

*All deck builders should refer to the DCA6 — prescriptive guidelines for residential deck construction — and coastal builders should pay extra-close attention to the material choices and structural connections outlined in its pages*

by Frank Woeste

**A** casual inspection of just about any wooden boardwalk or ocean-side deck will provide ample evidence of what a harsh coastal environment can do. Heat, ultraviolet light, elevated moisture levels, and salt spray all take a toll. The apparent degradation of materials evidenced by splintering, splitting, and rusting call attention to one of the coastal contractors' highest priorities: designing and building safe and durable decks. Fortunately, there is help at hand to guide deck builders toward code-conforming deck design and good construction practice.

#### THE DCA6

The reference document for safe residential construction is the International Residential Code (IRC), which has been adopted with some modifications by most states and jurisdictions. While the 2006 IRC provides comprehensive prescriptive design guidance on the foundation and structural framing of the residence from the walls inward, the available guidance on the design of an attached deck, until recently, has been very limited. In recognition of this deficit of information, the American Forest & Paper Association (AF&PA) developed and published *Design for Code*

*Acceptance 6 (DCA6): Prescriptive Residential Deck Construction Guide*, which is available on the Web at [www.awc.org/Publications/DCA/DCA6/DCA6.pdf](http://www.awc.org/Publications/DCA/DCA6/DCA6.pdf). The document is 20 pages and is branded by the AF&PA, the International Code Council, and Fairfax County, Va. The reader's attention is directed to the bottom of page 1, where the basis of the document is stated—IRC sections are bracketed when they form the basis of a section, while other sections are considered “good practice recommendations.”

While every section of DCA6 is important to deck safety, the purpose of this article is to give background on sections of the DCA6 that may be of special interest to the coastal deck contractor. All discussion is referenced to bracketed page numbers and sections of the DCA document.

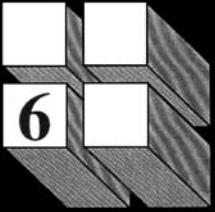
#### MINIMUM REQUIREMENTS: DECAY ISSUES FOR LUMBER COMPONENTS

Building a safe deck starts with selecting appropriate materials. The DCA6 [item 2, page 2] provides builders with two options for real wood decking: naturally durable species, such as redwood or western cedars, or pressure-treated lumber. Both deserve care-

# Safe and Durable Coastal Decks

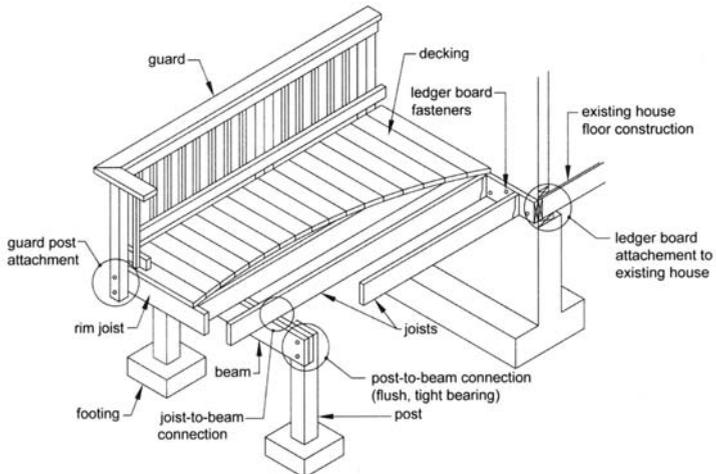
**Essential reference.** *The Design for Code Acceptance 6: Prescriptive Residential Deck Construction Guide*, provides practical guidance for designing and building safe, durable decks. Download and print the document at [www.awc.org/Publications/DCA/DCA6/DCA6.pdf](http://www.awc.org/Publications/DCA/DCA6/DCA6.pdf).

# Design for Code Acceptance



## Prescriptive Residential Deck Construction Guide

Based on the 2006 International Residential Code



WHERE APPLICABLE, PROVISIONS AND DETAILS CONTAINED IN THIS DOCUMENT ARE BASED ON THE INTERNATIONAL RESIDENTIAL CODE (IRC) [bracketed text shows reference to applicable sections of the IRC]. PROVISIONS CONTAINED IN THIS DOCUMENT THAT ARE NOT INCLUDED IN THE IRC ARE CONSIDERED GOOD PRACTICE RECOMMENDATIONS. WHERE DIFFERENCES OCCUR BETWEEN PROVISIONS OF THIS DOCUMENT AND THE IRC, THE PROVISIONS OF THE IRC SHALL APPLY.

