

CHAPTER 30 SITE INVESTIGATION AND GEOTECHNICAL ANALYSIS

30. INTRODUCTION

The technical guidance for this chapter has primarily been taken from Engineering Analysis of Dams by the Missouri Department of Natural Resources, Dam Safety Program, Rules and Regulations of the Missouri Dam and Reservoir Safety Council by the Missouri Department of Natural Resources and Soil Mechanics Design Manual 7.01 by the U.S. Navy, Naval Facilities Engineering Command.

31. SITE INVESTIGATION REPORT

A site investigation report shall be submitted for the construction of all new high and significant hazard dams. The report shall contain the following:

- ___ The site investigation report shall be signed, sealed, and dated by the Mississippi Registered Professional Engineer responsible for its development in a manner consistent with the requirements of the State Board of Registration for Professional Engineers and Land Surveyors, as they apply generally to the practice of engineering. The site investigation and report may also be done by a registered professional geologist, however all design and recommendations that affect public safety must be performed by or under the direct supervision of a Mississippi Registered Professional Engineer.
- ___ A description of the proposed lake and surrounding area, the county it is located in and a geological description of the soils under the proposed lake and dam.
- ___ A description of the sub-surface exploration and testing methods and equipment used.
- ___ A soils map with the outline of the lake, dam, locations for borrow areas shown and the boring and/or test pit layout shown.
- ___ The boring and/or test pit layout shall include borings taken at the location of the borrow area, cutoff trench, critical locations in the abutments, spillway and outlet works as well as along the centerline of the dam and over the foundation area. The boring layout should also include borings taken in the lake bed to establish the geology.
- ___ A copy of the boring log(s) with the responsible (State of Mississippi licensed geotechnical driller) driller's name and license number and the date of the borings.
- ___ A description and location on the soils map showing any problem soils such as dispersive clays, slaking shales, very compressible soils, etc.
- ___ A description, location and flow estimation on the soils map of any springs or seeps that are located in the area to be covered by the dam, the abutments as well as the downstream area and the possibility of providing a seepage path through the foundation of the dam.

32. EMBANKMENT DESIGN

A geotechnical report for the design of the embankment and support of structures shall be submitted for the construction of all high and significant hazard dams, medium and large height (see Section 10.2). The report shall contain the following:

For medium height dams

- ___ Degree of compaction specified for each zone and specification for water content.
- ___ Recommendation(s) for addressing problem soils (if any).
- ___ Recommendation(s) of filter design to be incorporated or justification for not incorporating a filter into the design.
- ___ Seepage analysis and recommendations for suitable seepage control measures.
- ___ Evaluation of potential for differential settlement.
- ___ Design recommendations for a filter diaphragm around any conduit through the dam.
- ___ Recommendation for quality control (QC) for construction.

For large height dams

- ___ A description of all laboratory tests conducted and results obtained.
- ___ A listing and description of all soil types (foundation and embankment) and their engineering properties as determined by laboratory testing (shear strength parameters, internal angle of friction, permeability, consolidation, dispersion, etc.).
- ___ Specifications for soil compaction and water content for each earth fill zone based on engineering property tests or correlations.
- ___ Seepage analysis, both through the embankment and through the foundation.
- ___ Design of cutoff measures.
- ___ Design of chimney filter and recommendation(s) for placement so that the filter can intercept all hydraulic fracture zones.
- ___ Design of drains.
- ___ Identification and characterization of problematic soils and design recommendations for addressing these soils.

— The geotechnical report shall evaluate the proposed embankment for slope stability and show that the following design factors of safety are met for the following loading conditions:

Loading Condition	Factor of Safety
End of construction, initial filling*	1.4
Steady seepage, normal pool**	1.5
Maximum pool***	1.3
Rapid drawdown (if applicable)	1.2

* This condition assumes that full consolidation hasn't occurred and excess pore water pressures haven't dissipated.

** This condition assumes that full consolidation has occurred, the normal phreatic surface has been established and no excess pore water pressures exist.

*** This condition assumes that the pool level is between the auxiliary spillway crest and top of dam and remains there long enough to load the slope but the phreatic surface is assumed to be in the same location as steady seepage, normal pool.

— The computer program used to do the slope stability analysis shall be named and all inputs and assumptions listed as well as the outputs.

— The computer program used to do the seepage analysis shall be named and all inputs and assumptions listed as well as the outputs. If the seepage analysis is done by hand, then all calculations, assumptions and flow nets shall be shown.

— Ultimate bearing capacity of foundation soils under large structures (ie. Concrete risers) shall be calculated and the report shall show that a factor of safety of three (3) shall be met under normal loading conditions.

— Riser and conduit structures shall be evaluated for resistance against uplift for conditions when normal pool (or near normal pool) is established and riser and conduit are dewatered.

— The report shall calculate differential settlement and show that it is within acceptable limits, or provide design recommendations for protecting hydraulic structures and the core against excessive movement.

— A geotechnical quality control plan during construction shall be outlined in the report.

— Critical or "alarm level" readings shall be established for all installed instruments or notation in the report that these shall be provided for the operation and maintenance manual following construction (See Chapter 50, Operation and Maintenance).

— A filling plan shall be provided to ensure that slope stability and other applicable stability factors of safety are met.

33. SEISMIC STABILITY

— A seismic stability analysis shall be performed for all new, medium and large, High and Significant hazard dams proposed for construction north of Highway 82 (see USGS 2002 National Hazard Maps for Spectral Acceleration with percent probability of exceedance). The analysis shall consist of adding a horizontal acceleration component to the slope stability analysis and determining that a factor of safety is greater than or equal to one (1). For medium height dams the designer may forgo the analysis provided a chimney filter design is done and the chimney filter is thicker than what is needed to handle normally expected seepage.

34. EMBANKMENT DESIGN FOR SMALL DAMS

— For small height, High and Significant hazard dams, a geotechnical report is not required provided plans show minimum 3:1 slopes, filter diaphragm design for all conduits, a core or cutoff is shown, compaction requirements are noted on plans or in the specifications and quality control is specified.