

## Conduit concerns

The National Electrical Code® provides guidance for conduit placement

by Mark S. Graham

During roof system replacement and sometimes when mechanically attaching rigid board insulation or roof membranes, roofing workers can encounter electrical conduit embedded within roof assemblies or placed directly beneath roof decks. In many instances, the presence of electrical conduit is unforeseen, problematic and potentially dangerous.

### Electrical code

The National Fire Protection Association's standard NFPA 70: National Electrical Code serves as the electrical code for most jurisdictions in the U.S. The current edition is the 2017 edition.

In NEC, materials and methods for wiring are addressed in Chapter 3-Wiring Methods and Materials.

Section 300.4-Protection Against Physical Damage indicates where items subject to physical damage, conductors, raceways and cables must be protected. Separate alphabetical subsections address cables and raceways through wood members (joists, rafters or other wood members); nonmetallic-sheathed cables and electrical nonmetallic tubing through metal framing members; cables and raceways parallel to

framing members and furring strips; cables and raceways installed in shallow groves; and cables through spaces behind panels designed to allow access. A nonmandatory, informational note in this section indicates minor damage to a raceway, cable armor or cable insulation does not necessarily violate the integrity of either the contained conductors or conductor's insulation.

Subsection (E)-Cables, Raceways, or Boxes Installed in or Under Roof Decking states: "A cable, raceway, or box, installed in exposed or concealed locations under metal-corrugated sheet roof decking,

shall be installed and supported so there is not less than 38 mm (1½ in.) measured from the lowest surface of the roof decking to the top of the cable, raceway or box. A cable, raceway or box shall not be installed in concealed locations in metal-corrugated, sheet decking-type roofs. *Exception: Rigid metal conduit and intermediate metal conduit shall not be required to comply with 300.4(E).*"

A nonmandatory, informational note in this subsection indicates roof deck material often is repaired or replaced after initial raceway, cabling and roof system installation and may be penetrated by the screws or other mechanical devices designed to attach the roof insulation or membrane to the roof deck.

The figure shows possible conduit placement locations based on Section 300.4(E).

For rooftop-mounted photovoltaic systems,

NEC has separate provisions in Article 690-Solar Photovoltaic Systems. Part IV-Wiring Methods, Section 690.31-Methods Permitted, Item (G)-Photovoltaic System Direct Current Circuits on or in a Building indicates the following regarding embedded wiring:

**“(1) Embedded in Building Surfaces.**

Where circuits are embedded in built-up, laminate, or membrane roofing materials in roof areas not covered by PV modules and associated equipment, the location of circuits shall be clearly marked using a marking protocol that is approved as being suitable for continuous exposure to sunlight and weather.”

**NRCA's recommendations**

Electrical conduit embedded within roof assemblies or placed directly below roof decks can be problematic—and potentially dangerous—for roofing workers.

The NEC somewhat acknowledges this by its requirement in Section 300.4(E) and marking requirement for embedded wiring in building surfaces in Part IV, Section 690.31(G)(1). However, NEC's exception to Section 300.4(E), which permits rigid metal conduit and intermediate metal conduit to be concealed within or close contact with metal roof decks, somewhat contradicts these NEC requirements.

Electrical professionals generally consider wiring placed in metallic conduit to be “protected.” However, roofing industry experience has shown fasteners used for mechanically attaching rigid board insulation or roof membranes can readily penetrate metallic conduit embedded within or directly underneath

roof assemblies. By way of comparison, the wall thickness of ½-inch-thick metallic conduit is comparable to the metal thickness of 20-gauge steel roof deck. Self-cutting or self-drilling roof fasteners can readily penetrate metals of these thicknesses.

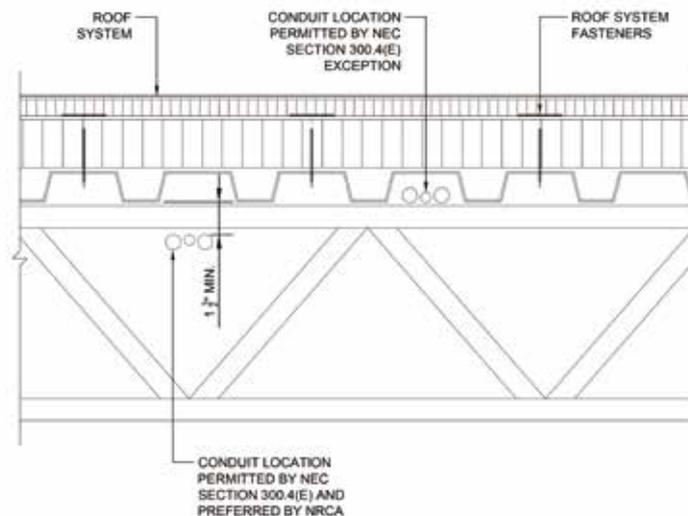


Illustration showing electrical conduit, raceway and box placement

Also, cutting and roof system removal operations can damage and penetrate metallic conduit.

