MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION	Office of Structures ***Guidelines and Procedures Memorandum***	DESIGN Number: D-85-25(G) Date: 03-16-2018
	Layout of Bridges on Non-Tangent Alignments	Approval:

General

On all projects where a proposed structure is on a non-tangent alignment, consideration shall be given to constructing the bridge with straight stringers and parapets.

In order to determine when this is feasible, the ordinate at the inside curve gutter line should be determined using the total length of bridge between centerlines of bearing of abutments. If this ordinate is less than 1 foot (1'-0"), then the structure should be laid out with straight stringers and parapets. This means that the bridge will be somewhat wider than it needs to be and the shoulder widths on the bridge will vary, with minimum required widths maintained throughout.

When a bridge falling within a non-tangent alignment is to be constructed with a straight superstructure, every effort should be made to construct the wingwalls on the same straight line as the parapets. On relatively short bridges, it may be possible to lay out the wingwalls along the same line as the bridge superstructure without exceeding the 1 foot maximum ordinate.

This is the most desirable case. If the wingwalls need to be kinked at a slight angle to the bridge superstructure, in order to accommodate the clearances, then the size of this kinked angle will depend upon the length of the wingwalls and the degree of roadway curvature. The clear roadway width between wingwalls will be somewhat wider than necessary and the shoulder widths will vary, with minimum required widths maintained throughout.

On bridges with curved superstructures, the designer should still attempt to lay out the wingwalls straight, using the same procedure as above.

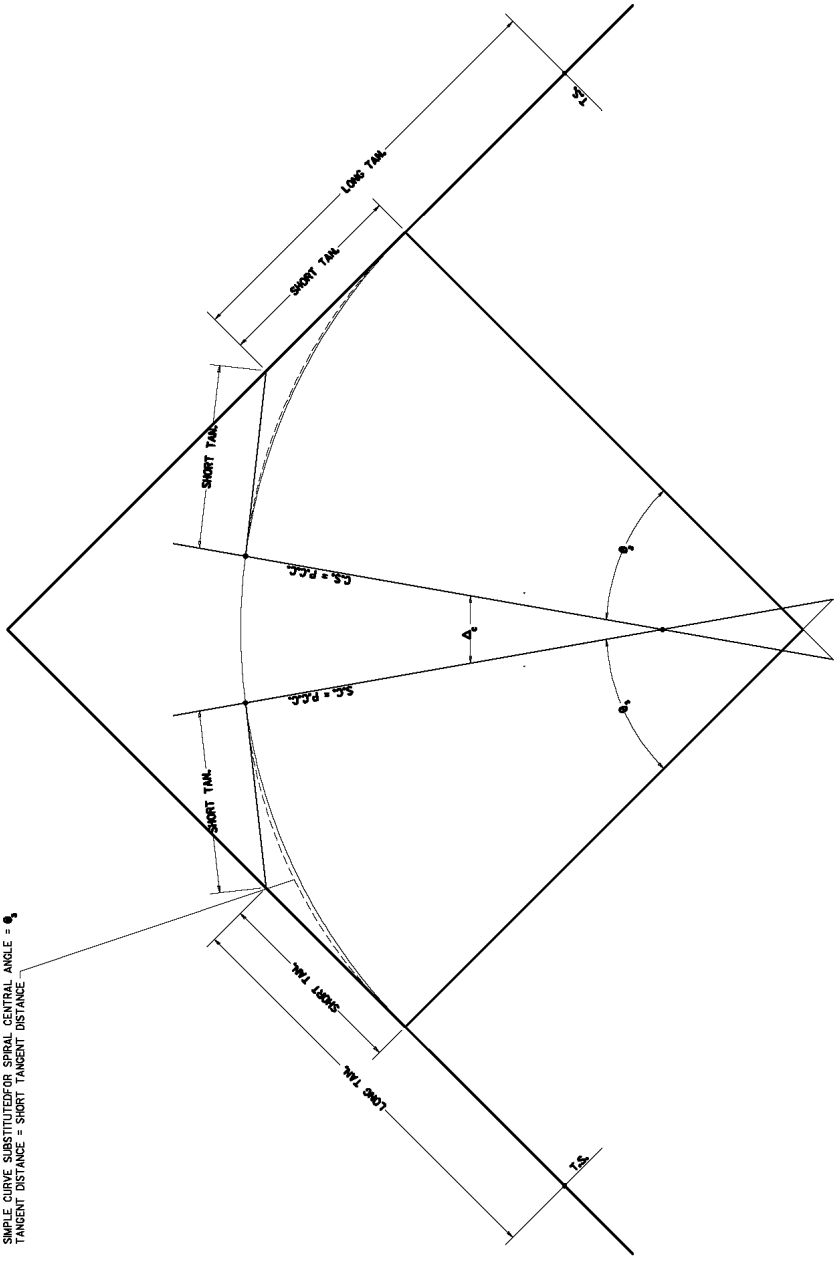
Bridges on spiral alignments represent a special case. In no case shall a bridge be constructed on a spiral. Bridges falling into areas of spiral highway alignments, shall be laid out using one of the following two methods.

