcf concrete.

1.2 Deck to be used is nominal 1⅜" deep, grade E steel conforming to ASTM-A446 (galvanized)

$f_y = 80{,}000$ psi

$f = 36{,}000$ psi

1.3 Joists at 5'-0" o.c. with 3" flange width (clear span = 4.75 ft.). All sheets of deck can span three or more supports.

1.4 For architectural considerations, the wet load deflection is to be limited to L/240 of the span.

2. Construction Loads (to find concrete weight, consult manufacturer's catalog).

Concrete weight (typical)	43 psf
Deck weight (estimated)	2 psf
Total wet load (W_1)	45 psf

3. Negative Bending

$-M = .117\,(W_1 + W_2)\,\ell^2\,(12) = .117\,(45 + 20)\,(4.75)^2\,(12)$

$-M = 2059$ in. lbs.

4. Positive Bending

$+M = [0.20\,P\ell + .094\,W_1\ell^2]\,12$

$+M = [0.20 \times 150 \times 4.75 + 0.094 \times 45 \times (4.75)^2]\,12$

$+M = 2855$ in. lbs.

5. Section Moduli

$-S$ (required) $= 2059/36{,}000 = 0.057$ in.^{3}

$+S$ (required) $= 2855/36{,}000 = 0.079$ in.^{3}

6. Calculate Required I.

$\Delta = \ell/240 = 4.75 \times 12/240 = 0.2375$ in.

$$\Delta = \frac{0.0069 W_1 \ell^4 (1728)}{EI}$$

$$I = \frac{.0069\,(45)\,(4.75)^4\,1728}{29.5 \times 10^6 \times .2375}$$

I (required) $= 0.039$ in.^{4}

7. Summary.

Designer should specify deck based on these properties or specify the performance requirements.

SDI Specifications and Commentary

For Cellular Metal Floor Deck with Electrical Distribution

1. Scope

1.1 These requirements cover cellular metal floor raceway systems intended to be installed as an integral part of the building structure and designed for the installation of wires and cables in accordance with the National Electrical Code.

Commentary: These requirements do not cover rigid or flexible conduit, surface metal raceways and fittings, underfloor duct and fittings, or other products of a similar nature.

The cellular metal floor systems in this specification are used both as a structural component as well as providing an enclosure for wires and cables. Cellular metal floor raceway is always installed with concrete poured over the raceway and may be installed on a support framing system, on top of a concrete slab or in a slab on grade.

1.2 A cellular metal floor raceway consists of the hollow spaces in cellular metal floors and associated fittings that serve as enclosures for wires and cables.

Commentary: A cell is a single enclosed tubular space in a cellular floor unit with a longitudinal axis of the floor unit. Trench header, header duct and feeder duct is a transverse wire raceway that, by providing access to predetermined cells of a cellular metal floor, facilitates the installation of wiring from a distribution center to the cells.

1.3 A cellular metal floor shall include the cellular floor units with the closures necessary to keep foreign material out of the cells. There shall be appropriate separation of different wiring systems.

Commentary: The installation of certain closures may be the responsibility of a different trade than the one installing the cellular deck units.

1.4 Cellular metal floor systems may be all cellular or a blend of cellular and non-cellular deck. These cellular and non-cellular units may be composite or non-composite in the finished concrete slab.

Commentary: There may be items to be furnished only by the deck supplier, for purposes of compatibility with the system. These items are as follows:

A. Inserts and temporary covers-factory installed preset, afterset or field installed preset.

B. Activation Kits.

C. Feeder distribution-header, duct, trench header or feeder duct.

The following related and compatible work is not a part of this division for overall system compatibility.

A. Structural steel. Division 5

1. Deck Support
2. Shear studs

B. Concrete. Division 3

1. Concrete materials
2. Reinforcing
3. Shoring
4. Placement

C. Fire proofing. Division 7

1. Fire proofing—Preparation for fireproofing materials

D. Ceilings. Division 9

1. Furnishing and installation of wires for hangers.

E. Electrical. Division 16

1. Installation of inserts, activation kits and any type header or feeder units.
2. Furnishing and installation of tape for cellular deck butt joints.
3. Furnishing and installing of receptacles for activation kits.

Materials

2.1 All materials to be used as metal floor units and/or cellular steel floor raceways shall be of materials acceptable for their particular application.

2.1a Cellular Steel Composite and Non-Composite Floor Deck Raceways: Cellular steel composite and non-composite floor deck raceways shall be fabricated

from steel conforming to Section A3 of the latest edition (1986), of the American Iron and Steel Structural Members. The steel used shall have a minimum yield point of 33 ksi. The delivered thickness of the uncoated steel shall not be less than 95% of the design.

Commentary: Various codes and standards for cellular steel floor raceways require minimum thickness, cell sizes, and top hat widths. Units employing heavier steel may be furnished where needed for structrual requirements.

2.1b Steel Floor Units: Cellular steel floor deck raceways can be blended with composite and non-composite steel deck. For material specifications, refer to the SDI Specifications and Commentary for Composite Steel Floor Deck (page 14) and Non-Composite Steel Form Deck (page 22).

2.1c Trench, accessories and other components shall be of materials suitable for their particular function and in conformance with applicable electrical standards and codes.

2.2 Finish: The finish of the steel deck, raceways, trench and components shall be as specified by the designer and be suitable for the environment of the structure and in conformance to applicable standards and codes.

Commentary: To comply with various codes and standards, composite and non-composite steel floor deck raceways are to be minimum G60 galvanized. For the finish of metal floor units used in conjunction with composite and non-composite cellular steel floor deck raceways, refer to the SDI Specifications and Commentary for Composite Steel Floor Deck (page 14) and Non-Composite Steel Form Deck (page 22).

The galvanized finish used on trench normally equals or exceeds that of the steel floor raceway finish.

3. Design (Deck as a Form)

3.1 The section properties of the steel floor deck (as a form in bending) shall be computed in accordance with the American Iron and Steel Institute Specification for the Design of Cold-Formed Steel Structural Members, 1986 edition.

3.2 Stress in the deck shall not exceed 0.6 times the yield strength with a maximum of 36 ksi under the combined weights of wet concrete, deck, and the following construction live loads: 20 pounds per square foot uniform load or 150 pound load concentrated load on a 1′-0″ section of deck. **See Figure 1.**

Commentary: The loading shown in Figure 1 is representative of the sequential loading of wet concrete on the form. The 150 pound load is the arithmetic result of 200 lb. (man's weight) x ¾. The philosophy here is to allow a ⅓ increase in stress due to the temporary nature of a man load. Decreasing the load by 25% is the mathematical equivalent of allowing a 33% increase in stress. Also the 150 pound load is considered to be applied to a one foot width —experience has shown that a greater distribution really occurs. In the past, many manufacturers have recommended using a 20 psf construction load simultaneously applied over all spans; the loading situations of Figure 1 are more severe than the old uniform load method. It is recommended that clear spans be used in the equations of Figure 1.

If the deck is a blended combination of alternating one fluted and one cellular unit, it is permissible to prorate section properties.

3.3 Calculated theoretical deflections of the deck, as a form, shall be based on the weight of the concrete (as determined by the design slab thickness) and the weight of the steel deck, uniformly loaded on all spans and shall be limited to L/180 or ¾ inch, whichever is smaller. Deflections shall be relative to supporting members. **See Figure 2.**

Commentary: The deflection calculations do not take into account construction

loads as these are considered to be temporary loads; the deck is designed to always be in the elastic range so removal of temporary loads should allow the deck to recover. The structural steel also deflects under the loading of wet concrete. The designer is urged to check the deflection of the total system especially if composite beams and girders are being used.

