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Analysis of an Advance Instrumental Slab Bridge

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ABSTRACT:
The entire investigation includes introduction to the behavior and analysis of slab Bridge. Because of quick construction and cost effectiveness, adjacent precast, pre stressed box girder bridges have been used nowadays more often for short-span bridges, and the standardization of this modular bridge is highly desired. The new design of using high strength rods will provide a more tightly integrated modular slab bridge system with higher post-tensioning forces. The structure was instrumented with a remote data acquisition system monitored over a year.

Keywords: Slabs, Finite element, Cracking, Concrete, & Truck loads

INTRODUCTION

Because of their quick construction and cost effectiveness, adjacent pre-cast, pre-stressed multi-girder bridges have been used nowadays more often for short-spans. During its service years, many attempts at making more durable and robust adjacent pre-cast, pre-stressed multi-girder bridges were made to prevent the bridges' typical deteriorations such as shear key failure, chloride's penetration into concrete deck, freeze-thaw damage, overlay cracking and so on. One of the attempts to fortify abridge is to increase the level of post-tensioning forces that contribute to the bridge behaving monolithically; it will eventually alleviate the possibility of cracking on the bridge deck and shear key.

Acknowledging the increase of the post-tensioning force is necessary and useful for facilitating better service of the bridge. In-depth investigation with field assessment of a bridge's real behavior will gain understanding of pre-cast and pre-stressed multi-girder bridges' behavior. . The structure was instrumented with a remote data acquisition system monitored over a year. In addition, a controlled load test was conducted in an effort to determine the demand on the link slab under known loads.

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LITERATURE REVIEW

Kotputali Bridge was implemented to accomplish the primary purpose of observing short-term live load deck behaviors under different transverse post- tensioning forces. For monitoring separate strains under the bridge, two different strain sensors were used. To meet this objective, a detailed instrumentation plan was produced to determine general and specific gage locations.

INSTRUMENTATION PLAN

- Gage locations
- Instrumentation
- Resistance Strain in Gages
- BDI Strain Transducer
- Data Acquisition System CR5000

- Dell Laptop Computerw/PC9000
- AM16/32 Relay Multiplexers

Gage location: Locations of the sensors were selected mainly based on targeted strain positions where the transverse post-tension rods are installed.
Instrumentation: Two types of strain gages were used. Vishay strain gages were soldered before installation and ready to attach. BDI (Bridge Diagnostics, Inc.) gage susing vibrating wire was also prefabricated in advance of the live load test.
Data Acquisition System: During the live load test, the CR5000 Measurement & Control System, Dell laptop computer and AM16/32 Relay Multiplexers was employed.

EXPERIMENTAL INVESTIGATION

LAB TEST: The BDI transducer and the Vishay strain gage were attached on the bottom side of each experimental concrete block which measured 3"W x 3"H x12"L. There are two concrete blocks can be prepare in lab. INSTRON 1331 servo hydraulic system was used for the 3 point flexure test. The INSTRON 1331 testing machine can maintain constant crosshead speeds ranging from quasi-static (0.08 mm/sec, ASTM Standard D1621) to 250 mm/sec with a closed-loop servo-controlled system. Since this lab test is mainly focused on connection verification and data calibration between all sensors and data acquisition system, the load rate during the concrete block test was set to an arbitrary rate of 150 lb/min.

- Types of Lab Test
- Vishay Strain Gage Flexure Testing
- BDI Strain Transducer Flexure Testing

- **LIVE LOAD TEST**
- Installation & Field Setup
- Test Vehicle

TEST RESULS

The key purpose of this research project is to provide confidence in using a new design of higher post-tensioning force. During this project, the field test data and FEA model were utilized to understand the bridge behavior under high post-tensioned forces. This chapter details the comparison and analysis of test results between the live load and as built bridge FEA model. Test results show the maximum strain data from field live load test and ANSYS model. Observing strain data in BDI1 through BDI3 clearly shows that the maximum field test data is close to the ANSYS model data. The maximum strain of BDI transducer is generated by applying the truck's rear wheel load. Hence the test on the slab is safe.

CONCLUSION

- Comparison between the FEA model and the live load test data showed that a tight integrated modular slab bridge system with higher post tensioning forces can provide better structural integrity.
- From the refined ANSYS model, strain results were very close to those from the field test data.
- The live load test carried out on the specimen.
- The analysis of the FEA model under different post-tensioning forces proved that the post-tensioning rods under the untracked shear key condition are not taking
  Into a significant action
- Once the shear key is cracked, the post- tensioning rod is brought into an eminent role in preventing the structure from undergoing further deterioration.

- In FEA model testing with an HS25 truck, which is different from the test truck but the same design truck for the bridge,. The current code practice IS recommended that to be modifying its sequence of construction of shear key and increase its post-tensioning force to a higher level.
- The shear key is strengthened by the post-tensioning force producing less cracking issues on the shear key section.
- This will give the bridge a better service life and more structural integrity in the future. In depth future research and monitoring will help to gain more confidence using a new level of post-tensioning forces.

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