

Building with Quad-Deck Floor & Roof System

What is Quad-Deck?

Quad-Deck panels are steel-reinforced, foamed plastic insulation boards used as permanent, stay-in-place concrete Formwork for cast-in-place floor and roof construction. Reinforced concrete joists are spaced at 24" [610mm] on center and poured monolithically with the slab to form a T-Beam reinforced concrete structure.

Quad-Deck concrete forming panels are available in several thicknesses / beam-depths to allow varying spans and loads of the one-way concrete slabs. Each Quad-Deck panel is custom-cut to the exact length required and reinforced with two continuous, galvanized steel, Z-shaped furring strips (22 Gauge [0.8mm thickness]), which provide attachment points for ceiling finishes and serve as secondary shoring/formwork support. Primary shoring must be designed and erected as per shoring supplier, project engineer, or applicable building codes (see below).

Quad-Deck panels do not provide any permanent structural support. Structural support is provided by the reinforced concrete joists and slab topping only, which need to be designed by a licensed engineer in accordance with ACI 318, ACI 301, or other applicable standards.

Span and Floor Loads for Quad-Deck

Depending on live and dead loads assumed in the structural design, clear spans of up to 33 feet [10m] - measured from the center of the supporting elements - can be accomplished without modification to standard Quad-Deck profiles. Live loads exceeding 100 psf (4.8 kN/m²) can be supported for shorter spans (see next page). Longer spans and/or higher loads may be achieved by: increasing the T-beam height profile with extra foam-blocks glued to the top of Quad-Deck panels; high-strength concrete, additional reinforcing steel, stirrups, post tensioning, and/or camber. Contact the Quad-Deck Technical Department for details. A licensed engineer has to provide the structural design for each building.

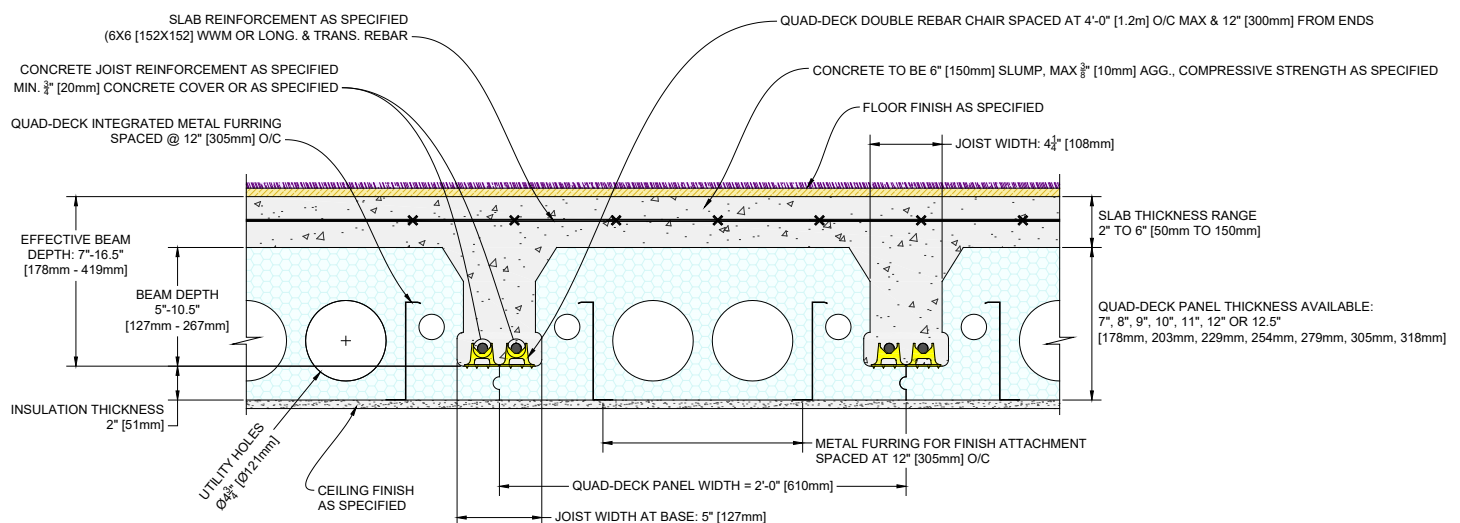
Reinforcement

Reinforcing requirements are a function of the desired span between supporting points and the load imposed on the structure. The size, grade, and frequency of reinforcing bar should be determined by a licensed engineer for each project. For estimating purposes, Quad-Deck provides span tables showing suggested reinforcement.

