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Analyzing the Expenses and Pricing for Welded Solar Panel Support Structures

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A B S T R A C T

The estimation and costing of welded structures, particularly in the context of solar panel supports, are critical elements in mechanical engineering projects. This study aims to analyze the multifaceted factors involved in estimating and costing such structures, encompassing materials, labor, equipment, and overheads. Through a comprehensive understanding of welding processes, material properties, design specifications, and project scope, precise estimations can be derived to ensure the cost-effectiveness and efficiency of fabricating solar panel support structures. This abstract provides a succinct overview of the pivotal considerations and methodologies utilized in estimating and costing welded structures for solar panel support applications within the domain of mechanical engineering.

Keywords: Welding, Solar Panel Supports Structure, Material's

LITERATURE SURVEY

J. Smith [1]

This article provides a thorough literature review on the costs associated with solar panel support structures, including welded options. It analyzes material costs, labor costs, design complexities, and market dynamics influencing pricing.

Y. Wang [2]

Chen and Wang conduct a review of recent studies focusing on the economic evaluation of welded solar panel support structures. The review covers various factors affecting expenses and pricing, including material costs, labor costs, and market competition.

Gupta [3]

Gupta and Sharma offer a comprehensive review of the cost components associated with solar panel support structures, with a specific focus on welded options. The review encompasses material costs, labor costs, regulatory compliance, and market dynamics.

Zhang [4]

Li and Zhang conduct a review of cost modeling and pricing strategies for welded solar panel support structures. The review examines different approaches to cost estimation, pricing strategies adopted by manufacturers, and factors influencing pricing decisions.

Wilson [5]

Brown and Wilson provide a market analysis of welded solar panel support structures, reviewing industry trends and pricing dynamics. The review covers market competition, regulatory influences, and future outlooks for pricing in the industry.

Murat Gunduza [6]

He has studied an early cost estimation model for hydroelectric power plant projects. The main indicators considered and studied in this paper are the amount of energy generated in a hydroelectric power plant and the cost of investment and there by decide whether a project investment is feasible or not. Cost of the project is calculated by detailed hydrological study, site investigation, good basin planning, geotechnical survey and various tests of the soils. Multiple regression method and artificial neural network analysis are taken for the validation. The models are developed by the data collected from forty-nine hydroelectric power plant projects and five projects are used for the validation of the models. Comparisons of validation results revealed that the regression model had a 9.94%, and neural network model had 5.04% prediction accuracy. In this paper the neural network shows more prediction accuracy than the regression analysis.

Alfredo Serpell [7]

He studied about the cost estimation of new construction projects using an integrated, computer-based approach. The paper studies the limitations of computer programs based on parametric estimating methodologies and CBR. Historical data was effectively reused in the modeling which is used by the CBR method. 17 historical data of construction were selected for the validation purpose. The system produced a suitably detailed and accurate cost estimate for each of the tested projects. This method generates estimates of construction projects with more accuracy and in an efficient way. The automation and support of CBR problem solving seems to make possible to carry out the scope definition process of a project in a short time and without too much effort. Each stage of the process can be assisted without the participation of manual information handling.

Hossein Shams Mianaei [8]

He has studied about the estimated cost for drilling wells using the cost estimation method Case Based Reasoning. It is obtained by studying the historic data and their problems and uses the data to solve new similar problems. The major findings of his study are that in the proposed CBR model despite limited data, the error of method according to the performance indicators was very low. Therefore, obtained estimation accuracy of the proposed CBR model is high and the model is useful. On the other hand, given that the available estimation methods spend much time to estimate cost, we could save time using the CBR method. In his proposed CBR method, if a feature doesn't have the value, it does not affect the model. While in other methods, if a feature doesn't have the value, then the model is not solved. By this method the speed of drilling which is very important is increased.

Seokyon Hwang [9]

He has studied the effect of time gaps between cost estimation and on-site operations. As the construction cost varies according to the time the cost estimation is process is hard. Two time series models were considered in this paper by analyzing time series index data and comparing them with existing models in the present study. The developed time series models accurately predict construction cost indexes. In particular, the model responds to large change of costs, which allows for accurate estimation of the short-term and long-term periods. Overall, the models are effective for understanding the trend of construction costs. The analysis was categorized as Factor analysis and Pattern analysis. In his paper series of comparisons proved that the new models are more accurate than existing models previously developed by others. In particular, the new models responded sensitively and swiftly to quick, big changes to predict the series for the periods following the change. The proposed models are envisioned to serve well the following purposes: preparing the initial budget for a new project, taking advantage of short-term fluctuations of prices of resources for the activities, and determining the level of contingency due to price inflation. In this paper Time series models are more accurate than other models in the case of time gaps.

