



**SPECIAL PROVISIONS
FOR
VIBRATION MONITORING**

**Clinton County
NHSN-030-9(214)--2R-23**

**Effective Date
September 24, 2024**

THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

23XXXX.01 DESCRIPTION.

This specification identifies the Contractor's responsibilities during monitoring of vibrations, tilt, and displacements in the existing bridge during construction of the rehabilitation. It shall be the Contractor's responsibility to determine the construction methods that will be used to complete the work without causing damage to the existing bridge. Vibration, tilt, and displacement monitoring will be performed by the Contractor under the supervision of the Engineer, and the Contractor shall perform the repair work in a manner that maintains vibrations, tilt and displacement levels at the existing bridge below levels required by this special provision. The primary monitor locations for vibration, tilt and displacement monitoring include the pier 2 cross girder column bearing areas, the cross girder itself, and the shoring and jacking structures erected to temporarily support the pier 2 cross girder.

23XXXX.02 PRECONSTRUCTION SURVEY.

- A.** The only information available regarding the original foundation construction of pier 2 is the original bridge plans. Copies of existing plans are available from the Iowa DOT.
- B.** Perform a pre-construction condition survey of the pier 2 columns and cross girder and provide a copy of survey report(s) to the Engineer no later than 30 calendar days prior to starting work. The Contractor shall have a Professional Engineer licensed in the State of Iowa and experienced in evaluating structural vulnerabilities and vibration monitoring perform the survey. The Professional Engineer shall have at least 5 years of experience conducting vibration analyses and monitoring of bridges or similar structures. The Professional Engineer shall demonstrate their capability by being willing to provide at least two completed vibration analysis sample projects to the Contractor and the Engineer.
- C.** The preconstruction condition documentation survey shall document aspects of the structural condition through observations, measurements, sketches, photographs, and other data deemed appropriate by the Professional Engineer performing the survey and monitoring. Prior inspection reports available from Iowa DOT will be collated and attached as an appendix to the preconstruction

condition documentation survey report.

23XXXX.03 INSTRUMENTATION AND MONITORING PLAN.

- A.** The Professional Engineer performing the monitoring will develop an instrumentation and monitoring plan to monitor the existing bridge during construction activities with the potential to result in vibration-related or movement-related damage. The instrumentation and monitoring plan will be issued prior to starting work.
- B.** Perform all construction work in a manner that maintains vibration, tilt, and displacements at the existing pier 2 and proposed temporary shoring and jacking supports below the alert thresholds established within the instrumentation and monitoring plan. Preliminary vibration, tilt, and displacement protective limits are provided in this special provision; see Preliminary Alert Thresholds article below.
- C.** The instrumentation and monitoring plan shall describe the following:
- 1.** A vibration monitoring program developed to monitor vibrations at the existing bridge caused by the adjacent construction. The vibration monitoring program shall include the following:
 - Description of the vibration monitoring systems and installation details.
 - Vibration monitoring locations, which will include monitoring on the pier 2 columns and cross girder and the shoring and jacking structures erected to temporarily support the pier 2 cross girder.
 - Vibration data collection protocols, which will include continuous monitoring of vibrations during construction activities with the potential to cause ground-borne vibration.
 - Establishment of a vibration alert threshold and an alert notification system.
 - Protocols to be followed in the event of an exceedance of the vibration alert threshold, which will include immediate review of the construction methods occurring at the time of the event, communication with the Engineer and the Professional Engineer performing the monitoring, review of tilt and displacement monitoring data, and appropriate actions to prevent damage to the existing bridge.
 - 2.** A tilt and displacement monitoring program developed to monitor ground displacement resulting in settlement or rotation at the existing pier 2 or proposed temporary shoring and jacking supports, or other unanticipated static movements of the existing bridge. Record ambient temperature to aid in the distinction between thermal static movements and construction-related movements of the structure. The tilt and displacement monitoring program shall include the following:
 - Description of the tilt and displacement monitoring systems and installation details.
 - Tilt and displacement monitor locations, which will include monitoring on the pier 2 columns and cross girder and the shoring and jacking structures erected to temporarily support the pier 2 cross girder.
 - Tilt and displacement data collection protocols, which will include discrete readings at a minimum frequency of four times per day during construction activities with the potential to cause vibration, static ground movement, or settlement.
 - Establishment of a tilt alert threshold and displacement alert threshold and an alert notification system
 - Protocols to be followed in the event of an exceedance of the tilt alert threshold or displacement alert threshold, which will include immediate review of the construction methods occurring at the time of the event, communication with the Engineer and Professional Engineer performing the monitoring, review of monitoring data, and appropriate actions to prevent further damage to the existing bridge. If the tilt or displacement alert thresholds defined herein are exceeded, immediately suspend work deemed contributing to the exceedance and immediately consult with the Engineer and Professional Engineer performing the monitoring to take appropriate actions to preserve

stability of, and maintain traffic on, the existing bridge.

23XXXX.04 SUMMARY OF CONSTRUCTION MEANS AND METHODS.

