CHAPTER 4

DESIGN OF CULVERTS

4.7 Flood Routing and Culvert Design

4.7.1 Introduction

Flood routing through a culvert is a practice that evaluates the effect of temporary upstream ponding caused by the culvert's backwater. By not considering flood routing it is possible that the findings from culvert analyses will be conservative. If the selected allowable headwater is considered acceptable without routing, then costly over-design of both the culvert and outlet protection may result, depending on the amount of temporary storage involved. However, if storage is used in the design of culverts, consideration should be given to:

- The total area of flooding.
- The average time that bankfull stage is exceeded for the design flood up to 48 hours in rural areas or 6 hours in urban areas, and
- Ensuring that the storage area will remain available for the life of the culvert through the purchase of right-of-way or easement.

Ignoring temporary storage effects on reducing the selected design flood magnitude by assuming that this provides a factor of safety is not recommended. This practice results in inconsistent factors of safety at culvert sites as it is dependent on the amount of temporary storage at each site. Further, with little or no temporary storage at a site the factor of safety would be unity thereby precluding a factor of safety. If a factor of safety is desired, it is essential that flood routing practices be used to ensure consistent and defensible factors of safety are used at all culvert sites.

4.7.2 Design Procedure

The design procedure for flood routing through a culvert is the same as for reservoir routing. The site data and roadway geometry are obtained and the hydrology analysis completed to include estimating a hydrograph. Once this essential information is available, the culvert can be designed. Floor routing through a culvert can be time consuming. It is recommended that the HY8 computer program be used as it contains software that very quickly routes floods through a culvert to evaluate an existing culvert (review), or to select a culvert size that satisfies given criteria (design). However, the engineer should be familiar with the culvert flood routing design process.

A multiple trial and error procedure is required for culvert flood routing. In general:

- A trial culvert(s) is selected.
- A trial discharge for a particular hydrograph time increment (selected time increment to estimate discharge from the design hydrograph) is selected.
- Floor routing computations are made with successive trial discharges until the flood routing equation is satisfied.
- The hydraulic findings are compared to the selected site criteria, and
- If the selected site criteria are satisfied then a trial discharge for the next time increment is selected and this procedure is repeated; if not, a new trial culvert is selected and the entire procedure is repeated.

END OF SECTION 4.7