

Test Your Knowledge of Geotechnical Instrumentation

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We have had the opportunity to teach the US Federal Highway Administration Geotechnical Instrumentation course to State Departments of Transportation for several years – the course and the associated 240-page manual were originally developed by John Dunicliff. Over that time we have developed a list of questions that are intended to help people apply their knowledge of geotechnical instrumentation. John obtained a copy of our questions and encouraged us to prepare

something similar for GIN. Thanks to his urging and patience, we have developed those provided below.

We think it would be interesting to evaluate the answers of the geotechnical community to these questions. To take the test, go online at www.geocomp.com/GINquestions or if you prefer, circle your answers on a copy of this article and fax to the first author at (978) 635-0266, with your comments attached. It is not necessary to disclose your name. We will compile

the results and prepare a discussion of the answers in a subsequent episode of GIN. Also if you have other good questions, send them to wam@geocomp.com and if there is sufficient interest, we will prepare a second version.

Please note that some questions have multiple answers and some may have no correct answer.

1. The best approach to obtaining high quality results from an instrumentation program is to:

- (A) Bid instrumentation work as part of general contract
 (B) Make instrumentation the responsibility of the owner
 (C) Make the party with the most vested interest in a successful outcome responsible for the instrumentation
 (D) Bid instrumentation to firms specializing in instrumentation
 (E) None of the above
2. What is the primary hindrance to more use of geotechnical instrumentation?
 (A) Cost of hardware
 (B) Cost of personnel
 (C) Poor definition of the benefits of effective instrumentation
 (D) Not enough time is available
 (E) None of the above
3. What are valid reasons to use geotechnical instrumentation?
 (A) Avoid surprises during construction
 (B) Control construction
 (C) Answer questions about geotechnical performance
 (D) Avoid damage to adjacent structures
 (E) Monitor contractor's means and methods
4. What is the recommended approach to obtain an effective geotechnical instrumentation program?
 (A) Design by committee
 (B) Delegate to staff engineers
 (C) Hire an instrumentation expert
 (D) Use a step-by-step systematic process
 (E) None of the above
5. Which measurement is most useful for monitoring a cut slope in fractured rock?
 (A) Temperature
 (B) Rainfall
 (C) Horizontal deformation
 (D) Strain
 (E) None of the above
6. Which one of the following is an advantage of an open standpipe piezometer?
 (A) Reliability
 (B) Long time lag
 (C) Porous filter can plug
 (D) Gives reading in digital form
 (E) None of the above
7. Which one of the following is an advantage of a vibrating wire piezometer?
 (A) Short time lag
 (B) Sensor is stable over long times
 (C) Lead wires don't affect the reading
 (D) All of the above
 (E) None of the above
8. Which of the following is used to measure deformation?
 (A) Tiltmeter
 (B) Inclinator
 (C) Extensometer
 (D) Liquid level gage
 (E) All of the above
9. Crack gages
 (A) Show where a crack might occur
 (B) Point to the local drug dealer
 (C) Are not expensive
 (D) Are difficult to install
 (E) None of the above
10. Settlement platforms
 (A) Should be placed on top of the fill after construction is complete
 (B) Should be placed on a cushion layer of dry bentonite to avoid overstressing the plate
 (C) Should not exceed 6 inches in size
 (D) May require extensions to be added during construction
 (E) None of the above
11. Earth pressure cells
 (A) Should be very stiff so they can survive installation
 (B) Should be used on every earthfill job to measure how much fill is placed
 (C) Should be placed in a bed of bentonite to obtain uniform stresses
 (D) Are affected by temperature changes
 (E) None of the above
12. Load in a tieback is best measured with
 (A) A load cell with a center hole
 (B) A strain gage welded onto one of the strands of the tie back
 (C) A hydraulic jack with a pressure gage
 (D) A proving ring
 (E) None of the above
13. The load at the tip of a pile can be measured most easily and reliably with
 (A) Four strain gages located in the bottom one foot of the pile
 (B) An Osterberg load cell
 (C) A dynamic load test
 (D) The number of blows required to drive the last inch of the pile
 (E) None of the above
14. Strain gages are used
 (A) In load cells
 (B) In pressure transducers
 (C) To measure bending in steel sheeting
 (D) To measure changes in distance
 (E) All of the above
15. Geotechnical instrumentation is used for construction of fills on soft ground to
 (A) Measure rate of settlement
 (B) Measure pore pressure in the soft ground
 (C) Determine when it is safe to add more fill
 (D) All of the above
 (E) None of the above
16. Specifications for instrumentation hardware and software
 (A) Should be obtained from the instrument manufacturers
 (B) Aren't necessary because the equipment are all standard products
 (C) Are available from various organizations, such as CSSI
 (D) Should be prepared for each project
 (E) None of the above
17. At most sites, groundwater
 (A) Does not exist
 (B) Is in a static state

