



Surface Preparation of Concrete Joints

By Gregory McCombs, S.E., and Steven Petroff, P.E.

The *Building Code Requirements for Structural Concrete* are specified in the American Concrete Institute's ACI 318-14. As stated in Section 1.2.5, "This code covers the materials, design, construction and strength evaluation of structural concrete members and systems in any structure designed and constructed under the requirements of the general building code."

The code defines a joint as the portion of a structure common to intersecting members. Joints in concrete may be either or both construction joints or shear-friction joints such as new concrete placed against hardened concrete. In principle, the two joints are the same. An example of a joint being a construction joint and a shear-friction joint is a concrete wall placed on a hardened concrete footing. This wall may be a concrete shear wall or a concrete foundation wall used to transfer the shear forces from a light-framed wall or masonry shear wall to the footing.

Are there special preparations for a concrete joint? For example, can a concrete shear wall or foundation wall transferring shear forces into a footing simply be cast on the hardened concrete footing without any surface preparation? ACI 318 Section 26.5.6.2(d) states that "Construction joints shall be cleaned and laitance removed before new concrete is placed." Note that the commentary to section 26.5.6.1(b) and 26.5.6.1(c) refers to section 22.9 for the necessary surface preparation if shear-friction is invoked in the design. Additionally, in Table 22.9.4.2, friction coefficients for shear friction calculations are provided. When concrete is placed against hardened concrete, the contact surface condition is required to be "free of laitance." Removal of laitance is not limited to concrete-to-concrete joints only. Per ACI 530.1-13/ASCE6-13 Section 3.2B, "Prior to placing masonry, remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation." Essentially, these code sections require preparation prior to placing concrete or masonry against previously hardened material. It is recommended that the engineer review Section 26.5, "Concrete production and construction," as there are multiple requirements that may not be obvious, such as Section 26.5.6.2(f) requiring

that the new concrete is prewetted prior to concrete placement.

So, what is laitance? *ACI Concrete Terminology*, ACI CT-16, defines laitance as: "a layer of weak material derived from cementitious material and aggregate fines either: 1) carried by bleeding to the surface or internal cavities of freshly placed mixture; 2) separated from the mixture and deposited on the surface or inter-

Are there special preparations for a concrete joint? For example, can a concrete shear wall or foundation wall transferring shear forces into a footing simply be cast on the hardened concrete footing without any surface preparation?

nal cavities during placement of the mixture." Relating to the example described above, when the concrete footing is cast, the top surface is screeded, floated, and finished. This process brings up the fines and covers the aggregate with concrete fines technically referred to as laitance. Laitance can cause a plane of weakness and reduce the bond between the concrete surfaces, creating a slip plane.

There are several methods used to clean the concrete surface and remove laitance. Many procedures are identified in the National Research Council-*Conseil National de Recherche Canada (NRC-CNRC) Construction Technology Update No. 24*. Below is a brief list with a basic description of the methods itemized in the document.

- **Chemical Cleaning:** Concrete contaminated with oil or grease can be cleaned and scrubbed with detergents or other chemicals.
- **Mechanical Cleaning:** Mechanically clean the concrete surface by using rotary or impact devices.
- **Impact Tools and Scabblers:** Brush hammers, scabblers, and needle guns can be used to remove several millimeters of concrete surface.
- **Scarifiers:** Scarifying devices use a rotating disc cutting wheel. They can be used for cleaning, grinding, or milling.
- **Blast Cleaning:** This includes wet or dry sandblasting, shotblasting, and water jet cleaning.

- o **Sandblasting:** Sandblasting machines are generally used to remove laitance, dirt, oil, and other contaminants.

- o **Shotblasting:** Shotblasting machines use steel shot to clean and scarify concrete surfaces. Excellent for removing large depths of concrete surface.

- o **WaterBlasting:** This method uses a high-pressure water jet to prepare the concrete surface.

- **Acid Etching:** Acid etching removes enough concrete paste to provide a rough concrete surface. This method has limitations per ACI Committee 515.

- **Flame Cleaning:** This method is used to prepare concrete surfaces to receive special coatings such as on slabs.

- **Washing and Brushing:** After the concrete has stiffened and the water has evaporated from the concrete surface, usually a couple of hours after the concrete is placed based on climatic conditions, brush and water are used to remove the laitance and clean the concrete surface. Care must be taken not to dislodge the aggregate.

- **Wire Brush and Washing:** The laitance can also be removed while the concrete is still green using a wire brush and water to clean the concrete surface.

ACI 318 and ACI 530.1 are clear that, for all construction joints consisting of fresh concrete or masonry placed against the hardened material, the laitance is required to be removed and the surface must be clean. While the means and methods of surface preparation, including laitance removal, is the responsibility of the contractor, the engineer may consider adding laitance removal to the specifications as well as the general structural notes on the construction drawings. In accordance with ACI 318 Section 22.9.1.4 and Section 22.5.6.2(e), surface preparation requirements of the shear plane assumed for design shall be specified in the construction documents.■

Greg McCombs is currently retired, having worked as an engineer in California for 18 years and another 5 years in Utah. He currently volunteers his time as a member of the Seismic Committee of SEAU. (spideygs24@icloud.com)

Steven Petroff is a Project Engineer at ARW Engineers in Ogden, Utah, and serves on the Seismic Committee and Resilience Committee of SEAU. (stevenp@arwengineers.com)