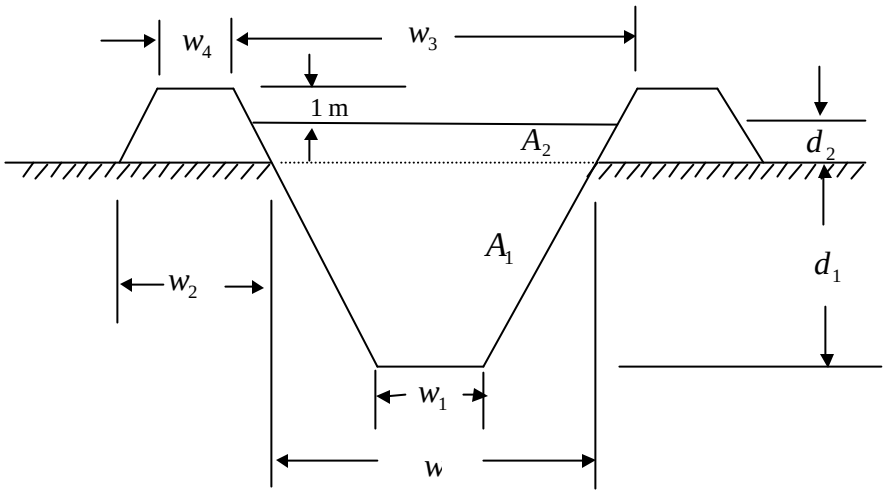
AOE/ESM 4084 - ENGINEERING DESIGN OPTIMIZATION
Fall Semester, 2000

Homework Assignment 1
Due 2.00 PM, Tuesday, September 5



Design a water canal that has a wet-section cross sectional area (area of the cross section occupied by water, A_1+A_2) of at least 150.0 m^2. For safe passage of boats, the water depth in the canal, $d_1 + d_2$, must be larger then 15 m. Least construction cost occurs when the volume of the excavated material, A_1, equals the amount of material used for the dykes as shown in the figure above.

Note that the water level in the canal is 1.0 m lower than the top of the cross-sectional area of the canal. In addition, the slope of the soil is assumed constant along the sidewalls of the canal.

a) Formulate the problem to minimize the dugout material A_1, and transcribe it in standard mathematical optimization formulation (the easiest complete formulation may not necessarily be the one with the fewer number of design variables).

b) Solve the problem graphically (by reducing it two design variable problem, w and d_1) to obtain an approximate numeric answer for the optimal design variables and objective function. Use the following values in this part of the problem,

$$w_1 = 4.0m, \quad w_2 = 15.0m\,.$$

c) Determine the exact numerical result by solving the constraint equations.