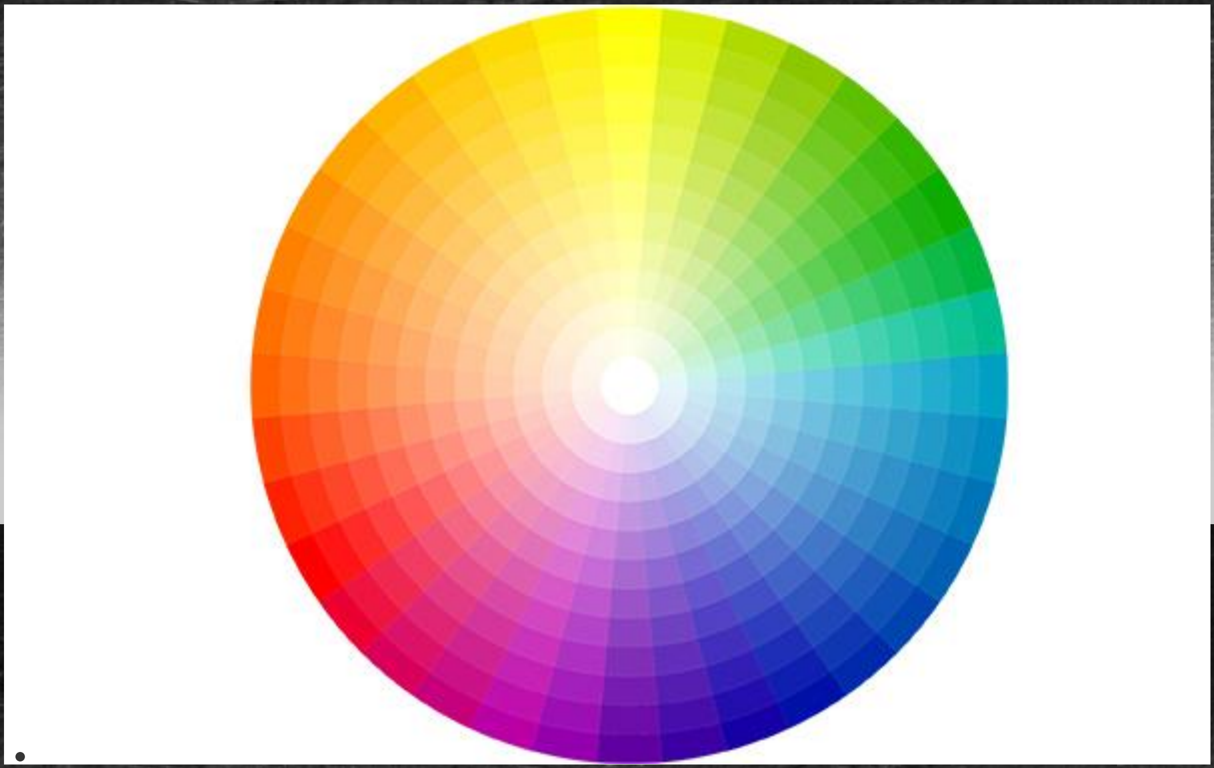

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Flattering Light: A New Look at Color

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By Craig DiLouie

From making clothing look vibrant in a retail store to facilitating interaction in offices by properly rendering skin tones, a light source's color quality is an important specification characteristic. For this, we use two metrics, correlated color temperature and the color rendering index (CRI). Varying these color qualities can affect how objects, spaces and people appear to the eye.

Developed by the International Commission on Illumination (CIE), the CRI expresses how closely a source renders colors compared to an ideal light source. While the current version of CRI has been in use since 1974, it has significant limitations. The CRI is based on color science going back to 1937, and many scientific advances have occurred since then. Despite its shortcomings and calls to overhaul it, the CRI has stood the test of time, apparently due to resistance based on a belief that the lighting industry wouldn't accept change.

The advent of solid-state lighting, however, increased demand for a more accurate color fidelity metric. The light- emitting diode (LED) source produces light differently than traditional sources, exposing the CRI's limitations and igniting calls for change.

Since 2006, the CIE has worked on creating a new metric but hasn't reached agreement. In 2013, the Illuminating Engineering Society (IES) formed the Color Metrics Task Group, which developed TM-30-15, IES Method for Evaluating Light Source Rendition, to introduce potential new metrics for industry use. It may result in revisions and further development before it becomes a standard. Until then, the intent is for the new metrics to be used alongside the CRI. The CIE is evaluating TM-30.