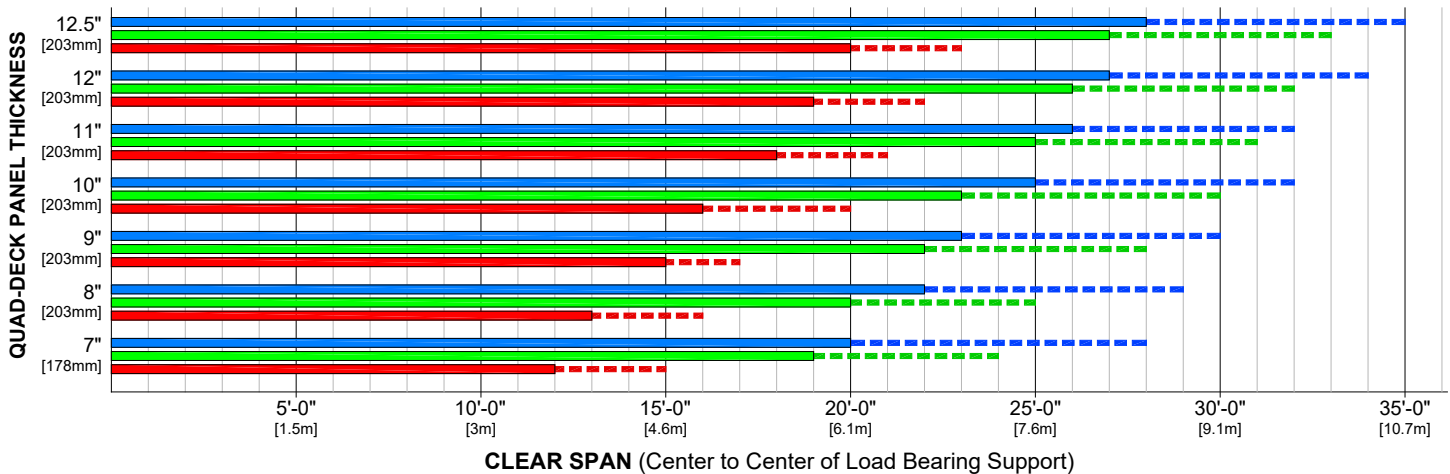
Minimum concrete cover as per ACI 318 or other applicable codes:

- Concrete for slabs, walls, joists not exposed to weather and not in contact with ground: ¾" [20mm]
- Concrete cast against and permanently exposed to earth: 3" [75mm]
- Concrete exposed to earth or weather, #6 [20M] and higher bars: 2" [50mm]; #5 [15M] bar, W31 or D31 [Ø16mm] wire, and smaller: 1½" [38mm]

The installer is responsible for placement of all reinforced concrete in accordance with ACI 318 "Building Code Requirements for Reinforced Concrete". Any variance from these standards must be provided and certified in advance by the Engineer of Record.



QUAD-DECK SPANS (FOR ESTIMATING PURPOSES ONLY)



LEGEND

- 20 psf [0.95 kN/m²] Live Load, 3\"/>
- 40 psf [1.92 kN/m²] Live Load; 3\"/>
- 100 psf [4.77 kN/m²] Live Load; 3\"/>
- - - - 4\"/>

Slab Thickness

Because of the support provided by the reinforced concrete joists every 24 inches (610mm), a much thinner slab section is required. Slab sections between 2 and 6 inches (50 and 150mm), depending on live loads and other forces applied to the slab, are commonly used. This design results in 30 to 40% concrete savings in most jobs, and therefore eliminates 30 to 40% of the mass of the floor or roof reducing the need for greater bearing capacity of walls and/or footings. A 3\"/>