1. A working line can be established, which is tangent to the spiral at some point, generally near the center of the bridge. The ordinate is then determined using the length of bridge between centerlines of abutment bearings. If this ordinate is less than 1 foot (1'-0") then the bridge can be laid out as described above for simple curves. Careful selection of the point of tangency for the working line is important. This may involve some trial and error.

2. A substitute base line can be established which will replace the spiral in the area of the bridge with a simple curve or a series of simple curves. The substitute base line will be offset somewhat from the original spiral alignment but for short spirals into relatively flat curves, this offset will not significantly alter the location of the bridge.

   The substitute base line is set up by replacing the spiral with an extension of the original tangent and a curve of constant radius. The spiral to curve (S.C.) point then becomes a point of compound curvature. The calculations for this substitute base line are such that the central angle of the curved portion of the substitute base line equals the θ_s of the spiral and the radius equals the short tangent of the spiral divided by the tangent function of one half of the central angle. The length of the tangent portion of the substitute base line equals the difference between the long and short tangents of the spiral.

   The following diagram shows the suggested method for substituting a constant radius curve for a spiral. The simplicity of this method is offset by the fact that for long spirals into relatively sharp curves, the substitute base line may fall a few feet outside the spiraling alignment. For a spiral 600 feet long going into a curve of 16 degrees the substitute base line falls a maximum of about 10 feet outside of the spiral. When large offsets result (greater than 10 feet) the substitute base line should be set up as a series of compound simple curves approximating the spiral. This approximation must be determined by trial and error.



A Method of Substituting Simple Curves for a Spiral

Using the replacement alignment, the ordinate to the simple curve is determined using the bridge length between centerlines of abutment bearings. If this ordinate is less than 1 foot (1'-0"), then the bridge superstructure can be laid out straight as described above. If the ordinate is greater than 1 foot, then the bridge will have to be constructed with a curved superstructure.

Working Lines

In a case where a bridge falls on a non-tangent alignment, it will be necessary to establish a working line from which to lay out the bridge. The following cases describe the manner in which working lines are to be established. Alternate methods may be approved on a case by case basis. However, these examples are to be followed whenever applicable.

1. A bridge constructed with a curved superstructure and radial substructure units should be laid out off of the curved baseline.

2. A bridge constructed with a curved superstructure and non-radial substructure units should have its superstructure laid out off of the highway curve data in the area of the structure, and its entire substructure laid out off of a straight working line. This straight working line will generally be a tangent to the baseline at a point near the center of the bridge. All dimensions, angles and other geometric information for the entire substructure should be referenced to this straight working line.

3. A bridge constructed with a straight superstructure and non-radial substructure units should be entirely laid out off of a straight working line. Established as noted above.

It is desirable to lay out both sides of a bridge (or all four sides of a dual bridge) off of a single working line. However, it is not mandatory. There may be cases where it is necessary to establish more than one working line. The use of only a single working line is preferred.

Lane Lines

The travel lines for the highway will be striped in accordance with the highway base line curve data (either circular or spiral) through the bridge area and the shoulder widths on the bridge would vary but never be less than the minimum established by MDOT policy.