

Reinforced concrete slab systems on steel decks

Decking can serve as form, shoring and finished surface

Systems of reinforced concrete slabs on steel decks can be used to save time and expense. They offer certain advantages over conventional construction. One is that they replace conventional wood forming and bar reinforcement. They can also eliminate shoring. The dead load of the decking is low yet it provides a working platform for other trades. Its die-set ends provide neat fitting end laps and the whole deck is sufficiently impervious to minimize concrete leakage and to prevent moisture loss from the bottom surface during the curing period.

There is a surprising number of design varieties available from a number of manufacturers. This makes it possible to meet almost any specification by selecting the proper combination of decking, concrete and reinforcement.

Many options available

Any of a variety of configurations may be chosen, depending on the strength required, the building framing design, ceiling surface desired and what utility provisions are needed. Decks are available which provide a smooth ceiling finish or a ribbed design. Built-in ducts for electrical wiring, heating, air conditioning and plumbing may be specified. Galvanized, painted or uncoated finishes may be ordered, and ceilings may be field painted in any color.

Some decks are designed so that their ribs provide reinforcement for

the slab—other designs do not. Mechanical bond of the steel to the concrete is provided in some designs by stamped projections or corrugations in the steel, usually on the sides of the ribs.

Some decks are one piece; others are built up of more than one layer of steel to provide a smooth ceiling, conceal utility ducts, increase structural strength and eliminate the need for shoring. Designs that provide for studs in composite beam construction are also available.

Load and design considerations

Since a wide variety of decking designs is available there is no one table of design and loading characteristics that applies to all. Tables I and II represent one design, however, to give an idea of the performance to be expected from this type of construction. The figures given are for normal weight concrete with

a strength of 3000 psi, a stress of 1350 psi, shear stress of 60 psi and a 25-psi bond stress.

The slab depths in the tables are measured from the top of the slab to the bottom of the ribs in the decking. Load characteristics must obviously vary with the decking configurations and thickness, span reinforcement, concrete strength and concrete thickness. The specifications provided by individual manufacturers should be consulted for specific product data.

Most designs do not require that reinforcing steel be used for structural strength. The use of some negative reinforcement in the top of the slab over the supports will prevent the formation of tension cracks due to flexure when slabs are continuous for two or more spans. Welded wire fabric is usually recommended for temperature and shrinkage reinforcement.

TABLE I Representative spans for type of floor deck shown in Figures 1 and 2
Maximum spans without shoring, feet—inches

Slab Thickness, inches	18 gage		20 gage		22 gage	
	Simple Span	Continuous Span	Simple Span	Continuous Span	Simple Span	Continuous Span
3	8-0	9-0	7-0	8-0	6-6	7-6
3½	7-6	8-6	6-6	7-6	6-0	7-0
4	7-6	8-0	6-6	7-0	6-0	6-6
4½	7-0	8-0	6-0	7-0	5-6	6-0
5	6-6	7-6	6-0	6-6	5-6	6-0

Slab thickness is measured from bottom of ribs. The requirements for shoring are based on the ability of the decking to sustain the weight of the fresh concrete plus a construction live load of 20 pounds per square foot without exceeding an allowable unit stress of 20,000 psi.

TABLE II Composite slab loads for type of deck shown in Figures 1 and 2, all gages

Superimposed load, pounds per square foot

Slab Thickness, inches	5-foot Span	5-foot 6-inch Span	6-foot Span	6-foot 6-inch Span	7-foot Span	7-foot 6-inch Span	8-foot Span	8-foot 6-inch Span	9-foot Span	6-inch Span	10-foot Span
	3	329	272	229	195	168	146	129	114	101	91
3½	400	330	278	236	204	178	156	138	123	111	100
4	488	433	364	310	268	233	205	181	162	145	131
4½	560	489	411	350	302	263	231	205	182	164	148
5	636	550	462	394	339	296	260	230	205	184	166

The most common method of supporting the fabric is on chairs over structural members with the fabric draped between the support points. This method gives added structural strength. Chair height varies with the thickness of the slab. For instance, a typical design would require 1½-inch chairs at the supports for a 3½-inch slab; 2-inch chairs for a 4-inch slab; 2½-inch chairs for a 4½-inch slab and 3-inch chairs for a 5-inch slab. Fabric may also be supported at the center of the slab, or it may be installed in two flat layers with the top layer (negative steel) extending on either side of the support for one-quarter of the span (See Figure 1).

The design and spacing of expansion and control joints is generally not specified by the decking manufacturer because of the great number of variables that must be considered. This would fall into the province of the architect or building

designer. His drawings should be carefully followed as decking is placed to ensure that his design recommendations are employed.

