

CECW-ED

Technical Letter
No. 1110-2-536

31 December 1994

**Engineering and Design
NONLINEAR INCREMENTAL STRUCTURAL ANALYSIS
OF ZINTEL CANYON DAM**

1. Purpose

This engineer technical letter (ETL) provides an example of the use of nonlinear incremental structural analysis (NISA) for a massive concrete structure (MCS).

2. Applicability

This ETL applies to all HQUSACE elements, major subordinate commands, districts, laboratories, and field operating activities (FOA) having responsibilities for the design of civil works projects.

3. References

- a. EM 1110-2-2006, Roller Compacted Concrete.
- b. EM 1110-2-2200, Gravity Dam Design.
- c. ETL 1110-2-365, Nonlinear Incremental Structural Analysis of Massive Concrete Structures.

4. Discussion

a. *Background.* NISA is a developing technology which has been used on several recent civil

works projects and valuable experience is gained with each new usage of the method. NISA is used primarily as a supplemental tool for the design of MCS in order to: improve the cracking performance of a particular type of structure which has exhibited unacceptable cracking in the past; to more accurately predict the structural behavior of an unprecedented structure, or to develop more cost effective structures by revising the geometric configuration, materials or construction parameters.

b. *Application to Zintel Canyon Dam.* Appendix A presents a study conducted of the Zintel Canyon Dam in the Walla Walla District using the NISA method of analysis. The dam was constructed using RCC and the NISA study was conducted by CENPW after completion of construction. The study provides insight into the use of NISA as an analytical tool for designers.

5. Action

The enclosed study demonstrates the procedures necessary to conduct a NISA analysis of a RCC structure. NISA should be performed according to the requirements of ETL 1110-2-365.

FOR THE DIRECTOR OF CIVIL WORKS:



PAUL D. BARBER, P.E.
Chief, Engineering Division
Directorate of Civil Works