The Effect of HP Pile Orientation, Grade and Soil Profile on Fixity Point of Pile in IABs

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Abstract

Integral Abutment Bridges (IABs) are single or multiple span continuous deck bridges. Instead of movable expansion joints between the spans and bearings at the abutments, IABs have continuous decks integral with abutment walls. Since the abutment is rigidly attached to the deck/girder, a temperature change of the deck produces a longitudinal displacement of the abutment wall. In order to minimize the effect of the resulting lateral force, the abutments are supported on flexible piles and granular backfill is placed behind the wall. The longitudinal displacement due to temperature varies linearly with the span length, and consequently the maximum span length is limited by the seasonal temperature change.

In order to simplify the analysis of the integral abutment bridges (IABs) at the abutments, the stiffness of the pile and the soil surrounding the pile can be replaced with a pile of equivalent length (fixity point). There are many factors such as soil condition, orientation of the pile, and grade profile that can control the location of the fixity point of the pile at the abutment. The LPILE software was used to study the impact of these factors on the fixity point of a given HP pile at the abutment, applying the lateral deflection and applied axial load and assuming zero rotation at the pile head (the connection between the abutment wall and the pile head).

Three different cases were created by varying the density of soil layers surrounding the HP pile. In addition, taking into consideration the change in the orientation of the pile, and the change in the ground grade profile, the displacement profiles and moment diagrams of the pile were plotted.
• For all 3 cases, if the HP pile is oriented in the weak axis, the length of the fixity point and the maximum moment in the HP pile will decrease, due to greater flexibility of the pile in comparison with that of the strong axis.
• For all 3 cases, increasing the ground slope will increase the length of the fixity point, due to the additional soil pressure, but will decrease the maximum moments in the pile.
• For all 3 cases, increasing the density of the soil surrounding the pile will decrease the length of the fixity

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