

**CE 466 / 566 Highway Geometric Design  
Homework 5**

Due Thursday, March 26, 2009

This homework involves the design of an alignment that connects the intersection of Sabino Canyon and Tanque Verde, on the east side of Tucson, with Kolb. You will need to use characteristics from the City of Tucson's Street Development Standards for the roadway design controls (posted on the web site).

In addition to the City of Tucson design standards, here are a couple major design controls:

- The design speed should be 50 mph. This reflects the current design of Sabino Canyon north of Tanque Verde, with a posted speed of 40-45 mph.
- A set of points (kolb-sabino.txt, in a zip file) are given on the course web site. The points are in the form Easting, Northing, and Elevation. Again, these points are comma-delimited and start on line 1.
- Assume (if needed) that the roadway will be a 4-lane divided highway with a raised median. You can use the typical cross-section of a 4-lane divided highway (with 100' of ROW) shown in Figure 4, page 13, of the Major Streets and Routes Plan (<http://www.tucsonaz.gov/planning/plans/all/msr.pdf>).

Problem 1

- (a) What is the minimum allowable radius of a horizontal curve?
- (b) What is the minimum radius at which a reverse crown can be used?
- (c) What is the minimum radius at which a normal crown can be used?
- (d) According to the Green Book, how long is the tangent runoff for the situations in (a) and in (b)? (Two numbers are needed.)
- (e) According to the Green Book, how long is the superelevation runoff for the situations in (a) and in (b)? (Two numbers are needed.)
- (f) What is the minimum length of a crest vertical curve that meets sight distance requirements?
- (g) What is the minimum length of a sag vertical curve that meets sight distance, drainage, *and* comfort criteria?

Problem 2

For this assignment, you should generate **one (1)** possible horizontal and vertical alignment for this roadway segment. In doing so, complete the following steps:

1. Load the topographic files for the area, and generate a surface.
2. Station the intersection of Tanque Verde and Sabino Canyon as 0+00, and provide stations all the way to Kolb.
3. Identify the horizontal alignment, and indicate this in a plan view. You should clearly indicate the radius, as well as the PC, PI, and PT of all horizontal curves, in the plan view.
4. If you choose to superelevate the roadway through any curves, complete a superelevation diagram for each horizontal curve. Clearly dimension the length of the tangent runoff and the superelevation runoff.

*We will talk later in the semester about setting up superelevation alignments within InRoads. For this assignment, all superelevation diagrams should be done manually. The use of Excel or similar program is highly encouraged.*

5. Accompanying your plan view should be 1-2 coherent paragraphs documenting and explaining (1) your choice of curve radius (or radii); (2) your choice of whether or how much to superelevate in each horizontal curve; and, (3) your choice of whether or how long to make any transition segments. Note that the City of Tucson generally does not use spirals.
6. Identify the vertical alignment, and annotate this in a profile view. The profile view should clearly indicate both the existing ground level and the proposed vertical profile of your roadway. You should also indicate on the profile (1) all tangent grades; and (2) the length of any vertical curves.
7. Accompanying your profile view should be 1-2 coherent paragraphs explaining (1) your choice of grades; and, (2) your choice of length of each vertical curve.

***You should make sure that your design meets the City of Tucson design controls, or that you explicitly justify any variance from these design controls. Homework that does not meet the City of Tucson's design controls will lose points, regardless of the accuracy of the design.***