

SECTION 740 Staking Structure Layout

Construction staking structure layout includes stakeout of bridges, box culverts, noise barriers and retaining walls. The staking contractor should consult with the structure contractor and engineer before proceeding with structure stakeout. Method of operation and construction project staging may impact staking operation.

The alignment, riding surface, and appearance of a structure are the result of quality plans and specifications, accurate staking, and construction according to the plan and specifications. The staking contractor must have full knowledge of the plans and methods and is responsible for the geometric layout of the structure. Systematic checks must be developed on each structure to ensure the accuracy of all points and stakes set. Stakes that are out of tolerance must be reset within the specified tolerance. Errors in staking or in replacing points for major structures can be very costly. Extra time and care is warranted in staking and checking to prevent errors.

Before staking, horizontal and vertical dimensions and elevations must be checked by the staking contractor. Structure grades must be checked for match with existing and proposed improvements grades. Alignment and stationing of abutments, piers, wing walls, and other bridge components must be checked in the field to ensure the structure fulfills the purpose for which it was designed. Any conditions found in the field by the staking contractor that may require adjustments, line or grade, should immediately be brought to the attention of the engineer.

Field notes should include any sketches and computations necessary to stake the structure. This information includes stationing of abutments and piers, span distances, skew angles, wing wall angles, lengths and offset distances, as-staked field location, and control points used. Several sketches may be required for clarity and neatness. All points referred to in the notes must be clearly described to allow rapid recovery in the field. Remember, the staking contractor may not be there when the structure is built, so the notes must be self-explanatory. The meaning of all stakes and markings must be understood completely by the structure contractor and engineer. Field notes must be kept at the project field office for use at all times.

Vertical control must be maintained by a minimum of 2 independent benchmarks (usually each end of structure).

740.1 Preparing for Layout

Preparing for layout is an indispensable part of the bridge layout procedure. When preparing to layout a structure, the staking contractor should take note of the following considerations:

740.1.1 General

- The layout should be done before the structure contractor starts to take down the existing bridge.
- Before staking, identify with the structure contractor equipment location, storage areas, and obstacles.
- Transfer benchmarks. All elevations on the plan may be referenced to one benchmark. Should the plan benchmark be destroyed there may be no other bench marks available.
- Use different color ribbon to mark the lath. Don't make offset tie points look like all the other points staked out on the job - make the points different so they stand out from other stakes.
- Notify the structure foreman of the location and markings of offset points. Are the points in the contractor's way?

740.1.2 Reviewing Structure Layout - Longitudinal Reference Line

- Does it require major preliminary work to reestablish?
- Is it straight or on a curve?
- Is it currently on a structure or roadway that will be removed or excavated?
- What is the terrain (water, woods, hills, etc.)?

740.1.3 Reviewing Substructure Layout - Transverse Reference Lines

- Are all the abutments, piers, and wing walls skewed at the same angles?
- Check individual units - are all angles the same as plan sheet?
- Are all intersecting points of reference lines and center lines of bearings the same points as shown on the plan sheet?
- Is the stationing on intersecting points consistent with distances as shown for span lengths?
- Are intersecting points accessible in field (could be in water, middle of heavily traveled roadway, building, tree, etc.)?
- Will points be visible after vegetation grows (can see easily in winter & spring until foliage grows out)?
- Field conditions determine where you can set the points. Set points out far enough so that the equipment does not destroy them.

- When staking, lay out both sides of the bridge at the same time.
- If there is a river or other obstacle, stake on both sides of obstacle. The user may not be able to cross.
- If the existing ground on both sides of the reference line is going to be disturbed, establish ties outside of the disturbed area.
- After staking out a structure on tangent, check the span lengths between offset points and the skew angle.