American Forest & Paper Association

ful study by the deck contractor who is focused on durability.

**Naturally durable species.** While such woods as redwood and cedar are widely considered to be naturally durable species, only the “heartwood” of redwood, cedars, black locust, and black walnut is actually considered decay resistant by the IRC. The sapwood, the outside part of a log, does not qualify. According to the *USDA Wood Handbook* (1999), “Untreated sapwood of substantially all species has low resistance to decay and usually has a short service life under decay-producing conditions.” Only the *average heartwood* of species is rated in Table 3-10 of the *Wood Handbook*. Corner sapwood is permitted if 90% or more of the width of each side on which it occurs is heartwood.

Given these restrictions, it is unlikely that the typical decking lumber available will consistently meet the IRC’s definition of “naturally durable wood.” To ensure deck durability, the deck contractor should consider special-ordering “all heartwood” in conformance with model code definition of naturally durable wood.

**Pressure-treated lumber.** Pressure-treated lumber works well for both the substructure and the decking. However, contractors should pay close attention to the retention level used for lumber on all parts of the deck.



**Deck disaster?** This is not an atypical condition of the materials and connections for decks built near the ocean. Heat, ultraviolet light, elevated moisture levels, and salt spray exact a stiff toll on wood decks in relatively short periods. A condition like this should raise safety concerns for both the deck builder and the general contractor.

# Safe and Durable Coastal Decks

PT Lumber Retention Levels		
Preservative	Above Ground (Minimum Retention, pcf)	Ground Contact (Minimum Retention, pcf)
CCA	0.25	0.40
CA-B	0.10	0.21
ACQ-C (or D)	0.25	0.40

This table gives the American Wood-Preserver's Association (AWPA) required minimum retention levels for dimension lumber. Treatment levels for both the "old" CCA and the new preservative chemicals are provided. Note that required retentions for the "above ground" treatment are substantially less than those required for "ground contact" materials.

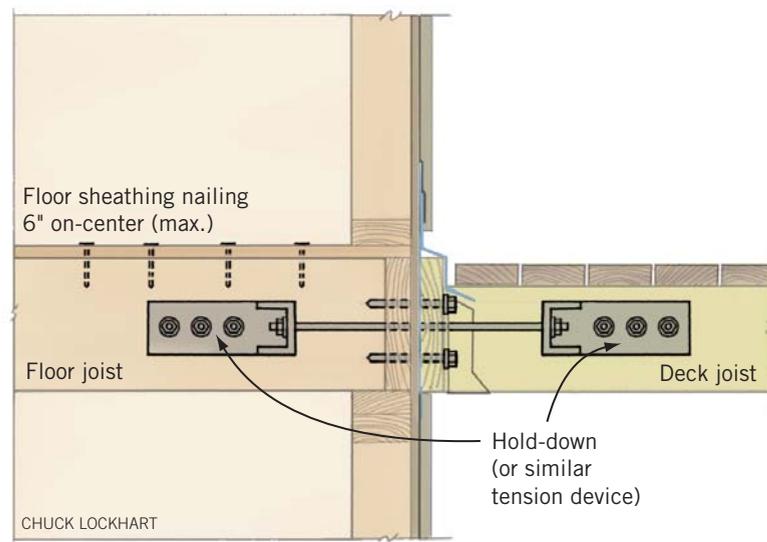
Citing the IRC, the DCA6 is clear: "All lumber in contact with the ground shall be rated as 'ground-contact.'" The difference in retention levels between "ground contact" material and "above ground" material is significant, as shown in the table at right.

To ensure the right treatment level, deck contractors must carefully examine the treatment tags on the lumber they purchase, making sure that "ground contact" material is being ordered and delivered when required. Once material with the proper retention level is purchased for the job, I recommend that contractors keep a sample of the lumber treatment tags, along with a copy of the PT lumber invoice, as part of the job file. This will help to substantiate the contractor's due diligence should a construction defect complaint related to the deck ever arise.

