Design Standards Letter

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Section/Plan No.: None

Subject: Hydraulics

Body

ALL DIVISION AND DISTRICT ENGINEERS AND CHIEF COUNSELS:

Attached is a copy of IM 20-1-67 "Evaluation of Flood Hazards-Federally Financed Highways" concerning hydraulic design criteria for structure and other drainage facilities on Federal-Aid projects. The memorandum restates and clarifies the design frequency to be used for Interstate designs. It also permits more flexibility in design frequency for other than Interstate projects.

Effective January 1, 1968, the magnitude, frequency, and pertinent water surface elevations for design floods over 500 cfs will be shown on all plans, regardless of system and/or federal participation in costs.

For drainage areas over 1,000 acres, we will continue the bridge survey and report requirement from Section X of the Design Manual using Forms BR105, 105S1, and 105S2. Final hydraulic analysis will be developed by the Bridge Division based upon design frequencies from Section 10.3.3, and the required plan data will be placed on each bridge design plan by the Bridge Division. A correction will be made in Section 10.3.3 to change 850 vpd to agree with traffic categories in the Table of General Design Data.

For drainage areas 1,000 acres and under which require a structure designed by the Bridge Division (multiple box, etc.), the District shall make the necessary analysis and provide to the Bridge Division, in addition to the other requirements of Section 14.3.5.2.7 the drainage area, the magnitude of the discharge, frequency, and design high-water for placement on the plans for each structure.

For drainage areas 1,000 acres and less with a magnitude 500 cfs or more, the road plans shall show the drainage area, magnitude of discharge, frequency, and design high-water data.

Minimum design flood frequencies and methods to determine magnitude of discharge for areas under 1,000 acres shall be as follows:

A. Interstate Routes - Design frequency shall be 50-year minimum for subverts and 10-year for roadway inlets for pavement drainage, except at critical locations. Magnitude of discharge shall be determined by the use of the Rational Method in urban or developed areas and by Figure 11.1 or the Rational Method in rural areas.

B. All Other Routes:

1. Cross Road Drainage

Design Traffic Frequency

0-400 ADT 10-Year
400-1,700 ADT 10- to 25-Year
1,700-5,000 ADT 25-Year
Greater than 5,000 ADT 50-Year

Magnitude of discharge shall be determined by the use of Figure 11.1 of the Rational Method. When discharge is less than 500 cfs, structure size may be determined by the use of Talbot's Formula (Section 11.2.2), except in an urban or other developed areas where the Rational Method is applicable.

2. Roadway Inlets for Pavement Drainage

Design Traffic Frequency

Less than 1,700 ADT * 5-Year
Greater than 1,700 ADT * 10-Year

*At critical locations 25- and 50-year respectively.

Magnitude of discharge shall be determined by use of the Rational Method

Variations in these noted design frequencies for other than Interstate routes may be made, but [in] all cases the flood frequency selected for design should be consistent with the magnitude of damage to adjacent property and importance of the highway. A flood frequency above minimum requirements can be used and should be used providing costs are commensurate with the type of facility to be provided. Critical points are defined as those where a structure drains a low point in grade or an underpass.

Discharge over 500 cfs shall be determined by use of the Bureau of Public Roads' Magnitude Frequency Chart Figure 11.1 or the Rational Method outlined in Section 11.2.3 of the manual. Figure 11.1 is for use in rural areas and is recommended to simplify work.

Rural drainage areas for which the discharge will not exceed 500 cfs will continue to be analyzed by use of the Talbot Formula, Section 11.2.2, to determine structure size. This

modified Talbot Formula using runoff coefficients from Table 11.2 and applied as per Section 11.2.2.2 has proven a simple and workable method of analysis with a record of satisfactory results. Runoff coefficients, however, should also be adjusted to account for development of the watershed 20 years hence. Other methods of hydraulic analysis for these drainage areas may be considered when conditions warrant a more detailed and thorough study.

Water surface elevations to be shown on the plans for drainage areas 1,000 acres or less with more than 500 cfs discharge shall be the head water elevation as determined from Figure 11.42 to 11.45. Charts for CM pipe and CM pip-arches are furnished with this letter.

It should be noted that hydraulic analysis will not be limited to crossings of watersheds or waterways but will also include longitudinal encroachments of a waterway. An analysis for this situation should be capable of determining the effect of the encroachment on the flood plain and resultant water surface elevation at design flood flow to determine any adverse effect. This information must be recorded on the plans when design flood exceeds 500 cfs.

Additional data should be secured from field surveys regarding high water marks, for locations other than those normally requiring a bridge survey, when available. In the case of a longitudinal embankment encroachment on a flood plain, valley sections, and channel slopes and hydraulic gradient would be required for a proper analysis.

Districts should submit, immediately, data for projects scheduled for the January 19, 1968, letting for placement on the plan tracings. Districts should also submit data as soon as possible for placement on the plan tracings for projects in later lettings where plan tracings have already been submitted to the Main Office. Data should be furnished to the Bridge Division where a multiple box design is involved.

Your immediate attention to this requirement will be appreciated. These features will be incorporated in the Design Manual at a later date.

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Surveys and Plans