740.2 Suggested Procedure

The staking contractor must always consult with the structure contractor and check with the engineer for changes to the approved plans before doing any staking or grade computations. The staking contractor should follow these steps when staking structures:

1. Locate all required information from the approved plan:
 - Longitudinal lines and stationing.
 - Centerline of bearing of abutments, centerline of piers, abutments, walls, barriers, or other pertinent structures (transverse reference lines). The centerline of bearing of the abutment and reference line of abutment are not always the same line.
2. Re-establish the roadway reference line from control points when needed.
3. Before construction begins, transfer the existing benchmark elevation to at least two other benchmarks on opposite ends of the structure.
4. Establish and clearly identify the longitudinal reference line from control points.
 - Line may be off to one side of the bridge, may be the roadway reference line, or a line tangent to the roadway curve or on curve.
 - Set line ties beyond structure's construction limits but close enough for the structure contractor's use.
 - Line tie points may be a stake and tacked hub, chiseled cross, PK nail, or other stable marker.
 - Locate tie points so that construction operations will not destroy them.
 - Document all information in the field book.
5. Field-locate the proposed points for the centerline of substructure units on the longitudinal reference line at the proper station.
6. Set and clearly identify points to establish the transverse reference lines.
 - 'Close' points should be approximately 90 to 100 feet from structure to stay out of the path of all the equipment.
 - 'Far' points are for line of sight only.
7. The staking contractor must systematically verify angles, span lengths, plan distances, and stationing of staked points.
8. Record all the data in field notes and make them available to the engineer within 24 hours as work progresses.

Refer to [CMM 715](#) for general field note information.

Field notes should include:

- Date, time, crew, location.
- Control used (horizontal and vertical).
- If conventional: Instrument heights and other back sights, foresights, etc.
- A layout sketch of the structure as staked.
- A layout diagram of staked point locations.
- Distances from stakes to centerline.
- All other pertinent information.

Examples of staking layouts are provided in figures 740-1, 740-2, 740-3, and 740-4. It's important to note that each contractor may have preferences that differ with the examples. The staking contractor should always verify staking procedures with the engineer and structure contractor.

Refer to figure 740-5 for example stake markings.

