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Productivity of Batching Plant and Quality of Concrete Production

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Abstract:-Ready mixed concrete (RMC) placing is a major on-going operation on construction projects in many countries. Evaluating the productivity of a ready mix concrete batch plant is one of the most challenging tasks of a plant manager and engineer, since it involves lot of uncertainties, thus risks. Delivering ready-mixed concrete (RMC) efficiently to construction sites is a practical concern and one of the most challenging tasks for RMC batch managers. Batch plant managers must consider both time and order factors in order to set an RMC truck dispatch schedule that successfully balances batch plant (supplier) and construction site (customer) priorities. This project develops a transportation model to determine the solutions for RMC truck dispatch scheduling. The model takes into consideration uncertainties as well as unexpected situations such as truck breakdowns during delivery. This project is highlighting the study of Batching plant productivity without affecting quality of concrete by prolonged recapitulation of various batching plants sites for the factors which could affect the output of subject batching plant and descry and predicament shooting of such factors in time. In this paper Past studies based on Productivity of batching plant is studied in detail.

Keywords: Batching plant productivity, recapitulation, descry, predicament.

I. INTRODUCTION

In the past, wheel barrows were used to "batch" and load the concrete mixer. Tipping trucks were used to haul the fine and coarse aggregate to the work site and dump the material in piles along the roadside. With hand shovel, the workman was loading the material into wheel barrows: which also served as a volumetric measure to load the skip hoist with two-bags, in a steam-powered concrete mixer. Cement bage were loaded by hand into the skip hoist. The next step was to reduce labour to achieve volumetric batching during early 1920s.Material was piled along roadside and workers used to hand-shovel them into the volumetric hoppers. A mobile (steel wheels) belt conveyor arrangement was devised with three-or four wheeled volumetric hoppers. The pioneer plant manufacturers started to construct aggregate bins with batch gates and volumetric batchers. Between 1 925 and 1 960 there were significant improvements in the fabrication of such plants. Prior to 1930, volumetric batching was used to proportion the material. This was replaced by weigh batching with a beam fitted with dial scales, being more accurate in proportioning the material. The first ready-mix plant was built in the 1930. With the increase in paving capacity the demand of paving concrete also increased. Mostly stationary plants were designed and constructed for specific application, through modular concept approach. The plant was divided into three distinct modules: aggregate storage and batching, cement silos, and the mixer unit. In India, the Concrete Plants were introduced in 1970's and their use was restricted to major construction projects. Bhakra Dam was the first project where RMC was used. Later on Concrete Plants were used for other large projects such as construction of long span bridges, industrial complexes etc. In 1993, first Concrete Batching and Mixing Plant were used for NH-2 Delhi-Mathura Road concrete pavement project of the Ministry of Road Transport and Highways. Modern concrete plants employ computer aided control system to assist in fast, accurate measurement of input ingredients, as well as to synthesize the various parts and accessories for coordinated and safe operation. With the performance of concrete being dependent on accurate water measurement, systems will often use moisture probes to measure the amount of water that is part of the aggregate (sand and coarse aggregates) while it is being weighed, and then automatically compensate to account for in mix design for water target. The plant can be supplied for virtually any type of batching, whether wet, dry, and half-wet or slurry (colloidal).

II. PURPOSE

Infrastructure development has resulted in increase in the demand for quality concrete. The two main criteria determining the quality of concrete are its strength and durability. The process of achievement of strength and durability of concrete begins with its production. The ease with which quality control measures can be implemented at the production stage is not available in later stages of transportation and placement of concrete.

Ready-mix concrete is a type of concrete that is manufactured in a factory or in batching plant, according to a set recipe, and then delivered to the work site. A Concrete Batching and Mixing Plant, combines various ingredients like sand, water, aggregates, chemical and mineral admixtures (fly ash, plasticizer etc), and cement by weight to form concrete. Capacity of the plant is measured in cum per hour. It depends upon capacity of mixer, number of mixers, charging, mixing and discharge time of each mixer. The purpose of Concrete Batching and Mixing Plant is to produce homogenous and uniform concrete, as indicated by physical properties such as

unit weight, slump, air content, and strength in individual batches and successive batches of the same mix proportions.

