Concordia University

Department of Building, Civil and Environmental Engineering

CIVI 341: CIVIL ENGINEERING SYSTEM

Assignment No. 1

(Due January 23 at the beginning of lecture)

Provide the **signed originality form (from Moodle) as the cover page for the assignment no. 1 **only**.*

**Please note that no late submission will be accepted.*

Identify the following problem components

(a) ***Decision Variables***

(b) ***Parameters***

(c) ***Objective function***

(d) ***Constraints***

1. (1.1) Environment. Acid rain in the northeastern part of US has been attributed in large part to sulfur dioxide emission from coal-fired 1. power plant in Ohio and other states of the Midwest. Generally, northeasterly winds blow the emissions from these electric power plants toward the Midatlantic, Northeastern, and New England states. Studies have indicated that the air quality in this downwind region is not equally contributed by all power plants in the large geographic region of the Midwest. That is, apound of sulfur dioxide emitted from each of two different plants in the Midwest does not result in the same reduction in air quality at each monitoring site in the Northeast. This differing impact is due to the different locations of the two plants and the Winds that blow past them. Said differently, a pound of sulfur dioxide emitted at each power plant site in the Midwest has a characteristic and predictable impact on air quality at each of the many downwind sites in the Northeast. A factor may be derived that translates each pound emitted at each origin site into a concentration contribution of Sulfur dioxide at each of the many destination sites where air quality is measured. The concentration at each monitoring site is the sum of contributions from each of the power plants in the Midwest.

In addition, the unit cost of sulfur removal from the air waste stream of plants in the Midwest differs significantly by plant. For some plants, it is less expensive to reduce emissions, for others it is more costly. It is also obvious that not all plants are the same size or technology. Therefore, the amount of untreated sulfur dioxide-the amount prior to cleanup—found at each plant differs. Any clean-up plan must also consider equity of impact among the sources: widely varying clean-up efficiencies or removal levels across the electric power plants will be viewed as discriminatory.

Further, since the consumer of the electricity must ultimately pay the clean-up cost in electric rates, a strong effort must be made to keep total costs as low as possible. A control strategy-a removal level for each midwestern power plant-is needed in order to reduce emissions to levels that ensure the air quality concentrations at all downwind monitoring sites meet environmental standards.

2. (1.4) Structures. A singly reinforced rectangular concrete beam must carry a known imposed moment and shear. The span length is also known, and the deflection of the beam must not exceed a certain value. The width and depth of the beam are to be determined, as is the area of steel to be placed in the bottom of the beam. The cost of concrete per-cubic yard and the cost of steel per-pound is known, as is the compressive strength of the concrete and yield strength of the steel. The designer wants to design the least-cost beam. The code for such beams states that a certain minimum amount of Steel, as a percent of the total effective cross-sectional area, must be present in Order to avoid excessive cracking on the bottom of the beam due to temperature fluctuations. The code also gives a limit on the maximum amount of steel, again expressed as a percentage of the total effective cross-sectional area of the beam, that can be present to avoid sudden compressive failure in the concrete at the top of the beam.

3. (1.6) Construction. A construction contractor employs a given force of skilled Workers and has a limited set of specialized machinery. There are a number of categories of skilled Workers, as well as a number of classes of specialized machinery. The contractor has a number of construction projects underway and has committed the company to completion dates for each of them. Certain job items (activities) are common to the various projects and require the same inputs of labor and equipment. The activities occur on various dates throughout the time span from project start to project completion.

However, the contractor does not have enough labor and equipment to work on these job items on the same day on all projects. Hence, the contractor wants to schedule (stagger) the specialized work forces and specialized equipment on the projects so that ideally no labor or equipment shortages exist on any day and so that each project is done on time. If any shortages do exist, extra costs must be incurred for temporary Workers or for equipment. A predetermined payment has already been received for each project. Now, the contractor Wants to keep construction costs to a bare minimum.