Built on the progress researchers have made over the past two decades and synthesizing many of their concepts, TM-30 is designed to address many of the CRI's limitations, providing more information with greater accuracy.

The TM-30-15 method quantifies color fidelity (closeness to a reference) through the Fidelity Index (R_f) (0–100 scale), which is analogous to the CRI but is based on average fidelity across 99 color samples instead of eight to 14.

The higher the score, the more accurately colors will render as they would under the reference light source. A high number doesn't inherently mean the light source is better for a given application. For example, suppose we have two light sources with an equal R_f and CRI, but one results in reds visually popping because its emission enhances reds or the other lamp mutes that color. To predict this, we use a second color metric, Gamut Index (R_g).

Gamut describes an increase or decrease in chroma. R_g ranges from around 60–140 when R_f is higher than 60. To calculate R_g, the 99 color samples are broken down into 16 bins consisting of multiple color samples, and those numbers are averaged. The resulting ratio between the plotted area between the test source and the reference source is multiplied by 100 to get R_g.

What's important to know: An R_g greater than 100 means there is an average increase in saturation, while a value less than 100 means there's an average decrease. This is valuable to know because we might have a light source with two lamps, each with an R_f of 90 but where one has an R_g of 110, increasing saturation, and the other has an R_g of 90, which can cause some colors to be muted. By using this second metric, we can more accurately predict how objects and spaces are going to look.

That being said, as with the CRI, R_f and R_g suffer from a limitation in that they are averages, which can conceal important information. A source with an R_g of 110 may, on average, enhance saturation, but only certain colors may be saturated, while others may not be affected or may even be muted. To address this, TM-30-15 offers a method to produce color vector and distortion graphics providing a visual depiction of hue and saturation changes. For example, in the color distortion graphic, colors outside the white circle indicates increased saturation, while a lack of color (black) inside the white circle indicates those colors will be muted.

For those who want to take their analysis further, TM-30-15 offers additional indexes, including skin fidelity ($R_{f,skin}$), fidelity by hue ($R_{f,h\#}$), chroma shift by hue ($R_{g,h\#}$) and fidelity by sample ($R_{f,CES\#}$).

On its face, TM-30 represents a major leap forward for predicting, evaluating and talking about color. However, TM-30 is not yet a standard, nor is it a standard due to become one. What the industry ultimately adopts as a standard may be different than what is being proposed. Stay tuned.

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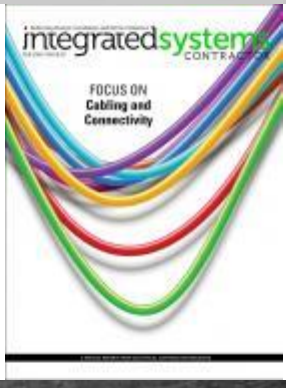