3.4 The bearing lengths shall be determined in accordance with the AISI specification; a uniform loading case of wet concrete plus deck weight plus 20 psf construction load shall be used. **See Figure 3.**

Commentary: In the past, 1½ inches of end bearing was the minimum; this is still a good "rule of thumb" that will, in general, prevent slip off. If less than 1½ inches of end bearing is available, or if high support reactions are expected, then the design engineer should ask the deck manufacturer to check the deck web stress. In any case, the deck must be adequately attached to the structure to prevent slip off.

4. Design Deck and Concrete as a Composite Unit

4.1 Service Loading—Span *Not* Containing (Trench) Headers

If the deck is to act compositely with the slab, the performance characteristics of the system shall have been determined in accordance with Section 5 of the "SDI Specification and Commentary for Composite Steel Floor Deck."

4.1a In a composite system composed of a blend of fluted and cellular deck of similar profile use the live load capacity for (composite) fluted deck unless test data are available that provide the load capacity of the (composite) cellular portion. If test data (for the cellular) are available, and the blend is a combination of alternating one fluted and one cellular unit, then it is permissible to prorate the uniform live load capacity of the system.

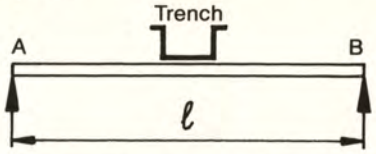
4.1b In a totally cellular composite system use the live load capacity of only the same profile top hat portion (in composite action with the slab) unless test data are available that provide the load capacity of the cellular deck/slab.

4.1c In non-composite systems, where the deck is considered to be the total load carrying element, the section properties of blended, fluted and cellular units may be prorated if the blend is a combination of alternating one fluted and one cellular unit. If concrete is present to stabilize compression flanges, the unreduced width of the compression element may be used to calculate section properties.

4.2 Service Loading—Spans Containing Trench Headers.

Deck is considered to be non-composite and thus the deck sheet becomes the structural element in the trench spans.

4.2a Steel deck is single span.

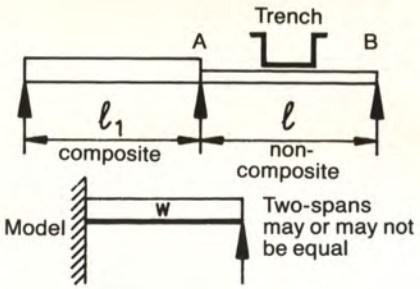


Design steel deck for:

$$+M = \frac{(W_D + W_L)\,\ell^2}{8}$$

$$\Delta = \frac{.013\,W_L\,\ell^4\,1728}{EI} \leqq \frac{\ell \times 12}{360}$$

4.2b Steel deck is two span —or the trench is in the end span of three (or more) span deck.



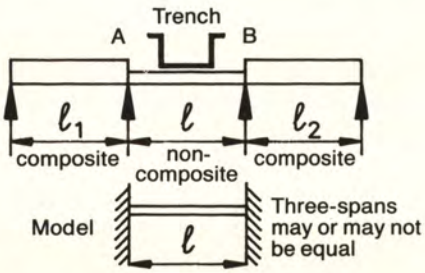
Design steel deck for:

$$-M = (W_D + W_L)\,\ell^2/8$$

$$+M = 9\,(W_L + W_D)\,\ell^2/128$$

$$\Delta = W_L\,\ell^4\,1728/(185EI) \leqq \frac{\ell \times 12}{360}$$

4.2c Steel deck is three (or more) span—trench is in interior span.



Design steel deck for:

$+M = (W_D + W_L)\ell^2/24$

$-M = 9(W_L + W_D)\ell^2/12$

$$\Delta = \frac{W_L \ell^4 1728}{384\,EI} \leqq \frac{\ell \times 12}{360}$$

4.2d If sufficient negative bending reinforcing is used at supports (A and B) then the steel deck may need to be only designed to carry the form load as the concrete cantilever slab could be designed for live loads.

Commentary: In all of the above equations:

ℓ is the non-composite span, ft.

W_L is the live load, psf

W_D is the dead load, psf

I is the I of the steel deck alone, in^4

In most cases these formulas will provide conservative answers. For instance, in case 3, if true composite I values are used in ℓ_1 and ℓ_2 and the I of the deck is used in ℓ, then moments at A and B will reduce; an analysis based on this approach would be acceptable. It is also generally conservative to use the concrete weight instead of the actual weight of the trench for dead load on form load.

EXAMPLE OF PRORATING SECTION PROPERTIES

For a blended system alternating one fluted and one cellular deck unit.

Blended System 60% Fluted; 40% Cellular	
Fluted:	I = 1.00; Sp = 0.55; Sn = 0.60
Cellular:	I = 1.55; Sp = 0.65; Sn = 0.68
Prorated:	I = 0.6 x 1 + 0.4 x 1.55 = 1.22 $in.^4/ft.$ Sp = 0.6 x 0.55 + 0.4 x 0.65 = 0.59 $in.^3/ft.$ Sn = 0.6 x 0.60 + 0.4 x 0.68 = 0.63 $in.^3/ft.$

FIGURE 1 Loading Diagrams and Bending Moments

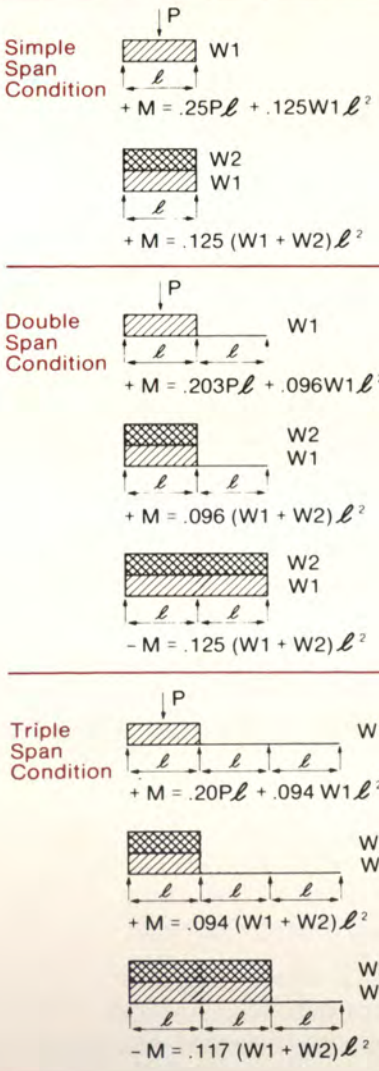
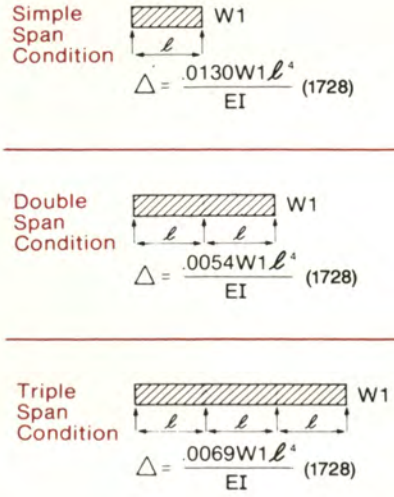


FIGURE 2 Loading Diagrams and Deflections



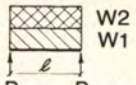
Note for Figures 1, 2 and 3

P = 150-pound concentrated load
W1 = slab weight + deck weight
W2 = 20 pounds per square foot construction load
ℓ = span length (ft.)

For Cellular Metal Floor Deck with Electrical Distribution

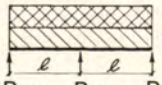
FIGURE 3 Loading Diagrams and Support Reactions

Simple Span Condition



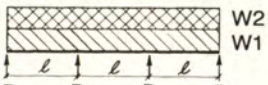
$P_{ext} = .5 (W1 + W2)\ell$

Double Span Condition



$P_{ext} = .375 (W1 + W2)\ell$
$P_{int} = 1.25 (W1 + W2)\ell$

Triple Span Condition



$P_{ext} = .4 (W1 + W2)\ell$
$P_{int} = 1.1 (W1 + W2)\ell$

5. Site Storage and Installation

5.1 Site Storage: All cellular and non-cellular deck, trench header and electrical accessories shall be stored off the ground and shall be protected from the elements with a waterproof covering, ventilated to avoid condensation. All deck units shall have one end elevated to provide drainage.

