Construction Bridge Surveying

Course Number: ST-02-301

PDH: 4

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Module 5: Bridge Surveying

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the specific requirements and data collection priorities for bridge reconnaissance, preliminary, and location surveys.
- **Select** appropriate methods for taking soundings and streambed profiles based on river depth and bed regularity.
- **Evaluate** the precision of pier and abutment layouts using triangulation and horizontal control systems.

Executive Summary: Bridge surveying is a multi-phased process—comprising reconnaissance, preliminary, and location surveys—designed to fix a site's exact coordinates, gather design data, and provide precise construction controls. Success depends on balancing tactical needs with technical constraints, ensuring subsurface stability, and maintaining rigorous records for pile and pier placement.

Section I. Location Surveys

Bridge surveying is essential for three primary objectives: locating the ideal site, obtaining design data, and furnishing the lines and grades required for construction. The process follows a structured progression:

- **Reconnaissance Survey:** Conducted at all potential sites to narrow down candidates.
- **Preliminary Survey:** Performed at the premier site to establish **horizontal and vertical control** and gather data for design and construction planning.
- **Location Survey:** The final phase used to lay out the bridge according to finished plans.
- **Construction Support:** During active building, the surveyor establishes additional lines and grades as required by the foreman.

Measurement accuracy depends on the project type. **Tactical bridges** may only require hand-levels and sketchboards, whereas **prefabricated steel bridges** demand high-precision measurements.

Reconnaissance Fundamentals

The selection of a bridge site is governed by a dual-constraint system:

1. **Tactical Requirements:** These define the general area.
2. **Technical Requirements:** These fix the exact location and may eliminate sites that are tactically acceptable.

💡 **Design Tip:** For permanent construction, technical considerations must always govern the final bridge location.

Data Collection Priorities

- **Access Roads:** Use maps or overlays to identify existing roads and railhead distances. Sketch any required new approach roads for the report.
- **Bridge Length:** Determine the crossing distance to estimate material requirements using tape, electronic devices, or **stadia methods**.
- **Bank Characteristics:** Report on the slope, height, and composition of banks, as well as vegetation and natural dikes. Identify usable existing abutments or piers.
- **Stream Flow:** Measure velocity by timing a floating object over a measured course. Determine high-water levels by inspecting drift marks on vegetation or consulting local flood records.
- **River Bottom:** For floating bridges, determine the bottom's character to estimate the **holding power of anchors**.
- **Streambed Profile:** Profile the bed to facilitate intermediate support design. Profile intervals are measured via horizontal tape, cable, or stadia.

Sounding Procedures

Soundings determine the relief of the stream bottom along the centerline and lateral lines. The surveyor must relate every sounding depth to the established **vertical control datum**.

Sounding Locations

The design engineer typically specifies the distance and intervals for soundings.

- **Uniform Streambed:** 25-foot intervals.
- **Irregular Streambed:** 10-foot intervals.

For high-precision requirements, use the **intersection method** by setting instruments on a baseline on shore and reading simultaneous angles to the sounding boat.

