DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers

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Technical Letter
No. 1110-2-546

30 September 1995

Engineering and Design
PROVISIONS TO SET FINAL LEVEE GRADE FOR PROJECTS
FORMULATED USING RISK-BASED ANALYSIS

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PROVISIONS TO SET FINAL LEVEE GRADE FOR PROJECTS FORMULATED USING RISK-BASED ANALYSIS

1. Purpose. This engineer technical letter (ETL) provides guidance for establishing the final top of levee grade for flood control projects and flood damage reduction studies formulated using risk-based analysis.

2. Applicability. This ETL applies to 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 1110-2-1913, Design and Construction of Levees.

b. ETL 1110-2-547, Introduction to Probability and Reliability Methods for Use in Geotechnical Engineering.

c. EC 1105-2-205 (change 1, 11 January 1995), Risk-Based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Flood Damage Reduction Studies (an ER and an ETL are being planned to supersede this EC which expires 3 1 December 1995).

4. Background.

a. In the past, freeboard was used to account for the following hydraulic, geotechnical, construction, operation and maintenance uncertainties:

(1) Hydraulic uncertainties of changes in loss coefficients, changes in rating curve due to scour or sedimentation, flow instabilities, cross-section geometry of the channel, encroachment into the channel, and insufficient gage records.

(2) Geotechnical uncertainties of embankment and foundation settlement, embankment shrinkage, geologic subsidence, and cracking of the embankment from desiccation. In most cases estimates are made and actual analyses are not performed due to general knowledge of the regional soil characteristics.

(3) Construction, operation and maintenance considerations included rutting, soil loss due to wind and/or wave forces, construction tolerances; and quality of maintenance.

b. The term and concept of freeboard to account for uncertainties in design parameters is no longer used in the design of levee projects.

c. In accordance with reference c., economic and hydraulic factors are used in a risk-based approach to establish a nominal top of protection and size of project. Outputs of the analysis include well defined

economic and hydraulic performance characteristics. To facilitate the risk-based analysis for project sizing, an implicit assumption embedded in that guidance is that all other parameters are known with certainty.

5. Policy and Procedures for Establishing the Final Top of Levee Grade.

The risk-based analysis directly accounts for the hydraulic uncertainties set forth in paragraph 4.a.(1) and establishes a nominal top of protection. Geotechnical engineers will perform deterministic analyses using physical properties of the foundation and embankment materials to set the top of levee to account for the following factors:

a. Settlement in the foundation and embankment, embankment shrinkage, cracking, and geologic subsidence.

b. Construction tolerances.

6. Planned Maintenance of Levee Height.

a. Erosion, rutting and other factors may reduce the top of protection of levees during the service life. The Operation, Maintenance, Repair, Replacement and Rehabilitation Manual for the project should contain provisions for surveying and maintaining the top of protection used in estimating the project's economic and engineering performance. The project NED cost estimate must include future maintenance to counteract decrease in levee reliability.

b. Although the timing and amount of erosion, rutting, etc. is not certain, planned maintenance is designed to take place on an as needed basis. Therefore, routine inclusion of adjustments to levee heights due to account for lack of maintenance should not be included. In the future, reliability analysis should allow more realistic estimates of recurring maintenance requirements. In addition, probabilistic life cycle analysis, similar to that conducted for major rehabilitation, will allow explicit tradeoffs between the costs of design that require less maintenance, but cost more to construct, and the future costs of maintenance.

7. Action. The design and evaluation of levees should be accomplished in accordance with the provisions in this ETL. Full coordination between hydraulic and geotechnical engineers is required in order to properly set the final levee grade.

FOR THE DIRECTOR OF CIVIL WORKS:

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