Structural Engineering Guidance No. 10-08

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Distribution: All Engineering Resources

SUBJECT: USE OF TEMPORARY CASING FOR EXTENDING DRILLED SHAFTS

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Effective Date: Immediately For New Jobs To Be Designed

EPG Submittal Status: To Be Submitted

Background and Purpose:

Permanent casing for drilled shafts is now required to terminate at 1 foot or greater above Ordinary High Water (OHW) which was addressed in June 10 Structural Engineering Guidance 10-04. Permanent casing is self-supporting and watertight which are necessary for constructing sealed shafts in open water which may be more practical at less cost than cofferdams and footings, and can reduce construction times and costs by eliminating the need for cutting the casing below the water line. However, there may be situations where the use of removable casing, i.e. temporary casing (TC) can provide a practical design advantage.

*TC as described in this guidance is used solely for the purpose of forming drilled shafts at higher elevations through open water or air intended to be removed after the drilled shaft pour is cured leaving permanently exposed concrete surface. It should be distinguished from the temporary casing method using temporary casing for construction of drilled shafts in the ground and as defined in Sec 701 of the Standard Specifications. The intent of each is different and the use of temporary casing for the former is determined by the bridge designer whereas the latter must be recommended by the Geotechnical Section based on soil conditions.*

The intent of this guidance is to provide direction and generate discussion for when the use of TC is appropriate and should be considered for use on the bridge plans based on practical design considerations, past design practice and successful/approved contractor change order requests.

Guidance:

Short Bridge Columns:

**TC may be used for extending drilled shafts to the bottom of an intermediate bent cap to avoid the design and constructability problems that can occur when short bridge columns are designed to be used on top of drilled shaft foundations.** First, if using short bridge columns, there may be insufficient length for lapping steel reinforcement in the column requiring that the reinforcement be ‘run through’ the column and developed in the bent cap. Pouring the drilled shaft concrete through these column bars is more difficult since they may be actually longer than spliced bars and especially if the bars are hooked inward. (Note that hooking bars inward is problematic for pouring shaft concrete and hooking bars outward is problematic for removing TC.) Secondly, supporting these longer bars outside the shaft is also difficult. In fact, supporting long dowel bars may be problematic in any situation and unavoidable except in the case of short bridge columns. These types of problems have led some contractors in the past to recommend that drilled shaft casing be extended to and terminated at the bottom of the intermediate bent cap with the result that the change orders were approved.

Therefore, consideration in this situation should be given to the availability of column height for lap lengths, steel reinforcement savings, presumed contractor labor and time preferences and savings, and the use of hooked column bars in the bent cap. Avoid using outwardly hooked column steel in the bent cap in the event that the TC can be removed by sliding up and off of column. In the event of a change order request, note that the concrete strengths of drilled shafts and columns are different which could influence approving a change order quickly because of the necessary structural checks and review. Further review and consideration should be given to the following:

* When the height of the column is just marginally sufficient where the lapped reinforcement is wholly developed within the column, using a column diameter that is the same as the shaft diameter may provide for substitution of a differently preferred alternate construction method with minimal changes to the design and details.
* Web wall constructability will be different when designed with a column than a drilled shaft using TC. Use of permanent casing extended to the bottom of the beam cap is not an option in this case.
* Beam caps may need to be made wider:
  + in order to accommodate larger drilled shaft diameters
  + in order to accommodate shaft placement plan and tilt tolerances to the bottom of the beam
  + which may mean less vertical clearance between sloping girders and a horizontal cap for bridges on severe grades which could affect bearing design
* Some contractors have preferred the use of short column construction over extended drilled shaft construction in the past and consideration should be given to including alternate details on the plans when in doubt. All that can be gleaned from these contractors’ preferences are concerns related to drilled shaft plan placement at the cap exceeding plan tolerance and possibly preferences to do the column work using their own labor forces and material.
* Modify drilled shaft placing tolerances by adding a note to the bridge plans; Consider feasibility and implications to construction cost.
* Permanent casing may be used in lieu of temporary casing and terminated at the bottom of the beam cap if it meets the aesthetic application requirements of June 10 Structural Engineering Guidance 10-04.
* Consult with the Structural Project Managers or Structural Liaison Engineers for further guidance.

Changed Field Conditions:

**Temporary or permanent casing may be used for constructing shafts in ephemeral or intermittent streams** but use of either type of casing provides a design challenge for the preliminary bridge designer. Field conditions of streams can change from when a drilled shaft is designed to when it is constructed and these two stream conditions, or more generally, a dry stream bed at the time of construction has prompted a contractor in the past to request elimination of temporary casing and substitution of column forming which was subsequently approved. *An ephemeral stream exists for a short period following precipitation or snowmelt and an intermittent or seasonal stream could exist for longer periods but not all year round.*

Current practice has been to anticipate worse than ordinary conditions, i.e. terminating shafts at 1 foot or greater above OHW. Permanent casing requires lead time for fabrication and delivery and the design decision to not use them on the bridge plans can create a risky situation in the field that is difficult to reverse if they should have been used, for example when ephemeral or intermittent streams are not dry and column forming is not possible from 1 below ground at the time of construction. It is much easier for a contractor to change the construction method from casing to column forms than the reverse. Of course, they are in a better position to know the actual field conditions and to recommend an alternate course of action which is their prerogative. This does not mean that their recommendation would be approved, but it should be reviewed.

Therefore, the use of permanent casing is recommended since the final field conditions are unknown until the time of construction. Its use shall be in accordance with June 10 Structural Engineering Guidance 10-04 where permanent casing is required to be terminated 1 foot or greater above OHW.

Due to changed field conditions at the time of construction, permanent casing could be removed, as in temporary casing, from 1 foot below ground and use of column forming permitted in lieu of a cased shaft above the ground. Review of all change order requests should consider the structural consequences of the concrete strength difference and stiffness differences between the use of drilled shafts and columns. Or, in anticipation of changed field conditions, drilled shaft details could be augmented with alternate column forming details on the bridge plans when the confidence level in the occurrence of this condition is greater than that required for current practice. Where these conditions can occur, a closer design review of these options may be warranted since the use of temporary or permanent casing can be excessive in which case a construction method at a reduced construction cost should be pursued.

In General:

Prime contractors (who are not sub-prime drill contractors usually) may prefer using column forms (“cans”) as often as practicable since the forms are owned by them, readily available and re-useable, and column construction is performed by them all of which translates into lower costs. Use of temporary casing for extending drilled shafts should be reviewed and approved by the Structural Project Manager or the Structural Liaison Engineer.

Different applications, reasoning, contractor preferences using TC either on the bridge plans or as part of a contractor-requested change order should be reported to the Development Section in updating guidance on drilled shaft design.