5.2 Installation: Install deck units and accessories in accordance with Manufacturer's recommendations and final approved shop drawings.

Commentary: Hoisting of deck units and accessories should be coordinated to prevent overloading of structural members and minimize excess handling.

5.2a Placing Units: Place deck units over supports and adjust to final position. Cellular Raceway units must be held on module with their ends accurately aligned at all butt joints prior to fastening.

Commentary: All deck units shall have adequate bearing and fastening to all supports so that bearing will not be lost during construction. Location of cellular raceway units must be held accurately to insure alignment for pulling of electrical wires and proper interfacing with electrical fittings and trench header.

5.2b Fastening:

5.2b.1 All floor deck units shall be anchored to supporting members, including bearing walls, with nominal $^5/_8$ inch diameter puddle welds or equivalent at all edge ribs plus a sufficient number of interior ribs to provide a maximum average spacing of 12 inches. The maximum spacing between adjacent points of attachment shall not exceed 18 inches.

Welding washers shall be used when welding steel floor deck of less than 0.028 inch thickness.

5.2b.2 Mechanical Fasteners: Mechanical fasteners (powder-actuated, screws, pneumatically driven fasteners, etc.) are recognized as viable anchoring methods, providing the type and spacing of the fasteners 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. The deck manufacturer may recommend additional fasteners to stabilize the given profile against sideslip of any unfastened ribs.

5.2b.3 Differential Deflection: Differential deflection shall be controlled by fastening together sidelaps of floor deck units as recommended by the steel deck manufacturer.

Commentary: If shear connectors are being applied through the deck onto the structural steel, the stud welds can be used to replace the puddle welds. (The deck should be welded to act as a working platform and to prevent blow off.) The layout, design, numbering or sizing of shear connectors is not the responsibility of the deck manufacturer.

Care shall be exercised when fastening cellular deck to supports or accessories to cellular deck with welds or mechanical fasteners that no penetration of the cells occur in any area where wiring will be present in the future. In some cases cellular raceways are placed

directly on concrete slabs or within reinforced concrete slabs. In these special cases, placing and fastening shall be in accordance with the electrical drawings and the manufacturers installation instructions.

5.2c Cutting and Fitting: Cut and neatly fit deck units and accessories around framed openings and columns that are located and dimensioned on the structural drawings. Openings other than shown on structural drawings, such as stacks, conduits, plumbing units, etc. shall be cut (and reinforced, if necessary) by the trades requiring openings.

Commentary: Cutting of openings through cellular raceway units is not permitted.

5.2d In-Floor Distribution System: Install trench headers, preset inserts, afterset inserts, risers and related electrical accessories in accordance with the electrical drawings and manufacturers installation instructions.

6. Construction Practice

6.1 Cleaning and Sealing: Prior to concrete placement, the cellular and non-cellular deck shall be free of soil, debris, standing water, loose mill scale or coating, and all other foreign matter. All openings in cellular raceway deck, inserts or trench headers shall be covered to seal out the entrance of concrete during pouring.

Commentary: Before pouring concrete, cellular raceways, trench headers and inserts shall be inspected and sealed by the electrical contractor. The electrical contractor shall furnish and install duct tape at all butt joints of cellular raceway units.

6.2 Temporary Shoring: The need for temporary shoring shall be investigated and if required, it shall be designed and installed in accordance with the manufacturer's shoring tables and the applicable ACI Code and shall be left in place until the slab attains 75% of its specified compressive strength.

6.3 Concrete Placement: Care must be exercised when placing concrete so that the cellular and non-cellular deck, inserts and trench headers will not be damaged. Concrete shall be placed in a uniform manner over the supporting structure and spread towards the center of the deck slab. Concrete shall be hand-finished along sides of trench headers to insure matching of adjacent surfaces. If buggies are used, they should only operate on planking. Planks shall be adequate to prevent damage.

Commentary: Since cellular raceways, inserts and trench headers are used as raceways and electrical fittings for electrical wiring and in some cases cover plates are exposed, extra care must be exercised during construction to prevent damage. Damage caused by roll bars or buggies or careless placement must be avoided. Furthermore, care must be exercised when welding, drilling holes, shooting in hangers and cutting to avoid penetrating any raceway or insert.

SDI Specifications and Commentary

For Steel Roof Deck

1. Scope

The requirements of this section shall govern only ribbed steel roof deck construction of varying configurations used for the support of roofing materials and design live loads.

Commentary: Suspended ceilings, light fixture, ducts, or other utilities shall not be supported by the steel deck.

2. Materials

2.1 Steel Roof Deck: The steel roof deck units shall be fabricated from steel conforming to Section 1.2 of the latest edition (1980) of the American Iron and Steel Institute, Specifications for the Design of Cold-Formed Steel Structural Members.

The steel used shall have a minimum yield strength of 33 ksi. The delivered thickness of the uncoated steel shall not be less than 95% of the design thickness.

Commentary: The steel roof deck shall be manufactured from steel conforming to ASTM Designation A611, Grades C, D or E or from A446 Grades A, B, C, D, E, or F or equal. If the published product literature does not show the uncoated steel thickness in decimal inches (or millimeters) but lists gage or type numbers, then the thickness of steel before coating with paint or metal shall be in conformance with the following table:

Type No.	Design Thickness Inches	Minimum Thickness Inches
22	0.0295	0.028
20	0.0358	0.034
18	0.0474	0.045
16	0.0598	0.057

Standard tolerance for ordered length is plus or minus 1/2 inch.

3. Design

3.1 Stress: The maximum working stress shall not exceed 20,000 pounds per square inch. The unit design stress shall in no case exceed the minimum yield strength of the steel divided by 1.65 for specific design uniform loads. The unit design stress shall be increased 33⅓% for temporary concentrated loads provided the deck thus required is no less than that required for the specific design uniform loads.

3.2 Section Properties: Structural adequacy of deck sections shall be established by the determination of Section Modulus and Moment of Inertia, computation for which shall be in accordance with conventional methods of structural design. Such computation shall reflect the concept of Effective Compression Flange Width as limited by the appropriate provisions of the latest edition (1980) of the American Iron and Steel Institute's Specification for the Design of Cold Formed Steel Structural Members.

Commentary: Arbitrarily assumed effective compression flange widths shall not be allowed. Testing shall not be used in lieu of the above in determination of vertical load carrying capacity of steel deck.

3.3 Moment and Deflection Coefficients: A moment coefficient of $\frac{1}{8}$ shall be used for simple and dual spans and a moment coefficient of $\frac{1}{10}$ shall be used for 3 or more spans. Deflection coefficients shall be .013 for simple spans, 0.0054 for double spans and 0.0069 for triple spans.

3.4 Maximum Deflections: Deflection of the deck shall not exceed L/240 under the uniformly distributed design live load. All spans are to be considered center-to-center of supports.

Commentary: The adequacy of deck edge support details should be reviewed. At the building perimeter, or any other deck termination or direction change, occasional concentrated loading of the roof deck could result in temporary differences in deflection between the roof deck and the adjacent stationary building component. Supplimental support such as a perimeter angle may be warranted.

