



PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

1. The Contractor shall develop a Track Monitoring Program for monitoring of the railroad track, railroad embankment and temporary shoring installed within the Theoretical Live Load Influence Zone of the Railroad.
2. The purpose of the Track Monitoring Program include but are not limited to providing:
3. Preconstruction baseline data for comparison with construction and post-construction data.
4. Monitor track and embankment during and after construction, to determine whether they have been adversely affected by construction activities.
5. A forewarning of unforeseen conditions that may require remedial or precautionary measures.
6. The Railroad and Railroad Representative are not responsible for the safety of the Work based on Contractor instrumentation data collection and reporting.

1.02 CONTRACTOR RESPONSIBILITIES

- A. Develop a Track Monitoring Program for monitoring the track, railroad embankment and temporary shoring installed within the Theoretical Live load Influence Zone of the Railroad.
- B. Furnish all instrumentation.
- C. Install, monitor, and report data collected from all track monitoring instrumentation.
 1. Protect from damage and maintain instruments installed by the Contractor. Repair or replace damaged instruments in a timely manner.
 2. Interpret instrumentation data and implement remedial and precautionary measures based on results of instrumentation monitoring.
 3. The Contractor shall immediately implement a Contingency Plan if Threshold Values specified in section 3.03.C Table 1 of this special provision, are exceeded. The proposed plan shall include, but not be limited to, additional bracing, segmented and/or slotted excavation, temporary berms, backfilling the excavation, bracing slabs and/or other measures. The Contractor shall demonstrate that the proposed measures can be implemented immediately to prevent damage to Railroad.

1.03 QUALIFICATIONS OF CONTRACTOR'S INSTRUMENTATION PERSONNEL

- A. Development and implementation of a track monitoring program requires highly specialized personnel. The Contractor's personnel responsible for furnishing installing,



maintaining, monitoring, reporting, and interpreting data of instrumentation required, shall include and have the following qualifications:

1. Track Monitoring Instrumentation Specialist with a minimum of a Bachelor of Science Degree in civil engineering and who has five years prior experience in installation and monitoring of the types of instruments to be installed. A comparably qualified engineering geologist is also acceptable as the Instrumentation Specialist. The Instrumentation Specialist shall:
 - a. Prepare detailed step by step procedures for implementing the Contractor's Track Monitoring Program.
 - b. Be on site and supervise at least the first installation of each type of instrument.
 - c. Supervise the interpretation of all instrumentation data.
 2. Superintendent who will be in responsible charge during implementation of the Track Monitoring Program. The Superintendent shall have prior field experience in excavation adjacent to sensitive structures, temporary shoring systems, installation and monitoring of the types of instrumentation installed. The Superintendent shall:
 - a. Be on site and supervise all instrument installations following installations supervised by the Instrumentation Specialist.
 - b. Supervise data collection and reporting in cooperation with the Instrumentation Specialist
 3. The person in responsible charge of survey data collection shall be a Registered Land Surveyor in the state the Work is to take place. The field survey party chief shall have experience in survey measurements of the types and accuracies specified herein.
- B. The Contractor's instrumentation personnel including the Instrumentation Specialist, Superintendent, Registered Land Surveyor, field survey party chief and all other field or office personnel responsible for scope of the Track Monitoring Program may be subject to review by the Railroad.

1.04 MONITORING INSTRUMENTATION

- A. Instrumentation shall be installed to monitor the horizontal and vertical deformation of existing structures, ground, and temporary shoring systems installed Within the Theoretical Live Load Influence Zone.
- A. Qualified instrumentation personnel, under the supervision of the Instrumentation Specialist, Superintendent, and or Surveyor shall install the following instrumentation.
 1. Track monitoring instrumentation
 2. Embankment monitoring instrumentation
 3. Temporary shoring monitoring instrumentation
 4. The Contractor may obtain additional data from the instrumentation and/or furnish, install and monitor, and determine the need for additional instrumentation as necessary to monitor construction performance and safety aspects of the Work.

G&W SPECIAL PROVISION FOR TRACK MONITORING



Furnishing, installing and monitoring of additional instrumentation shall be at the Contractor's discretion.

1.05 REFERENCES

- A. ASTM: Specifications of the American Society for Testing and Materials.

1.06 SUBMITTALS

- A. Review of design submittals by the Railroad will require a minimum of four (4) weeks. To avoid impacting the construction schedule, the Contractor must schedule submittals well in advance. Partial, incomplete or inadequate designs will be rejected, thus delaying the approval. Drawings and calculations must be signed and stamped by a Registered Professional Engineer familiar with Railway loadings and who is licensed in the state where the shoring system is intended for use. Drawings accompanying the shoring plans shall be submitted in 11" x 17" or 8½" x 11" sized paper format.
- B. The Contractor shall submit for review by the Railroad the following information:
 - 1. A Track Monitoring Program to be implemented on the project based means and methods of excavation and temporary shoring to be used within the Theoretical Live Load Influence Zone of the Railroad.
 - 2. Product information indicating the instrumentation sizes, material types, specifications, installation procedures, and locations.
 - 3. Personnel Qualifications for Instrumentation Specialist and Superintendent.
- B. As-built data and monitoring data of all Contractor installed instrumentation.
- C. Contingency Plan
 - 1. The Contractor shall submit a Contingency Plan, in the event that the Threshold Values specified in section 3.03.C Table 1, are exceeded.
 - 2. Emergency contact numbers and notification procedures shall be included in the plan.
- D. Contractor submittals shall be acceptable to the Railroad prior to undertaking the Work. The Contractor shall obtain an acceptable submittal and shall forward submittals in advance considering that re-submittals may be required.