Construction Details

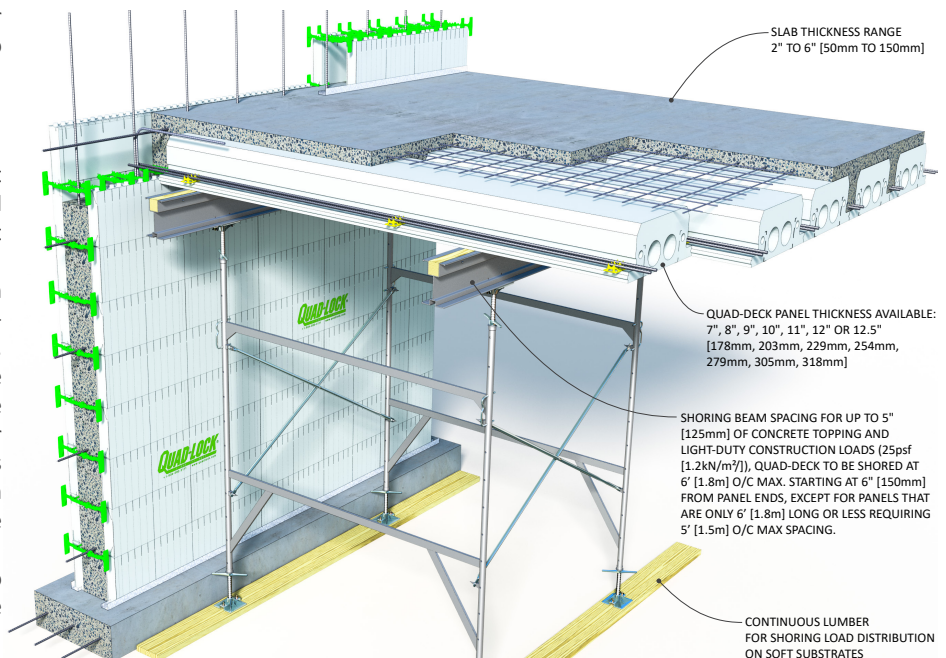
Typical construction details are available on the Quad-Deck website, www.quaddeck.com, and can be downloaded at no charge in PDF or DWG file formats. Many common design features are shown, including multiple story applications, pitched roofs, cantilevers and more.

Shoring & Bracing

Quad-Deck Panels require only primary shoring for support or, if required, camber. This means that less shoring is generally required, approximately every 6' [1.8m] on center and perpendicular to Quad-Deck Panels. First and last shoring beams must start at maximum 6\"/>

Shoring Removal

The concrete structure must be able to support its own weight (dead load) and the loads imposed during construction (construction load) without excessive deflection that will harm the structure. Preferred Method: Determination of the length of time required before removal of shoring (or re-shoring) should be made by the Engineer of Record, based on the compressive strength of the concrete and curing conditions. A ready-mixed concrete supplier can supply high-early-strength concrete for early removal of shoring. Alternate Method: If plans and contract documents contain no specification for minimum compressive strength of concrete at the time of formwork and shoring removal, ACI 347, Section 3.7 provides guidelines pertaining to one-way floor slabs and the removal of shoring. See standards list at the end of this bulletin.



Ceiling Finishes

Ceiling finish (GWB or equiv.) can be attached directly to metal Z strips integrated in Quad-Deck panels. A minimum 15 minute thermal barrier is required over exposed EPS insulation surfaces. Dropped ceilings can be installed over 15 min. thermal barrier for projects requiring more room for HVAC or other utilities.

Independent tests (October 2008 Applied Technical Services) confirm the average ultimate load required to pull the Z strip from the Quad-Deck EPS at 380 pounds [172kg] per linear foot. With a factor of safety of 3, the allowable load is 127 pounds [57kg] per linear foot. Quad-Deck Z strip furring is manufactured with 22 ga. [0.8mm] galvanized steel. Consult fastener manufacturer tables for pullout values of specific screw fasteners.

EPS Board Type – ASTM C578/CAN-ULC S701

Quad-Deck is manufactured from Expanded Polystyrene (EPS) at an average density of 1.25 lbs/cu. Ft. [20 kg/m³]. The EPS material corresponds to Type VIII in the USA (ASTM C578) and Type 1 in Canada (CAN/ULC S701). EPS is treated with a flame-retardant for use in building insulation. In most design scenarios, building codes require that exposed foamed plastic insulation be covered with a minimum 15-minute rated thermal barrier, such as those listed in this table:

Structure Type	Thermal Barrier	Fastening	Confirmed By
Non fire rated	½ in. non-fire rated GWB	Screwed to metal Z strips @ 12" o.c. w/#6 TEK	NFPA 286, ISO 9705
2 hr. fire rated*	¾ in. Type C rated GWB	Screwed to metal Z strips @ 12" o.c. w/#6 TEK	ASTM E119, UL263, CAN/ULC S101

* Contact Quad-Deck Technical Department for full description of 2 hr. fire rated assembly & loading details

The raw material vendor's evaluation & test reports, and any reports referenced below, are available on request to engineers and building officials.