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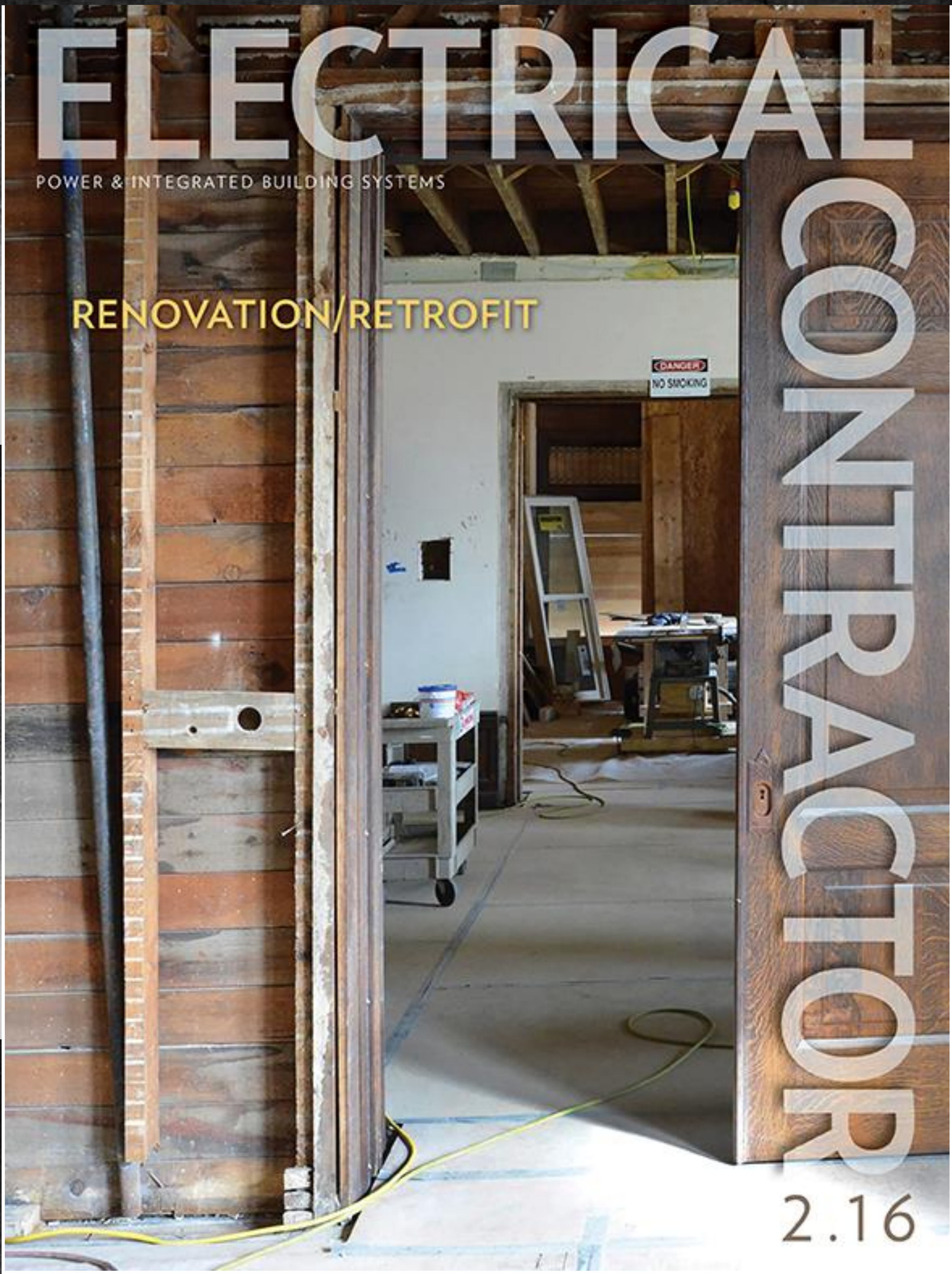