BUILDING DECK EDGE OR INTERIOR TERMINATION CONDITION

Recommended Maximum Spans for Construction and Maintenance Loads Standard 1½-Inch and 3-Inch Roof Deck

	Type	Span Condition	Span Ft.-In.	Maximum Recommended Spans Roof Deck Cantilever
Narrow Rib Deck	NR22	1	3′-10″	1′-0″
	NR22	2 or more	4′-9″	
	NR20	1	4′-10″	1′-2″
	NR20	2 or more	5′-11″	
	NR18	1	5′-11″	1′-7″
	NR18	2 or more	6′-11″	
Intermediate Rib Deck	IR22	1	4′-6″	1′-2″
	IR22	2 or more	5′-6″	
	IR20	1	5′-3″	1′-5″
	IR20	2 or more	6′-3″	
	IR18	1	6′-2″	1′-10″
	IR18	2 or more	7′-4″	
Wide Rib Deck	WR22	1	5′-6″	1′-11″
	WR22	2 or more	6′-6″	
	WR20	1	6′-3″	2′-4″
	WR20	2 or more	7′-5″	
	WR18	1	7′-6″	2′-10″
	WR18	2 or more	8′-10″	
Deep Rib Deck	3DR22	1	11′-0″	3′-6″
	3DR22	2 or more	13′-0″	
	3DR20	1	12′-6″	4′-0″
	3DR20	2 or more	14′-8″	
	3DR18	1	15′-0″	4′-10″
	3DR18	2 or more	17′-8″	

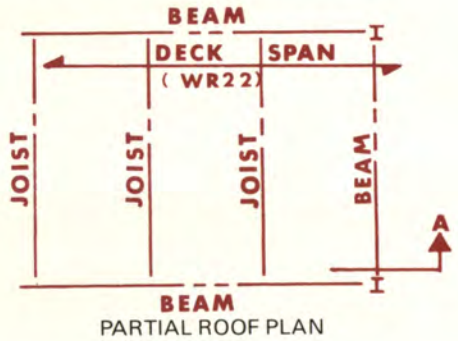
Commentary: Construction and maintenance loads:

Spans are governed by a maximum stress of 26,000 psi and a maximum deflection of L/240 with a 200-pound concentrated load at midspan on a 1′-0″ wide section of deck.

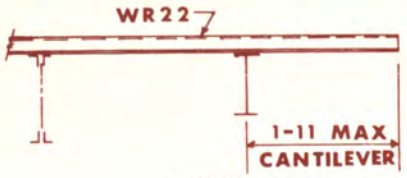
If the designer contemplates loads of greater magnitude, spans shall be decreased or the thickness of the steel deck increased as required.

All loads shall be distributed by appropriate means to prevent damage during construction to the completed assembly.

STEEL DECK CANTILEVER



PARTIAL ROOF PLAN



SECTION A

Cantilever loads:

Construction phase load of 10 psf on adjacent span and cantilever plus 200 pound load at end of cantilever with a stress limit of 26.67 ksi.

Service load of 45 psf on adjacent span and cantilever plus 100 pound load at end of cantilever with a stress limit of 20 ksi.

Deflection limited to 1/240 of adjacent span for interior span and deflection at end of cantilever to 1/120 of overhang.

Notes:

1. Adjacent span: Limited to those spans shown in Section 3.4 of Roof Deck Specifications. In those instances where the adjacent span is less than 3 times the cantilever span, the individual manufacturer should be consulted for the appropriate cantilever span.

2. Sidelaps must be attached at end of cantilever and at a maximum of 12 inches on center from end.

3. No permanent suspended loads are to be supported by the steel deck.

4. The deck must be completely attached to the supports and at the sidelaps before any load is applied to the cantilever.

4. Installation

4.1 General: Steel deck units shall be anchored to supporting members, including bearing walls, to provide lateral stability to the top flange of the supporting structural members and to resist the following gross uplifts: 45 pounds per square foot for eave overhang; 30 pounds per square foot for all other roof areas. The dead load of the roof deck construction shall be deducted from the above uplift forces.

Commentary: In the past, 1½ inches of end bearing was the minimum; this is still a good ''rule of thumb'' that will, in general, prevent slip off. If less than 1½ inches of end bearing is available, or if high support reactions are expected, then the design engineer should ask the deck manufacturer to check the deck web stress. In any case, the deck must be adequately attached to the structure to prevent slip off.

4.2 Welds: Care shall be exercised in the selection of the electrodes and amperage to provide positive weld and to prevent high amperage blow holes. Puddle welds shall be at least ½ inch diameter or elongated welds with an equal perimeter. Fillet welds when used, shall be at least 1 inch long. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting members.

Commentary: The selection of welding rod and amperage are left to the preference of the individual welder. Welds are made from the top side of the deck with the welder immediately following the placement crew. Welding washers are neither necessary nor recommended for steel deck of 0.028 inches or greater.

4.3 Screws: The allowable load value per screw used to determine maximum fastener spacing for either self-drilling or standard metal type is based on a minimum size 12 and on a minimum structural support thickness of 0.06 inches.

4.4 Spacing of Attachments for Welds or Screws: The location and number of welds or screws required for satisfactory attachment of deck to supporting structural members are as follows: all side laps plus a sufficient number of interior ribs to limit the spacing between adjacent points of attachment to 18 inches. For spans greater than 5 feet, the side laps shall be fastened together at a maximum spacing of 3 feet.

Commentary: The fastening requirements described in 4.4. are the minimum necessary to anchor the deck and prevent large differential deflections between deck units. Side lap fasteners can be welds, screws, crimps (button punching), or other method approved by the designer. The SDI *Diaphragm Design Manual,* Second Edition, should be used to determine fastening requirements if the deck will be designed to resist horizontal loads. The most stringent requirements, of either section 4.4 or the *Diaphragm Design Manual,* should be used.

4.5 Powder-Activated or Pneumatically-Driven Fasteners: The allowable load value per fastener used to determine the maximum fastener spacing is based on a minimum structural support thickness of not less than 1/8 inch and on the fastener providing a 5/16 inch diameter minimum bearing surface (fastener head size). Documentation in the form of test data, design calculation, or design charts shall be submitted by the fastener manufacturer as the basis for obtaining approval.

Commentary: Powder actuated and pneumatically driven fasteners are recognized as viable anchoring methods, providing the type and spacing of said fasteners satisfies the design criteria.

5. Protective Coatings

5.1 Finishes: All steel to be used for roof deck shall be galvanized, aluminized or prime painted. The roof deck shall be free of grease and dirt prior to the coating. 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.

Commentary: Field painting of prime painted deck is recommended especially where the deck is exposed. In corrosive or high moisture atmospheres, a galvanized finish is desirable in a G-60 or G-90 coating.

In highly corrosive or chemical atmospheres, special care in specifying the finish should be used. In this case, individual manufacturers should be contacted.

5.2 Fireproofing: The metal deck manufacturer shall not be responsible for the cleaning of the underside of metal deck to ensure bond of fireproofing. Adherence of fireproofing materials is dependent on many variables; the deck manufacturer (supplier) is not responsible for the adhesion or adhesive ability of the fireproofing.

6. Site Storage

Steel deck shall be stored off the ground with one end elevated to provide drainage and shall be protected from the elements with a waterproof covering, ventilated to avoid condensation.

7. Erection

Deck sheets will be placed in accordance with approved erection layout drawing supplied by the deck manufacturer and in conformance with the deck manufacturer's standards. End laps of sheets shall be a minimum of 2 inches and shall occur over supports.

Commentary: The deck erector normally cuts all openings in the roof deck which are shown on the erection drawings and which are less than 16 square feet in area, as well as skew cuts which are shown on the drawings. Openings not shown on the erection diagrams, such as those required for stacks, conduits, plumbing, vents, etc., shall be cut (and reinforced, if necessary) by the trades requiring the openings.

8. Insulation

Insulation board shall be sufficient strength and thickness to permit unsupported spans and edges over the deck's rib openings. Cementitious insulating fills shall be poured only over galvanized deck and shall be adequately vented. In all cases, the recommendations of the insulation manufacturer shall be followed.

9.