Even in "above ground" applications, however, there is a strong argument for using materials suited for ground contact. At this time, the adequacy of the new PT chemicals at above-ground treatment levels is largely unknown. Since about 1985, all the PT lumber in our area was CCA-treated to the ground-contact level. As such, deck contractors have vast experience using the ground-contact southern pine in deck applications. After the transition to the new chemicals, the above-ground material came to be readily available for deck construction in the Virginia area and along the eastern seaboard. However, the durability of the new preservatives

## Deck Attachment for Lateral Loads

**The lateral load connection** required by section R502.2.2 of the 2007 IRC requires hold-down tension devices like those shown here. This type of connector is required in at least two locations per deck, and each device must be designed for an allowable stress capacity of at least 1,500 pounds.



# Safe and Durable Coastal Decks

and lower treatment levels in deck applications is unknown at this time. Faced with uncertainty on this subject, I would strongly recommend that contractors consider returning to the practice of using “ground contact” lumber for all above-ground deck parts.

Solid-sawn deck posts (timbers) embedded in the ground may even require a preservative treatment level that is above the “ground contact” treatment level typically used for 2-inch dimension lumber. (For additional information on the recommended treatment for timbers in the ground, please visit [www.southernpine.com/pdf/tpsp\\_table4.pdf](http://www.southernpine.com/pdf/tpsp_table4.pdf) and refer to category “Lumber/Timbers,” subcategory “Ground Contact or Fresh Water.” Structural deck posts covered here are in the realm of “Critical Structural Components.”) Also keep in mind that regardless of the PT wood materials selected, decks should be inspected annually for evidence of decay and unsafe conditions.

**Corrosion protection of metal parts.** Item 4 of the Minimum Requirements in the DCA6 covers the corrosion resistance of fasteners and metal hardware. Coastal con-

tractors should skip right to the fourth bullet point, which trumps the previous three bullets wherever the job site is located near the ocean:

- Fasteners and connectors exposed to, and located within 300 feet of, a saltwater shoreline shall be stainless steel grade 304 or 316.

“Fasteners” include all nails, screws, lag screws, and bolts. “Connectors” are typically joist hangers and other framing hardware that is fabricated from rolled steel. In the interest of deck safety and increased durability, the provision should be considered by the contractor and owner for decks greater than 300 feet from a saltwater shoreline.

**Assumed design loads.** DCA6 is based on an assumed live load of 40 psf and the 10 psf dead load.

The 40 psf live load (LL) anticipates occupants *only* with typical deck furniture such as lightweight tables and chairs. It does not anticipate heavy loads such as large planters, portable pools, the water in a hot tub, or any other load

Based on Table 5 of the DCA6, the table at right shows the required fastener spacing for southern yellow pine, Douglas-fir larch, or hem-fir deck ledgers that will be secured to a 2-inch nominal spruce-pine-fir band joist or engineered-wood rim board. While the spacing values for 1/2-inch lag screws and bolts are easy to select from this table, careful study of footnotes 1 to 9 is crucial before using the data.

Noncompliance with any of the footnote provisions could produce a disastrous in-service result. For example, footnote 3 directly relates to the photo on page 28 (top left), which shows the result of overlooking the Z-flashing on a ledger.

Fastener Spacing for Deck Ledgers								
Joist Span	Rim Board or Band Joist	6'-0" and less	6'-1" to 8'-0"	8'-1" to 10'-0"	10'-1" to 12'-0"	12'-1" to 14'-0"	14'-1" to 16'-0"	16'-1" to 18'-0"
Connection Details		On-Center Spacing of Fasteners <sup>4,5</sup>						
1/2"-diameter lag screw with 15/32" maximum sheathing <sup>1</sup>	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1 1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1 1/2" Lumber <sup>7,9</sup>	30"	23"	18"	15"	13"	11"	10"
1/2"-diameter bolt with 15/32" maximum sheathing	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1 1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1 1/2" Lumber <sup>7,9</sup>	36"	36"	34"	29"	24"	21"	19"
1/2"-diameter bolt with 15/32" maximum sheathing and 1/2" stacked washers <sup>2,8</sup>	1" EWP <sup>6</sup>	24"	18"	14"	12"	10"	9"	8"
	1 1/8" EWP <sup>6</sup>	28"	21"	16"	14"	12"	10"	9"
	1 1/2" Lumber <sup>7,9</sup>	36"	36"	29"	24"	21"	18"	16"