Kyong Ju Kim [10]

He has done a study of cost estimation model using the Case Based Reasoning and Genetic Algorithms. In case-based reasoning similar cases from a set of historic data is compared and predict the construction cost. Cost estimation based on the Genetic algorithms are based on genetics and artificial intelligence. In this paper cost estimation of a bridge construction is taken. A genetic algorithm-based method was adopted to find out the weightage of the parameters. By these methods the accuracy of the early cost estimation model is increased when compared to the conventional methods. This method can also apply to another type of construction projects which will increase the accuracy of the estimated cost.

Sung-Hoon An [11]

He has done a predictive modeling for cost estimation Experience is included in all process of construction cost estimating by the analytic hierarchy process. He proposed model which included experience in all processes of construction cost estimating by the analytic hierarchy process. The model overcomes the difficulty of measuring experience for determining the weights of attributes. Three different models were compared by their efficiency. The model using the analytic hierarchy process was more accurate, reliable, and explanatory than the other models, and closer to the original aim of the case-based reasoning model, for solving new problems using experience from previous cases. In his study a case-based reasoning model using analytic hierarchy process was proposed. The result shows that the hierarchy based CBR method is more accurate reliable and explanatory than other models.

Gwang-Hee Kim [12]

He has compared cost estimation models. This examines the performance of three cost estimation models. Data from 530 residential building projects were selected for training the model. The examinations are based on multiple regression analysis, neural networks, and case-based reasoning. In his results the Neural Network model gave more accurate estimation results than the CBR or MRA models. When considering the accuracy of estimation results, the time and accuracy tradeoffs and the clarity of explanation in its long-term cost estimation the CBR model was more effective. Further research is required to develop a hybrid model integrating the various tools, such as NNs, case-based reasoning, and genetic algorithms.

Abdulrazak Mohamed [13]

He has discussed about the Knowledge based-system for alternative design, cost estimating and scheduling. In this study, an automated construction cost estimating and scheduling was presented. The automated system addresses the integration of cost estimating and scheduling at two stages; at predesign stage and after detailed design stage. More notable is its timeliness and accuracy which makes a true valuable value engineering tool prior to design and a valuable analysis tool after design.

Tariq S Abdelhamid [14]

He has studied the Time series analysis for construction productivity. This paper gives a brief overview of time series analysis and demonstrates its application using previously published data. Paper has demonstrated the value of using time series analysis for experiments. Kyong Ju Kim et.al (2010) has done a study of cost estimation model using the Case Based Reasoning and Genetic Algorithms. In case-based reasoning similar cases from a set of historic data is compared and predict the construction cost. Cost estimation based on the Genetic algorithms are based on genetics and artificial intelligence. In this paper cost estimation of a bridge construction is taken. A genetic algorithm-based method was adopted to find out the weightage of the parameters. By these methods the accuracy of the early cost estimation model is increased when compared to the conventional methods. This method can also apply to another type of construction projects which will increase the accuracy of the estimated cost. evaluating construction productivity experiments.

Hojjat Adeli [15]

In his paper, a regularization neural network is formulated and a neural network architecture is presented for estimation of the cost of construction projects. The model was used to estimate the cost of reinforced concrete pavements. The new computational model is based on a solid mathematical foundation making the cost estimation consistently more reliable and predictable. The result of cost estimation from the model depends only on the training data. It does not depend on the architecture of the neural network and the number of iterations required for training the system. The regularization neural networks are mainly based on a solid mathematical foundation. The regularization neural network presented in this paper is an objective cost estimator.

Tarek Hegazy [16]

He has discussed about neural network model for parametric cost estimation of highway projects. This paper uses a neural network approach estimation of project cost in an effective way for highway projects. Eighteen cases of highway projects constructed in Newfound land, Canada, have been used as the data for training the model. Rather than using black-box Neural network software, a simple Neural Network simulation has been developed in a spreadsheet format that is customary to many construction practitioners. As an alternative to NN training, two techniques were used to determine network weights by simplex optimization and genetic algorithms. This paper demonstrated the practicality of using spreadsheet programs in developing adequate NN models for use in construction.

Alice E Smith [17]

He discussed about Cost estimation predictive modeling: Regression versus neural networks. The research paper studies the stability, performance and ease of cost estimation modeling using regression versus neural networks to develop a cost estimating relationships. Neural networks have advantages when dealing with data for which there is little a priority for knowledge of the appropriate cost estimating relation to select for regression modeling. However, in cases where an appropriate Cost estimating relation can be identified, regression models have significant advantages in terms of accuracy, variability, model creation and model examination. The Neural Network model is an attractive substitute for regression.

Barik [18]

This paper presents an extensive review of various methodologies and techniques used for estimating the costs associated with welded structures. It discusses the factors influencing welding costs such as labor, material, equipment, and overhead expenses. Both traditional and modern cost estimation methods are explored, including empirical models, parametric estimation, and activity-based costing. Additionally, the paper examines cost optimization strategies such as value engineering, process improvement, and lean manufacturing principles. Although not specific to solar panel support structures, the insights provided in this review are relevant to estimating and optimizing costs in welded structures across different industries.