Fire resistance

Building codes require that floors and roofs be of fire resistive construction for most occupancies in certain types of buildings. There are various ways of providing fire resistance for steel deck-reinforced concrete slab systems. Details of such constructions are given in publications such as Underwriters' Laboratories Fire Resistance Index and model building codes. Manufacturers can supply information applicable to their systems.

Sound transmission

The FHA Minimum Property Standards for Multi-family Housing sets minimum requirements for sound transmission and impact noise through floors. Manufacturers

of steel decking should be able to provide data for their systems and information on how to reduce sound transmission and impact noise to the level required. It is possible to nullify the adequacy of a floor-ceiling construction in its resistance to transmitting noise if careless detailing provides alternative sound paths.

Installation and placement

Job scheduling is important in erecting steel deck. Decking should be installed and covered as soon as possible after it arrives on the job-site, because most finishes on the steel are not designed to protect it during long periods of exposure. If storage is necessary the decking has to be stored off the ground, with one end elevated for drainage, and protected from the elements with a waterproof covering.

Decking sheets are usually lapped two inches at the ends. Laps are

Figure 1. Floor details for sheets placed perpendicular to wall and parallel to wall, and decks of various thicknesses

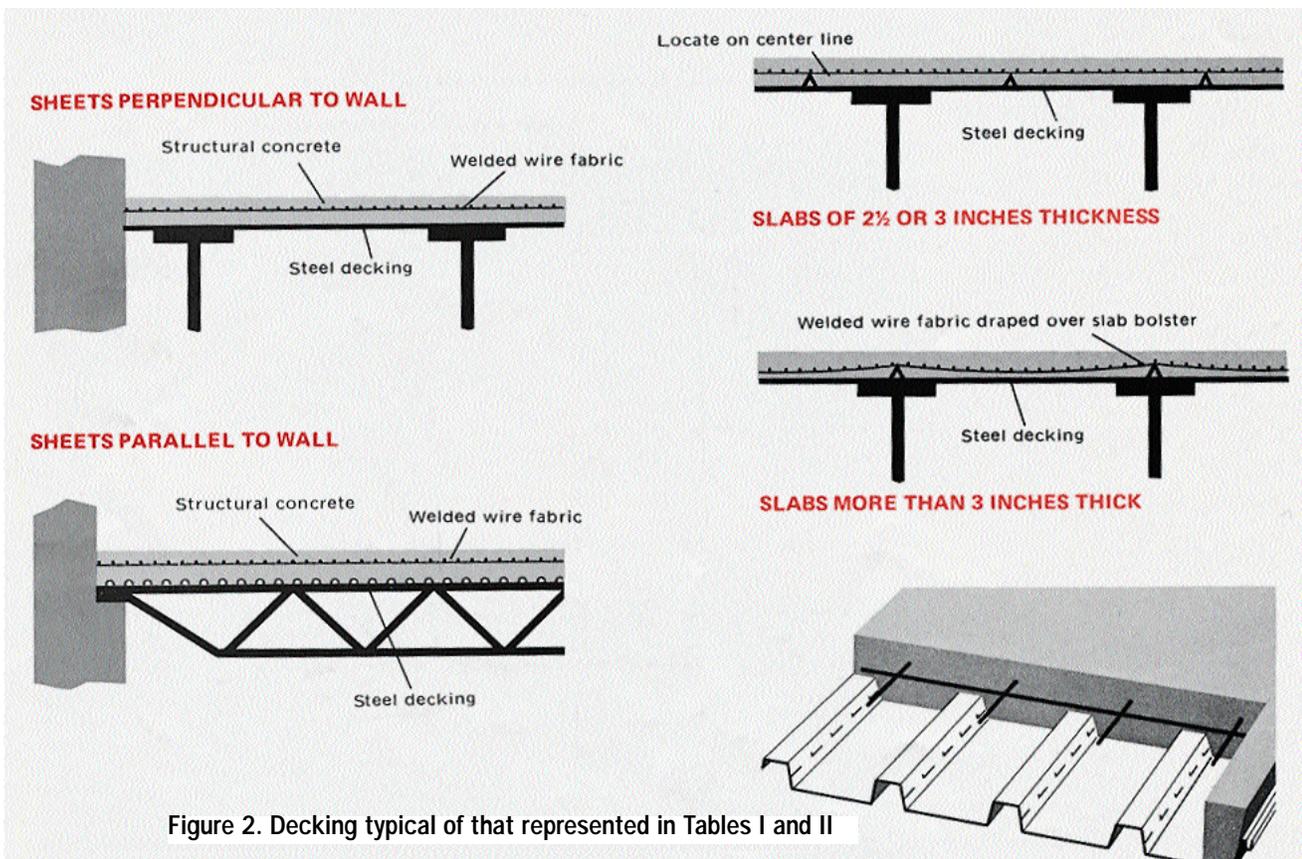


Figure 2. Decking typical of that represented in Tables I and II

placed over support beams. The sides of the panels are usually interlocking and are joined mechanically or by on-site tack welding.

