

Neglecting Size Effect Factor for One-Way Shear Strength in Isolated and Combined Foundations

Q. *I am looking for an explanation for Section 13.2.6.2 of ACI 318-19, which states: “For one-way shallow foundations, two-way isolated footings, or two-way combined footings and mat foundations, it is permissible to neglect the size effect factor specified in 22.5 for one-way shear strength and 22.6 for two-way shear strength.”¹*

I would like to know why the size effect factor can be neglected for one-way shear check in isolated and combined foundations. Also, can pile caps be treated the same as isolated foundations?

A. ACI 318-19 permits the licensed design professional to ignore the size effect of one-way shallow foundations, two-way isolated footings, two-way combined footings, and mat foundations. This exception was added to provisions introduced in ACI 318-14² because:

- No failures attributed to the size effect have been observed in these foundation types; and
- Deep concrete foundation members in direct contact with and supported by soil tend to benefit from the redistribution of soil pressures, often inducing load-transfer mechanisms involving struts and arching mechanisms rather than beam action.

The situation for pile caps is not trivial and requires judgment by the licensed design professional for the following reasons. In general, the Code treats pile caps as components of deep foundations. Hence, direct application of the exemption for shallow foundations in Section 13.2.6.2 should not proceed. When not designed using the strut-and-tie method, Section 13.4.6 calls for one-way pile caps to be designed in accordance with Section 22.5 for one-way shear, and two-way pile caps in accordance with Section 22.6 for two-way shear, depending on the geometric characteristics of the pile cap relative to the size and layout of the piles supporting it. Both Sections 22.5 and 22.6 include the size effect on the concrete shear strength formulation. The size effect exemption of Section 13.2.6.2 may be invoked if it is demonstrated that the pile cap behaves as a shallow foundation member, benefitting from direct contact with the soil beneath it.

References

1. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19) (Reapproved 2022),” American Concrete Institute, Farmington Hills, MI, 2019, 624 pp.
2. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14),” American Concrete Institute, Farmington Hills, MI, 2014, 520 pp.

Wet Setting of Reinforcement

Q. *ACI 318-05, Section 7.5.1, very clearly stated that wet sticking of reinforcing bars isn't allowed: “Reinforcement, including tendons, and post-tensioning ducts shall be accurately placed and adequately supported before concrete is placed, and shall be secured against displacement within tolerances permitted in 7.5.2.”¹ I'm currently battling a contractor about Section 26.6.2.2 in ACI 318-19,² as it is not so clear that it requires bars to be secured prior to concrete placement. Construction workers have wet-stuck the masonry shear wall dowels at the top of foundation walls and then vibrated around them. Do you have*

any guidance on this matter? Is wet sticking of reinforcing bars an acceptable practice?

A. The restriction in ACI 318-05, Section 7.5.1, on adequately supporting reinforcement before concrete placement is no longer included in Section 26.6.2.2 of ACI 318-19. Instead, Commentary Section R26.6.2.2(a) states: “Reinforcement, including bundled bars, should be adequately supported in the forms to prevent displacement by concrete placement or workers.” Even though ACI Committee 318 does not encourage wet setting of

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reinforcement, the committee recognizes that this may be necessary in some cases. Therefore, it recommends that reinforcement should be supported before concreting.

Wet setting is more common in residential construction. For example, in ACI 332.1R-18, Guide to Residential Concrete Construction, Section 4.3.6.2 states that: “Unless prohibited by local code, the dowels may be pushed into the fresh concrete (also referred to as wet setting) immediately following striking the final level, or they may be secured to the formwork before concrete placement to maintain their vertical and horizontal positions as well as alignment.”³

In addition, Section 8.2.2.1.2 of ACI 332-20, Code Requirements for Residential Concrete and Commentary, states: “A vertical No. 4 dowel shall extend at least $36d_b$ into the wall and 6 in. into the footing at a maximum of 24 in. on center along the footing. To facilitate positioning before concrete placement, vertical dowels are permitted to be driven into the grade in the bottom of the footing.”⁴

Therefore, wet setting of reinforcement can be used in residential construction as long as the tolerances are maintained and respected.

References

1. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05),” American Concrete Institute, Farmington Hills, MI, 2005, 430 pp.
2. ACI Committee 318, “Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19) (Reapproved 2022),” American Concrete Institute, Farmington Hills, MI, 2019, 624 pp.
3. ACI Committee 332, “Guide to Residential Concrete Construction (ACI 332.1R-18),” American Concrete Institute, Farmington Hills, MI, 2018, 61 pp.
4. ACI Committee 332, “Code Requirements for Residential Concrete (ACI 332-20) and Commentary,” American Concrete Institute, Farmington Hills, MI, 2020, 72 pp.

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