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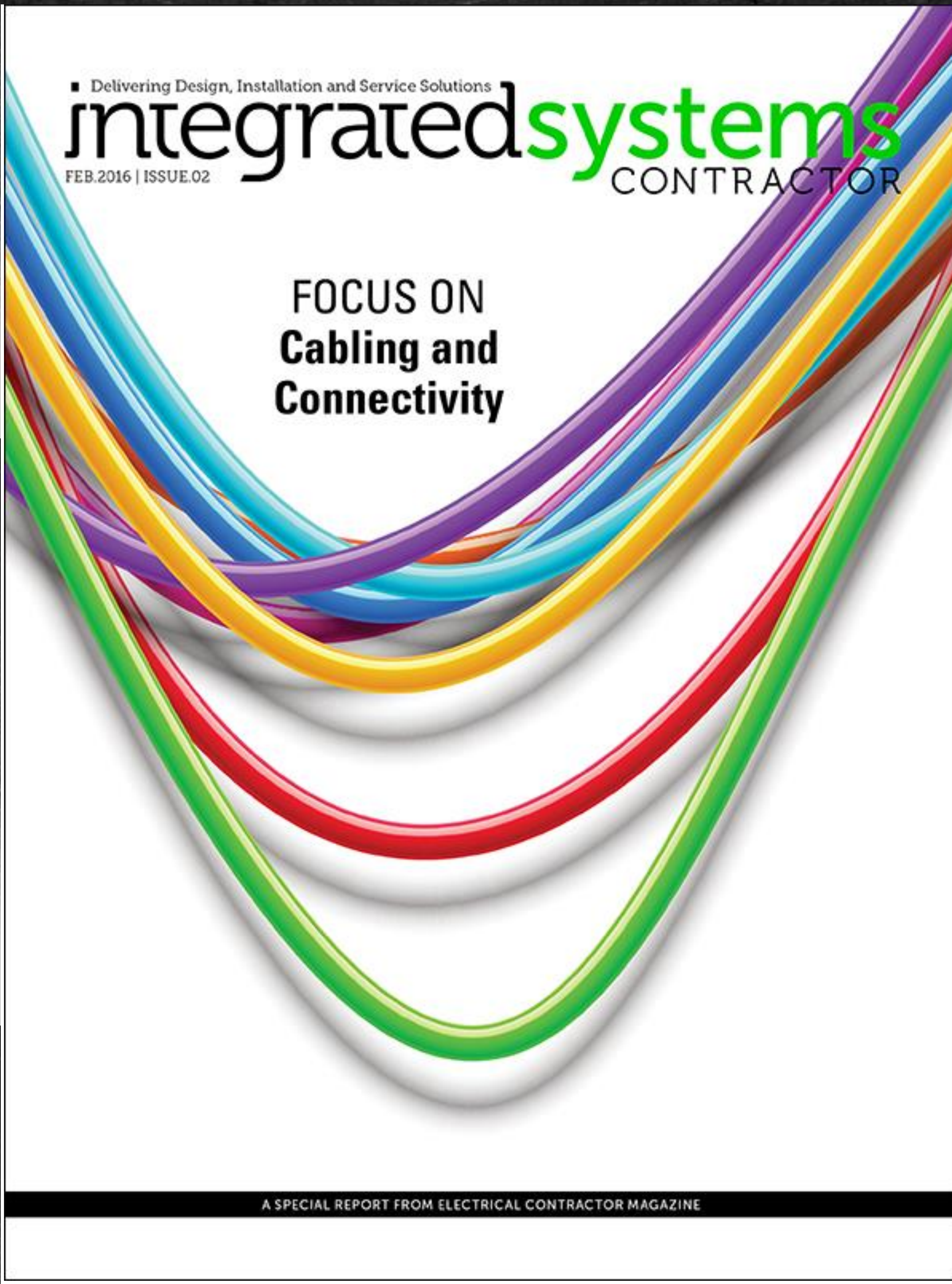

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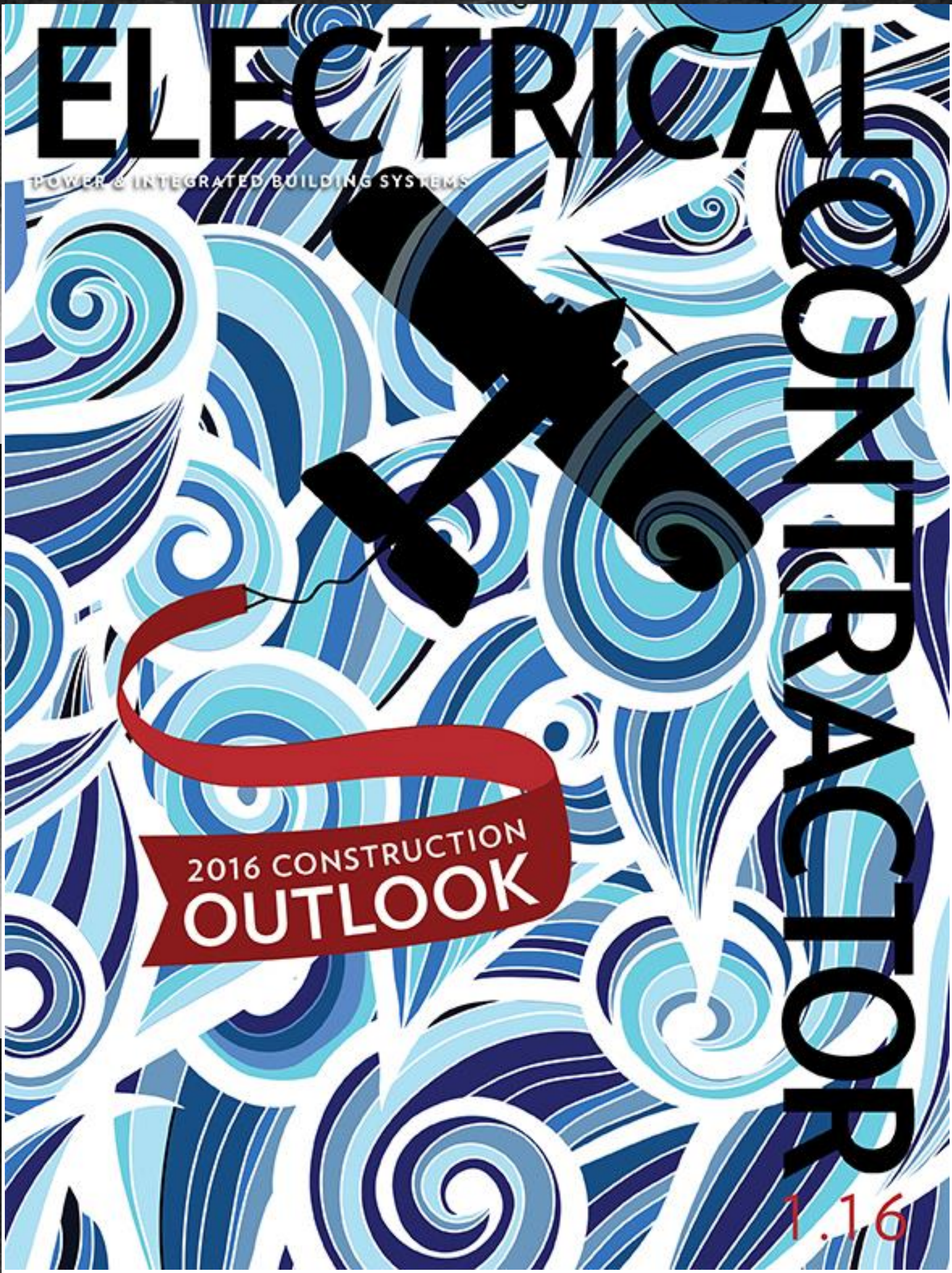