<sup>1</sup>The tip of the lag screw shall fully extend beyond the inside face of the band joist.  
<sup>2</sup>The maximum gap between the face of the ledger board and face of the wall sheathing shall be 1/2".  
<sup>3</sup>Ledgers shall be flashed or caulked to prevent water from contacting the house band joist.  
<sup>4</sup>Lag screws and bolts shall be staggered.  
<sup>5</sup>Deck ledgers shall be minimum 2x8 pressure-preservative-treated No. 2 grade lumber or other approved materials as established by standard engineering practice.  
<sup>6</sup>When solid-sawn pressure-preservative-treated deck ledgers are attached to engineered wood products (oriented strand board or structural composite lumber, including laminated veneer lumber), the ledger attachment shall be designed in accordance with accepted engineering practice. Tabulated values based on 300 lb. and 350 lb. for 1" and 1 1/8" EWP rim board, respectively.  
<sup>7</sup>A minimum 1"x9 1/2" Douglas fir-larch laminated veneer lumber rim board shall be permitted in lieu of the 2" nominal band joist.  
<sup>8</sup>Wood structural panel sheathing, gypsum board sheathing, or foam sheathing not exceeding one inch thickness shall be permitted. The maximum distance between the face of the ledger board and the face of the band joist shall be one inch.  
<sup>9</sup>Fastener spacing also applies to southern pine, Douglas fir-larch, and hem-fir band joists.

# Safe and Durable Coastal Decks



**Premature decline.** On a beachfront home in Virginia, no Z-type flashing was installed over the ledger-to-house connection, which led to extensive decay.

beyond the weight of occupants.

Dead load (DL) is defined as the self weight of the structure and the weight of fixed objects. The use of a 10 psf DL anticipates wood framing with wood or plastic decking. It does not include the dead weight of a hot tub or any other permanently attached objects.

For coastal contractors, especially, it should be noted that the DCA6 does not address lateral loads on decks produced by wind or seismic events. For this, builders should turn first to the 2007 IRC, which does address the issues of lateral loads on decks as shown in the illustration on page 3. These new deck provisions to the 2007 IRC can be viewed at [www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/IRC07S.pdf](http://www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/IRC07S.pdf).

As a matter of good construction practice, the deck contractor should formally communicate these load assumptions to the homeowner by reviewing the DCA6 Minimum Requirements [items 5 and 6, page 2]. If the customer's expectations call for loading conditions that go beyond occupant loading, you will need to get a design professional involved.

## JOISTS AND BEAMS

Maximum joist spans provided in the DCA6 [page 3] are based on No. 2 grade lumber and wet-service conditions. The tabulated spans are less than common residential floor

spans because the assumed wet-service conditions reduce the strength properties of the lumber.

All carrying beams (multiple deck girders) must bear fully on supporting posts, while the joists above should fully bear on the beams. Such "wood-to-wood" bearing provides the most efficient connection possible between wood framing members. Bolting the beams to the sides of the post is not an efficient connection. In the case of a 2x beam bolted to a 6x6 post, for example, the force is applied to the beam members perpendicular-to-grain and the bolt forces are applied parallel-to-grain in the post. In this situation, the capacity of a typical 1/2-inch bolt in the perpendicular-to-grain loading is relatively low under wet-service conditions. Splitting is also likely to occur when two (or more) bolts are aligned vertically in the beam, because the shrinkage rates between the beam members and the post are dramatically different (about 40:1).

## LEDGER ATTACHMENT AND FLASHING

Based on deck collapses and injuries reported in media sources, the connection of the deck ledger to the house band joist is the most critical structural element of a deck. But the integrity of the connection is based on the assumption that the house band and deck ledger has no decay [DCA6 Table 5, page 12]. Therefore, flashing the connection is easily as important as the connection design (fastener size and spacing).

