

ACI SUBCOMMITTEE 318F – FOUNDATIONS

ACI 2020 Spring Virtual Meeting
Tuesday, March 31, 2020
9:00 AM - 12:00 AM (US **Eastern** Daylight Time)
GotoMeeting, The World

AGENDA

1. Call to Order
2. Virtual Meeting Tips (See Appendix 1)
3. Self-Introductions
4. Announcements
 - a. No audio, photo or video recording
 - b. Confidentiality of ACI technical committee work in progress
 - c. Attendance
 - d. Welcome to New Subcommittee Members Edith Smith and Luis Fargier
5. Action Items
 - a. Overview of Ballot LBF-01
 1. CF001a: Design of Cast-in-place Concrete Deep Foundations for Seismic Design Categories (SDCs) A & B (Stevenson and McFarlane)
 - a. Ballot Results
 - b. Resolution of Negatives
 - c. Status of CF001b
 2. CF002a: Strength reduction factor ϕ for design of concrete piles subjected to axial load versus combined axial load and flexure (Hartmann)
 - a. Ballot Results
 - b. Resolution of Negatives
 - c. Status of CF002b
 - b. Impact of ACI 318-19 shear design provisions on design of concrete foundation members
 1. Intro: Evaluation of Dolan's examples (See Attachment 1 of Fall 2019 meeting agenda) (Ospina, Pujol)
 2. Spread footings (Rautenberg, Patel, Ospina)
 3. Retaining walls (Fargier, Pujol)
5. Discussion and answers to questions and comments on ACI 318-19 received from code users and during public review of ACI 318-19:

- a. Treatment of size effect on shear strength of grade beams (See Attachment 4 of Fall 2019 meeting agenda)
 - b. Can 8.6.1.2 be applied to shear design of footings? (Ospina, Hawkins)
 - c. Questions on 18.13.5 from Raul Labbé (via Zeisler) (See Appendix 2).
 - d. Consistency between ACI 318 and PCI provisions for precast prestressed concrete pile design (See Attachment 5 of Fall 2019 meeting agenda)
 - e. Minimum transverse reinforcement size for precast concrete piles in SDC A and B (13.4.5.6) (See Attachment 6 of Fall 2019 meeting agenda)
 - f. Other action items
6. Liaison with PCI (Smith), ACI 543 (Frizzi / Hartmann), DFI, ICC/IBC (Stevenson), ASCE 7 (Ghosh), ASCE/COPRI 61 (Ospina)
7. Timeline
 - a. ACI 318 Schedule
 - b. Subcommittee Ballots: CF001b, CF002b, CF003
 - c. Main Committee Ballots
8. Other New Business
 - a. TBD
 - b. TBD
9. Adjournment
10. Next Meeting: Raleigh, NC, Tuesday, October 27, 2020, unless we want to meet (on-line) again in the Summer (TBD)

ACI 318F
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APPENDIX 1
GoToMeeting Etiquette

As we approach this unprecedented ACI virtual convention, here are some quick tips about the meeting we will hold:

1. Whenever you attend a virtual meeting, mute yourself – that background noise can stop a meeting. I cannot stress this enough.
2. Headphones with a microphone are best – again, I cannot stress this enough. The poor sound quality and background noise of built-in computer microphones makes it difficult for everyone on the call to understand the person speaking.
3. Use the chat box feature in GoToMeeting to request speaking privileges with the chair.
4. Please be aware that voice communications are NOT allowed to be recorded without 100% consent of the committee, but the chat box messages will be recorded.
5. Please verify meeting times in the agenda distributed by the subcommittee chair. The timeslots and links that were setup by ACI staff are based on a “normal” convention schedule. The links sent by ACI’s automated system reserved a GoToMeeting line for the fully allotted time in the convention schedule. You will use the link that was sent to join the meeting at the appropriate time in the agenda given to you by the chair. It is OK if the meeting ends earlier than originally planned.

This will be a very interesting experiment. Please be patient with both the subcommittee chair, ACI staff and your fellow committee members because we have never done this at this scale before. Thank you.

APPENDIX 2: ACI 318-19 QUESTIONS FROM R. LABBE (RECEIVED 03/16/20)

18.13.5 *Deep foundations*

18.13.5.3 For structures assigned to SDC C, D, E, or F, the minimum longitudinal and transverse reinforcement required by 18.13.5.7 through 18.13.5.10 shall be extended over the entire unsupported length for the portion of deep foundation member in air or water, or in soil that is not capable of providing adequate lateral restraint to prevent buckling throughout this length.

QY 1.

The response of piles or piers for the situations being considered in 18.13.5.3, is practically a 'column' behavior. In fact R18.13.5.3 indicates that ". . . *the member should be designed as a column*". Throughout the various reinforcement-related provisions, ultimately, the minimum reinforcement for these piles, is being specified in Table 18.13.5.7.1.

According to Table 18.13.5.7.1, the specification for minimum longitudinal reinforcement ratio at 0.005, remains unchanged even for site Class E and F.

For the situations depicted in 18.13.5.3, besides the specification at this table, there is no other specific minimum reinforcement ratio, for cast-in-place piers.

On the other hand, precast piles, even in lower SDC, are specified for a minimum reinforcement ratio 0.01, as indicated in 18.13.5.10.2.

The question is : a clarification/confirmation for the minimum reinforcement ratio 0.01, in the situations addressed by 18.13.5.3, for cast-in-place piers.