FIGURE 740-1 Example Stake Layout for Span Structure with No Obstacles

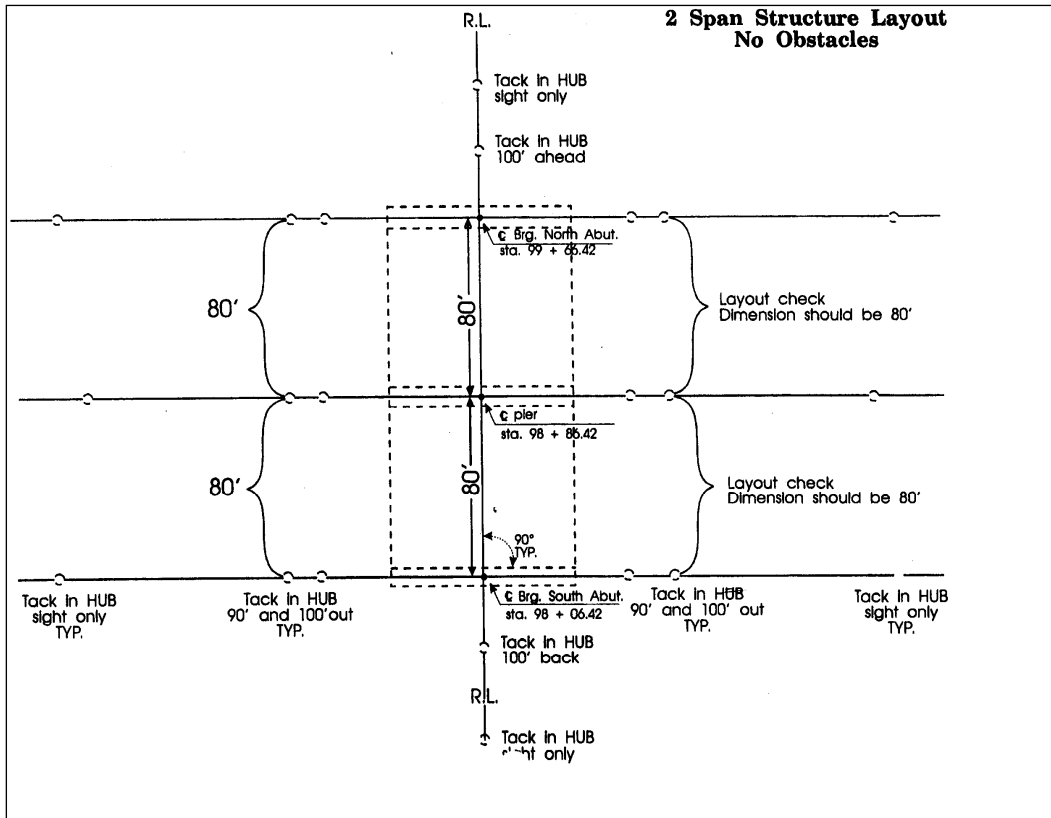


FIGURE 740-2 Example Stake Layout for Span Structure with River

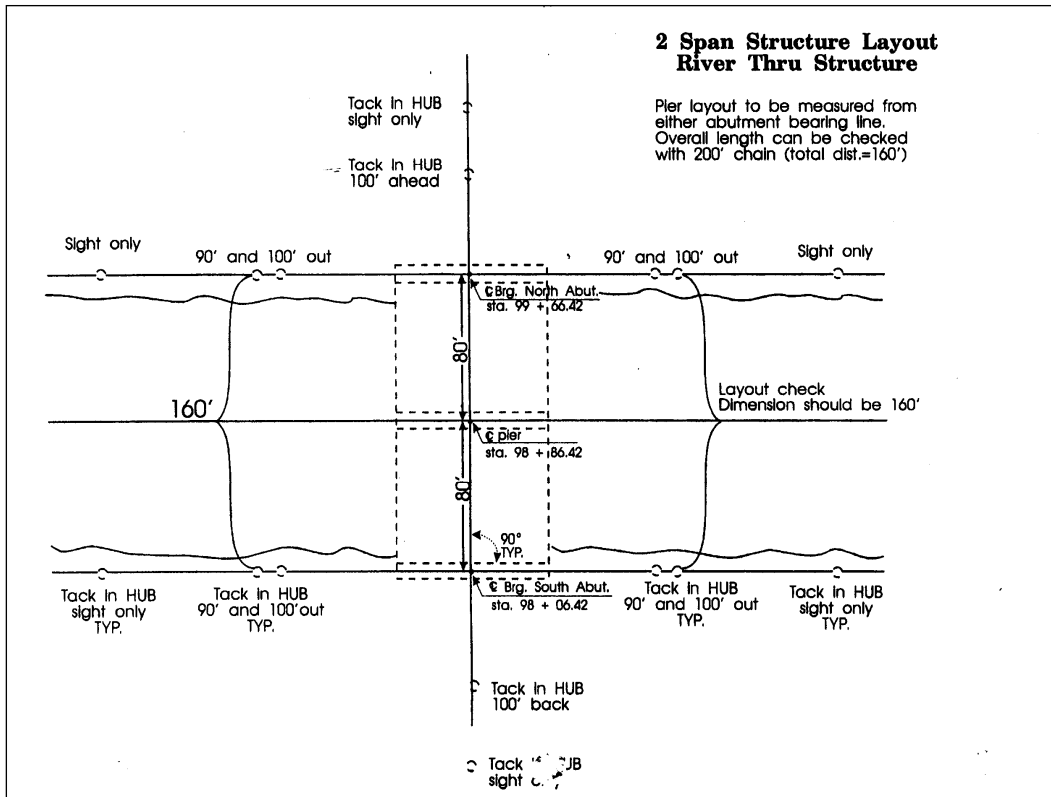


