# UPLIFT

1. General. Uplift pressures at the base of a structure may be determined using an assumption that excess hydrostatic pressures at the base of the impervious blanket are dissipated to zero through the thickness of the blanket. The uplift at the base of a structure would then be determined based on its relative position within the blanket. The uplift (flotation) calculations should conform to ETL 1110-2-307, "Flotation Stability Criteria for Concrete Hydraulic Structures", which provides guidance for determining if the structures are adequately stable with respect to buoyant forces.

2. River stages to be considered for uplift calculations. River stages for the individual cases should be obtained from the U.S. Army Corps of Engineers, Hydrology and Hydraulic Section.

2.1. River stages for urban levees are as follows:

a. River at the top of flood protection structure.
b. Design river stage (for urban levees considered 500 year flood event).
c. 100 year flood events during construction and maintenance.

2.2. River stages for rural levees are as follows.

a. River at the top of flood protection structure.
b. Design river stage

3. Uplift factors of safety for critical structures, for different river stages and loading conditions are as follows:

| OPERATION CONDITIONS | UPLIFT FACTOR OF SAFETY | RIVER STAGE | LOADING CONDITIONS |
|---|---|---|---|
| During Construction and Scheduled Maintenance | 1.3 | 100* year | Structure considered empty |
| Normal Operation | 1.5 | Design stage | Water in structure at the normal operation elevation |
| Extreme Condition | 1.1 | Top of flood protection | Structure considered empty |

Note: * applies only for urban levees.

The above factors of safety address seepage from the river to the landward excavation and provide uplift factors of safety only. The piping and heave factors of safety for the excavation should conform to the topic UNDERSEEPAGE. The uplift factors of safety should apply to both temporary

and permanent excavations (permanent lined basins or drainage ditches excavated landward of flood protection).

4. The factors of safety for a non-critical structure are the same as for a critical structure, except that for normal operation conditions with the river at the design elevation, the acceptable factor of safety is F.S. = 1.3.

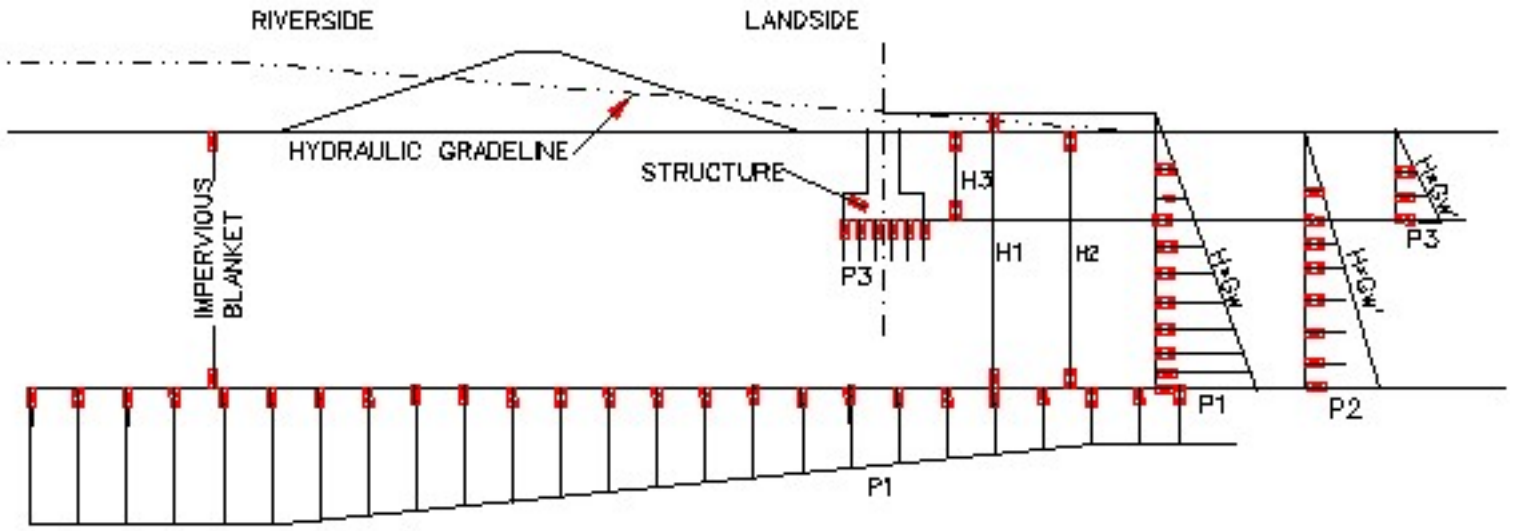
5. A guide for calculations of uplift is provided in the attached Figure F-1.

6. Recommended references.

6.1. EM 1110-2-3104, STRUCTURAL AND ARCHITECTURAL DESIGN OF PUMPING STATIONS, describes the following requirements:

a. Method of computing uplift on pumping plants.
b. Defines factors of safety to resist uplift for pumping plants for different loading cases.

Figure 1 – COMPUTATION OF UPLIFT ON A STRUCTURE WITHIN THE IMPERVIOUS BLANKET IN THE CRITICAL AREA OF A FLOOD CONTROL PROJECT




P1 - Pressure at the base of the impervious blanket
at the location of the structure being investigated

P1 - H1×Gw  Where: H1 - Height of the hydraulic grade line above the base of the blanket at the structure location

Gw - Unit weight of water, 62.4 pcf

Assume pressure is dissipated to 0 (zero) at the ground surface

P2 - H2×Gw'  Where: H2 - Impervious blanket thickness

Gw' - Equivalent unit weght - (H1/H2)×Gw

P1 - P2
H1×Gw = H2×Gw'
P3 = H3×Gw'

| UPLIFT PRESSURE AT BASE OF STRUCTURE |
| --- |
| P3 - H3×(H1/H2)×GW |

# COMPUTATION OF UPLIFT ON A STRUCTURE WITHIN THE IMPERVIOUS BLANKET IN THE CRITICAL AREA OF A FLOOD CONTROL PROJECT