Prepare a detailed summary of the proposed means and methods of construction for all construction phases and tasks with the potential to produce ground vibration, ground movement, or settlement that may affect any portions of the existing bridge. Submit the summary of proposed means and methods of construction to the Engineer no later than 30 calendar days prior to commencing work that can impact the existing bridge, including any shaft or pile driving tests and foundation construction work. The means and methods submittal shall include:

- Detailed description of construction methods and equipment, including type of equipment, equipment model, and technical specifications for all construction phases and tasks with the potential to produce ground vibration, ground movement, or settlement that may affect the existing bridge.
- Detailed description of alternate methods or equipment to be used in the event that alert thresholds are exceeded to ensure that vibrations, tilt, and displacements are kept below the established alert thresholds (defined below).

23XXXX.05 ALERT RESPONSE PLAN.

- A. Prepare an alert response plan summarizing the response protocols that will be followed in the event of an exceedance of the vibration, tilt, or displacement alert thresholds established in the instrumentation and monitoring plan. The alert response plan shall be submitted to the Engineer no later than 15 calendar days prior to commencing work that can impact the existing bridge. The alert response plan will be reviewed by the Engineer. Any comments from the Engineer must be addressed through revision or amendment, resubmittal of the plan, and subsequent approval prior to commencing work.
- B. The alert response plan shall detail the following information and protocols to be followed in the event of an exceedance of the monitoring alert thresholds:
 - Identification of the individuals, and their contact information, of the Contractor's site personnel designated to receive and respond to alert notifications from the vibration, tilt, and displacement monitoring system(s).
 - Method for coordinating with the Professional Engineer performing the monitoring to promptly review the monitoring data and construction activities that occurred at the time of the exceedance.
 - Establish a protocol for the identification of the activity or construction equipment that caused the vibration, tilt, or displacement threshold to be exceeded.
 - Daily activity log of vibration-inducing activity to ensure the identification of the cause of any vibration, tilt, and/or displacement event. A daily activity log for the duration of the construction project shall be maintained either in written or electronic form.
 - In the event of a verified exceedance of the tilt alert threshold or displacement alert threshold, a Professional Engineer licensed in the State of Iowa and retained by the Contractor shall conduct a post-alert condition survey of the existing bridge. This alert response plan shall detail the method for coordinating with the Engineer and conducting the post-alert condition survey. The post-alert condition survey shall include a comparative evaluation of the condition of the existing bridge relative to the preconstruction condition documented within the preconstruction condition documentation report issued by the Professional Engineer performing the monitoring. Submit a written post-alert condition survey report signed by the Contractor's engineer, summarizing the results of the survey, and clearly identifying any visible and/or measurable changes in conditions relative to the preconstruction condition.
- C. In the event that the vibration, tilt, or displacement alert thresholds are exceeded at any monitor location, immediately suspend work with the potential to have caused vibration or movement of the existing bridge and follow the alert response plan. Suspension of the work will remain in effect until, to the satisfaction of the Engineer, the cause of the exceedance has been identified, the Alert Response Plan has been executed, and if warranted the means and methods of

construction have been adjusted to reduce the potential for further exceedance of the alert thresholds. Submit a written recommendation to resume work from the Contractor's engineer prior to authorization to resume work.

23XXXX.06 VIBRATION, TILT, AND DISPLACEMENT ALERT THRESHOLDS.

- A.** The alert thresholds defined in this special provision represent the preliminary vibration, tilt and displacement alert thresholds recommended for monitoring of the existing bridge. The preliminary thresholds assume that monitoring will be conducted on the pier 2 columns and cross girder and the shoring and jacking structures erected to temporarily support the pier 2 cross girder. The monitoring locations and Alert Thresholds may be revised within the final Instrumentation and monitoring plan; however, the preliminary thresholds represented below are not expected to be reduced within the final Instrumentation and monitoring plan.
- B. Vibration:** Vibration alert threshold: 2.0 inches/second (ips) peak particle velocity (PPV), regardless of frequency.
- C. Tilt and Displacement.**
- Vertical displacement alert threshold: +/- 0.50 inches
 - Out-of-plane tilt (parallel to the bridge centerline) alert threshold: +/- 0.10 degrees
 - In-plane tilt (transverse to the bridge centerline) alert threshold: +/- 0.10 degrees
 - Out-of-plane horizontal displacement (parallel to the bridge centerline) alert threshold: +/- 0.50 inches
 - In-plane horizontal displacement (transverse to the bridge centerline) alert threshold: +/- 0.50 inches

23XXXX.07 BASIS OF PAYMENT.

Vibration Monitoring will be paid for at the contract lump sum price. This price shall be full payment for pre-construction surveys; furnishing, installing, monitoring, and removing instrumentation & monitoring equipment; preparing and providing a report documenting monitoring data collected during this project; intermediate construction surveys; post-construction surveys; and all labor, equipment and materials necessary to complete the work as described. There will be no additional compensation for delays as the result of exceedance of the vibration, tilt, or displacement Alert Thresholds, or for adjustment of construction activities or equipment should an exceedance occur. There will be no additional compensation for Contractor's response to exceeding the Alert Thresholds, including but not limited to, coordination with the Professional Engineer performing the monitoring, coordination with the Engineer, post-alert data reviews, and post-alert condition surveys and associated reporting.