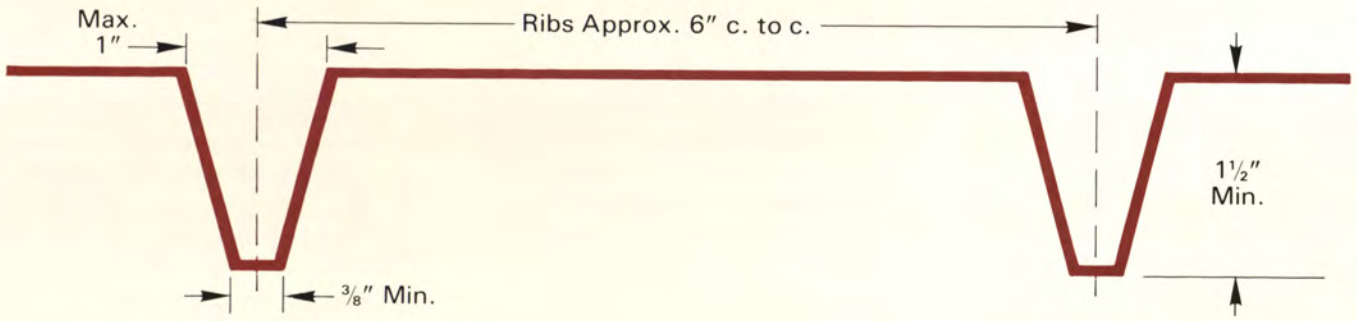
CAUTION

Steel roof deck may be used in a variety of ways, some which do not lend themselves to a standard ''steel deck'' analysis for span and loading. There are, in these cases, other criteria which must be considered besides that given by the Steel Deck Institute. Make sure that this investigation starts with a review of the applicable Codes and that any special conditions are included in the design.

SDI Standard Roof Deck

Load Tables

Narrow Rib Deck Type NR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds Per Sq. Ft. Span Length—c. to c. Joists or Purlins (Ft.-In.)												
			4-0	4-6	5-0	5-6	6-0	6-6	7-0	7-6	8-0	8-6	9-0	9-6	10-0
NR 22	Simple	0.0295	73	58	47										
NR 20		0.0358	91	72	58	48	40								
NR 18		0.0474	121	95	77	64	54	46							
NR 22	2	0.0295	80	63	51	42									
NR 20		0.0358	96	76	61	51	43								
NR 18		0.0474	124	98	79	66	55	47	41						
NR 22	3 or more	0.0295	100	79	64	53	44								
NR 20		0.0358	120	95	77	63	53	45							
NR 18		0.0474	155	123	99	82	69	59	51	44					

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½-inch depths: 6, 7½, 8, 9, and 12-inch rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf. All loads are governed by the allowable flexural stress limit of 20,000 psi for a 33,000 psi minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center-to-center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

$$\text{Simple \& Two Span } M = \frac{w\ell^2}{8}$$

$$\text{Three Span or More } M = \frac{w\ell^2}{10}$$

6. Deflection formulae for deflection limitation are:

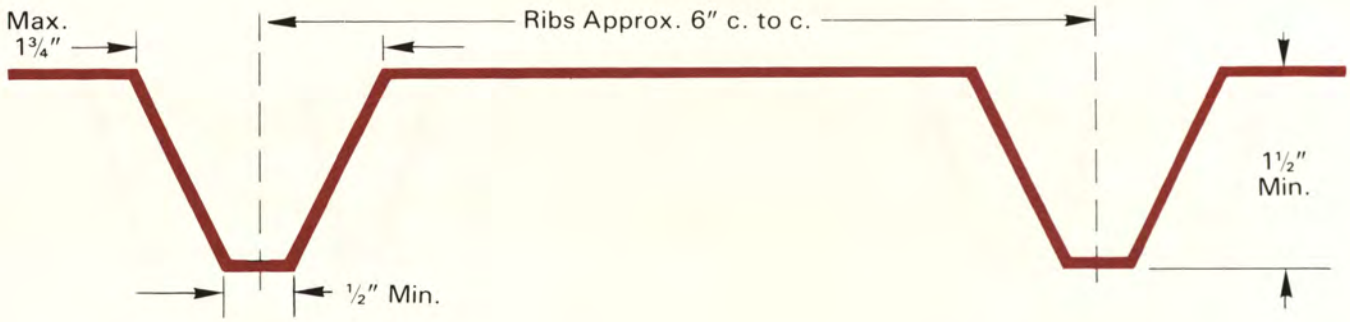
$$\text{Simple Span } \Delta = \frac{.013\, w\ell^4}{EI} \quad (1728)$$

$$\text{Two Span } \Delta = \frac{.0054\, w\ell^4}{EI} \quad (1728)$$

$$\text{Three Span } \Delta = \frac{.0069\, w\ell^4}{EI} \quad (1728)$$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

Intermediate Rib Deck Type IR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds Per Sq. Ft. Span Length—c. to c. Joists or Purlins (Ft.-In.)												
			4-0	4-6	5-0	5-6	6-0	6-6	7-0	7-6	8-0	8-6	9-0	9-6	10-0
IR 22	Simple	0.0295	86	68	55	45									
IR 20		0.0358	106	84	68	56	47	40							
IR 18		0.0474	142	112	91	75	63	54	46	40					
IR 22	2	0.0295	93	74	60	49	41								
IR 20		0.0358	112	88	71	59	50	42							
IR 18		0.0474	145	115	93	77	64	55	47	41					
IR 22	3 or more	0.0295	117	92	75	62	52	44							
IR 20		0.0358	140	110	89	74	62	53	46	40					
IR 18		0.0474	181	143	116	96	81	69	59	52	45	40			

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½-inch depths: 6, 7½, 8, 9, and 12-inch rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf. All loads are governed by the allowable flexural stress limit of 20,000 psi for a 33,000 psi minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center-to-center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

$$\text{Simple \& Two Span } M = \frac{w\ell^2}{8}$$

$$\text{Three Span or More } M = \frac{w\ell^2}{10}$$

6. Deflection formulae for deflection limitation are:

$$\text{Simple Span } \Delta = \frac{.013\, w\ell^4}{EI} \quad (1728)$$

$$\text{Two Span } \Delta = \frac{.0054\, w\ell^4}{EI} \quad (1728)$$

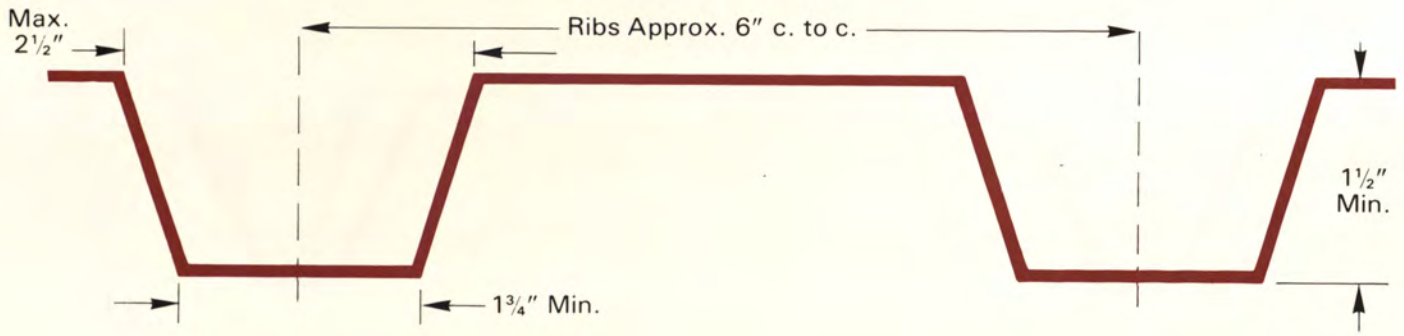
$$\text{Three Span } \Delta = \frac{.0069\, w\ell^4}{EI} \quad (1728)$$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

