Post-Tensioning Technologies

Introduction

Post-tensioned bridge design and construction can result in very efficient use of construction materials; the post-tensioning system can be designed to keep nearly all structural concrete under compression under service loads, where it is most effective. Additionally, post-tensioned construction can facilitate longer spans, curved girders, and if designed and constructed properly, improved durability. For these reasons, post-tensioned bridge construction has become more popular and financially more competitive with traditional prestressed concrete and steel plate girder bridges.

Unfortunately, Indiana has experienced several construction-related problems in the few post-tensioned structures built, some of which have caused significant long-term durability concerns. Indiana's problems have generally been attributed to a lack of a standard set of specifications for post-tensioned construction as well as inexperience and inadequate training of contractors and inspectors. These types of issues, however, were once more prevalent throughout the industry and much work has been accomplished in recent years to address them. In particular, courses have been developed by the industry, and standard provisions have been created to familiarize and standardize the design and construction community with common construction techniques and standards of practice.

This research program had two primary objectives: (1) to improve the quality of post-tensioned bridge construction in Indiana and (2) to provide the State with more confidence when using this type of construction. First, past problems related to post-tensioned construction were identified, and for each, case studies were conducted. Each case study included an overview of the bridge, a summary of the problems related to post-tensioning, and possible sources and remedies to those problems. Next, a standard post-tensioning construction specification was developed. The specification addresses problems specific to Indiana, which were found in the case studies, and common problems experienced in the industry as a whole. Specifically, the specification addresses industry standards of practice, requirements for certification and experience of personnel, and proper testing and sampling procedures. In addition, specific recommendations are provided for training programs and certification of INDOT construction personnel to ensure they are properly trained to inspect post-tensioned construction.

Findings

From the case studies, it was determined that most of the problems encountered could be alleviated through additional experience by both the contactor and construction inspectors as well as knowledge of proper post-tensioning procedures. Though the increase in experience will only come over time, a requirement for certification training for contractor foremen, grouting personnel, and construction inspectors should be employed. The Post-
Tensioning Institute (PTI) offers training certification for both bonded and unbonded post-tensioned construction, and these courses are a requirement of several departments of transportation for construction foremen as well as inspectors. The “Level 1 & 2 Bonded PT Field Specialist” is a general program for all bonded post-tensioned construction and should be required, at the very least, for all contractor foremen and construction inspectors. Also, the American Segmental Bridge Institute (ASBI) offers training specific to grouting and awards an “ASBI Certified Grouting Technician” certificate upon successful completion of the program. Due to the importance of grout in tendons, all personnel involved in the grouting process, including construction inspectors, should have received this training.

In addition to contractor inexperience, many of the problems encountered could be attributed to both inadequate and inconsistent special provisions related to post-tensioning. The post-tensioning provision currently used by INDOT is not current with standard post-tensioning practices. As a result, an updated provision is needed.

Implementation

A unique special provision was developed to provide uniformity and consistency in post-tensioned construction for the State of Indiana. The new provision includes several modifications and additions to the previous INDOT provision, and the layout was changed to be in accordance with other INDOT Recurring Special Provisions. This updated special provision incorporates new standards for materials and construction and references recently released specifications by PTI and ASBI that are becoming commonplace among state DOT specifications. The reference specifications include the “Guide Specification for Grouted Post-Tensioning” and the “Specification for Grouting of Post-Tensioned Structures.” The recommended provision references industry specifications and only modifies or adds provisions specific to Indiana or includes provisions that are more restrictive or explicit than those of the reference specifications. Because of this format, updating the special provision is a relatively simple task.

Required training and certification of inspectors monitoring post-tensioned projects in Indiana are recommended. The training and certification is similar to that required by construction foremen and personnel outlined in the recommended special provision. Inspectors present during any post-tensioned construction should have the PTI Certification of “Level 1 Bonded PT—Field Installation.” This certification requires attendance of a three-day workshop conducted by PTI and successful completion of an exam administered at the conclusion of the workshop. This certification workshop provides an overview of standards of practice and proper safety regarding all bonded post-tensioned construction. In addition to the PTI certification, inspectors present during any grouting operations or grout material testing related to post-tensioned construction should have an “ASBI Grouting Training Certificate.” This certificate requires attendance of a two-day workshop provided by ASBI and successful completion of an exam. Similar in nature to the PTI certifications, this program and certificate is specific to the standards of practice for proper grouting and grout material testing.

While these recommended requirements provide minimum training for inspectors, it is desirable for inspectors to have more advanced certifications from these programs. These advanced certifications, however, have significant experience requirements. This experience may not be feasible for inspectors in Indiana due to the infrequent use of post-tensioned construction, but it would be advantageous to use inspectors that have training as well as experience in this type of construction to monitor these projects.

It is recommended that the special provision as well as the inspector requirements be adopted by INDOT. From these measures, the reliability of post-tensioned construction in Indiana can be improved and provide added confidence to the successful deployment of this bridge technology.

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