

requirements will be determined by the modeling method used for analysis. Coastal modeling should only be considered if the available fetch of the waterbody is 0.5 miles or greater.

#### 4.1.2 Riverine Freeboard

The riverine freeboard requirements are stated in 44 CFR 65.10(b)(1)(i) and states the following:

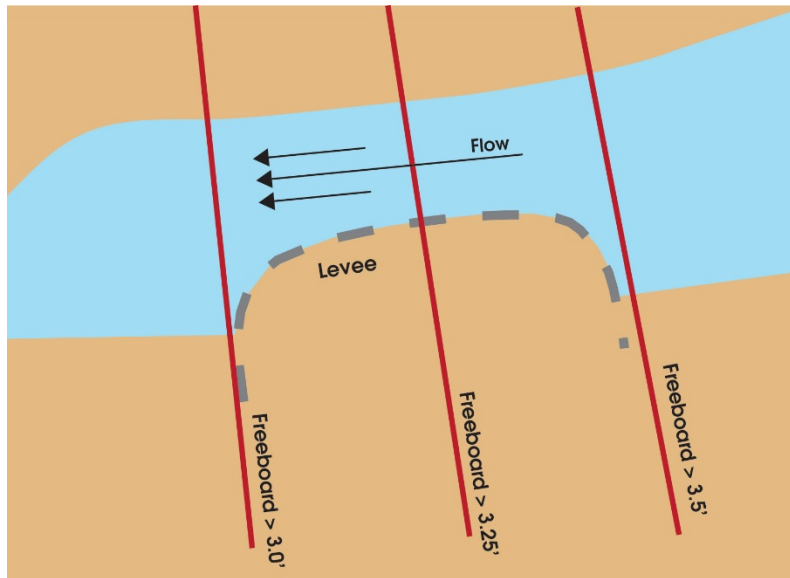
*Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.*

The freeboard shall be based on the difference between the top of levee elevation to the elevation and the BFE at the riverside of the levee. A current top of levee survey or certified as-built plans should accompany any documentation regarding the freeboard requirement for a levee system. Older data may be accepted if accompanied with a statement from the certifying engineer that the older survey data still reflects current top levee conditions for the levee.

The levee shall tie into high ground at both the upstream and downstream end and maintain the required minimum freeboard at the tie into high ground. There may be cases in which high ground itself may not have the required freeboard at the tie-in location. If the tie into high ground cannot meet the minimum freeboard requirements within the vicinity of the levee, the levee can still be considered for meeting freeboard if the high ground lies above the BFE at the tie-in location of the levee. In some geographic areas, levee systems are designed to end in the absence of high ground at the downstream end. In these cases, the levee system may still be considered for accreditation as described in Subsection 4.2.1 of this guidance.

The levee freeboard should be determined based on the effective hydrologic and hydraulic models. New hydrology or hydraulics may be introduced for evaluation of freeboard as part of a FEMA initiated study, LOMR or Conditional Letter of Map Revision (CLOMR) to be evaluated by FEMA prior to consideration for accreditation. If during collection of data for accreditation it is determined that the effective BFEs are incorrect (too low), it is incumbent on the P.E. to provide updated information to FEMA through the MT-2 process such that the levee can be determined to reduce risk against the current base flood.

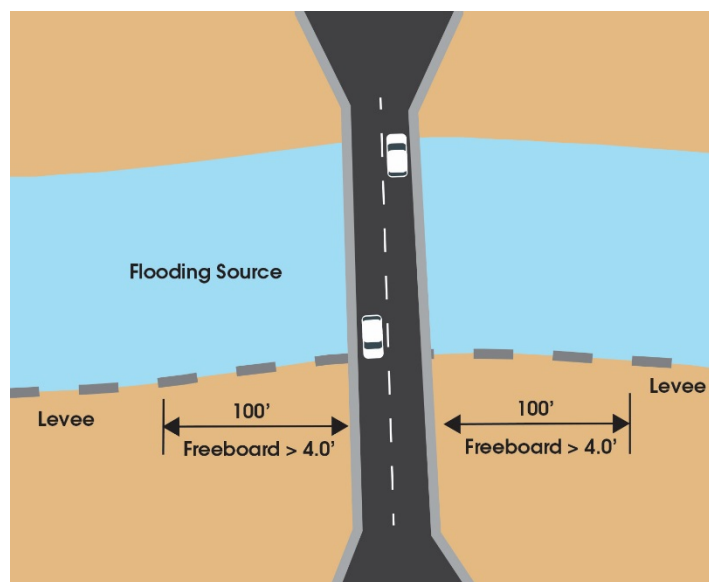
The tapering requirement for the additional 0.5-foot freeboard requirement at upstream end of levee system will be determined perpendicular to the flow of the base flood event and to help prevent overtopping at the structure. All aspects of levees, including mainline and tributary levees, are subject to an additional 0.5 feet of freeboard if they are perpendicular to flow at upstream end of levee. See Figure 2.



**Figure 2: Freeboard Determination**

There may be some circumstances in which the upstream end and downstream end of the levee are indistinguishable and the freeboard tapering requirement may not apply. This may include levees along stillwater bodies or large rivers where velocities are slow and there is no change in water-surface elevation along the length of the levee system. A waiver may be granted from FEMA for exclusion of the freeboard tapering requirement if the certifying engineer can provide data that justifies the waiver request.

The additional 1.0 foot of freeboard around structures is needed for any areas that constrict the natural flow of the river, such as bridges or culverts perpendicular to the flow. The 100 feet on either side of the structure shall be considered from the furthest upstream and downstream point of the structure that influences the flow, not the center of the structure. See Figure 3.



**Figure 3: Freeboard Near Structures**