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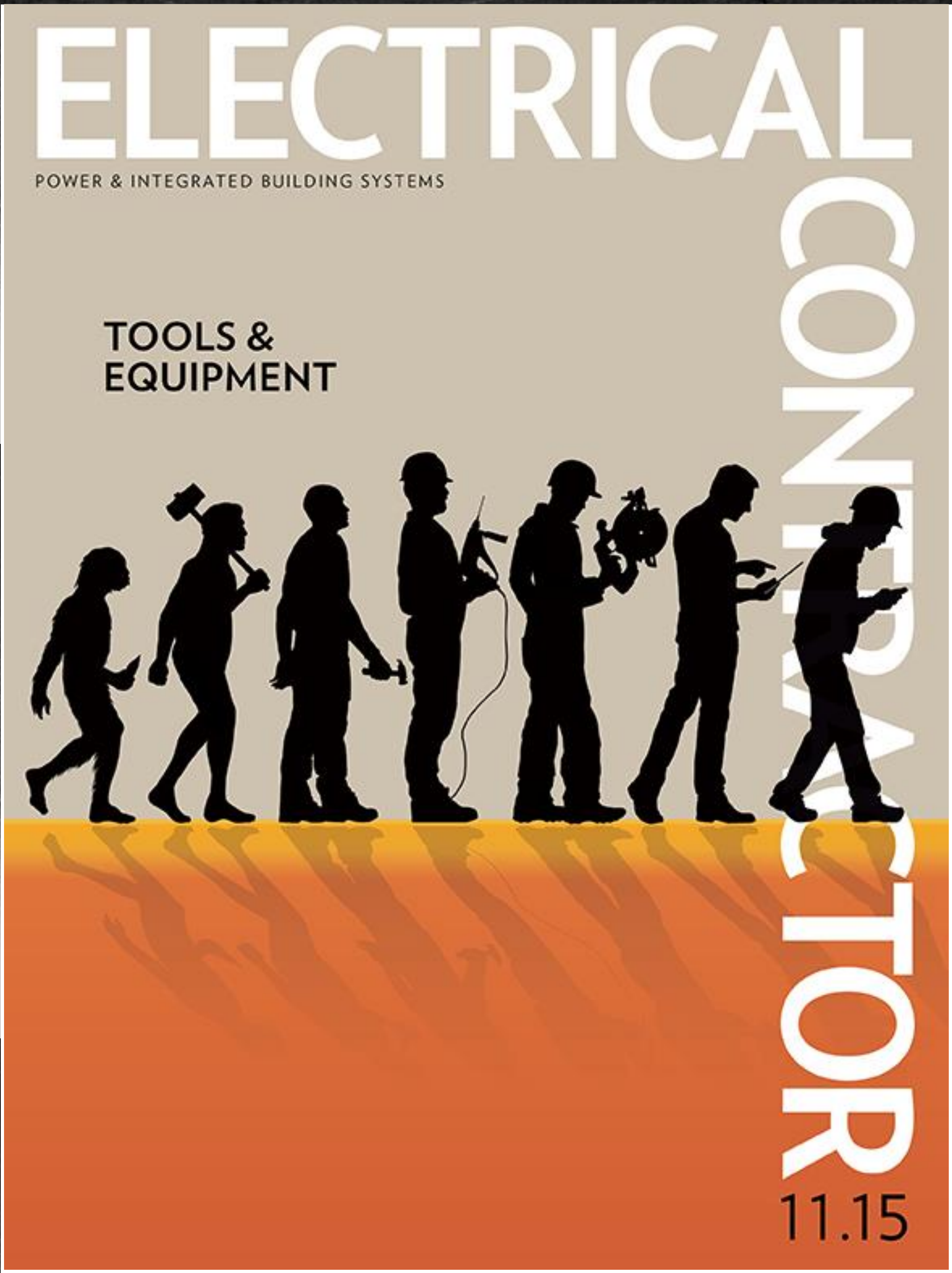