Surface Burning Characteristics – ASTM E84 / UL 723/ NFPA 286

Flame Spread <25; Smoke Developed <450 (prior to floor ignition). CAN/ULC-S102: Flame Spread ≤290, Smoke Developed over 500.

Quad-Deck max. 12.5" [318mm] foam thickness has been confirmed as code compliant under IBC 2603.9 or IRC R316.6 and R302.9.4 via independent NFPA 286 testing using ½" [13mm] GWB as described above.

Fire Resistance Ratings

Quad-Deck has successfully completed a 2 hour 40 minutes Fire Resistance Rating per ASTM E119, UL 263, and CAN/ULC S101 for a suspended concrete floor/roof structure constructed with 8" [203mm] thick Quad-Deck panels with 3" [76mm] thick concrete topping. Refer to the Quad-Deck design manual for details concerning spans, loading, and added components to the assembly. Other fire rated assemblies may be designed by the Engineer of Record for each project using prescriptive models such as ACI 216 (Table 2.1) "Fire resistance of singular layer concrete walls, floors and roofs" below:

Aggregate Type	Quad-Deck Slab Thickness for Fire Resistance Rating				
	1 hr	1.5 hr	2 hr	3 hr	4 hr
Siliceous	3.5" [89mm]	4.3" [109mm]	5.0" [127mm]	6.2" [157mm]	7.0" [178mm]
Carbonate	3.2" [81mm]	4.0" [102mm]	4.6" [117mm]	5.7" [145mm]	6.6" [168mm]
Semi-lightweight	2.7" [69mm]	3.3" [84mm]	3.8" [97mm]	4.6" [117mm]	5.4" [137mm]
Lightweight	2.5" [64mm]	3.1" [79mm]	3.6" [91mm]	4.4" [112mm]	5.1" [130mm]

Insulation Values - ASTM C518

Per ASTM C518 tests, R-Values for Type VIII EPS are 3.92 and 4.54 per inch thickness @ 75°F and 25°F, respectively.

EPS insulation performs better in cold conditions, in contrast to many other insulation materials that perform worse than advertised when heating is actually required. Calculated R-Values for Quad-Deck & concrete assemblies per ASTM C518 values for EPS are:

Quad-Deck Panel Thickness	7" [178mm]	8" [203mm]	9" [228mm]	10" [254mm]	11" [279mm]	12" [305mm]	12.5" [318mm]
R-values at 25°F (h•ft ² •°F/BTU)	16	19	22	24	26	27	28
R-values at 75°F (h•ft ² •°F/BTU)	14	17	19	21	23	24	25

STC Sound Tests

Results of Airborne Sound Transmission Loss Testing - ASTM E90 (Sound Transmission Classification):

Floor Type & Assembly	STC
16" [406mm] Floor Assembly (12" [305mm] Quad-Deck & 4" [102mm] Concrete), Rubber Underlayment & Tile Flooring and 1/2" [13mm] GWB ceiling finish	55
16" [406mm] Floor Assembly (12" [305mm] Quad-Deck & 4" [102mm] Concrete), Rubber Underlayment & Wood Flooring and 1/2" [13mm] GWB ceiling finish	54
12" [305mm] Floor Assembly (9" [228mm] Quad-Deck & 3" [75mm] Concrete), 2 layers 5/8" [16mm] gypsum board	53
12" [305mm] Floor Assembly (9" [228mm] Quad-Deck & 3" [75mm] Concrete), 1 layer 5/8" [16mm] gypsum board	49

IIC Sound Tests

Results for Impact Sound Tests - ASTM E1007-04 and ASTM E492 (Field Impact Insulation Class):