For these reasons, NRCA does not recommend metallic conduit or wiring be embedded within roof assemblies or placed directly below roof decks. If metallic conduit or wiring needs to be placed near the roof assembly, NRCA recommends it be positioned and securely supported at least 1½ inches from the bottom side of the roof deck or substrate to which the roof system is applied.

The NEC can be purchased by accessing NFPA's website, [www.nfpa.org](http://www.nfpa.org). 🌐🌟

**MARK S. GRAHAM** is NRCA's vice president of technical services.  
 🌐 @MarkGrahamNRCA



To read how some European companies are overcoming the challenge to find skilled workers, go to [www.professionalroofing.net](http://www.professionalroofing.net).

## Construction industry uses robots to problem-solve

Construction companies increasingly are using robots to solve labor shortages and improve speed, efficiency, safety and profits, according to [www.constructiondive.com](http://www.constructiondive.com).

“Construction & Demolition Robots,” a recent report from Boulder, Colo.-based market intelligence firm Tractica, says construction companies are using robots for various tasks, which will change the way the industry operates. The largest market will be for robot assistants used at construction sites, followed by infrastructure robots for demolition, site prep and road building; structure robots such as bricklayers, welders and 3D concrete printers; and finishing robots, which perform tasks such as drilling, drywall installation, cleaning and painting.

The revenue for robot suppliers is forecast to increase from \$22.7 million in 2018 to \$226 million annually by 2025. The report also predicts more than 7,000 construction robots will be deployed to address construction and demolition tasks during the same period.

Although the construction industry has sometimes resisted automation, the ongoing skilled labor shortage may force U.S. companies to consider using artificial intelligence to address the issue. Construction robots currently available can hang drywall, weld, drill and lay bricks.

Companies concerned about maintaining high standards of craftsmanship are looking to a hybrid “cobot” option—collaborative robots designed to work alongside human counterparts instead of replacing them entirely to improve productivity for tasks that otherwise would be considered busy work for employees. They reportedly also can significantly lower operating costs by reducing the amount of labor needed to complete a project.

## Contractors’ ability to collect data improves profitability

Dodge Data & Analytics, in collaboration with Portland, Ore.-based construction management software provider Viewpoint, has released a report showing changes regarding the way project data is gathered and analyzed in the construction industry, according to [www.construction.com](http://www.construction.com).

“Improving Performance with Project Data SmartMarket Report: How Improved Collection and Analysis is Leading to the Digital Transformation of the Construction Industry,” reveals contractors believe improvements in field data collection will bring significant change during the next three years that can lead to an increase in key project outcomes, such as budget, productivity and profitability.

Sixty-four percent of respondents said their ability to gather and analyze data has improved or improved significantly. Contractors using commercial software to gather job-site data reported significantly higher satisfaction rates than those using paper forms or spreadsheets.

Additionally, general contractors and specialty trades listed security concerns as the top reason for not managing data in the cloud, and 65% of respondents continue to use on-premise servers. Although 86% of respondents are relying on anti-malware software to address data security, only 45% of those surveyed have implemented employee compliance training.

The report also highlighted current and emerging methods of gathering data, including via apps, cameras, sensors and wearables.

“We think this is a critical area to watch in the future,” says Steve Jones, senior director of industry insights research for Dodge Data & Analytics. “The smarter jobsite will transform the industry, but companies need their data gathering and analytics fundamentals in place before they can fully profit from all of the exciting technology that is now emerging.”

## AI in construction predicted to reach \$4.51 billion by 2026

A new report from New York-based market research firm Reports and Data shows the global market for artificial intelligence in construction is forecast to reach \$4.51 billion by 2026, according to [www.forconstructionpros.com](http://www.forconstructionpros.com). Market growth is expected to be driven by the mitigation of risk to quality and safety, as well as reduction of time and costs for the construction industry.

AI can reduce the risks of hazards and accidents on job sites and is being used by firms to monitor the real-time interactions of machinery, workers and objects on the site and alert supervisors of potential safety issues, productivity issues and construction errors. It also is expected to reduce the human workforce, reduce expensive errors and work-site injuries, and increase productivity.

Additional findings from the report include:

- Machine learning and deep learning technologies accounted for a larger market share of about 63% during 2018. Deep learning reportedly gives more accurate and quality results, as well as time and cost consumption benefits.
- The services segment is forecast to witness a higher growth rate of 34.9% by 2026.
- Small and medium-sized organizations are forecast to witness a higher growth rate of 35.8% by 2026 because of these firms’ rapid adoption of AI.
- Cloud deployment is anticipated to witness a higher growth rate of 37.3% by 2026.
- Risk management application is anticipated to witness a higher growth rate of 35.8% by 2026 because of the ability of AI to identify potential risks and frauds.
- The safety segment is anticipated to witness a higher growth rate of 35% by 2026 because of the increasing risks and accidents reported at work sites.