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Investigation of Ready Mixed Concrete Transportation Problem Using Linear Programming and Genetic Algorithm

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Abstract

Ready-mixed concrete (RMC) is one of the most common building material for construction industry for nearly all developed and developing countries. Generally, because of the technical requirements, concrete must be mixed in a batch plant and transported to the construction site. There are two important factors affected the cost of RMC: raw material cost and transportation cost. Additionally, transportation cost is also included when determining the unit price of RMC. However, profitability affects adversely in the case of long distance between the plant and construction site. For these reason, distribution of RMC from supply to the demand points with minimum cost is aimed in this study. This work contributes to both modelling and dispatching of RMC as an optimization problem by applying linear and heuristic methods. For this purpose, as an example, an urban area which divided into 7 districts and contained 4 concrete batch plants is discussed. Linear programming and genetic algorithm were applied to solve this problem and compared each other under the same conditions. The result shows linear programming is more efficient for this application because of the limited constraints and variables.

Keywords: Optimization; Genetic Algorithm; Mathematical Modeling; Ready-Mixed Concrete.

1. Introduction

Concrete is one of the most widely used construction material in the world which was first introduced into the construction industry in the early 20th century. Nowadays, concrete is especially prepared by concrete batch plant according to varied recipes to meet the requirements of the construction site and then transported to the construction site. Therefore this product is called Ready Mixed Concrete (RMC). To expand the service of RMC without establishing high cost batch plant at the construction site, the RMC truck was invented to deliver RMC to the construction site. From the business point of view, the RMC batch plant manager may want to dispatch RMC trucks to different construction sites as many as possible to maximize the production and profits of the plant. In addition to, the necessity of the concrete placement in a limited time supports the importance of distance. RMC usually needs to be cast within 1.5 hour after being produced by the batch plant, which limits the service areas of the RMC batch plant. In addition, because of limited service area, the business competition between RMC batch plants is intense [1].

Optimization is the first technique that comes to mind to solve RMC transportation problems. There are many efficient and flexible models and researches based on optimization techniques in literature that have been proposed to solve RMC production and delivery problems. Especially, in the last decade a number of studies have been conducted using heuristic methods to obtain notable solutions for this problem by researcher. The majority of them are related to scheduling. Lu and Lam [2] focused on how to simultaneously optimize concrete delivery schedules and resource provision for the plant, based on a simulation modeling platform which incorporated a combined discrete event simulation and genetic algorithms to model and further optimize one-plant-multisite RMC plant operations.

Feng and Wu [3] analyzed factors that impact on the delivery process, then built a model based on genetic algorithms and simulation techniques to find the best dispatch schedule that minimized the total waiting time for trucks

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