SDI Standard Roof Deck

Load Tables

Wide Rib Deck Type WR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds Per Sq. Ft. Span Length—c. to c. Joists or Purlins (Ft.-In.)											
			4-0	4-6	5-0	5-6	6-0	6-6	7-0	7-6	8-0	8-6	9-0	9-6	10-0
WR 22	Simple	0.0295			89	70	56	46							
WR 20		0.0358			112	87	69	57	47	40					
WR 18		0.0474			154	119	94	76	63	53	45				
WR 22	2	0.0295			98	81	68	58	50	43					
WR 20		0.0358			125	103	87	74	64	55	49	43			
WR 18		0.0474			165	137	115	98	84	73	65	57	51	46	41
WR 22	3 or more	0.0295			122	101	85	72	62	54	46	40			
WR 20		0.0358			156	129	108	92	80	67	57	49	43		
WR 18		0.0474			207	171	144	122	105	91	76	65	57	50	44

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½-inch depths: 6, 7½, 8, 9, and 12-inch rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf. Loads in shaded areas are governed by live load deflection not in excess of L/240. The dead load included is 10 psi. All loads are governed by the allowable flexural stress limit of 20,000 psi for a 33,000 psi minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center-to-center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

$$\text{Simple \& Two Span } M = \frac{w\ell^2}{8}$$

$$\text{Three Span or More } M = \frac{w\ell^2}{10}$$

6. Deflection formulae for deflection limitation are:

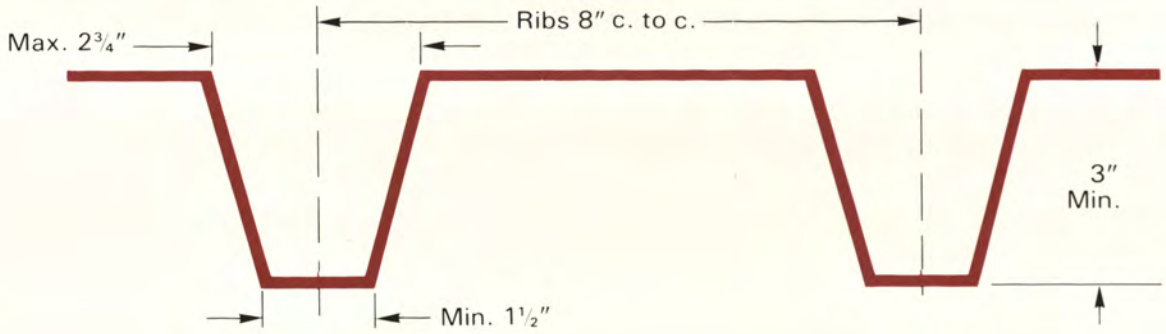
$$\text{Simple Span } \Delta = \frac{.013\, w\ell^4}{EI} \quad (1728)$$

$$\text{Two Span } \Delta = \frac{.0054\, w\ell^4}{EI} \quad (1728)$$

$$\text{Three Span } \Delta = \frac{.0069\, w\ell^4}{EI} \quad (1728)$$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

Deep Rib Deck Type 3DR



Deck Type	Span Condition	Design Thickness (In.)	Uniform Total (Dead & Live) Load in Pounds Per Sq. Ft. Span Length—C. to C. Joists or Purlins (Ft. In.)											
			9-0	9-6	10-0	10-6	11-0	11-6	12-0	12-6	13-0	13-6	14-0	14-6
3DR22		.0295	61	55	49	43	39	35	32	30	28	26	24	23
3DR20		.0358	75	68	59	53	47	42	39	35	32	30	28	26
3DR18	Simple	.0474	102	92	81	71	63	57	51	46	42	40	36	33
3DR22		.0295	69	62	56	51	47	43	39	36	33	31	29	27
3DR20		.0358	84	75	68	62	56	51	47	44	40	37	35	32
3DR18	2	.0474	110	98	89	81	73	67	62	56	53	49	45	42
3DR22		.0295	87	78	70	64	58	53	48	44	40	39	36	33
3DR20		.0358	105	94	85	77	70	64	59	53	48	47	43	40
3DR18	3 or More	.0474	137	123	111	101	92	84	77	71	65	61	57	53

Steel decks complying with SDI Roof Specifications are available from member companies in 1½, 2, 3, 4½, 6, and 7½-inch depths: 6, 7½, 8, 9, and 12-inch rib spacings; with and without stiffening elements.

Notes:

1. Load tables are calculated using Section Properties based on the steel design thicknesses shown on page 30.
2. Loads shown in tables are uniformly distributed total (dead plus live) loads in psf. All loads are governed by the allowable flexural stress limit of 20,000 psi for a 33,000 psi minimum yield steel. Where heavy construction loads or other unusual concentrated loads are anticipated during the lifetime of the deck, the specified live load must be increased to offset the effects of the abnormal concentrated loading. *See Maximum Spans for Construction and Maintenance Loads on page 31.*
3. The rib width limitations shown are taken at the theoretical intersection points of the flange and web projections. Depending on the radius used, the load table could vary from that shown.
4. Span length assumes center-to-center spacing of supports. Tabulated loads shall not be increased by assuming clear span dimensions.
5. Bending Moment formulae used for flexural stress limitations are:

$$\text{Simple \& Two Span } M = \frac{w\ell^2}{8}$$

$$\text{Three Span or More } M = \frac{w\ell^2}{10}$$

6. Deflection formulae for deflection limitation are:

$$\text{Simple Span } \Delta = \frac{.013\, w\ell^4}{EI} \quad (1728)$$

$$\text{Two Span } \Delta = \frac{.0054\, w\ell^4}{EI} \quad (1728)$$

$$\text{Three Span } \Delta = \frac{.0069\, w\ell^4}{EI} \quad (1728)$$

7. Normal installations covered by these tables do not require sidelap fasteners between supports for spans of 5 feet or less.
8. The manufacturer guarantees that the product identified as complying with a Standard Load Table conforms to the Roof Deck Specifications of the Steel Deck Institute and to the dimensional parameters established for that load table.