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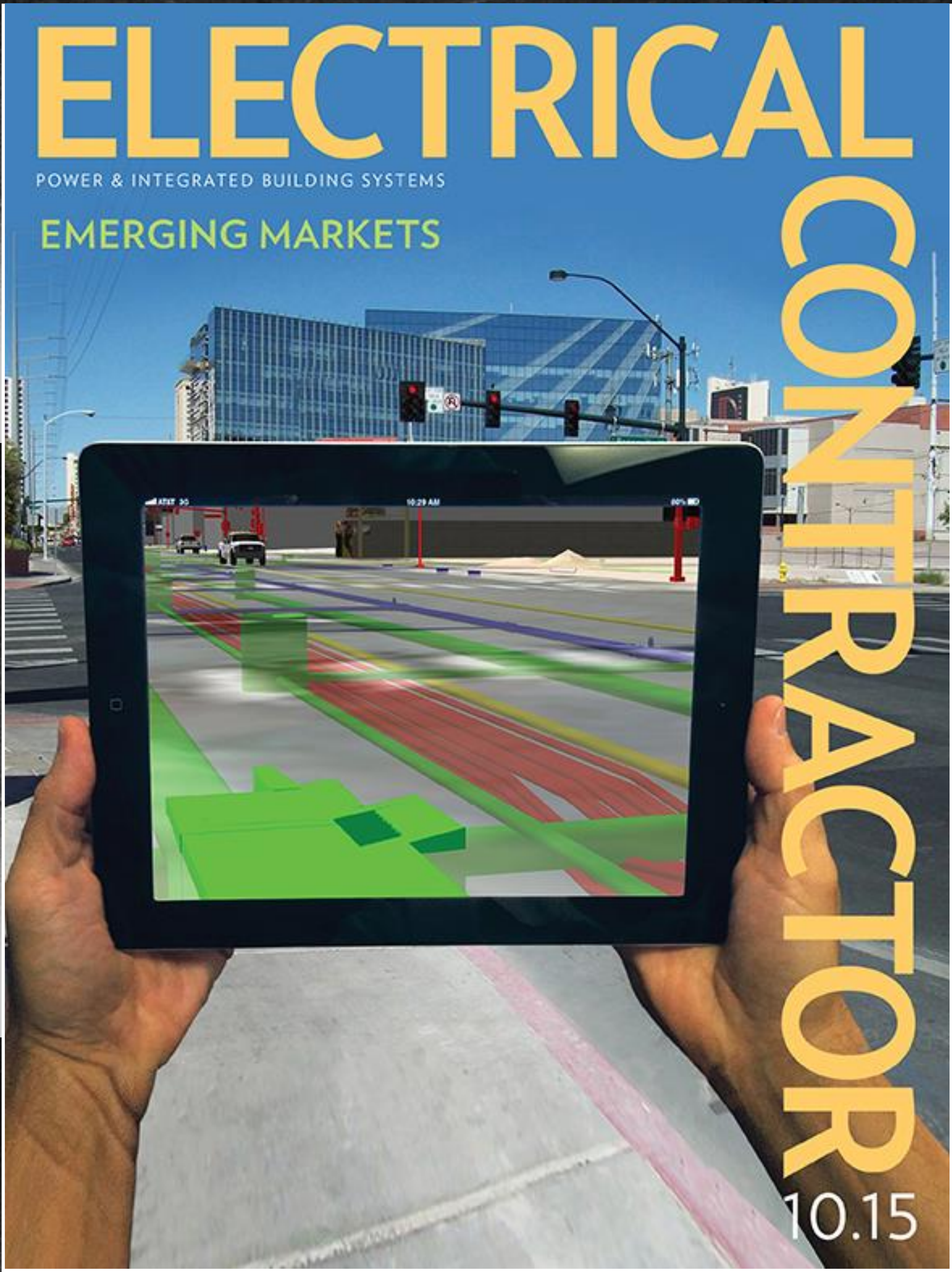