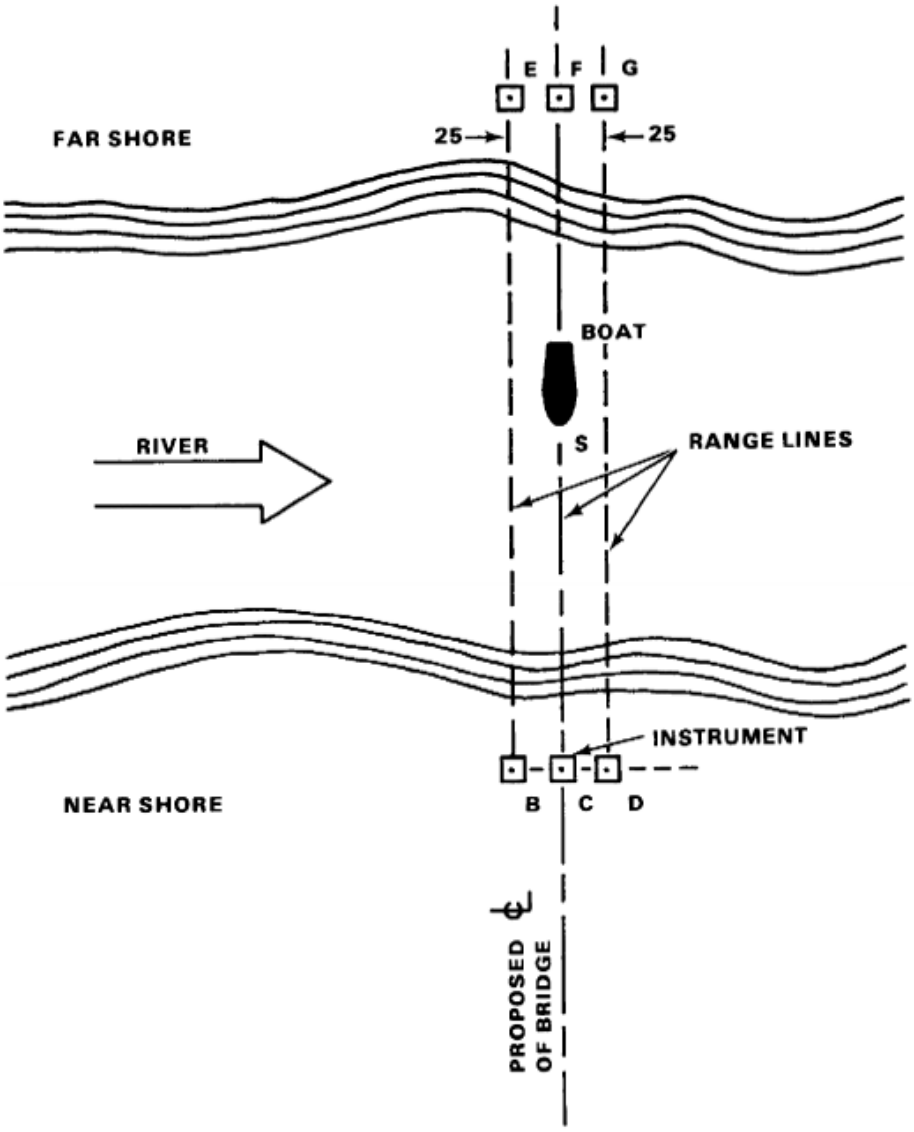

Figure 5-1: Taking soundings

Execution in the Field

- **Alignment:** The instrumentman (at point C) signals the sounding crew to stay on the range line (CF) at specified intervals.
- **Measurement:** Use direct rod readings in shallow water. In deeper water, use appropriate boat-mounted measuring devices.
- **Lateral Profiles:** Set stakes at specified distances (Points B, D, E, G) to establish profiles on each side of the centerline.

Foundation Investigation

Subsurface investigations determine **bearing capacities** for substructure design. These investigations include borings, test pits, trenches, and field tests.

⚠️ **Safety Constraint:** Surveyors must reference all boreholes and test pits to nearby instrument stations and record exact elevations of every strata layer encountered.

Section II. Bridge Site Layout

Abutments

Surveyors must check the layout after excavation but **before concrete is poured**. This includes verifying elevations and establishing lines for forms.

🧮 **Calculation Note:** Ensure the distance between abutments is within steel fabrication limits, particularly for **prefabricated sections**.