- (C) Is experiencing flow
(D) Can be determined from borehole measurements
(E) None of the above
18. For mechanically stabilized earth walls (MSEW)
- (A) Instrumentation is never used because it is too expensive for this application
(B) May be used to measure load in the reinforcement
(C) Is installed after construction of the wall to avoid being damaged by the contractor
(D) Is not used because MSEW structures are designed to not move
(E) None of the above
19. Which of the following instruments are used to measure loads in struts to support a deep excavation?
- (A) Proving rings
(B) Strain gauges
(C) Pressure transducers
(D) Accelerometers
(E) None of the above
20. A reading on an instrument that differs significantly from the previous reading
- (A) Is a warning that failure may soon occur
(B) Is not possible because all changes in geotechnical instrumentation are slow
(C) Should be confirmed by re-reading the instrument immediately
(D) Is definitely wrong and should be ignored
(E) None of the above
21. Which of the following steps are necessary for instruments obtained from a reliable manufacturer?
- (A) Pre-installation acceptance tests
(B) Calibration check
(C) Establish purpose of the instrument
(D) Maintenance
(E) All of the above
22. Which of the following can cause significant errors in data from geotechnical instruments?
- (A) Surveying error
(B) Temperature changes
(C) Atmospheric pressure changes
(D) Human error
(E) None of the above
23. Which of the following may affect modern electronic sensors?
- (A) Temperature
(B) Moisture
(C) Lightning
(D) Vibrations
(E) None of the above
24. Piles may be instrumented to
- (A) Determine the load capacity of the pile
(B) Determine if the pile material is overstressed by driving
(C) Determine when driving of the pile can be stopped
(D) All of the above
(E) None of the above
25. Geotechnical instrumentation can be used to
- (A) Answer questions that come up during design
(B) Reduce claims
(C) Reduce risk
(D) All of the above
(E) None of the above
26. Which one of the following is a disadvantage when using a vibrating wire strain gage to measure strains in a geosynthetic?
- (A) Allowable range of strain measurements
(B) Interference from gage-soil interaction
(C) Strain compatibility between gage and geosynthetic material
(D) All of the above
(E) None of the above
27. Which one of the following characteristics is the most important for selecting an instrument?
- (A) Accuracy
(B) Reliability
(C) Size
(D) Manufacturer
(E) Price
28. Which statement is true?
- (A) All instruments should usually be read manually to reduce the possibility of errors
(B) Instrumentation data are always reported in tabular form to provide the most precision.
(C) A warning alarm should be issued as soon as a high reading is recorded.
(D) A significantly different reading can be ignored until the next scheduled reading.
(E) None of the above
29. Which of the following are potential benefits that can be obtained from effective geotechnical instrumentation?
- (A) Reduce delays
(B) Prevent surprises from unexpected ground behavior
(C) Improve labor relations
(D) Save money
(E) None of the above
30. The demand for geotechnical instrumentation
- (A) Is increasing because it is required on all projects funded by the government
(B) Is decreasing because geotechnical engineers are much better than they used to be
(C) Is decreasing because quality control of construction is much better than it used to be
(D) Is increasing because modern electronics have made it very cheap to install the instruments
(E) None of the above

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