

CECW-EG  Engineer Regulation 1110-2-110	Department of the Army U.S. Army Corps of Engineers Washington, DC 20314-1000	ER 1110-2-110  8 July 1985
	Engineering and Design  INSTRUMENTATION FOR SAFETY EVALUATIONS OF CIVIL WORKS PROJECTS	
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Engineering and Design  
INSTRUMENTATION FOR SAFETY EVALUATIONS OF CIVIL WORKS PROJECTS

1. Purpose. This regulation provides policy guidance for the planning, installation and maintenance of instrumentation programs as well as the analyzing and reporting of instrumentation data to insure timely evaluation of the safety of each structure of a civil works project.
2. Applicability. This regulation applies to all HOUSACE/OCE elements and field operating activities having civil works activities.
3. References.
  - a. ER 1110-2-100
  - b. ER 1110-2-103
  - c. ER 1110-2-1150
  - d. ER 1110-2-1901
  - e. EM 1110-2-1908
  - f. EM 1110-2-1913
  - g. EM 1110-2-2300
  - h. EM 1110-2-4300
4. Policy. All Corps of Engineers civil works projects will have an adequate level of instrumentation to enable the designers to monitor and evaluate the safety of the structures during the construction period and under all operating conditions. The term "project" includes all dams, appurtenant structures, facilities, levees and any other structure whose failure would cause loss of life or severe property damage.
5. General. The planning, design and layout of an instrumentation program is regarded as an integral part of the project design. Instrumentation is an extremely valuable asset because it can supply an insight into the field behavior of the structure and its environment. In the case of older structures, which were designed using criteria that have been revised due to changes in the "state-of-the-art", instrumentation provides most of the data necessary to evaluate the safety of the structure with respect to current

standards and criteria. The data obtained are influenced by the condition of the instrument itself, and only beneficial if properly recorded and analyzed. A realistic assessment of project performance can only be made after the data trends are evaluated and compared with threshold limits.

6. Planning. Careful attention and detail should be incorporated in the planning of an instrumentation program to ensure that the required information is obtained. Requirements for instrumentation depend on the type of measurement and time in which the information is desired. Generally, the types of measurements are as follows:

- a. Horizontal and vertical movement.
- b. Alinement and plumb.
- c. Stresses and strains in soil and rock-fill.
- d. Pore pressure.
- e. Uplift pressure.
- f. Phreatic surfaces.
- h. Seismic effects.
- i. Seepage clarity and quantity.

The planning process for an instrumentation program should include an evaluation of the adjacent terrain as well as the structure and should identify sufficient time and resources to obtain background or baseline data for each type of measurement desired. Other considerations include the risk of damage during construction, effects of a severe environment on the instruments, maintenance and personnel requirements for data collection and evaluation.

7. Performance Prediction. During the initial project design, or re-evaluation in the case of existing structures, the physical properties of the construction materials, design data, loading conditions and the appropriate factors of safety should be utilized to determine the desired threshold limits for the design condition. Quantitative values should be established for these limits that can be accurately translated into measurements that are easily and readily obtained in the field, which will enable the designers and operators to evaluate the behavior and performance of the structure. A detailed discussion of the design assumptions should be presented in the feature design memorandum. The threshold limits along with the predicted performance levels should be addressed in the project instrumentation design memorandum and in detailed instructions to project personnel and any other personnel involved with the instrumentation.

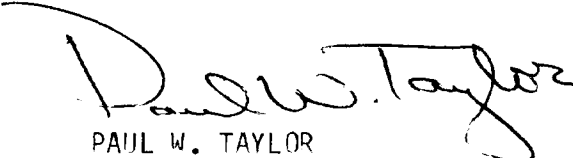
8. Installation and Maintenance. Instrumentation for a project should be installed in the design phase, during construction and throughout project life as conditions warrant. After a project has been operational for several years, scheduled maintenance, repair and replacement of instrumentation must be included in the normal plan of operation.

9. Data Collection, Interpretation and Evaluation. The frequency with which instrumentation data is obtained is an extremely important issue, and must be tailored to the instrument purpose, period of project construction and project operating conditions. In all cases, sufficient calibration and background data must be obtained to insure a reliable data base is available to facilitate subsequent comparisons. The subsequent reading of instruments during construction and operating conditions should be based on an anticipated rate of loading or changes in reservoir levels. The timely reduction and interpretation of instrumentation data are essential for a responsive safety evaluation of the project. For all Corps projects, this reduction, interpretation and evaluation should occur as soon as conditions warrant from the time that the data were obtained. The evaluation of the data should follow immediately. As a minimum, all data should be plotted as instrument response with respect to time, as well as reservoir level or other range of loading.

10. Reporting and Review. The primary documents for reporting instrumentation data and the appropriate evaluations are the Embankment Criteria and Performance Report (ER 1110-2-1901) and the Periodic Inspection Report (ER 1110-2-100). After the project is complete, the instrumentation data along with the written evaluation should be consolidated yearly and a copy submitted to the division for review. For those years that coincide with the normally scheduled Periodic Inspection, the data and evaluation should be submitted in the pre-inspection brochure. The Division review will ensure that an appropriate level of instrumentation exists at each project, that adequate maintenance is programmed, that sufficient effort and funding is devoted to the program, that timely reduction, interpretation and evaluation occurs and that the technical level of the safety evaluation is adequate. Each Division should schedule their project reviews in a time frame that will facilitate Division wide input during the budget cycle. The New England and Pacific Ocean Divisions will submit the above instrumentation data along with the evaluations to CDR HOUFACE (DAEN-ECE-B), WASH DC 20314-1000 for review.

11. Funding. The appropriate funding (General Investigation, Construction General and/or Operation and Maintenance General appropriations) should be utilized to accomplish the level of instrumentation outlined in this regulation within the time indicated.

FOR THE COMMANDER:

  
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Colonel, Corps of Engineers  
Chief of Staff