Computer-aided Construction Engineering Management Evaluation Based on Chaotic Optimization Algorithm

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Abstract. With the continuous acceleration of economic development and the improvement of urbanization, people have a higher and higher demand for better living and working environments. The quality and safety of buildings have become the focus of people's attention. For the computer-aided construction engineering projects, engineering quality is the priority, which requires the full attention of the building, supervision, and construction units to ensure the total quality of the computer-aided construction project.

Keywords: Computer-aided, Construction Engineering, Quality Control, Management

1. Introduction
The quality of construction products plays a crucial role in social and enterprise benefit. With the progress of science and technology[1-2], the application of new construction technology, new building structures, and new building materials to build high-grade buildings is emerging. In most of modern buildings, high-level, precise, and advanced building structures, decoration, and application functions are required [3-4]. Absolute safety, reliability, and high economic value lead to strict quality assurance requirements for construction enterprises. From the current situation of construction project quality, there are mainly the following problems in the quality management work, many construction enterprises have yet implemented serious quality management and quality assurance standards in the actual work, the project quality assessment process is arbitrary, and the authenticity and accuracy of data are difficult to be effectively controlled. The real-time management and management of building quality cannot be achieved[5-6].

2. Computer-aided Construction Engineering Management Based on Chaotic Optimization Algorithm
The structure of computer-aided engineering quality assessment system. This system is used for the
quality control and evaluation of each stage in the construction process, including the generation of various quality evaluation reports and the quality grade evaluation of divisional and subdivision works based on various measured data, to provide reliable material guarantee for the quality management crew to implement dynamic control of the project quality. Its feature is to provide a variety of flexible methods to help users collect, edit and modify the original data. In the traditional quality management method, the data collection and arrangement mainly depends on various forms of quality assessment forms. The quality control crew rely on the specific requirements in the form, to fill in the description of project quality and the corresponding measured data. Through the application of a computer-aided engineering quality assessment system, the relevant quality assessment form provided by the system can be used directly based on the engineering sequence, to fill in the corresponding data directly on the screen. Clear data structure conducive to quality evaluation. The data required by the system mainly includes the data of the guaranteed project, the data of basic engineering, and the measured data of allowable deviation project. When using the system, the user first fills in the data of the guaranteed project. If the requirements are not met, the user cannot continue to fill in the following data until it reaches the requirements. Each process can be implemented through analogy based on qualified quality.

Chaotic optimization algorithm simulates the influence of management on work progress and labor productivity. It uses an exponential mathematical relationship between labor productivity and the ratio of the number of supervisors to the number of workers. If there is no management, labor productivity is assumed to be the optimal 50% participation rate. Using this assumption, use the following formula to calculate the building factor.

$$RF = 1 - \frac{0.5}{e^{x}}$$

(1)

Where Pf = productivity factor
In addition,

$$R = \frac{Number\ of\ foremen}{Number\ of\ operatives}$$

The final duration of the activity can then be calculated as the maximum resource-based duration divided by the productivity factor indicated in Formula 2.

$$D = \frac{D_{(max)}}{PF}$$

(2)

3. Leading Factors Affecting Computer-aided Construction Engineering Management

3.1. Quality of the Crew

In the computer-aided construction engineering construction, most of the front-line construction workers are migrant who have some construction experience but lack of professional knowledge. Although they can complete the tasks assigned by the constructors, they sometimes rely on their construction experience to carry out construction instead of strictly following the construction specifications. Besides, some supervisors will not have the correct attitude at work. They are not responsible for their own work, and ignore some quality and safety hazards. The primary work of
Party A's site representative participating in the construction site management is to ensure construction quality. Party A's on-site representative shall go deep into the construction line of computer-aided construction engineering, master the construction process in detail, strengthen construction supervision, ensure that the construction unit strictly complies with relevant technical specifications and operation standards, do a good job in construction quality inspection, inspection, and supervision, and ensure that the construction quality of each process meets the design standards. However, due to the busy daily work, some site representatives of Party A should not only pay attention to the situation of the construction site but also be busy with the work of the construction unit, which leads to the lack of time and cannot go to the site well for management, thus easily leading to quality problems.