Introduced in the construction industry in the early 20th century, ready-mixed concrete (RMC) is widely used because of its good quality and quick execution .RMC delivery, however, presents complex problems in terms of logistics and combinational optimization due to the relatively short time permitted between batching (production) and placement. RMC must typically be poured within 2 h of batching to prevent hardening in transit. Also, concrete should be cast continuously on a jobsite to ensure consistent quality. RMC delivery delays will cause concrete to become disjointed. In addition, RMC distribution involves various other problems such as accurately estimating travel durations and traffic conditions between the batch plant and jobsites and maximizing truck capacities. While the timely, regular delivery of RMC to a construction site is crucial to project success, this task is a particularly difficult supply chain to maintain due to many complex factors and constraints. High variability in terms of site concreting operations, plant-to-site travel times, and site orders have

Encouraged the construction industry to continue to rely primarily on trial-and-error strategies and staff experience to run RMC batching and distribution operations. There remains a general lack of effective scientific, analytical, or systematic methodological support.

III. RELATED WORK

Jae G.Jeong, Makarand Hastak, Matt Syal [2006], Communication, visibility, and control of materials across the supply chain are necessary components for an efficient supply chain management system. The objective of this research is to identify the bottlenecks in the entire supply chain process in the manufactured housing industry and suggest ways of improvement. The methodology for this research is based on use of simulation models to compare the current systems and the proposed systems. The supply chain simulation model was developed by using the ARENA simulation package for the manufactured housing industry based on conceptual model which was developed from analysis of the current supply chain practices. Finally according to the simulation results, the most feasible and optimized new supply chain management system, an online ordering system combined with the ERP system, was proposed for the manufactured housing industry.

Anil Sawhney, Osama Abudayyeh ,Tavatchai Chaitavatputtiporn [1999], Computer modeling and analysis of construction processes have gained importance in recent years because of an increase in the complexity of construction processes. Petri nets provide a modeling and analysis approach that can be used to effectively study, understand, analyze, and improve construction processes. This paper highlights the advanced features of petri nets and describes their utilization as a process modeling and analysis tool for the study of a ready-mix concrete plant. Usually process modeling and analysis are performed by initially developing a graphical portrayal of the process and then dynamically studying the response of the process to external and internal factors. A petri net is a formal graphical modeling tool that can be efficiently utilized as a process modeling and analysis tool because it can graphically portray and dynamically analyze a process in an integrated manner. The paper contributes significantly in the area of computer-based decision making and provides value to practicing schedulers, estimators, and project managers who deal with complex construction processes.

Min-Yuan Cheng, Duc-Hoc Tran [2016], Delivering ready-mixed concrete (RMC) efficiently to construction sites is a practical concern and one of the most challenging tasks for RMC batch managers. Batch plant managers must consider both time and order factors in order to set an RMC truck dispatch schedule that successfully balances batch plant (supplier) and construction site (customer) priorities. This paper develops and optimization framework that integrates discrete event simulation (DES) and multi objective differential evolution (MODE) to determine the solutions for RMC truck dispatch scheduling. The model takes into consideration uncertainties as well as unexpected situations such as truck breakdowns during delivery. In addition, the chaotic initialized opposition multi objective differential evolution (COMODE) algorithm is used to optimize the dispatching schedule, which minimizes the total waiting duration both of RMC trucks at construction sites and of construction sites for trucks.