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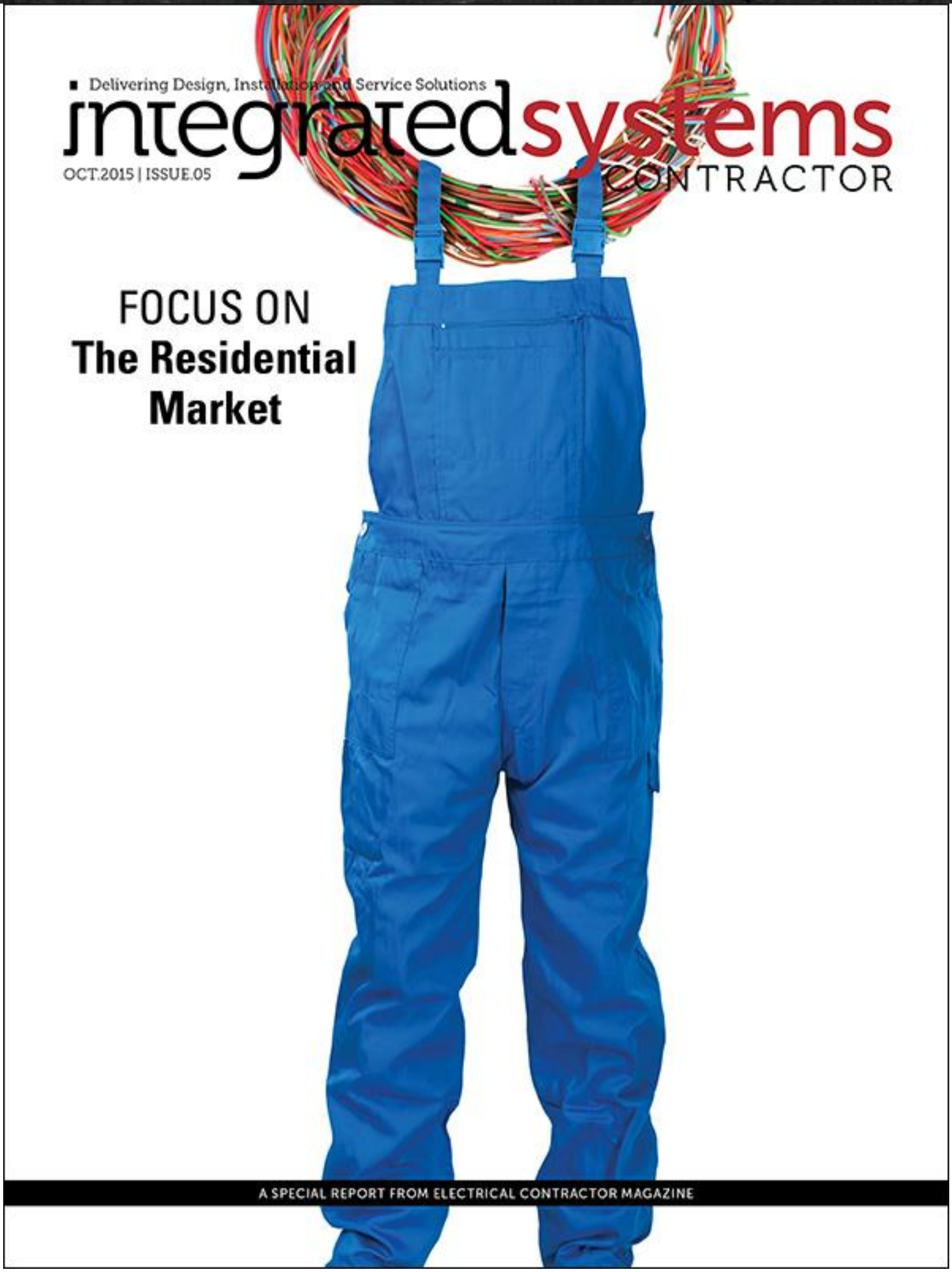