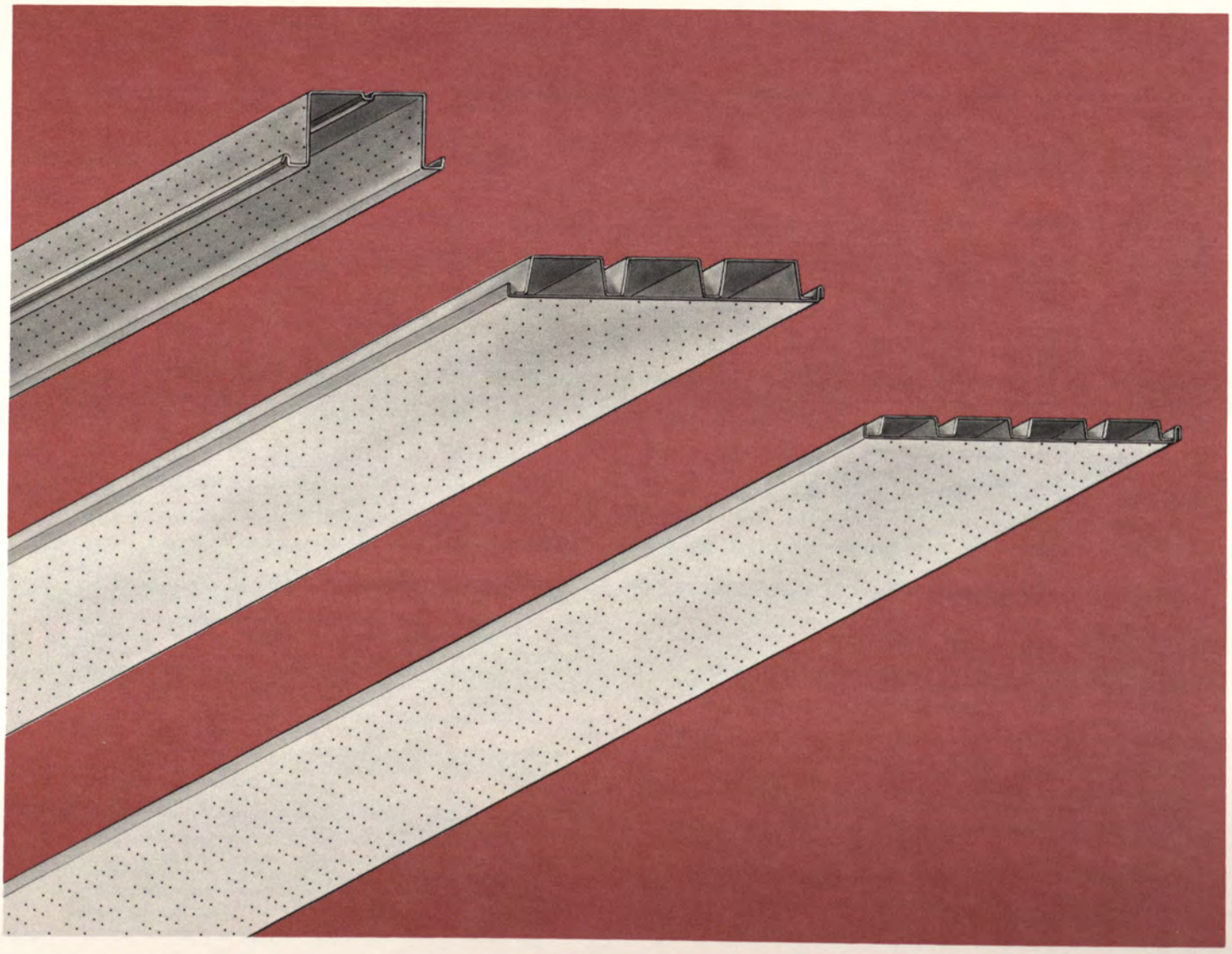
Acoustical Decks

Sound absorbing decks are often used as a combination of acoustical ceiling and structural deck. These decks are commonly referred to as ACOUSTICAL DECKS.

Acoustical Decks are available as roof decks, fluted and as cellular floor decks. The steel deck is perforated.

Glass fiber insulation, when required, is field installed in the flutes or cells.
The load carrying capacity of the deck may be affected due to holes punched in the metal.

The efficiency of sound absorption is expressed as the noise reduction coefficient (NRC). The NRC values are obtained by testing assemblies by the requirements of the American Society for Testing and Material Standard Test Method for Sound Absorption Coefficients by the Reverberation Room Method:ANSI/ ASTM C432-77.
Individual deck manufacturers should be consulted for NRC values with their products. The finish for Acoustical Decks should be either galvanized or galvanized and painted.

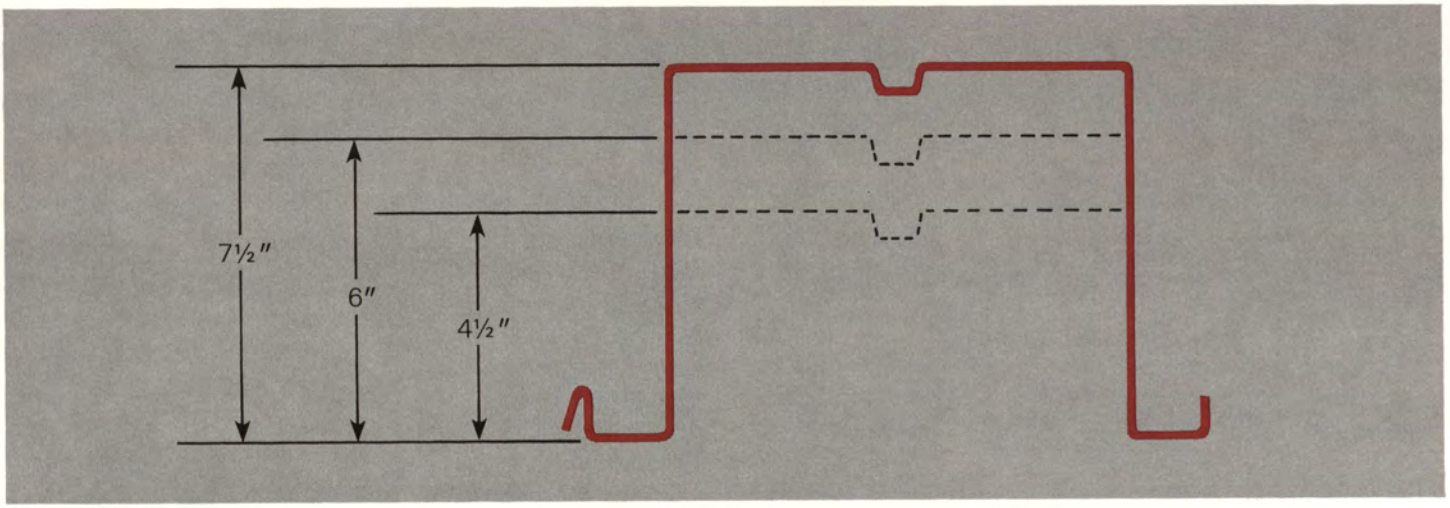


Steel Deck Institute sdi

Roof Decks

Long Span Roof Decks are used to support roofing materials and design live loads for spans up to thirty feet. The bottom side presents an attractive finish which can be field painted to enhance the appearance.

When Long Span Roof Decks are used to span between masonry walls the ceiling is not cluttered with beams or joists. In addition, building height is reduced. For very large open areas a minimum of support members are required.



Cellular Roof Decks

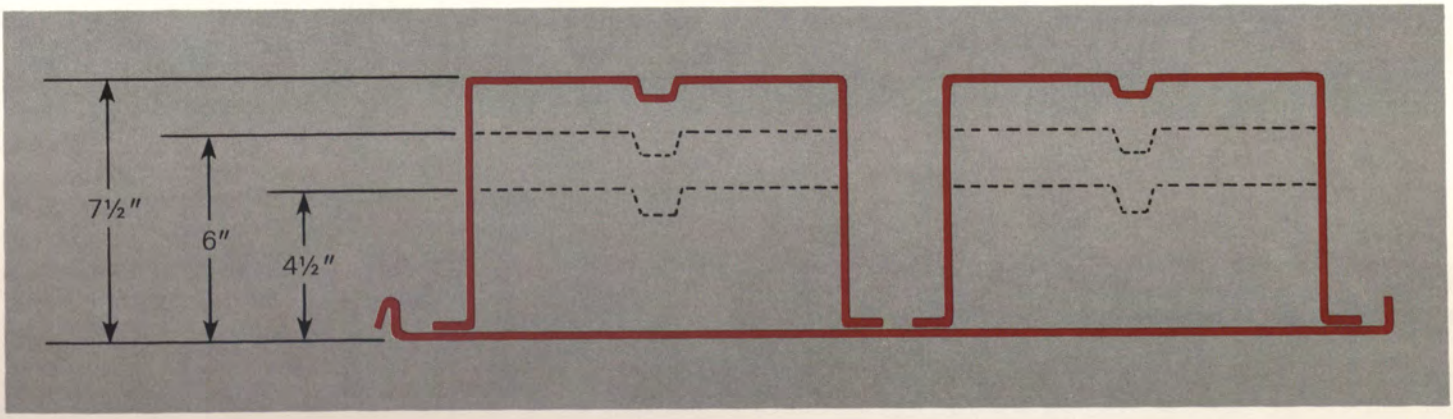
Long Span Cellular Roof Decks have all the advantages of the Non-Cellular Long Span Decks and more.