1.07 QUALITY ASSURANCE

- A. The Contractor shall monitor, record, and plot the instrumentation data.
- B. The Contractor shall install all instrumentation to the satisfaction of the Railroad. The Contractor shall immediately repair or replace any Contractor installed instrumentation, which fails, for whatever reason, to perform its intended function.

PART 2 - MATERIALS

G&W SPECIAL PROVISION FOR TRACK MONITORING



- 2.01 Instrumentation may be of an optical survey type with readings taken using an optical survey instrument to observe levels of rail-mounted, ground-mounted and shoring mounted targets.
- 2.02 Instrumentation may alternatively involve an electronic track monitoring system using rail mounted sensors that transmit via radio signals to a nearby base station.
- 2.03 The proposed monitoring system must minimize the risk of railway operations as well as track surveyors. It must be possible to collect monitoring data remote from the track. Viewing of survey targets must be from a position away from the track and the position must allow the survey measurements to be taken without the need for Railroad Protection.
 - A. Track monitoring instrumentation must be securely fixed to the rail, but must not interfere with the passage of trains. Drilling of rail is not permitted. No target may protrude above the height of the plane of the top of rails and must not be susceptible to vibration of passing trains.
 - B. Embankment monitoring instrumentation shall be used to monitor vertical deformation of the ground adjacent to excavations within the Theoretical Live Load Influence Zone of the Railroad. Ground surface monitoring points shall consist of a 1/4-inch diameter masonry nail driven into wooden stake, or a 3-foot long, 3/4-inch diameter steel rod at locations.
 - C. The maximum spacing of temporary shoring instrumentation shall be 10 feet.
- 2.04 At least 3 survey control points must be established for collection of survey information of monitoring instrumentation. The location of each survey control point must not be affected by settlement due to construction works or traffic.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The Contractor shall establish a Track Monitoring Program as described above prior to excavation activity within the Theoretical Live Load Influence Zone.
- B. Prior to installation of any instrumentation, the Contractor shall evaluate field conditions and select proposed locations for the instrumentation. The Contractor shall submit the proposed locations of instrumentation to the Railroad for review.
- C. The Contractor shall notify the Railroad at least 72 hours prior to installing the first instrument.
- D. The Contractor shall install, monitor, and interpret data from instrumentation in addition to that specified herein, that the Contractor deems necessary to ensure performance of the work in accordance with the specifications.
- E. The Contractor shall exercise caution during the progress of Work and shall prevent damage to all track monitoring instrumentation.



INSTALLATION

- A. Monitoring instrumentation shall be installed in accordance with approved Contractor's Track Monitoring Program. Following completion of installation, the as-built location of survey dependent monitoring instrumentation shall be determined to an accuracy of 0.03 ft. in horizontal position and to an accuracy of 0.01 ft. in elevation.
- B. The Contractor's instrumentation personnel shall consider field conditions, obstructions and the Contractor's means and methods when determining field locations of instruments. Final location of instrumentation that deviate from the Track Monitoring Program shall be subject to review and acceptance by the Railroad.

3.02 DATA COLLECTION AND REPORTING

- A. The Contractor will monitor the instrumentation on a schedule based on the location and extent of construction activities. Data collected by the Contractor shall be emailed to the Railroad a maximum of 24 hours after collection in report form. At a minimum, the report must include:
 - 1. Project Title
 - 2. Date of report
 - 3. Instrument data presented in tabular form showing all previous readings of the instrument.
 - 4. Plot of readings versus time.
- B. The Contractor shall collect data from the instrumentation in accordance with the following schedule:
 - 1. Obtain a minimum of three initial readings over a period of 2 weeks prior to excavation to establish baseline readings.
 - 2. Obtain daily readings, or at a frequency approved by the Railroad, when excavation activities are within 25 feet of the monitoring point or if threshold limits are reached.
 - 3. Reading must be taken during construction and during a 2 week period thereafter.
- C. Threshold and Limiting Values
 - 1. If Threshold Values of instrumentation readings are reached, the Railroad and Contractor shall jointly assess necessity of altering methods, rate, or sequence of excavation and temporary shoring within the Theoretical Live load Influence Zone.
 - 2. If Limiting Values of instrumentation readings are reached, Railroad can order the Contractor to cease construction operations, make site and affected properties secure, and take necessary and agreed upon measures to mitigate movements and to assure the safety of the Work and the public.



3. The project threshold and limiting values are specified in Table 1 below. Immediately inform the Railroad verbally, and in writing within 24-hours, when the threshold and limiting levels are reached.

TABLE 1

INSTRUMENTATION TYPE	INSTRUMENT CRITERIA	
	THRESHOLD	LIMITING
Track Monitoring	0.25-in.	0.5-in.
Ground Monitoring	0.5-in.	1.0-in.
Temporary Shoring Monitoring	Vertical: 0.25-in. Horizontal: 0.75-in.	Vertical: 0.5-in. Horizontal: 1.0-in.

- E. Each week the Contractor shall submit to the Railroad a description of the work performed during that week including:
 1. A summary of excavation support system construction activities. This summary shall include any sheet pile driving activities and other activities associated with construction of excavation support systems.
 2. A summary of excavation and filling activities. This summary shall include a general description of where excavation has occurred during the week.
 3. A description of any events which may have affected instrumentation readings. Include a description of any remedial or precautionary measures that were implemented during the week in response to monitoring instrumentation or other data, including when they were implemented and for what reason. Include a description of any future remedial or precautionary measures that are planned in response to existing monitoring instrumentation or other data.