FIGURE 740-3 Example Stake Layout for Span Structure with Obstacles on One Side

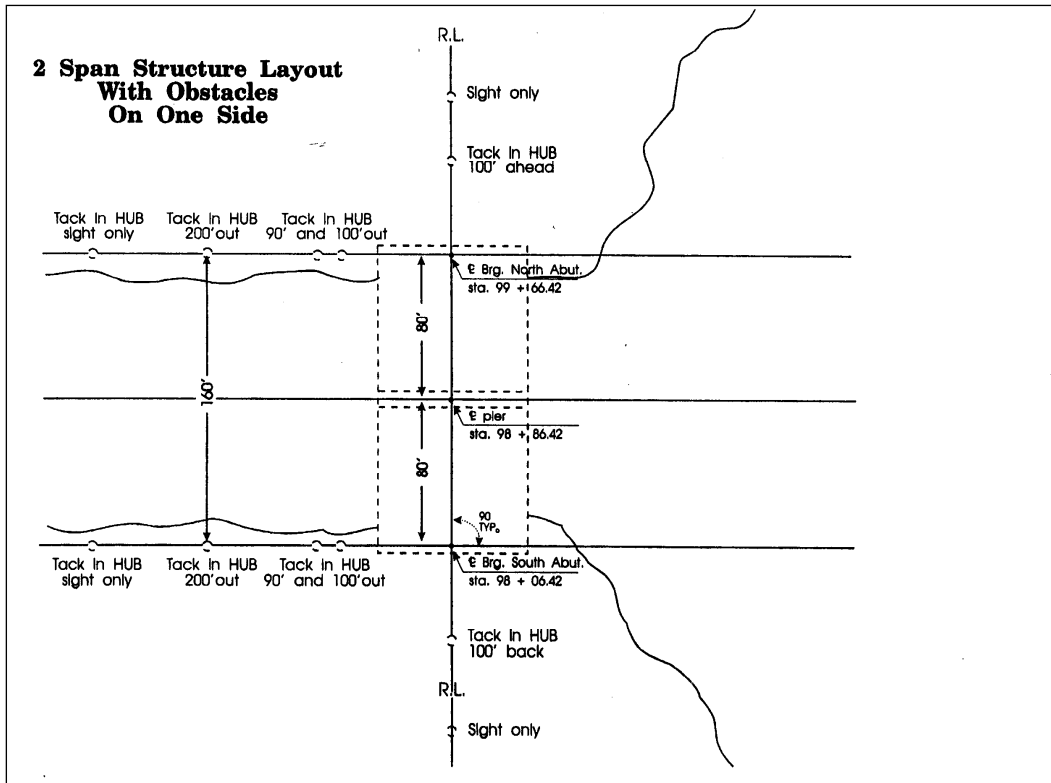


FIGURE 740-4 Example Stake Layout for Skewed Span Structure with No Obstacles

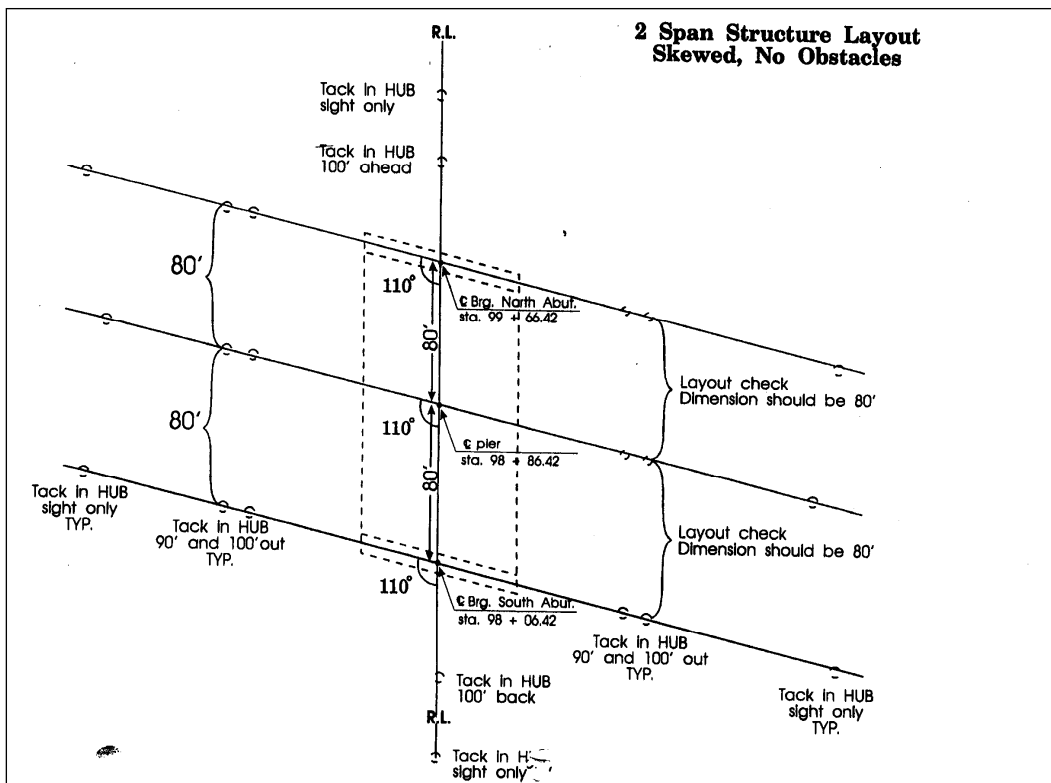


FIGURE 740-5 Labeling Structure Layout Stakes