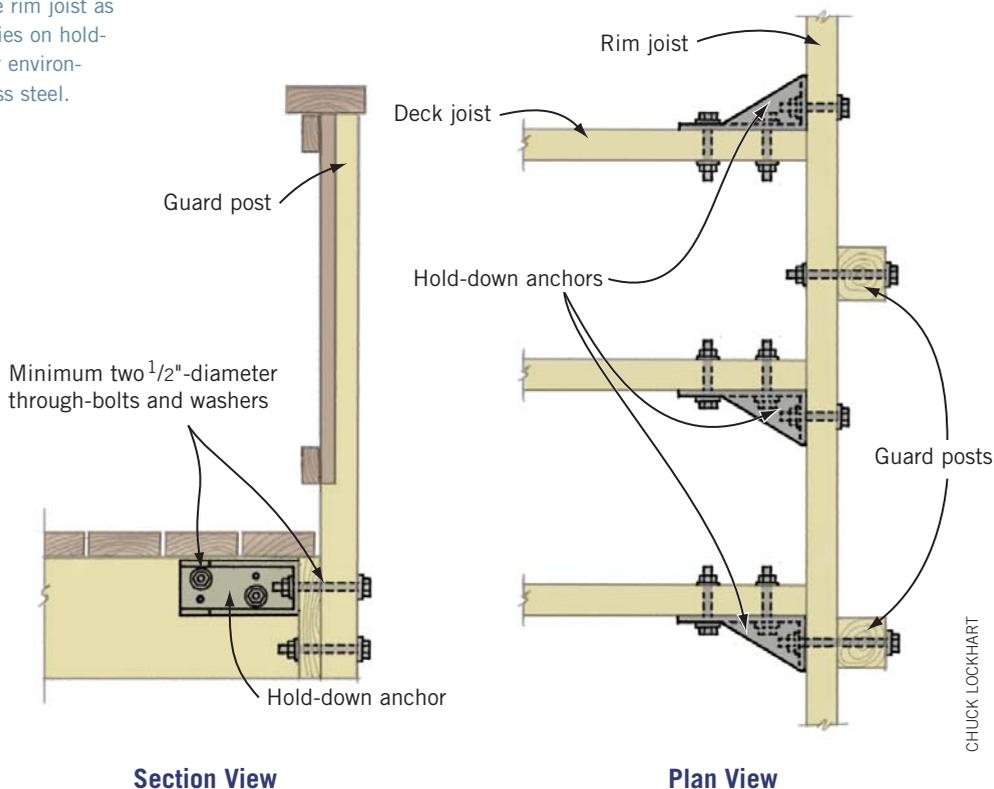


**Deadly rail.** The photo above shows an example of a grossly deficient guardrail system that produced a fatality and another injured party. In this case, a young man died after falling through the guardrail with posts that were nailed only to joists on the end of the deck. Note the notched 4x4 posts — a detail that is *not* permitted in the DCA6.

# Safe and Durable Coastal Decks

**Hold-downs required.** To meet code, guard posts for deck guards that run perpendicular to the deck joists must be attached to the rim joist as shown at right. This connection relies on hold-down anchors, which in a saltwater environment should be made from stainless steel.

## Guard Post to Rim Joist Detail



**Ledger fastening.** The fastener spacings from DCA6 Table 5 (shown on page 4) are based on tests of simulated deck-ledger to band-joist connections performed at Virginia Tech and Washington State University that form the basis of an IRC code proposal. The design data (except for engineered wood product [EWP] rim boards) with footnotes were adopted into the 2007 IRC. Since the publication of the ledger fastener table in the 2007 IRC, AF&PA has added EWP rim boards to the DCA6 Table 5 based on tests at APA.

**Ledger flashing.** The critical role of effective ledger flashing cannot be overemphasized. The photo at the top of page 5 underscores the result from overlooking the Z-flashing on a beachfront home. If for any reason the wall sheathing and house band joist are exposed to water, decay will follow because the typical ledger connection is “water trapping,” and significant decay is the likely outcome.

Best practice calls for not *only* including the Z-flashing recommended by DCA6 but also providing self-adhesive flashing against the house. This type of membrane is strongly recommended in coastal conditions to help protect against water infiltration resulting from wind-driven rain.

