



For the second time, the test slab you've mixed has turned out a different color than what the architect approved, and for the second time you've had to delay construction. The engineer is getting sick of recasting tests. The architect is getting sick of having to come down to the site again and again. Workers are sitting idle, and you've got egg on your face. You've been using the same mix every time—so what's the problem? How can you stop this from happening?

Slight changes in the cementitious materials used in your mix can, of course, result in color variation that exceeds established tolerances. Gravel, aggregate, and additives from different suppliers will produce differently colored slabs, as will variations in your water to cement ratio. But even when all of this is controlled for, improper measurement can cause your team to misidentify sample colors—leading otherwise acceptable results to fail.

Color Delays Cost in Construction

And these failures don't come cheaply. To ensure that, by the time you need to pour concrete, you know exactly *what* to pour, sample testing of field batches already needs to be conducted at least a month¹ prior to construction. But as any project manager knows, plans unravel easily. Between the need to prepare samples for each separate color, the logistics of coordinating architects' and engineers' schedules, and the lead time required for each test, problems with sample slabs can easily delay the initial pour.

Time lost is money wasted on labor and materials, of course, but repeated failures to produce the color specified in your contract can also result in legal squabbles² with architects, project managers, or building owners. Even a successful lawsuit can damage reputations and cause contractors to lose potential business. Bad news travels quickly.



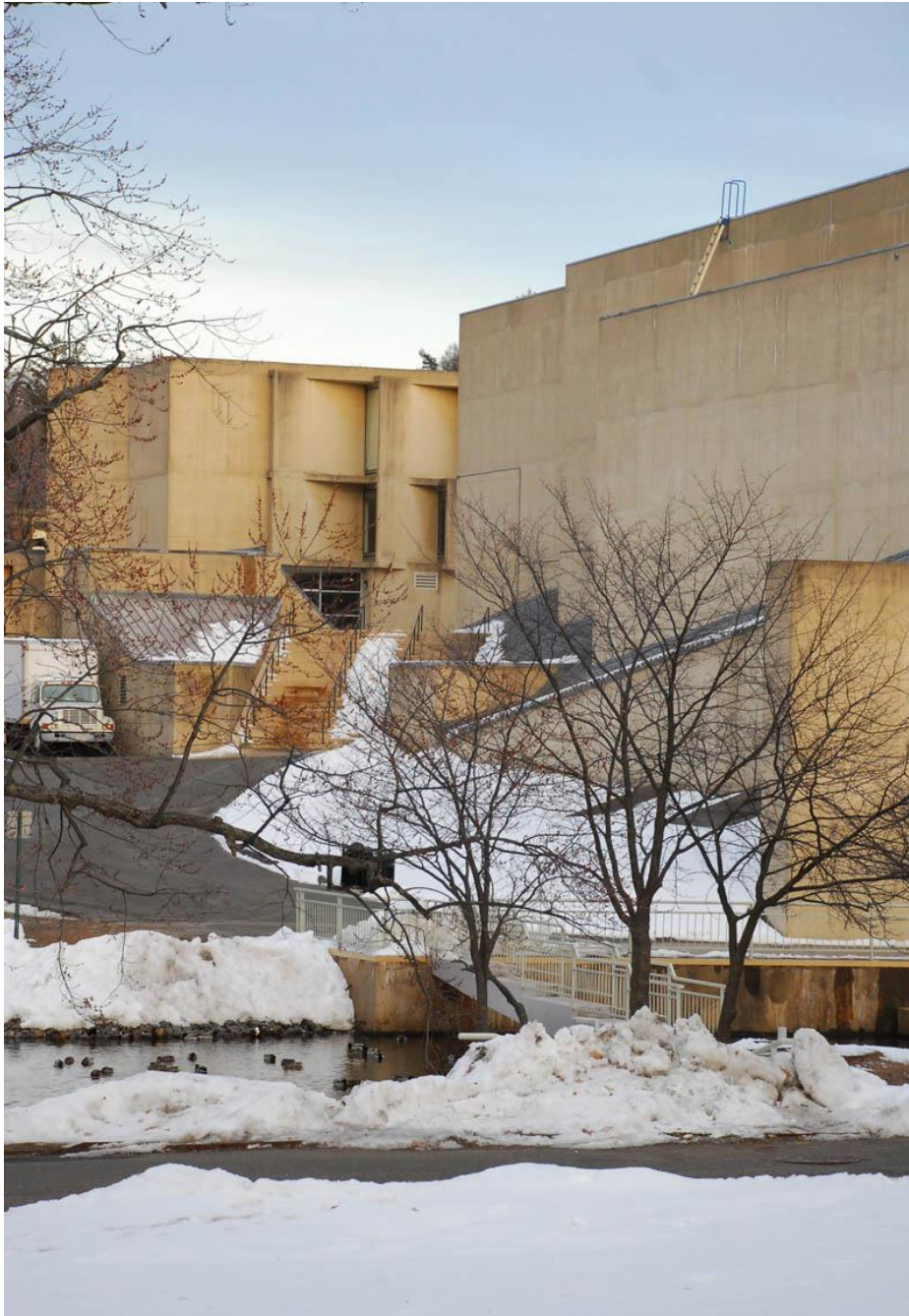
Color standard delays can cost time and money. Image credit: Flickr User Mikkal Noptek ([CC BY 2.0](#))