3.2. Building Materials
Reinforcement is the main force-bearing component in the computer-aided construction engineering, and its quality directly affects the total quality of the computer-aided construction engineering. Reinforcement to the scene, when the steel factory certificate shall be strict inspection, including the manufacturer name, batch number, steel type, steel number, strength, specification, grade, weight, number of pieces, production date, batch number, mechanical property inspection data and conclusion, chemical composition inspection data and conclusion, seal and standard number of the quality inspection department for the steel plant. Also, the reinforcement entering the site shall be protected to ensure the quality of the reinforcement. In the process of concrete pouring, concrete test blocks shall be made to facilitate the inspection by inspectors, ensure that the workability, strength grade and durability of concrete can meet the design requirements, and maintain the concrete after pouring to prevent cracks and other phenomena. When the wood formwork is assembled, the plate edge shall be leveled and planed straight, and the joint shall be tight. When the concrete surface is no longer painted, the plate surface shall be planed smooth.

4. Measures to Improve Computer-aided Construction Engineering Management
The foundation slab of the main body of a high-rise building is a rectangular structure. Inside the foundation slab, the symmetrical axis of the plane center of the foundation slab and the half axis of the diagonal line is taken as the temperature measurement area, and a total of 10 concrete temperature measurement monitoring positions are set, numbered ah. Each monitoring point is equipped with five temperature sensors along the thickness direction of the bottom plate, which are 50mm, 850mm, 1650mm, 2450mm, and 3250mm from the upper surface of the bottom plate, respectively. The actual monitoring position is shown in Figure. 1.

![Figure1. Profile of temperature measurement point of the foundation slab](image_url)
During the construction of computer-aided construction engineering, the process operation procedures shall be strictly followed. For example, for the construction of cement cushion of the independent column foundation, the groove should be inspected before pouring, the axis, foundation pit size, and soil quality shall meet the design requirements and the floating soil, ponding, silt and sundries in the pit shall be removed. Meanwhile, the surface vibrator shall be used to vibrate the concrete during pouring, and the surface shall be flat. After the cushion reaches a certain strength, snap the line, erect the formwork, lay the reinforcing mesh, and use the cement mortar block with the same thickness as the concrete protective layer to cushion the bottom to ensure the correct position of the reinforcing steel. The weight of other layers is also calculated layer by layer according to this method. Up to the lowest level, the weight ranking of all risk factors relative to the highest level can be obtained, that is, the target layer, and we can achieve the importance ranking of all risk factors. The main steps of Fuzzy AHP are shown in Figure 2.

![Diagram](image)

**Figure 2.** Steps of Fuzzy AHP

The responsibility sense and construction crew self-discipline are improved. On the one hand, improve the sense of responsibility of construction crew through education. Party A shall require the construction company to organize the construction crew to learn the relevant construction points, clarify the division of responsibilities, and implement the reward and punishment system before the construction of various construction procedures of the computer-aided construction project, and give necessary material rewards to those who strictly abide by the construction specifications, and carry out necessary criticism and education to those who do not follow the construction specifications, to improve their sense of responsibility. On the other hand, strengthen the self-discipline awareness of construction crew through the management mechanism. Party A shall require the construction company to establish a strict management mechanism, improve the self-discipline awareness of the construction crew by managing the operation process of the construction crew, and make the construction crew comply with the construction specifications in the computer-aided construction project, to ensure the project quality.

To improve the quality of on-site supervision crew, we need to strictly close the "entrance". On the one hand, the supervision company should make a series of selection measures when hiring supervisors to ensure that the hired supervisors have real talent and learning. On the other hand, before the supervisor enters the construction site, Party A shall assess the theoretical knowledge and practical
ability of the supervisor, to ensure that the supervisor has the ability that the supervisor should have. If
the supervisor does not have the corresponding ability, the supervisor shall be replaced by the
supervision company. On the one hand, the construction unit shall arrange enough time for the site
representative of Party A to be familiar with the situation of the project, to focus on the management
of important construction procedures. On the other hand, Party A's site representative shall be required
to report the site situation weekly and arrange relevant crew to verify the situation on-site, to improve
the management of its site representative.

5. Conclusions
The quality control in the computer-aided construction engineering stage is affected by multiple
factors. As long as the construction unit requires the construction unit to organize the construction
crew to learn the construction key points systematically before construction, enhance the quality
management of each construction link in the construction process, take timely countermeasures for the
problems identified, and improve the sense of responsibility of the supervision crew, quality problems
in the computer-aided construction engineering can be solved totally.

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