

Accepting Substrates Prepared by Other Contractors

Q. *I'm working on a project that requires my team to place concrete on various substrates prepared by other subcontractors. What should I focus on when accepting these substrates to avoid any unnecessary issues?*

A. As with any project, coordination and preplacement meetings are highly recommended. The subcontractors that are responsible for the various substrates have no contractual agreement with your company, so you need to discuss issues and coordinate solutions in advance with the general contractor (GC), other subcontractors, and design professionals present. For projects where ACI 117-10¹ is specified, preconstruction tolerance meetings are mandatory, as described in Section 1.1.3. The following examples discuss issues that the concrete contractor should check before accepting various substrates. By making these checks known in advance, there should be less risk of problems and delays.

Earthwork Substrate for a Concrete Mat Foundation

Prior to accepting an earthwork substrate, insist on receiving a licensed surveyor's certification in the form of a drawing confirming the pad has been graded within tolerance, including at all contours, slopes, and elevation changes. Also, request certification that the geotechnical engineer has signed off on the pad substrate preparation before taking ownership of the site and starting concrete work.

Tolerances for top-of-subgrade elevation are typically found in Division 31 specifications (formerly Division 2),² civil/shoring drawings, or the project geotechnical report. A commonly accepted rough grade tolerance is ± 0.1 ft, assuming a "mud slab" working surface will be installed on top of the prepared substrate. In those rare cases when the mat is placed directly on the subgrade, the plus tolerance would be 0.06 ft (the ACI 117-10 slab thickness tolerance of $-3/4$ in. would govern).

For a pad substrate with a constant elevation, spot-checking can be self-performed easily using typical survey layout instruments. Alternatively, a laser scanner can be used to efficiently check the quality of the substrate preparation and, if needed, to run a reasonably accurate volume calculation to determine the actual concrete quantity required for the mud slab. If the scan indicates the substrate is low and will require extra concrete, submit the scan results to the GC for review by the earthwork sub and/or the surveyor. This should be done early to minimize delays.

Soldier Pile/Lagging Substrate for Perimeter Sheeting and Shoring

This substrate results when concrete foundation walls are constructed below grade. Whether placed using single sided-formwork or shotcrete application, concrete is generally applied directly against a waterproofing membrane attached to the shoring substrate.

As with an earthwork substrate, the concrete contractor should insist on a certified survey confirming the as-built location of the shoring system before starting concrete work. In cases where the shoring system substrate encroaches on the wall thickness, notify the architect and structural engineer straightaway. The licensed design professional (LDP) may need to make changes to the wall reinforcement, concrete strength, or formwork, as relocation of the substrate is generally not an option. Attempting to spot-check several levels of shoring substrate behind the surveyor is typically impractical to self-perform. As with the pad substrate check, a laser scanner can quickly verify the substrate is installed correctly, and the data can be used to calculate the volume of concrete required to place the foundation concrete walls.

Questions in this column were asked by users of ACI documents and have been answered by ACI staff or by a member or members of ACI technical committees. The answers do not represent the official position of an ACI committee. Comments should be sent to rex.donahey@concrete.org.

Tolerances for placement of the shoring system are typically included in the general drawing notes prepared by the shoring specialty engineer. For soldier piles, assume a tolerance of 2 in. (away from the structure) and zero tolerance for mislocated substrate encroaching on the nominal design thickness of the structural concrete foundation walls.

In most cases, where several levels of substrate below grade require waterproofing, the waterproofing consultant should also certify the waterproofing installation is acceptable before accepting the substrate and starting the concrete scope.

Waterproofing Substrate for Foundation Mat Reinforcing Steel

On some projects, a protection slab or protection board is specified to protect a waterproofing membrane from damage during installation of reinforcing steel and other follow-on work installed by multiple trades. On other projects, the mat slab reinforcing steel is placed directly on top of the waterproofing membrane substrate. Despite all good intentions, damage to the membrane substrate inevitably occurs when reinforcing steel bars are placed production-style on schedule-driven projects.

Suggest writing a qualification clause in bid proposal letters that excludes the cost of such “trade damage” and instead request the owner carry an allowance to cover repairs of incidental (and inevitable) damage to the waterproofing membrane substrate. If this approach is unsuccessful, suggest photographing the entire surface of the waterproofing membrane prior to accepting the substrate and then carefully monitoring the work of all trades (reinforcement, electrical, plumbing) who can possibly contribute damage. Because the costs to repair waterproofing substrate can quickly escalate, this topic should be discussed with all parties—including the waterproofing inspector—during the preconstruction conference and before the concrete contractor accepts the substrate.

Metal Deck Substrate: Structural Steel Buildings

According to ACI 117-10, Section 4.4.1, there is no tolerance requirement for the location of the top of the concrete slab placed on a metal deck substrate. This is one work scope where almost all the slab formwork (that is, the sheet metal surfaces defining the soffits and slab edges) is installed by others. Responsibility and risk associated with tolerances for slab-edge locations, opening sizes/locations, and other substrate features are also shifted outside of the concrete contractor’s scope.

In some cases, the timing of acceptance of a metal deck substrate by the concrete contractor can come into play, especially in the case of multistory buildings. Consider the case of the American Society of Concrete Contractors (ASCC)

member who bid a multistory project under the assumption that the floors would be placed using a 25% fly ash mixture during the summer. After schedule delays pushed the work into the winter, the member’s labor costs to install the work increased dramatically. The low ambient temperature, combined with the shade created by overhead structural steel and metal decks, resulted in slow setting times and forced finishing crews to be on-site far longer than had been anticipated for a summer placement. Although the concrete contractor accepted the substrate, the company also requested a change order to cover costs associated with crew overtime and accelerating admixture, using “ASCC Position Statement #15: Setting Time Expectations for Hard-Trowel Finishing”³ as justification.

Other issues that can arise during placement on metal deck substrates should be neutralized during bid time, long in advance of the work. For example, design callouts in many project specifications require metal deck panels to be vented, apparently based on an assumption that allowing mixing water to drip through the deck will reduce slab moisture content and reduce the delay required prior to the application of flooring materials. A position statement issued by the Steel Deck Institute (SDI)⁴ explains that, in most cases, vented deck is not required. Further, the statement indicates that slabs on metal deck should be considered to behave like slabs-on-ground placed on vapor barriers when assessing potential moisture issues. For the concrete contractor, vented deck adds labor costs to the project for cleanup during and after placements. It is in the owner’s best interest for the concrete contractor to question the need for this substrate item early, during the bid process.

References

1. ACI Committee 117, “Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary (Reapproved 2015),” American Concrete Institute, Farmington Hills, MI, 2010, 76 pp.
2. “Division 31—Earthwork,” MasterSpec®, The American Institute of Architects, Washington, DC.
3. “ASCC Position Statement #15: Setting Time Expectations for Hard-Trowel Finishing,” American Society of Concrete Contractors, St. Louis, MO, www.ascconline.org/concrete-technical-resources/position-statements/setting-time-expectations-for-hard-trowel-finishes, accessed Jul. 22, 2021.
4. “SDI Position Statement: Venting of Composite Steel Floor Deck,” Steel Deck Institute, Glenshaw, PA, May 2012, 2 pp.

Thanks to Jim Klinger, Concrete Construction Specialist, American Society of Concrete Contractors, St. Louis, MO, USA, for providing the answer to this question (based on Klinger, J., “Getting the Record Straight on Substrate,” published in the May 2021 edition of ASCC’s newsletter *The Voice*).