CE 466 / 566 Highway Geometric Design
Homework 2
Due Thursday, February 5, 2009 by 5 pm (hard copy) or midnight (electronic)

Problem 1
On the class web site are links to two documents: (1) the City of Tucson's Major Streets and Routes Plan at http://www.tucsonaz.gov/planning/plans/all/msr.pdf and, (2) the Pima County Department of Transportation's Roadway Design Manual at http://www.dot.co.pima.az.us/transeng/roaddesign/

You should familiarize yourself with these documents; they will be used regularly throughout the semester.

(a) What is an arterial? Using the Green Book (Chapter 1), briefly describe (by *paraphrasing*, not *plagiarizing*, in a paragraph), the function of an urban arterial.

(b) Identify any similarities or differences in the definition of an arterial, comparing what is stated in the Green Book (i.e., your answer to part a) to what is specified in the Major Streets and Routes Plan.

(c) The two jurisdictional reports (for the City of Tucson and for Pima County) give examples for the recommended cross-section of an arterial. Using a 4-lane divided (urban) and a 5-lane divided roadway cross-sections, compare the templates for the City of Tucson with those from Pima County. What are the similarities and differences? ***And***, briefly comment on any differences.

Problem 2
One local project in Tucson is examining design concepts for Grant Road, between Oracle and Swan. The primary project site on the web is http://www.grantroad.info/ . At that site, you might be interested to download a recent overview of the proposed design concept, preliminary alignment, and both 137-ft and 160-ft roadway cross-sections. This can be found on the main page, under "Quick Links" on the right, under "View the Recommended Alignment for Grant Road." Note: this PDF file is about 18 MB. After glancing through this, answer the following questions.

(a) What is (are) the design vehicle(s) for the new alignment of Grant Road? I.e., try to identify "the largest design vehicle likely to use that facility with considerable frequency or a design vehicle with special characteristics appropriate to a particular intersection in determining the design of such critical features as radii at intersections and radii of turning roadways." (Green Book, p. 15)

(b) For the design vehicle(s) from part (a), identify elements in the Grant Road alignment and/or cross sections that should be directly dependent on this (these) design vehicle(s).

(c) Look up what you believe to be the most important dimensions for the design vehicle(s) from part (a). These are in the Green Book, and/or you can use common reference web sites for bicycling (http://www.bicyclinginfo.org/engineering/) and walking (http://www.walkinginfo.org/engineering/). Identify these dimensions in your answer. Then, as best as you are able from the Grant Road drawings, briefly compare these dimensions to the recommended alignment and/or cross sections for Grant Road.

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Problem 3

Perform the following set of experiments to determine the rate at which you process information. Use a standard deck of cards (52 cards, with 4 suits, Ace through King (13 cards) in each suit, and no jokers).

1. Perform all seven tasks listed in the table below. You should also perform **each task *at least three times***; that is, you should complete at least 21 experiments.
2. Shuffle the cards carefully after each experiment. A common rule of thumb is to shuffle at least 7 times to achieve a random re-arrangement of the cards.
3. Begin each experiment with the cards facing down, and do not begin timing until you understand completely what is to be done in the experiment and you are ready to begin.
4. Using a stopwatch or a second hand, time yourself to complete the experiment.
5. Find the average time per card (Average = Total time for experiment / # of cards in the experiment).
6. Using your favorite graphing technique (e.g., an X-Y Chart in Excel), plot the average time per card from step 5 vs. the information per card (in bits, given below for each experiment). Note that you should have at least 21 data points on this graph.
7. Fit a line to the resulting data, of the form:

   Average time per card = $a + b$*(Information per card, in bits)

   where a is the intercept and b is the slope from your fitted line.

   Excel is a perfectly reasonable tool to fit this line, either within the Chart Options or using Tools-> Data Analysis-> Regression. Again, you should have at least 21 data points in your chart or table.
8. Identify, from your line, your information processing speed, in bits/sec. Note that the coefficient b is in units of (seconds per bit).

Task	Number of Alternatives (N)	Information/card (bits) = $\log_2 N$
Divide the deck into two equal parts	1	0.00
Divide the deck into red and black cards	2	1.00
Using only face cards, divide the deck into jacks, queens and kings	3	1.585
Divide the deck into the 4 suits	4	2.00
Divide the deck into the 4 suits, but separate the face cards from the numbered cards	8	3.00
Divide the deck into 13 piles, in increasing order (ace to king)	13	3.70
Divide the deck into 13 piles, in increasing order (ace to king), separating the red and black cards	26	4.70