Gupta [19]

This paper presents a detailed case study on the design, optimization, and cost analysis of solar panel support structures tailored for flat terrain. The study discusses various aspects of structural design, including load calculations, material selection, and fabrication techniques. It evaluates different design options based on structural integrity, cost-effectiveness, and ease of installation. Cost estimation methods specific to the fabrication and installation of solar panel support structures are presented, along with insights into optimizing costs without compromising quality or safety. The case study offers practical insights into the estimation and costing aspects of solar panel support systems.

Zhang [20]

This paper proposes a systematic methodology for material selection in solar photovoltaic panel support structures using Analytic Network Process (ANP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods. The study considers multiple criteria, including mechanical properties, cost, and environmental impact, to evaluate and rank potential material options. It provides a structured approach to selecting materials that balance technical requirements with economic considerations. The methodology presented assists engineers and designers in making informed decisions regarding material selection, thereby optimizing the overall performance and cost-effectiveness of solar panel support structures.

Zhang [21]

This paper presents a comprehensive cost analysis of solar photovoltaic mounting structure systems based on a case study conducted in China. The study examines various cost components, including material costs, labor costs, and installation costs, associated with different mounting structure designs. It evaluates the cost-effectiveness of various design options and identifies factors influencing the overall cost of solar panel support systems. The case study provides valuable insights into cost estimation and optimization strategies specific to solar energy installations, contributing to the development of cost-effective and sustainable solar photovoltaic systems.

Arockiasamy [22]

This paper discusses cost estimation and optimization strategies within the welding industry, with a focus on reducing costs while maintaining quality standards. It explores various factors influencing welding costs, such as material selection, process efficiency, and resource utilization. The study presents techniques for estimating and controlling costs throughout the welding process, from material procurement to final fabrication. Additionally, it discusses cost optimization strategies, including value engineering, process improvement, and waste reduction. While not specific to solar panel support structures, the principles and techniques discussed in the paper are applicable to estimating and optimizing costs in welded structures across different applications.

Gao [23]

This paper presents a cost estimation model specifically tailored for solar photovoltaic panel support structures. The model incorporates various factors such as material costs, labor costs, transportation costs, and installation costs. It provides a systematic approach to estimating the total cost of constructing solar panel support systems, taking into account different design configurations and geographical locations. The study aims to assist project planners and engineers in accurately forecasting project costs and optimizing budget allocation for solar energy installations.

Kumar [24]

This paper presents a life cycle cost analysis (LCCA) of solar photovoltaic mounting structures, considering the total cost of ownership over the entire operational lifespan of the structures. The study evaluates various cost components, including initial investment costs, maintenance costs, and decommissioning costs, to assess the economic viability of different mounting structure designs. It provides insights into long-term cost considerations and sustainability implications, helping decision-makers make informed choices regarding solar panel support systems.

Ghandhari [25]

This paper presents an economic assessment of various solar panel support structures used in utility-scale photovoltaic systems. The study compares the costs and benefits of different mounting options, including fixed tilt structures, single-axis trackers, and dual-axis trackers, considering factors such as installation costs, land use efficiency, and energy yield. It provides insights into the economic feasibility and performance implications of different support structure configurations, helping project developers and investors make informed decisions regarding solar energy investments.

CONCLUSION

In conclusion, several key points can be highlighted regarding the estimation and costing of welded structures like solar panel supports:

Material Selection: Choosing the appropriate materials is vital to ensure structural integrity, longevity, and cost-effectiveness. Factors such as strength, durability, corrosion resistance, and availability need to be considered during estimation.

Labor Costs: Skilled welders and fabricators play a significant role in the welding process. Estimating labor costs involves considering factors such as wage rates, productivity, overheads, and any specialized skills required for the project.

Welding Processes and Techniques: Different welding methods (e.g., MIG, TIG, SMAW) have varying cost implications in terms of equipment, consumables, and labor. The selection of welding techniques should align with project requirements while optimizing costs.

Quantity Estimation: Precise estimation of the quantities of materials needed is essential to avoid shortages or excess inventory, which can impact project timelines and budgets.

Overhead and Contingency: Factoring in overhead costs (e.g., utilities, facility maintenance) and contingency allowances helps mitigate risks associated with unforeseen circumstances or fluctuations in material prices.

Quality Assurance: Implementing quality control measures throughout the fabrication and welding processes ensures compliance with industry standards and specifications, reducing the likelihood of rework and associated costs.

Lifecycle Cost Analysis: Beyond initial construction costs, considering the long-term maintenance, repair, and replacement expenses provides a comprehensive understanding of the total cost of ownership for the welded structure.

Value Engineering: Exploring alternative design and construction approaches to optimize costs without compromising quality or functionality can lead to cost savings during estimation and throughout the project lifecycle.

In conclusion, effective estimation and costing of welded structures like solar panel supports require a comprehensive understanding of materials, labor, processes, and project requirements. By leveraging accurate data, informed decision-making, and proactive cost management practices, project stakeholders can ensure the successful delivery of cost-effective, high-quality welded structures.

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