Making a choice between elevation control and crack control

BY BRUCE A. SUPRENANT AND WARD R. MALISCH

Isolation joints are the most common detail for slabs-on-ground that abut foundations. In theory, isolation joints allow the slab to move up or down without restraint when soil settlement or expansion is uniform. Because there is no restraint to the movement of these floating slabs, no stress is generated in the concrete and no cracking is expected. In practice, soil movement is often nonuniform and differential soil settlement or expansion creates stress in the slab that can lead to cracking. Furthermore, either uniform or differential soil movements can lead to slab elevation changes that cause problems other than cracking. In many cases, there are no concerns about soil movements. In some regions, however, owners must cope with problematic soils, budget constraints, and risk evaluation. In these cases, the specifier must decide on the relative importance of crack control or elevation control as each relates to the function and performance of the structure. This leads to the consideration of two choices:

■ Letting the slab float to reduce the possibility of restraint and cracking; or
■ Supporting the slab on or attaching it to the foundation wall or grade beam to maintain elevation control.

WHY MANY SLABS DON’T SETTLE UNIFORMLY

Concrete slabs-on-ground can sink due to shrinking or settling soil or rise due to frost heave or expansive soils. Improper construction—primarily inadequate compaction—is often cited as a reason for differential soil movements. Projects such as schools, light commercial or retail structures, and houses, however, are often built in areas with marginal soils that have the potential for larger-than-normal movement. Tight budgets can limit the choices for dealing with marginal soils. Removing expansive soils and enlarging the extent of excavation prior to importing select backfill may not be economical solutions. Increasing inspection of excavation and backfilling, including compaction testing, can be helpful, but light commercial and residential structures are often built with minimal specifications and little or no inspection and testing.

Figure 1 illustrates one cause of nonuniform settlement: fill near the wall is deeper than the fill under the rest of the slab. It’s not uncommon to have 4 to 5 ft (1.2 to 1.5 m) of fill near the wall and 6 to 12 in. (150 to 300 mm) of fill under the rest of the slab. Even with good compaction, the difference in settlement for the two different fill depths can lead to crack formation.
depths can lead to elevation changes and cracking of the slab. Specifiers sometimes decide to emphasize elevation control and connect the slab to the wall. Because this connection causes restraint to vertical movement, soil settlement causes the slab to bridge between the wall and supporting subgrade; therefore, cracking can still occur.

**ELEVATION CONTROL OPTIONS**

A crack is typically less objectionable than the lack of elevation control. If the slab-on-ground settles, undesirable water drainage toward the foundation wall can occur. The elevation difference can also be a tripping hazard. If the slab-on-ground rises, it’s again a potential tripping hazard and can also prevent swinging doors from opening. To control elevation differences, specifiers can choose to use smooth dowels to connect the slab and wall (Fig. 2) or to lower the wall elevation with a blockout so the wall supports the slab (Fig. 3). Both of these options provide the vertical restraint needed to control elevation. The dowels allow horizontal movement to accommodate slab shrinkage, but a slab supported within a wall blockout is also restrained against horizontal movement, and shrinkage cracking can occur. Some specifiers require a double layer of plastic sheeting or roofing felt over the foundation wall beneath the slab to permit some horizontal movement.

Either of the abovementioned options improves elevation control, but when the soil settles or expands, a crack can occur due to this restraint. Figure 2 shows the location of the potential crack when the slab is doweled into the wall, whereas Fig. 3 shows the location of the potential cracks when the slab is supported on the wall. If both elevation and crack control are important, requiring reinforcing as shown in Fig. 4 will help maintain a tight crack width.

**ECONOMIC ASPECTS OF ELEVATION CONTROL**

The economics of the elevation control should be considered. The most expensive option is supporting the slab on the wall because this requires a blockout in the wall form at each doorway or other location where elevation is controlled. These blockouts are expensive to form. Requiring slab dowels to be embedded in the wall is also expensive because it requires that holes be drilled in the wall forms.

A less expensive construction procedure is drilling holes in the wall after the forms are stripped, and then installing the dowels. It’s typically easier to get the dowels parallel, level, and at the correct elevation using this procedure rather than placing and tying them into the wall form. Some specifiers require filling dowel holes in the wall with epoxy adhesives, inserting the dowels, and later greasing the slab end of the dowel. Others require oversize holes to be drilled in the wall and filled with thick grease before the dowel is inserted into the wall.
hole, allowing the protruding bar to bond. Another option is premanufactured round, square, or plate dowels with plastic sleeves that allow movement in one or more directions.

For minimal expense, specifiers can allow deformed reinforcing bars to be used instead of smooth dowels if the oversized hole is large enough. For instance, a specifier could detail a 1 in. (25 mm) diameter hole that’s drilled in the wall and filled with grease that supports a No. 4 reinforcing bar in the middle of the hole. The other end of the deformed bar would be allowed to bond to the slab concrete, but the greased hole is large enough to let the bar slide horizontally while still limiting vertical movement.

References

1. ACI Committee 332, “Code Requirements for Residential Concrete and Commentary (ACI 332-08),” American Concrete Institute, Farmington Hills, MI, 2008, p. 15.


Selected for reader interest by the editors.

Bruce A. Suprenant, FACI, is President of Concrete Engineering Specialists, Boulder, CO. He is a member of ACI Committees 117, Tolerances; 222, Corrosion of Metals in Concrete; 228, Nondestructive Testing of Concrete; 301, Specifications for Concrete; and 302, Construction of Concrete Floors.

Ward R. Malisch, FACI, is Technical Director for the American Society of Concrete Contractors (ASCC). He has been an ACI member for more than 40 years, is a licensed professional engineer, and has answered contractor questions on all aspects of concrete construction via the ASCC hotline for more than 20 years.

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