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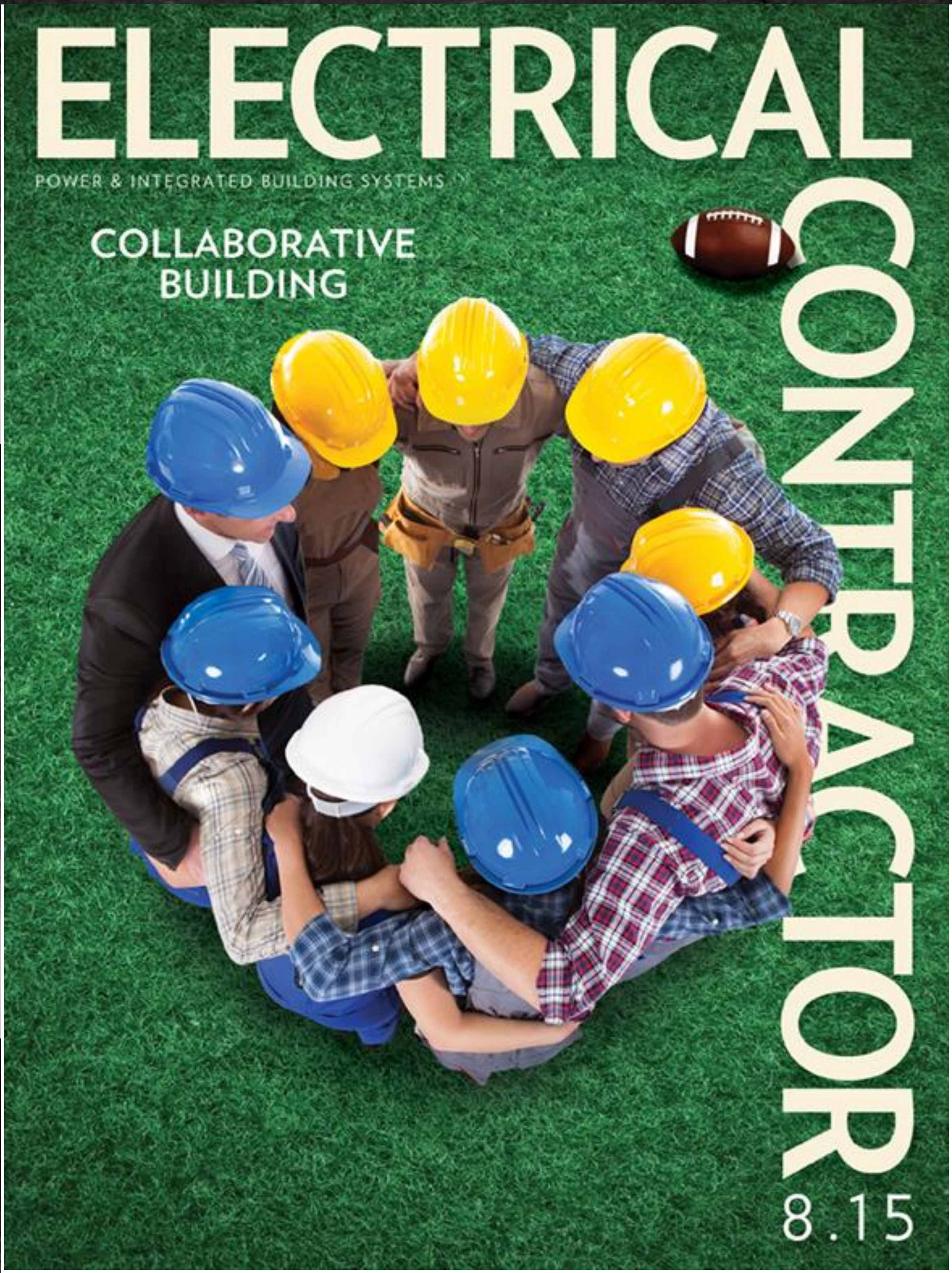

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