Tarek M. Zayed, Daniel Halpin,[2001], The decision-making process is a very essential part of any construction operation. Simulation can be used as a tool to assist construction managers in making informed decisions. In this paper, simulation is applied to concrete batching operations to analyze alternative solutions and resource management. Data are collected to define activity durations for the plant. A simulation model is constructed for the plant using the Micro CYCLONE simulation system. Based on sensitivity analysis, management tools are constructed to help the decision maker. These tools are a time-cost-quantity chart, a feasible region analysis, and a contour lines chart. Time-cost-quantity and contour lines charts are used for determining production time, production cost, and resources for a required distance from the plant. The feasible region chart is used for determining the range of alternative solutions that can be taken to minimize production time and cost of the available plant resources, according to the required transportation distance.

Tarek M. Zayed, Issam Minkarah, [2004], A concrete batch plant is an important element in any concrete construction process, whether it is working as a central mixing plant onsite or is offsite supplying ready mixed concrete to a project. This study tackles the problem of optimizing plant production to maximize profit and, if possible, revenue. A linear programming model has been designed to optimize the plant operation. The maximum production rate for each type of concrete can be obtained by solving the model under the given constraints. A sensitivity analysis is conducted to provide management with a flexible range of prices per cubic yard cubic meter and material storage limits. In addition, a model has been designed to determine the optimal number of transit mixers based upon the required quantity of concrete. A chart has been developed to determine the quantities of concrete ingredient materials required daily to organize the available storage space and to plan their delivery. This research helps the concrete batch plant management organize its fleet of transit mixers, design its storage areas, and plan materials delivery. A model has been designed to determine the optimal number of transit mixers based upon the quantity of concrete. A chart has been developed to determine the quantities of different materials required daily to organize the available storage space and plan the delivery. Therefore, this research presents an important contribution to the successful management of concrete batch plants.

W. T. Chan,Hao Hu Amit Rana [2002], There are two alternatives for production organization in precast factories—namely, the comprehensive method and the specialized method. Production scheduling under the specialized alternative has been found to be a difficult optimization problem if heterogeneous elements are involved. A flow shop sequencing model that incorporates actual constraints encountered in practice is proposed for this difficult case of precast production scheduling. The model is solved using a genetic algorithm. The traditional minimize make span and the more practical minimize tardiness penalty objective functions are optimized separately, as well as simultaneously using a normalized weighted GA. Comparisons between the GA and classical heuristic rules show that the GA can obtain good schedules for the model, giving a family of solutions that are at least as good as those produced by the use of heuristic rules.

Xueying Tian, Yasser Mohamed, Simaan AbouRizk ; [2010], Production and supply of construction materials plays a significant role in the delivery of constructed facilities, especially for concrete and asphalt batch plants. The construction material (e.g., concrete) supply chain presents unique challenges, but is a key factor in successfully delivering facilities. This paper presents the development and application of a simulation-based aggregate planning approach that facilitates modeling and coordination of a batch plant's supply chain.
The tool is applied to a real case of asphalt production operations, where fluctuating demand affects the service level of the production plant and makes the planning of production and inventory processes a challenging task. The model quantifies the effects of different parameters of the asphalt production plant on its level of service and assists in finding the best configurations for the plant's production, inventory, and distribution processes. This paper described a simulation-based approach for modeling and aggregate planning of batch plants. A simulation template is presented together with a real case study work hours. Under the ranges of model parameters set by the asphalt producer, the model showed sensitivity to the number and capacity of storage silos, and to any increase in customer demand.

CONCLUSION

Efficient RMC truck dispatching is a critical task for batch plant managers. They must generate dispatching schedules quickly in order to balance operation batch plant production with construction site needs. Factors that affect delay in the concrete batching plant operation are identified and analysed. The study summarizes the main causes of delay that affect construction project. This project is highlighting the study of Batching plant productivity without affecting quality of concrete by prolonged recapitulation of various batching plants sites for the factors which could affect the output of subject batching plant and descry and predicament shooting of such factors in time. A case study for determining the optimum supply areas around the batching plant and develop decision making tools for concrete batch plant management. Data collection for the optimum resource combination that minimizes cost per unit is determined.

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