**Ledger connection to cantilevers.** Without a connection detail by a professional engineer, a deck ledger should

never be supported off the end of a cantilevered floor [DCA6 Figure 18] because the load path is not complete. It is extremely difficult to transfer the vertical load from the deck ledger to the floor joist of the house using fasteners, because the rim joist/house band is bearing on “air” instead of a plate with a high wood-to-wood bearing capacity. This situation is depicted in the photo on page 7. It is extremely dangerous and likely to collapse under relatively low deck loads (possibly dead load only).

### GUARD REQUIREMENTS

In the vernacular of DCA6 [pages 15–16, 18–19], a deck’s “guard” is the guardrails or handrails surrounding the deck. All deck surfaces greater than 30 inches above grade are required to have a guard. Details for a proper guard can be found in DCA6 Figure 24. At stake here is the protection of the occupants against severe injuries and fatalities (see photo, page 5). Falls through decks guards are generally grave, and among problems with decks, only deck ledger failures are reported more frequently in the media.

# Safe and Durable Coastal Decks

## What About Plastic Decking?

While the DCA6 covers only wood, the advent of wood-plastic-composite and plastic materials raises legitimate questions regarding the suitability of these materials for decks. Materials used for decking surfaces and guardrail systems must be proven by tests, have a current Evaluation Report (ER), and be approved for use by the code official.

Evaluation Reports, such as those that are issued by ICC Evaluation Services ([www.icc-es.org](http://www.icc-es.org)), are acceptable alternatives to the code-prescribed requirements, and the elements covered by the evaluation reports are made code-compliant via the modification procedure. In Virginia, as well as most other states, the code official is empowered to accept alternative materials and

methods as equivalent to code-prescribed requirements as long as there is a basis for the approval of the alternative.

The basis can be an evaluation report (ER) issued by a nationally recognized evaluation service, or it could be a report issued by a registered design professional wherein equivalency is established. In any case, the code official has the final say as to whether to accept or not to accept the alternative. It is extremely important for the deck contractor to obtain a copy of the ER for the product and to make sure the “conditions of use” of the product are not violated by the specific application. For discussion of the weatherability of plastic decking, refer to “Materials Report: Plastic Decking,” Spring 2005; [www.coastalcontractor.net](http://www.coastalcontractor.net).

DCA6 Figure 26 shows the rail post construction needed to meet the intent of the IRC code (shown in the illustration “Guard Post to Rim Joist Detail,” page 6). By code, the top of the rail must *safely* resist a 200-lb. outward force. “Safely” in this case means that a safety factor is applied to a test of a detail to prove that it can work in the field, because tests rely on virgin material and perfect fabrication that doesn’t always exist on site. In an effort to determine what constitutes a safe rail post connection to the end of deck joists, we tested



**Wrong!** Deck joists (framed with PT framing lumber) have been hung from a ledger that is lagged into the rim board of a cantilevered I-joint system. Even if the lag screws were to be positioned to penetrate the I-joint flanges, the connection would be dangerously weak. It is likely to collapse under very low loads, possibly the dead load of just the deck structure itself. DCA6 strictly prohibits the connection of a deck to a cantilevered overhang.

numerous details at Virginia Tech. All lagged and through-bolted connections failed to meet the 500-lb. test load, despite numerous attempts to reinforce the connection with blocking. Only the connection that relied on a metal hold-down anchor, such as the Simpson HD2AHDG ([www.strongtie.com/products/connectors/HDA-HD.asp](http://www.strongtie.com/products/connectors/HDA-HD.asp)) or DeckLok ([www.mtdecklok.com/railpost.htm](http://www.mtdecklok.com/railpost.htm)), passed the test (as illustrated in “Guard Post to Rim Joist Detail,” page 6).

As mentioned previously, stainless steel connectors and fasteners are recommended in DCA6 for saltwater shoreline exposure. DeckLok is one source for 304 and 316 stainless steel hold-down anchors that resisted the 500-lb. load used in the Virginia Tech guard post tests.

## LANDMARK STEP

The publication of DCA6 by the AF&PA is a landmark step in advancing the cause of safe decks in order to prevent injuries and fatalities from deck collapses. While I have only commented on a few sections with respect to deck safety and durability, the entire DCA6 is important and deserves careful study and consideration by the professional deck contractor. For decks applications and conditions that fall outside the scope of DCA6, the contractor should seek professional design input and evaluation by the local jurisdiction through the permitting and inspection program.

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