13. BRIDGE AND HYDRAULIC SURVEYS
13.1 BRIDGE LOCATION REQUIREMENTS

13.1.1 Types of Bridge Projects

Field survey requirements for bridges will depend on the anticipated scope of work for the bridge. Projects involving bridge work include new, replacement and rehabilitation. Major rehabilitation such as bridge widening, deck replacement or major reconfiguration of the bridge will have different and more extensive survey requirements. Section 5.4 of the HDM should be referred to for additional survey needed to meet the terrain data requirements for the particular type(s) of bridge work anticipated for the project.

13.1.2 New and Replacement Bridges

New Bridges

Survey requirements for bridges on new alignments, where the proposed structure does not require ties with existing structural elements and/or existing highway features will only need to meet the terrain data requirements of Section 5.4 of the HDM.

13.1.3 Replacement Bridges

There are generally two types of replacement bridges.

1. Replacement at the same general location, with traffic being detoured either at or off site.
2. Replacement at the same general location, with traffic being maintained at the site using stage construction.

Prior to any field survey, an attempt should be made to secure as-built plans for the existing bridge. These as-built plans should be verified in the field by survey. To insure that the designer will be able to adequately relate the existing geometry to the proposed geometry, the surveyor should precisely and redundantly tie the new baseline to the old baseline, existing centerline and the controlling features of the existing structure. The extreme limits of existing permanent bridge features that will be adjacent to new construction shall be located to verify possible physical conflicts during construction.

Refer to Section 6.10 for information on datum transformations.

The existing bridge plan (Figure XVI) and elevation(s) (Figures XVII) shown below depicts points on some typical bridge features which are important and are considered control points in pinning down the existing geometry of the bridge.

Additional survey will be required for replacement bridges utilizing stage construction as shown in the bridge section (Figure XVIII) to establish required dimensions needed for stage construction control. Additional survey will also be required for any project where channel work is being proposed and is described in items 32 and 33 of the Bridge Data Sheet Part 2 in Appendix 3B of the Bridge Manual.

Substructure components (e.g. abutments, walls, piers, columns and stems) should be located and defined at ground level with strings of individual shots. When record plans are not available, the work required will be substantial and the surveyor is provided with instructions unique to each situation.
FIGURE XIX. Bridge Plan

NOTE: SURVEY POINTS 4, 5 & 6 SHALL BE TAKEN AT 10 TO 20 FT INCREMENTS TO CAPTURE THE NECESSARY LINE STRINGS.
FIGURE XX. Bridge Abutment/Pier

FIGURE XXI. Bridge Section

NOTE: SURVEY POINT 7 REQUIRED FOR EACH INDIVIDUAL PIER COLUMN

NOTE: SURVEY POINTS SHOULD ALSO BE TAKEN ALONG POR IF BRIDGE IS SUPERELEVATED OR IN TRANSITION
13.2 WATERWAY HYDRAULIC REQUIREMENTS

13.2.1 Introduction

It is important for the surveyor to determine the input file format required by the bridge program before entering data into the system. For example, when hydraulic cross sections are required for a stream flowing under a proposed bridge, cross sections need to be taken at the positions indicated below.

As an alternative to the very time-consuming laying-out of a precise cross section, a total station can be used to measure a single profile across a stream at the location of the needed cross section.

13.2.2 Site Data

The research required to collect the site information necessary to complete the bridge data sheets 1 & 2 is performed by the hydraulics engineer and incorporated into the bridge data sheets BD 124-1a and BD 124-2a and submitted along with any hydraulic information obtained from the bridge inspection report. The hydraulics engineer may request survey to collect the following site data.

Sections should be taken perpendicular to the direction of flow at design high water and at low flow. This may require a dog-leg shape section where the low flow channel meanders through the flood plain. The cross sections required for the hydraulic analysis of each structure should be taken as follows:

1. For bridge replacement projects, sections should be taken at both the upstream and downstream faces of the existing bridge, including elevations of the low chord, top of road, faces of piers and abutments. Sections should also be taken at upstream and downstream faces as stated above for any bridges within the limits of all the cross sections as listed below.

