VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

Parameters Effecting the In-Plane Rotation of Skewed Integral Abutment Bridges Under Thermal Expansion

PROJECT TITLE
Parameters effecting the in-plane rotation of skewed integral abutment bridges (IABs)

STUDY TIMELINE
June 2018 – June 2023

INVESTIGATORS
Susan Faraji, Ph.D.
Susan_Faraji@uml.edu

VTRANS CONTACTS
Dr. A. Emily Parkany, P.E.
emily.parkany@vermont.gov

Mr. James Lacroix PE
James.Lacroix@vermont.gov

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Acute corner
Obtuse corner
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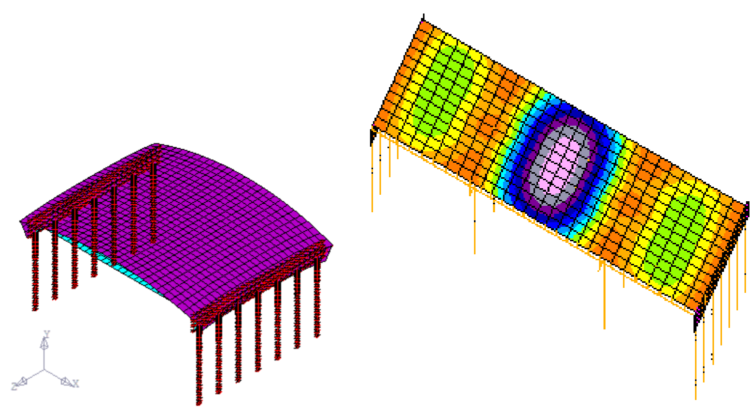
Skew angle
3-D finite elements modeling
Refined guideline

Introduction

Integral abutment bridges (IABs) are single story, three-member indeterminate framed structures where the horizontal member of the frame represents the deck and the legs are composed of two members, stiff abutment walls with soil behind them and flexible HP piles with soil around them. As in any indeterminate frame, the distribution of the forces between the frame members depends on the relative stiffness of the frame members. Therefore, for IABs, varying such parameters as the span length, the soil compactness behind the abutment walls, the stiffness of the HP piles, and the soil surrounding them will change the distribution of forces between the superstructure and the substructure. When integral abutments are located on skew their behavior is more complicated than of non-skew bridges.

Over the past few decades many researchers have been studying IABs. Many field tests have been conducted and much data has been collected for individual bridges and more IABs are being designed and constructed. The influence, however, of a bridge's geometric definitions, such as substructure skew, on the overall performance of the bridge has not been researched in the industry enough to provide a unified set of design guidelines. IABs are generally limited to prescriptive span lengths and skew angles set by local agencies, without substantial research to support these limitations.

Therefore the objective of this proposed research is to provide the bridge engineers with refined guidance on analysis and design of IABs specially skewed IABs.



Methodology

Based on the literature search and the input from the DOTs, the focus of the first two years of this ongoing research project was: the analytical study of the effect of the range of skew on the superstructure and substructure; the effect of the roadway profile grade on substructure; and the constructability of short HP pile on sites with shallow bedrock.

The goal of the third year of this study is the verification of the findings of the analytical study on skew IABs. This is being done by means of a parametric study using a full three-dimensional finite element model of a sample single span skew IAB, varying such parameters, as the skew angle, the ratio of the length to the width of the bridge, and the stiffness of the wing walls.

The goals of years 4 and 5 of this research project will be to build on the research findings of the first three years and provide the bridge engineers with guidance in predicting structure behavior more accurately, better defining the geometric limitations on where IABs should be used and providing refined guidance on IAB design approach.

Summary of Research Activities

Analytical study of the behavior of skewed IABs under thermal loading

Parametric verification of the findings of the analytical study of skewed IABs

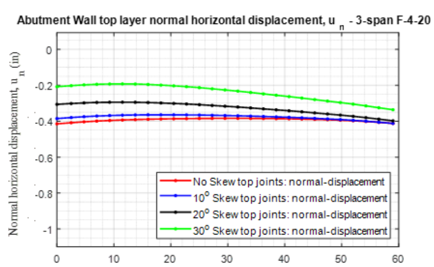
Creating 3-D finite-element templates for single span and three span skewed IABs

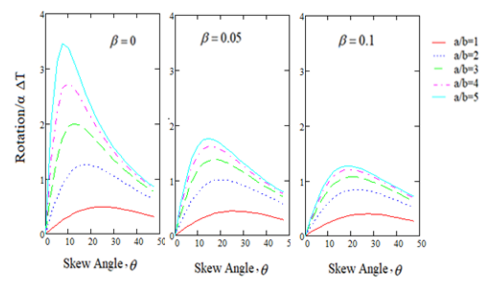
Creating 3-D finite-element templates for single span and three span non-skew IABs

Verification of the accuracy of finite element modeling and analysis results

Developing design and modeling guidelines for skewed IABs

Presentations and Final Report





Potential Impacts

This research will provide the bridge engineers with guidance in predicting structure behavior more accurately, better defining the geometric limitations on where IABs should be used and providing refined guidance on finite elements modeling and design of skewed IABs.