

# EM-1110-2-2100 Stability Analysis of Concrete Structures

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This manual provides guidance for stability analysis of concrete gravity structures. Stability refers to resistance to sliding and floatation, limits on the eccentricity of the resultant of the applied loads, and limits on the bearing capacity of the foundation materials. The manual applies to all types of structures founded on rock or soil, such as: dams, outlet works, navigation locks, floodwalls, and pumping stations. It is not applicable to piles or caissons, or to structures founded on these elements.

The manual is written to be compatible with risk-based planning and design methods currently being implemented within USACE. It consolidates and standardizes stability requirements, which were previously contained in several other publications. Changes contained in Chapters 3 and 4 will provide adequate safety factors for all types of structures and loading conditions, while reducing excess conservatism for infrequent loadings of short duration. This

will result in project cost savings when compared to some structures designed using previous criteria. Stability criteria in other manuals is being revised to be consistent with this manual. In the interim, where there are conflicting stability criteria, the provisions of this manual shall govern.

This manual covers requirements for static methods used in stability analyses of hydraulic structures. The types of concrete structures addressed in this manual include dams, locks, retaining walls, inland floodwalls, coastal floodwalls, spillways, outlet works, hydroelectric power plants, pumping plants, and U-channels. The structures may be founded on rock or soil and have either flat or sloped bases. Pile-founded structures, sheet-pile structures, and footings for buildings are not included.

These requirements apply to all potential failure planes at or slightly below the structure/foundation interface. They also apply to certain potential failure planes within unreinforced concrete gravity structures. This manual defines the types and combination of applied loads, including uplift forces due to hydrostatic pressures in the foundation material. The manual defines the various components that enable the structure to resist movement, including anchors to the foundation. Most importantly, the manual prescribes the safety factors, which govern stability requirements for the structure for various load combinations. Also, guidance is provided for evaluating and improving the stability of existing structures.