Precast Concrete Overhang Panels for Safer and Faster Bridge Deck Construction

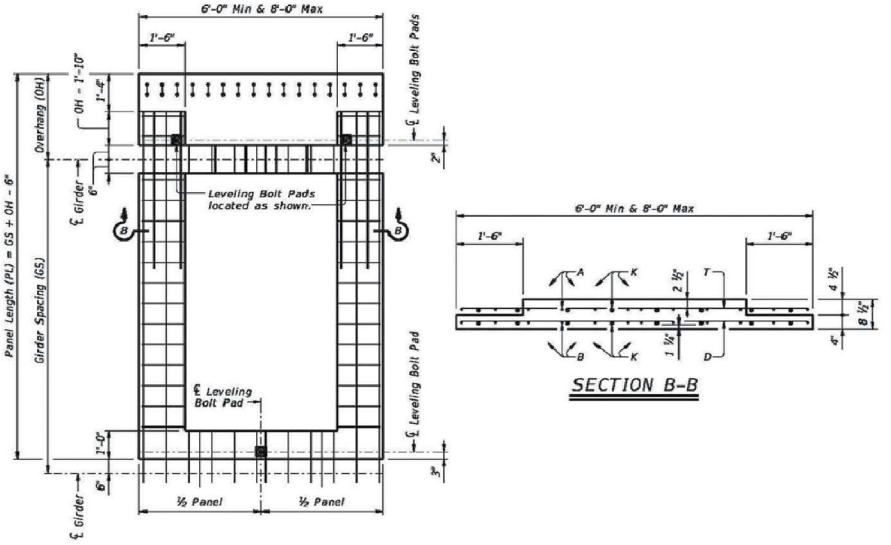
by Kevin Moyer, Texas Department of Transportation

The Texas Department of Transportation (TxDOT) constantly seeks innovative accelerated bridge construction methods that reduce the impact to the traveling public, improve safety in the work zone, and reduce costs. TxDOT began developing deck construction methods using precast, prestressed concrete panels (PCPs) in the 1960s, and these methods continued to evolve. In 2008, TxDOT sponsored a research project[1] to develop a precast, prestressed concrete overhang panel system for potential use in bridge construction.

This panel system was successfully implemented on the Farm-to-Market Road 1885 Bridge over Rock Creek in Parker County, Tex. The result was an improvement in safety due to the sturdy work platform provided by the panels, and elimination of the need for overhang brackets and formwork. TxDOT recently implemented the "second generation" of conventionally reinforced precast concrete overhang panels [PCP(O)s] on a bridge on Farm-to-Market Road 726 over Brushy Creek in Marion County, Tex.

The panel dimensions for the second generation of PCP(O)s vary from 6 to 8 ft in width (longitudinal direction of bridge) and 6½ to 13½ ft in length (transverse direction of bridge). The minimum width accommodates the development length of the reinforcement along the width of the panel. The maximum width keeps the panel within the transportation width limits so a permit is not required.

Two types of panels were designed: one for the interior of the span and one for the thickened slab at the ends of units. The full-depth panels (8½ in.) have conventional reinforcement and a full-depth gap over the exterior girder to integrate the PCP(O) with the girder after cast-in-place (CIP) concrete deck placement. The panels also have the ability to:



Plan view and typical section of a precast concrete overhang panel. All Photos and Figures: Texas Department of Transportation.

- be used with variable girder spacing,
- accommodate a sealed expansion joint,
- adjust their elevations with leveling bolts instead of the use of dense foam, and
- integrate with adjacent PCP(O)s and CIP concrete.

The main improvement of the second generation of PCP(O)s over the first generation is a full-depth gap that runs the entire width of the panel (along the girder), which eliminates the need for shear pockets and a separate grouting operation. Additionally, the partial-depth panel ledges allow for reinforcing steel that enables the adjacent PCP(O)s and the CIP deck concrete to work as a unit.

The ledges of the panels are 1 ft 6 in. wide and run the length of the panel, except for 1 ft 4 in. in the overhang region. The ledges that integrate the interior deck concrete are 1 ft wide and run the width of the panel. The main design challenge was designing the full-depth gap to handle stresses induced from lifting, transportation, CIP concrete deck placement, and stability during leveling. The panel was analyzed as a beam with different support conditions for each stage to determine the amount of reinforcing steel needed to stabilize the gap.

Another second-generation improvement is the leveling system, which consists of three leveling pads with coil bolts. Designed to support the panel during leveling, the leveling pad is a 4 × 4 × ¼-in. steel plate with a coil nut and 3-in. -diameter steel pipe welded to the plate. After the panel is leveled to the correct elevation, additional support needs to be provided by welding the gap reinforcing bars to the R-bars of the TxGirders or by placing a grout pad at the PCP(O) corners. The coil bolts may be left in place as long as the tops of the bolts are 2½ in. below the top of the deck. Unlike PCPs, PCP(O)s use an elastic polyurethane foam

Precast concrete overhang panel fabrication and completed panel.

Precast concrete overhang panel placement.

strip that is only used to contain the CIP concrete during deck placement.

The Brushy Creek Bridge project consists of two 90-ft spans, is 34 ft wide, has four girder lines, uses conventional PCPs between interior girders, and has no skew. The primary contractor was Longview Bridge and Road (LBR). The concrete for the panels was placed in two lifts which were approved by TxDOT as long as supplementary reinforcement was used to integrate the lifts. There were two challenges: the "notch" in the overhang region hindered the stripping of the forms, and the custom-made leveling pads were expensive components.

LBR erected most of the 24 east span PCP(O)s in approximately six hours, or approximately 15 minutes per PCP(O). With proper planning and equipment, all the panels, PCP(O)s and PCPs could have been placed in one day. LBR chose to support the panels after leveling with a grout pad.

The deck concrete placement took an average of four hours per span, due to concrete truck delays; this time could be reduced. LBR used both a longitudinal screed and transverse screed. The transverse screed was preferred for its ease of removal. The transverse screed spanned only the PCPs, not the entire bridge width. "Bridges" were made of 2 × 4 lumber to run the transverse screed over the PCP(O) ledges. Approximately 6 months after construction, the deck shows no signs of cracking at the cold joints where the deck concrete was placed against the PCP(O)s or at the panel joints.

The type of concrete used in the PCP(O)s and PCPs was TxDOT's Class H concrete (f'_c = 4 ksi) and the CIP deck concrete was Class S concrete (f'_c = 4 ksi). No special requirements were required to bond the CIP deck concrete and the PCPs and PCP(O)s, except for a roughened surface. The deck was ground approximately ½ in. to improve ride quality in the region of the PCP(O)s.

The use of PCP(O)s successfully decreased construction time on Brushy Creek Bridge by approximately three days by eliminating the need to erect and disassemble overhang brackets, and decreasing the time needed to place and finish the CIP concrete deck. PCP(O)s also made the work site a safer environment by decreasing the chance of workers falling while erecting and disassembling the overhang brackets. The panels provided a convenient work platform and convenient location to place a screed rail. Because the PCP(O)s were full- to partial-depth, they decreased the amount of CIP concrete used for the bridge deck as well as the amount of labor required to place and finish the deck.

Looking ahead, TxDOT will continue to use and improve on the second generation of precast concrete overhang panels, especially for projects requiring safer, faster bridge construction.

Reference

1. Trejo, D., M. Hite, J. Mander, T. Mander, M. Henley, R. Scott, T. Ley, and S. Patil. 2008. *Development of a Precast Bridge Deck Overhang System for the Rock Creek Bridge*. Report 0-6100-2, Texas Transportation Institute: College Station, TX.

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