CIVL 1112 – Assignment #8   Name: _____

Objective

The purpose of this assignment is twofold: first, to continue to develop your engineering spreadsheet skills, and second, to develop a complete analysis tool for your reinforced concrete beam project. This spreadsheet will combine your work from the ACI mix design (Assignment #6) and rectangular reinforced concrete beam (Assignment #7) with an estimate of the reinforced beam cost to predict a cost-adjusted strength-to-weight ratio (*ASWR*).

Part 1. Compute the *ASWR* for each beam from the Week 1 data. Average the results for each beam type (the set of beams with no reinforcement, 1 rebar, 2 rebar, and 3 rebars) and plot the average *ASWR* as a function of the number of reinforcing bars.

Part 2. Develop a spreadsheet to predict the *ASWR* of a rectangular reinforced concrete beam in bending without considering shear reinforcement in the beam weight or cost. Use the spreadsheet to predict the *ASWR* for the reinforced concrete beam in the sample interface sheets.

- Input parameters should include the height and length of the beam, the amount of reinforcement material (both tension and shear), the compressive strength of the concrete, the yield stress of the reinforcement, the unit weight of the concrete, the minimum concrete cover for the reinforcement, the minimum spacing between rebars, and the shear reinforcement spacing.

- From these inputs, you should compute the minimum width of the beam b, the depth to the center of the reinforcement d, the area of steel in tension A_s, the area of steel is shear A_v, the b_1 constant, The height of the Whitney stress block a, and depth to the neutral axis c, the c/d, the predicted strength in tension, shear, and compress, the weight of the beam, the *SWR*, the cost of a single beam, and the *Adjusted SWR*.

- In addition, check to see if the reinforcement yields before the concrete crushes (see class notes) and if the reinforcing bars fit into the proposed beam.

- Compute the cost of the reinforced concrete beam on the "ACI Mix" sheet of your workbook. Use the format shown below. The costs of the concrete materials and steel rebar are included (see the cost sheet for details). Also, notice that this sheet includes the new values for the material parameters. Values for the concrete compressive strength, beam dimensions, and steel volume are available on the "Rectangular Beam Analysis" sheet.

Use your spreadsheet to predict the *ASWR* for the following reinforced concrete beam:

Concrete mix criteria: f'_c = 6,000 psi, 3 to 4 inches of slump, 0.375 inch maximum aggregate size. Use the coarse and fine aggregate material parameters shown in the "ACI Mix" sheet above, and assume the unit weight of concrete is 150 lb/ft^3.

Beam criteria: L = 30 in., h = 6 in., f_y = 60,000 psi, A_s = two #3 bars in tension, concrete cover = 1.0 in., bar spacing of 1 in., and one #3 U-shaped rebar spaced at 3 in. for shear reinforcement.

Part 3. Read Chapters 13 and 14 in A Mind for Numbers by Barbara Oakley.