HR-252 Design of Integral Abutment Bridges

Key Words: Integral abutment bridges, piles,

ABSTRACT

More and more, integral abutment bridges are being used in place of the more traditional bridge designs with expansion releases. In this study, states which use integral abutment bridges were surveyed to determine their current practice in the design of these structures.

To study piles in integral abutment bridges, a finite element program for the soil pile system was developed (1) with materially and geometrically nonlinear, two and three dimensional beam elements and (2) with a nonlinear, Winkler soil model with vertical, horizontal, and pile tip springs. The model was verified by comparison to several analytical and experimental examples.

A simplified design model for analyzing piles in integral abut-ment bridges is also presented. This model grew from previous analytical models and observations of pile behavior. The design model correctly describes the essential behavioral characteristics of the pile and conservatively predicts the vertical load carrying capacity.

Analytical examples are presented to illustrate the effects of lateral displacements on the ultimate load capacity of a pile. These examples include friction and end-bearing piles; steel, concrete, and timber piles; and bending about the weak, strong, and 450 axes for H piles. The effects of cyclic loading are shown for skewed and non-skewed bridges. The results show that the capacity of friction piles is not significantly affected by lateral displacements, but the capacity of end-bearing piles is reduced. Further results show that the longitudinal expansion of the bridge can introduce a vertical pre-load on the pile.