(This is fitting 13.4.4.2 & Chap.10).

18.13.5.5 For structures assigned to SDC D, E, or F **or** located in Site Class E or F, concrete deep foundation members shall have transverse reinforcement in accordance with 18.7.5.2, 18.7.5.3, and Table 18.7.5.4 Item (e) within seven member diameters above and below the interfaces between strata that are hard or stiff and strata that are liquefiable or soft.

QY 2.

A clarification is needed, if the right sentence is

"For structures assigned to SDC D, E, or F **or** located in Site Class E or F, . . ." or is it as follows?

"For structures assigned to SDC D, E, or F **and** located in Site Class E or F, . . ."

Table 18.7.5.4, seems to fit more with the latter.

QY 3.

Regarding the range along the pile, for special transverse reinforcement, it applies also at the head of the pile, as indicated in Table 18.7.5.4. In usual designs providing an important degree of fixity at the head, this is the more probable spot, where larger moments may occur.

However, contrary to deeper soil strata, the pile head position is at a well-defined elevation. Therefore, the question is: which are the reasons underlying the proposed range of 7 times the pile diameter, underneath the pile cap, for the special transverse reinforcement?

In this regard, please see also last question **QY 7**.

18.13.5.7.1 For structures assigned to SDC C, D, E, or F, reinforcement shall be provided in uncased cast-in-place drilled or augered concrete piles where required by analysis and in accordance with the requirements in Table 18.13.5.7.1.

QY 4.

According to the minimum reinforcement requirements in Table 18.13.5.7.1 and other reinforcement-related provisions, in fact the Code is addressing the minima for flexural actions and for confinement conditions in these members. Regarding shear, the Code is silent.

We are well aware that transverse reinforcement can simultaneously serve as confinement reinforcement and as shear reinforcement. It is not required to sum the reinforcement required for each purpose. Despite this well-known but unwritten rule (*), shear must be checked for piles and the required reinforcement verification should be assessed. This is not being considered in these provisions.

(*) There is no explicit mention nor clarification for this property throughout Chapter 18.

18.13.5.8 *Metal-cased concrete piles*

18.13.5.9 *Concrete-filled pipe piles*

QY 5.

18.13.5.8 Except for confinement provisions, this prescription is ignoring the steel case at all, requiring full reinforced concrete.

18.13.5.9 This prescription is meaning full consideration of the steel case (pipe), i.e. no reinforcement required for concrete.

Noting that 13.4.2.3 is following the language of 18.13.5.8 (*metal cased concrete*).

Noting that R13.4.2.3 is mentioning the provisions of AISC 360, which is addressing composite action.

Noting that 13.4.3.2 in the table referred to (only compressive members), both 'categories' (metal-cased and concrete filled pipe) are mentioned, indistinctly.

Noting that for members under the scope of 18.13.5.8, permanent steel casings in practice, for drilled piers, are having thickness around 0.19 in. at the least.

Noting also, that for design of these members AASHTO is allowing the contribution of the steel case, when this is just more than 0.12 in. thick.

Noting that ACI 453R, which is recommended by this Code in R1.4.7, is mentioning steel casing with thickness not less than 0.1 in. as *load-bearing casing*, in composite action with cast-in-place concrete (6.4.1). This is rather aligned with AASHTO.

Considering all of the above, ultimately the question is:

Which sort of pier members are to follow 18.13.5.8 and which members are to follow 18.13.5.9? Which is the criterion to draw the boundary for applicability in between one and another? Diameters (D)? thickness (t)? ratio D/t ?, depth or else?

QY 6

Still regarding 18.13.5.8 and 18.13.5.9, both of these prescriptions are only specifying requirements for minimum reinforcing steel, there are no design provisions.

Therefore, the question is:

Which standard is the Code recommending for design of this type of members?

Should AISC 341, be used? (Composite action).

18.13.5.3, 18.13.5.5, 18.13.5.6, 18.13.5.7.1,

QY 7.

Seemingly, most of the provisions related to specification for the reinforcement quantities and positions along the pile/pier are not reflecting much reliance in the outcome of the current engineering procedures, for these members.

The performance of analyses for pile/pier systems nowadays, involves as a minimum:

- Full subsurface geotechnical investigation, through each layer.
- On the basis of the above, determination of soil profile and specific soil parameters, i.e. these parameters are not defined by standard Class-site data, but are specific to the particular soils involved in design.
- [Not to mention, field load testing in larger projects, providing detail information on side resistance and/or parameters].
- Use of *special-purpose software*, specifically addressed to pile/pier analysis and design, including the consideration of nonlinear behavior of soils, in lateral load transfer actions.

Analyses of piles/piers, as developed currently with resources indicated above, provide a dependable approach for the response of the pile-soil system. In this way, plus realistic assessment of pile head restraint against rotation, good evaluations are provided for bending moments along the shaft.

Therefore the said analyses may provide good assessments for the location of the potential plastic hinge and for the extent of hinge regions.

Accordingly, the question is: In the same way that the Code in 18.13.5.7.3 is relating known section design properties (M_{cr}) with the bending out-put from analysis (M_u), for determination of the extent of longitudinal reinforcement, why a similar concept could not be used for specifying the extent of special transverse reinforcement?

For example, for some cases in CALTRANS the plastic hinge region is taken as the region where M_u exceeds 75% of the plastic moment.

Your feed-back on this issue will be appreciated.

Raúl Labbé P.
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