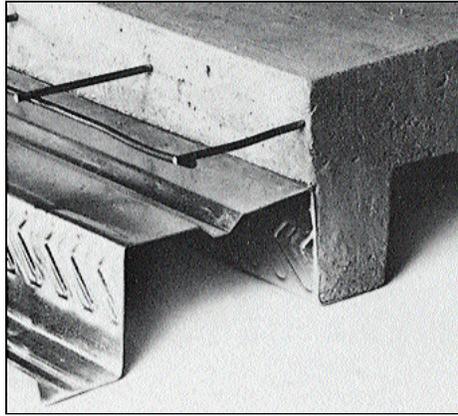
The erection of roofs with a slope of $\frac{1}{4}$ inch or more in 12 inches should begin at the low side so that end laps lie shingle fashion. Chalk lines can be snapped at reasonable sheet width modules to assure proper coverage and alignment.

Welding is the usual method of attaching the decking to support beams. Safety requires that this be done immediately after the sheets are aligned so that gusts of wind do not displace sheets and endanger workmen below. All sheets must unfailingly be welded before the end of the working day. Broken bundles must be tied or weighted to prevent the wind from blowing sheets.

Most manufacturers provide detailed specifications on welding. These include recommended patterns for welding sheets to beams, diameter and thickness of welds, and requirements for special welding washers and chairs.

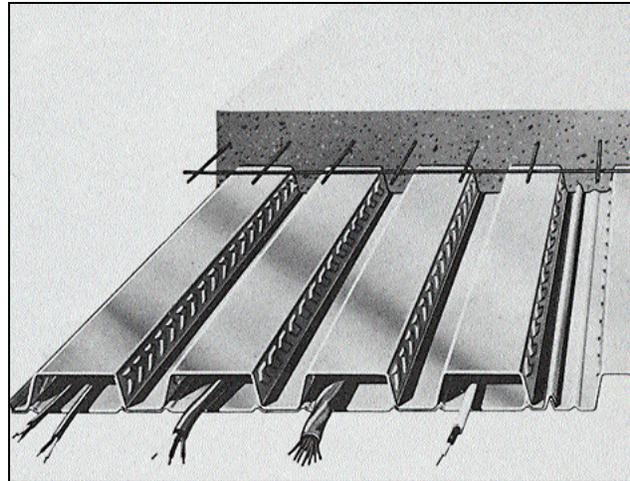
The welder generally follows closely behind the decking placement crew and welds from the top side of the deck. Fusion welding is usually employed because it is efficient and economical. The welder should select welding rods and amperages that provide sound welds and prevent blowholes. The welds to supports should generally be about $\frac{1}{2}$ -inch-diameter puddle welds. Usually these are spaced about 15 inches apart along support beams. The welds must penetrate all layers of deck material and be well fused to the support beams.

Manufacturers supply various pieces of hardware for fastening and hanging decking. Screw-type side-lap fasteners, nonpiercing hanger tabs, piercing hanger tabs and inte-



Single thickness decking with embossed ribs to develop mechanical shear bond with concrete. Ends are die set for neat fit; side laps are interlocking.

This floor deck system offers greater strength than single thickness decking and provides a flat ceiling surface and channels for wiring.



gral hanger tabs are among the many accessories available.

During placement of concrete, care should be taken to avoid overloading the decking or supporting structural members. Heavy transporting equipment, bundles of steel deck or other construction loads should not be placed on the roof unless the structural members and decking have been checked for load capacity. Placement of concrete proceeds in the direction opposite to that in which the sheets were erected so that the concrete will flow away from the lap. This procedure minimizes stresses on the lap that could cause separation and result in

leakage.

Corrosion

Although protective coatings and finishes are available for decking, calcium chloride should not be used in concrete that is in direct contact with steel because of the danger of corrosion. Use of the steel deck systems would not be advisable in buildings to be exposed to excessive moisture or corrosive fumes. Neither would it be advisable to use them where strong vibration might be expected. 

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