This manual provides guidance for the safe design and economical construction of retaining and flood walls. It is intended primarily for retaining walls which will be subjected to hydraulic loadings such as flowing water, submergence, wave action, and spray, exposure to chemically contaminated atmosphere, and/or severe climatic conditions. For the design of retaining walls which will not be subjected to hydraulic loadings or severe environmental conditions as described above, TM 5-818-1 may be used for computing the loadings and evaluating the stability of the structure.

Types of Walls. This manual presents design guidance for retaining walls and inland and coastal flood walls. Retaining walls are defined as any wall that restrains material to maintain a difference in elevation. A flood wall is defined as any wall having as its principal function the prevention of flooding of adjacent land.

Not specifically covered in this manual are seawalls which are defined as
structures separating land and water areas, primarily designed to prevent erosion and other damage due to wave action. They are frequently built at the edge of the water, but can be built inland to withstand periods of high water. Seawalls are generally characterized by a massive cross section and a seaward face shaped to dissipate wave energy.

Coastal flood walls, however, are generally located landward of the normal high water line so that they are inundated only by hurricane or other surge tide and have the smooth-faced cantilever stems shown in this manual.

Types of Foundations. This manual describes procedures for the design of retaining and flood walls on shallow foundations, i.e., bearing directly on rock or soil. The substructure design of pile-founded walls is not included, but is covered in EM 1110-2-2906.

Flood Wall Guidance. A flood wall is treated as a special case of a retaining wall. Unless specifically noted, the guidance herein applies to both retaining and flood walls.

Geotechnical and Structural Aspects. Both geotechnical and structural aspects of wall design are included. Coordination between geotechnical engineers, structural engineers, and geologists in the design of retaining and flood walls is essential.

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

| Author(s): | USACE |
| Publisher: | USACE |
| Year: | 2005 |
| Links: | PDF, USACE Publications |
| Subjects: | Dams, Foundations, Reinforced concrete, Retaining walls, Structures |
| Size: | 161 pages, 1.85 MB |
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.