Floor Type & Assembly	(F)IIC
15" [381mm] Floor Assembly (12" [305mm] Quad-Deck & 3" [75mm] Concrete), 5/8" [16mm] Jute Carpet on floor and 1/2" [13mm] GWB ceiling finish	70
16" [406mm] Floor Assembly (12" [305mm] Quad-Deck & 4" [102mm] Concrete), Rubber Underlayment & Wood Flooring and 1/2" [13mm] GWB ceiling finish	52
16" [406mm] Floor Assembly (12" [305mm] Quad-Deck & 4" [102mm] Concrete), Rubber Underlayment & Tile Flooring and 1/2" [13mm] GWB ceiling finish	48
15" [381mm] Floor Assembly (12" [305mm] Quad-Deck & 3" [75mm] Concrete), 1/2" [13mm] tile on floor and 1/2" [13mm] GWB ceiling finish	26

Quad-Deck Floor Weights

Quad-Deck Floor Weights (lbs/sqft)							
Quad-Deck Panel Thickness	Slab Thickness						
	2"	2.5"	3"	3.5"	4"	4.5"	5"
7"	45.1	51.4	57.6	63.9	70.1	76.4	82.6
8"	47.3	53.6	59.8	66.1	72.3	78.6	84.8
9"	49.5	55.8	62.0	68.3	74.5	80.8	87.0
10"	51.7	58.0	64.2	70.5	76.7	83.0	89.2
11"	53.9	60.2	66.4	72.7	78.9	85.2	91.4
12"	56.2	62.5	68.7	75.0	81.2	87.5	93.7
12.5"	57.3	63.5	69.8	76.0	82.3	88.5	94.8

Notes: The above are unfactored estimated weights which include concrete (150 lbs/cuft), reinforcement (3 lbs/sqft), Quad-Deck Panel (2 lbs/sqft) & misc. (2 lbs/sqft).

Quad-Deck Floor Weights (kg/m ²)							
Quad-Deck Panel Thickness	Slab Thickness						
	50mm	75mm	90mm	100mm	110mm	120mm	130mm
178mm	218.8	278.8	314.8	338.8	362.8	386.8	410.8
203mm	229.6	289.6	325.6	349.6	373.6	397.6	421.6
228mm	240.4	300.4	336.4	360.4	384.4	408.4	432.4
254mm	251.2	311.2	347.2	371.2	395.2	419.2	443.2
279mm	262.0	322.0	358.0	382.0	406.0	430.0	454.0
305mm	272.8	332.8	368.8	392.8	416.8	440.8	464.8
318mm	278.2	338.2	374.2	398.2	422.2	446.2	470.2

Notes: These are unfactored estimated weights which include concrete (2400 kg/m³), reinforcement (15 kg/m²), Quad-Deck Panel (10 kg/m²) & misc. (10 kg/m²).

Publications

More information, code requirements, and guidelines can be found in these publications:

Document	Title
ACI 216	Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 332	Guide to Residential Cast-in-Place Concrete Construction
ACI 347	Guide to Formwork of Concrete
ACI 347.2R	Guide for Shoring/Reshoring of Concrete Multistory Buildings
ANSI A10.9	American National Standard for Construction and Demolition Operations
ASCE 24	Flood Resistant Design and Construction
ASTM E84	Surface Burning Characteristics of Building Materials
ASTM E119	Standard Test Methods for Fire Tests of Building Construction and Materials
CAN/ULC S101	Fire Endurance Tests of Building Construction and Materials
CSA 23.1	Concrete Materials & Methods of Construction
CSA 23.2	Methods of Test and Standard Practices for Concrete
CSA 23.3	Designing Concrete Structures
CSA S269.1	Falsework for Construction (Reaffirmed 1998)
CSA S269.3-M92	Concrete Formwork
NFPA 286	Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth
OSHA 29 CFR	Construction Safety and Health Regulations for Construction
SEI/ASCE 37	Design Loads on Structures During Construction
UL 263	Standard for Fire Tests of Building Construction and Materials
UL 723	Surface Burning Characteristics of Building Materials

CAUTION: This product is combustible. Keep away from high heat and ignition sources.

A protective barrier or thermal barrier is required as specified in the appropriate building code.

Additional Information or a Free Estimate: www.quadlock.com

This document is for information purposes only. No representation is made or warranty given as to its contents.

User assumes all risk of use. Quad-Lock and its suppliers assume no responsibility for any loss or delay resulting from such use.