The bottom side presents a flush ceiling. The bottom plate may be embossed, which adds to the ceiling appearance and also tends to camouflage the spot welds, which are used to attach the plate to the fluted section.

Field painting completes the ceiling decoration treatment.

The addition of the bottom plate increases the span and load carrying capabilities of Long Span Roof Decks.

For economy, appearance, and ease of construction Long Span Decks are an excellent choice.



Steel Roof Deck

Design Example

Given:

A. **Joist spacing 6′-0″ c. to c.**

B. **Live load = 30 psf**

C. **Total load = 50 psf.**

D. **2″ total insulation with built-up roof.***

E. **Steel deck diaphragm not required.****

1. Refer to Standard Load Tables on pages 33, 34, 35, 36.

   1.1 Enter 50 psf total load at 6′-0″ span, 3-span condition.

   Select deck types that equal or exceed the 50 psf required.

   From Table:
   NR 20 = 53 psf capacity
   IR 22 = 52 psf capacity
   WR 22 = 85 psf capacity

2. Refer to *Maximum Spans for Construction and Maintenance Loads* on page 30.

   Select deck types that equal or exceed the 6′-0″ span required.

   From Table:
   NR 18 = 6′-11″ span
   IR 20 = 6′-3″ span
   WR 22 = 6′-6″ span

   WR 22 fulfills requirements most efficiently.

   *Refer to Roof Deck Specifications, Section 8—Insulation, page 32. Also refer to insulation manufacturers' recommendations for maximum allowable rib opening.

   **If the steel deck is required to act as a diaphragm, refer to *Steel Deck Institute Diaphragm Design Manual* (#DDM01), a publication of the Steel Deck Institute.

Steel Deck Institute sdi

Suggested Architects' Specifications

1. Scope

This section shall include all materials, equipment, and labor necessary for the installation of steel roof deck in accordance with this specification and drawings. Requirements for deck supports, field painting, sumps, flashings, drains, collars, gutters, downspouts, and other miscellaneous items are specified as needed.

2. Deck

The steel roof deck shall be (narrow rib) (intermediate rib) (wide rib) configuration, _____ inches in rib depth, as manufactured by

_____

and shall be designed in accordance with the Roof Deck Specifications of the Steel Deck Institute.

3. Loads

The deck shall be capable of supporting a uniformly distributed live load of _____ pounds per square foot with the live load deflection not to exceed L/240 of the span length center-to-center of supports and with a uniformly distributed load of _____ pounds per square foot without exceeding a unit stress of 20,000 pounds per square inch.

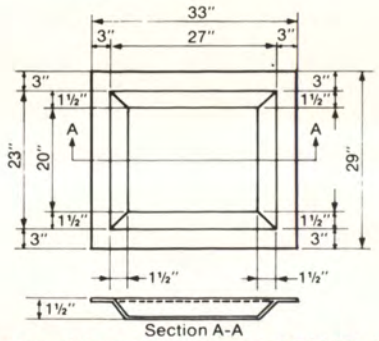
4. Accessories

The deck manufacturer shall furnish ridge and valley plates, steel cant strips, and sump pans attached directly to the steel deck as shown on the plans to provide a finished surface for the application of insulation and roofing.

5. Installation

Steel deck shall be erected and fastened in accordance with the manufacturer's specifications and erection layouts. Cutting openings through the deck which are less than 16 square feet in area and all skew cutting shall be performed in the field.

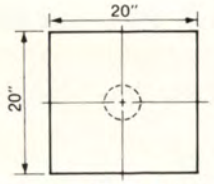
ACCESSORIES



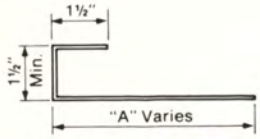
Recessed Sump Pan - Level (0.071" Min.)
(Hole cut in field by others)

6. Coating

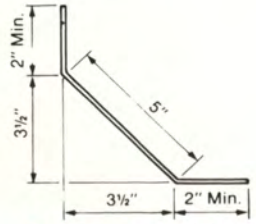
Roof deck shall receive one primer coat of manufacturer's standard paint or shall be galvanized or aluminized.



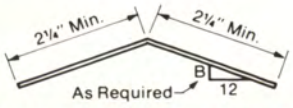
Flat Sump Plate (0.071" Min.)
Dimensions shown are minimum.
(Hole cut in field by others)



Eave Plate (0.028" Min.)



Cant Strip (0.028" Min.)



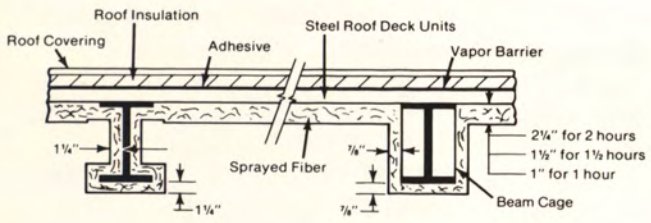
Ridge and Valley Plate (0.028" Min.)

Steel Roof Deck

Fire Resistance Ratings

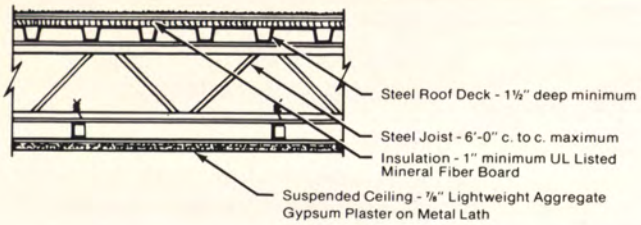
2-Hour Rating with Directly-Applied Protection

Illustration refers to UL Design P801 using a sprayed mineral fiber insulation. See also UL Designs P701, P711, and P805.



2-Hour Rating with Metal Lath and Plaster Ceiling

Illustration refers to UL Design P404. See also UL Design P409.



Other 2-Hour Ratings

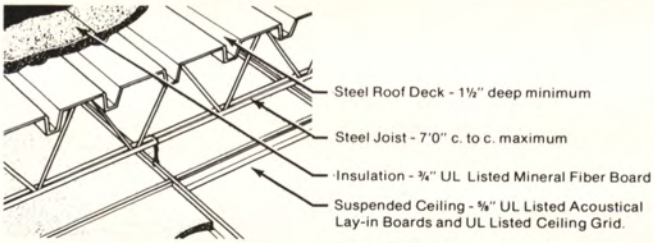
Although standard roof deck sections were not used for the following tests, it is the opinion of persons knowledgeable in fire test procedures that galvanized steel roof deck with a minimum depth of 1½ inches and a 0.0295-inch design thickness can be used without decreasing the fire resistance of the assembly. In each case, the assembly was tested using either a steel form unit with a minimum depth of 9/16 inch or a steel floor deck essentially identical to products marketed as roof deck. The authorities having jurisdiction should be consulted before substituting steel roof deck in the following assemblies:

UL Designs P215 and P219: accoustical ceiling systems. 2 inches vermiculite concrete on special roof topping mixture on steel deck.

UL Design P902: no ceiling required. 2¾ inches cellular concrete on steel deck.

1-Hour Ratings with Suspended Acoustical Ceiling

Illustration refers to UL Design P201. See also UL Designs P204, P210, P211, P224, P232, P235, P238, and P243, and Factory Mutual Roof-Ceiling Construction 3-1 hour.



SPECIAL NOTICE

The information presented in this manual has been prepared in accordance with generally recognized engineering principles. We recommend that this information not be used or relied upon for any application without a thorough review by a licensed professional engineer, designer or architect of the proposed application.

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Since hazards may be associated with the handling, installation, or use of steel and its accessories, prudent construction practices should always be followed. We recommend that parties involved in such handling, installation or use review all applicable manufacturers' material safety data sheets, applicable rules and regulations of the Occupational Safety and Health Administration and other government agencies having jurisdiction over such handling, installation or use, and other relevant construction practice publications.

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