Job Site Challenges for Spectrophotometric Measurement

Accurate color measurement via spectrophotometer will help ensure that you're not wasting resources by throwing out perfectly good samples. But you still face a number of smaller challenges, starting with choosing the right machine.

Benchtop spectrophotometers can't be brought into the field, and rough conditions, dust, and the differences in calibration between jobs can throw off the settings of many handheld models. Plus, even if you're using the right unit, variations in your illumination settings can alter³ a spectrophotometer's reading—and even with illumination properly set, the texture of the concrete itself can affect the uniformity of your color readings. It's an exhausting set of challenges.

In fact, lighting plays a large role in spectrophotometric measurement. The machines use a flash of light reflected off a surface to infer an object's color via the differences in the light that bounces back. This means that the machine's different illuminant settings, such as noontime daylight versus light from fluorescent or incandescent bulbs, will return different results. The same setting, D65 or daylight illumination, must be used for all outdoor applications unless otherwise specified. Operators need to be fully trained on their devices and understand these key differences for spectrophotometers to be successfully used on the job site.



Choosing the right spectrophotometer supplier can keep your project on track. Image credit: Flickr User Inga Anger ([CC BY 2.0](#))

Choosing the Right Supplier to Reduce Color Measurement Error

Choosing the right manufacturer for your color measurement equipment can provide you with the information necessary to mitigate these measurement error issues. First, your supplier should be able to help you identify the correct spectrophotometer for the job. Handheld machines with directional $45^{\circ}/0^{\circ}$ geometry are preferred by [70% of HunterLab's clients](#) for concrete measurement, as this geometry ignores the effects of gloss and luster and reads color as it appears to the naked eye.

With the right machine, simple techniques can also ensure accurate readings. Lighting conditions should be controlled during measurement, and to reduce daylight variability, standardized artificial

light sources can provide uniform illumination. Look for a supplier [willing to educate you](#) on lighting techniques, equipment tolerances, and how to properly clean the ports and calibrate the machine—as well as solutions for your specific issues, such as how to [average multiple samples](#) from the same slab to account for textural differences in uniformity. Your supplier should also be able to provide accessories like hard carrying cases to protect your machine against job site conditions.

Inaccurate color measurement of concrete can cost you time and money. But by knowing how to handle the challenges of spectrophotometers on the job site, you can help keep your project on schedule and within budget. HunterLab is a leading supplier of spectrophotometers for the construction industry. [Get in touch](#) to learn how we can help.

1. “Chromix Admixtures for Color-Conditioned Concrete,” November 1998, <http://www.scofield.com/tdbpdf/ChromixTD11-98.pdf>
2. “Impossible Color Requirements,” June 30 2008, http://www.theconcreteproducer.com/how-to/concrete-production/impossible-color-requirements_o
3. “CIE Colorimetry – Part 2: Standard Illuminants for Colorimetry,” 2006, http://cie.co.at/index.php?i_ca_id=484