2. For all stream bridges, sections should be taken downstream from the proposed bridge location at the following approximate distances: 100 ft. (30 m); 200 ft. (60 m); 300 ft. (90 m); 400 ft. (120 m); 500 ft. (150 m); 1000 ft. (300 m); 2000 ft. (600 m). For streams with slopes flatter than 1 foot (0.3 m) in 1000 feet (300 m), an additional section should be taken 4000 ft. (1200 m) downstream.

3. For all stream bridges, sections should be taken upstream from the proposed bridge location at the following approximate distances: a distance equal to the length of the proposed bridge; that length plus 100 ft. (30 m); that length plus 200 ft. (60 m) and one at a bridge length plus 500 ft. (150 m). In cases where the bridge length exceeds 1000 ft. (300 m) the bridge hydraulic design unit shall be contacted for a recommendation for the locations of the sections.

4. Additional cross sections should be taken at points where the characteristics of the terrain change radically, where the flow is constricted, where the shape of the channel changes, at sharp bends in the stream, at dramatic changes in the profile of the stream flow, etc. Contact the Regional Hydraulic Engineer or Main Office Hydraulic Unit for information.
5. Sections should be at least 7 times the width of the low flow channel, and if possible, as wide as the 100 year flood plain. In cases where the flood plain is very wide, shots should be taken as far away from the stream bank as practical.

6. If a special feature such as a lake or dam exists within 10 miles (16 km) downstream from the bridge site, this should be brought to the attention of the Main Office Hydraulic Unit to see whether additional sections may be required.

7. Cross sections should be reported in an ascii text file, listed from left to right looking downstream, starting with the farthest downstream section.

8. If a DTM generated from photogrammetry has been used to generate cross-sections electronically, these sections must be supplemented by survey crossing the stream at the cross-section locations to pick up the stream bed elevations below the water surface.

13.2.3 Cross Sections Required for Scour Susceptibility Study

1. The following cross sections should be taken along the stream baseline progressing from upstream to downstream. Cross-section elevations shall be in the USGS Datum.

2. A section at the upstream and downstream face of the bridge, including any piers or abutments that may be inside the face, within 3 feet (a meter) of the facia. This section should be taken along the face of the bridge even though this may not be perpendicular to flow. However, an estimate of the angle between the flow and the face of the bridge should also be included.

3. A section about 500 ft. (150 m) downstream of the bridge should be taken perpendicular to flow. It should be a full valley section to the estimated high water line and should be what the Surveyor considers a typical section. The distances between that section and the downstream face of the bridge should also be given; if it is around a curve of the river the distances of the right and left overbank should also be given to the downstream face of the bridge.

4. Another section 200 ft. (60 m) downstream of the downstream bridge face, also taken perpendicular to flow and similar to the above section.

5. Sections perpendicular to the flow should be taken approximately one bridge length and one bridge length plus 100 ft. (30 m) upstream of the bridge. These should be full valley sections to whatever extent the flow is during an extreme flood. If they are around a bend in the curve, the distances of the left and right overbanks should be determined.

6. Additional cross sections should be taken at points where the characteristics of the terrain change radically, where the flow is constricted, where the shape of the channel changes at sharp bends in the stream, etc. These sections should be taken perpendicular to the direction of flow at design high water and at low flow.
7. Sections should be at least 7 times the width of the low flow channel, or if practical, they should be as wide as the 100 year flood plane. If the estimated high water is obviously within the stream banks, an elevation should be taken at the top of bank or at a location 10 ft. (3 m) + vertically higher than estimated high water.

8. The elevation of a prominent point on the structure should be established, possibly the top of an existing wingwall. Also, the lowest bottom of beam elevation on the upstream facia should be determined.

9. Need stream section at end of wingwalls upstream and downstream.

13.2.4 Additional Information

The following information is also necessary in order to perform a hydraulic analysis. The hydraulics engineer may ask the regional survey group to provide some of this information. Submission of a MicroStation DGN file and an InRoads DTM file may be substituted in place of paper copies of this information required below in “a” through “d”:

a) A small scale map showing the location and orientation of the cross sections.

b) A 1:40 scale (1:250 metric) map of the bridge area showing the existing topography.

c) A cross-section of the proposed pavement section.

d) A copy of the existing and proposed roadway profile.

e) Copies of boring logs or information as to whether there is rock close to the channel bottom.