Problem Description - Module 1

This project involves designing an efficient last-mile delivery system for a city. A company has a set of customers $C = \{1, \ldots, \bar{c}\}$, each requiring the delivery of a package. The weight of each package $w_c, c \in C$ is known. The delivery time for each customer is equal to $s_c, c \in C$. The company has a set $K = \{1, \ldots, \bar{k}\}$ of delivery vans available that all start from the same depot 0 at time 0, have the same capacity W, and must return to the depot withing t_{max}. Each vehicle can exit the depot at most once. The problem can be formulated on a complete directed graph $G = (V, A)$, where $V = C \cup \{0\}$ is the set of nodes and $A = \{(i,j)|i,j \in V, i \neq V\}$ is the set of arcs. Each arc can be traveled at most once by any of the vehicles. For each arc $(i,j) \in A$, let us define the time t_{ij} required to travel over the arc. Travel times satisfy the triangle inequality. The goal of the company is to minimize the total time required to complete the service for all customers. Provide a mathematical formulation of the problem and its optimal solution.