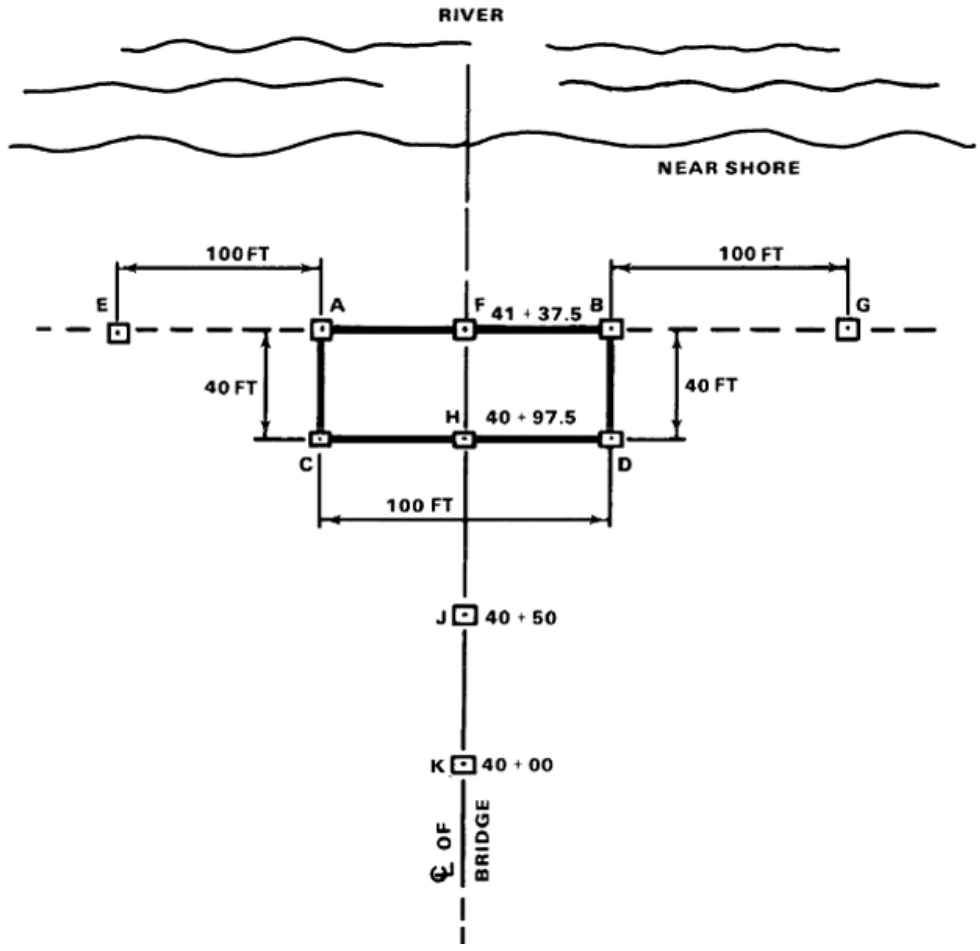

Figure 5-2: Staking an abutment

Abutment Staking Procedure

1. Set the instrument at Point H (station 40+97.5), sight on Point J, and invert to locate Point F.
2. Turn 90-degree angles to locate foundation points C and D.
3. Move to Point F (station 41+37.5), sight on H, and turn 90-degree angles to locate Points A and B.
4. Establish Points E and G as horizontal control points in line with the abutment face.

Wing Walls

Wing wall layout is an extension of the abutment process.

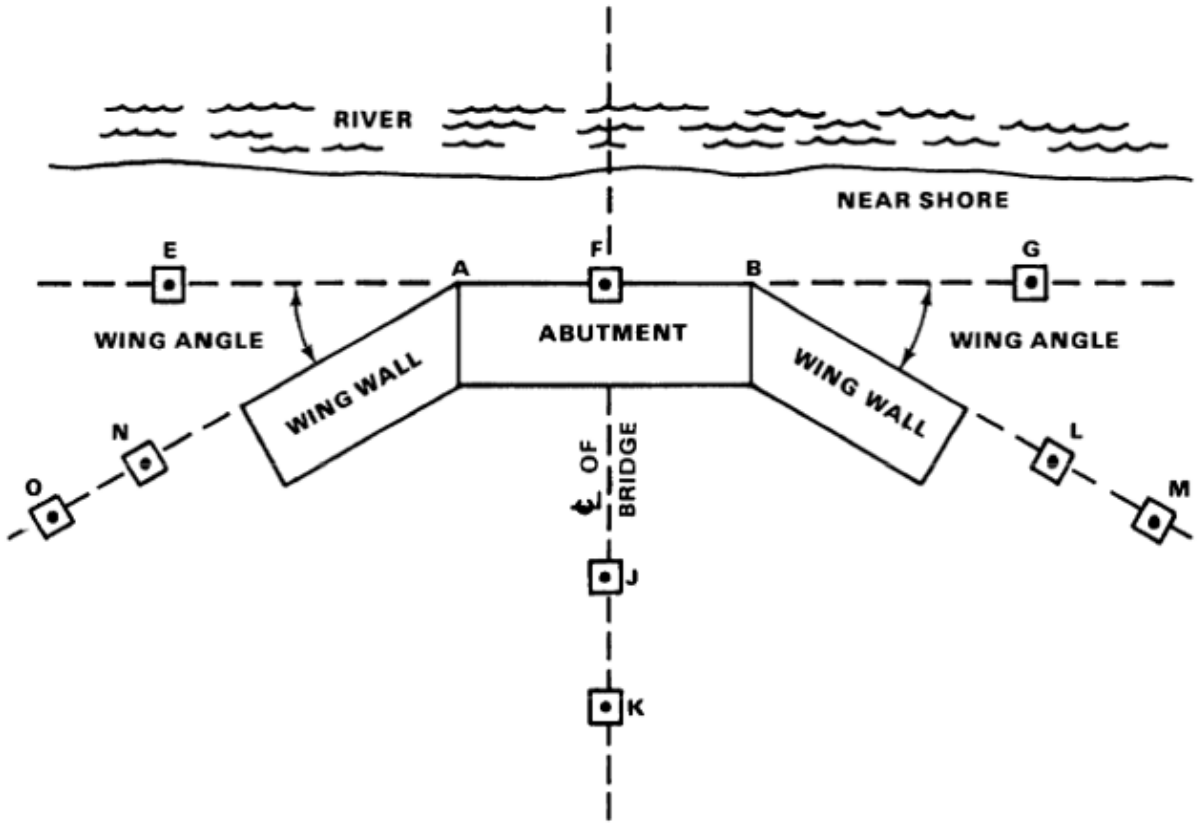

Figure 5-3: Staking wing walls

Because Points A and B are often damaged during construction, the surveyor must locate two reference points (L and M; N and O) along the line of sight for each wing wall. These points allow for the **relocation of Point A** by sighting through the references and inverting the instrument.

Purchase this course to see the remainder of the technical materials.