

## **ABSTRACT**

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The strut-and-tie method (STM) is a powerful tool used for the design of D-regions (disturbed regions) of reinforced concrete structures. Many typical bridge substructure components consist of D-regions and require the use of the STM for design. Implementation of the STM is more complex than typical design methods, and engineers are often unfamiliar with the design process. As a result, designing using the STM is more time consuming than traditional design methods. The Indiana Department of Transportation (INDOT) identified a need for a tool that assists with the design of typical bridge substructure components using the STM. STEP (Strut-and-Tie Evaluation Program) is a computer program created to fulfill this role. To use the computer program, engineers input geometric conditions, material properties, and reinforcement information for a structural component. STEP uses this information to develop a strut-and-tie model and perform STM design procedures. A graphical representation of the model and a summary of the design results are provided as program outputs for the user.

STEP, created using Excel VBA, is intended to aid in the design of multi-column bent caps and integral and semi-integral end bent caps. Within this thesis, an overview of the STM is provided, including the basic procedures for designing using the STM. An introduction to Excel VBA is also presented. The document describes the layout and formatting of the computer program, required user inputs, and program outputs. Furthermore, limitations and assumptions within the computer program for the substructure components are also included. Finally, design examples focused on the use of STEP for the design of a five-column bent cap and an integral end bent cap are presented. This document can be used as a resource for engineers when designing bridge substructure components using STEP.