

Use of Artificial Neural Network for Cost Estimation of Building Projects

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Abstract— the principal causes of delays in this research study were analyzed after data collection using a questionnaire survey with a wide range of construction professionals based in High-rise Projects. The findings of this study could help the construction industry better analyze not just the principal reasons of delays on construction projects, but also how to minimize them through appropriate planning. Despite its importance in ensuring the safe application of working processes, safety leadership is occasionally overlooked in recommendations.

Aside from addressing increased demand, good decision-making during the construction phase can mitigate Delay concerns, however additional research is required. This could involve research on decision-making processes, the content of construction site management training programs, the value of training programs in building a more skilled workforce, and the use of pre-cast materials. An investigation into construction project delays in India during the outbreak.

Because high-rise projects are vital to the city, they must be completed quickly. Almost all Indian projects are late. Delay is the most common, complex, and dangerous problem in construction. Most construction projects in poor countries run late. Regardless of size or complexity, deadlines and unpredictability abound. Every construction project has delays, and the severity of these delays varies widely. This study reviews prior research on time and cost overrun drivers.

Keywords—Low Rise & High Rise Buildings, Cost-benefit analysis,

I. INTRODUCTION

Management of the supply chain

In several places of the world, the supply chain has been interrupted in various ways. Various construction materials are necessary, but they are not reaching the construction site from outside due to lockdown, which is causing delays in the construction process. Various resources for construction work that come from various industries in the country or overseas via various vehicles, those items cannot come. Because all cars are unable to come to lockdown, the essential materials are unable to arrive, and the work is halted. It has not only caused the construction sector to shut down, but it has also harmed the livelihoods of those who transport these materials in cars, as well as the factories that produce these products, which are losing a lot of money because they are not being sold.

An issue with transportation

All modes of mobility in the country have been hampered as a result of the nationwide lockdown. As a result, no materials are being delivered to the construction industry, and no workers are able to work from home. As a result, the work has come to a halt.

Labor scarcity

To begin with, workers are unable to get to work since the transit system is entirely shut down. Second, because the sickness is caused by a viral infection, workers who come into touch with one another are more likely to spread it. As a result, many workers refuse to come to work. Furthermore, forcing workers to labour without any protection is impossible.

Financial difficulty

Companies are not making any profit as a result of the work stoppage; on the contrary, more losses are being incurred, and not only the company is losing money, but all of the suppliers who provide the required materials to various companies for use in the construction sector are also losing a lot of money. Since the company's shutdown, the supply chain has been disrupted, and factories that create goods have ceased operations, resulting in several job losses. Furthermore, the government is unable to collect adequate taxes from all of these sites due to the non-sale of factory-produced goods and the shutdown of the building sector, which has a direct influence on the country's GDP, which impacts the global economy.

Issues with contractual implication

It is primarily based on the 'force major' clause. This clause has a number of rules, one of which is 'Large Scale Epidemic.' This category includes the COVID-19 pandemic. Different contractors placed their various tools in various locations for usage in various machinery construction sectors, but because to the lockdown, all of these equipment have been laying around for a long period. Companies have contracts with contractors to work with all of this equipment for a fee, and if the contract includes a 'Force Majeure' clause, the contractor will not be compensated by the agency if the project is delayed. When contractors stop working, the effect is a significant financial loss.

Unemployment

Because of the lockdown, businesses are losing a lot of money. As a result, businesses are unable to appropriately compensate their employees, and many people are laid off. Many people's jobs have been taken away as a result of this. Their families are also dealing with a lot of difficulties as a result of their job loss. Overall, a concerning scenario has developed.

1.1.1 Background Information

The building sector, the coronavirus pandemic and past research investigations are all included in this section.

Coronavirus Pandemic and the Construction Industry

COVID-19 has had an impact on a variety of economic, social, and industrial activities. Despite the fact that the construction industry was one of the most hit by the pandemic, there was a lot of misunderstanding and uncertainty about how to deal with the pandemic on construction sites due to the lack of clear construction-related guidelines and best practises. This section provides background information and statistics about the construction industry in order to put the paper's focus on this business in context.

The construction industry is a crucial driver of growth and prosperity in the United States, employing over 4.7 percent of the workforce. The construction business, on the other hand, is a project-based industry, with significant complexities and uncertainties. As a result, the construction industry is extremely sensitive to market conditions, posing unique challenges for businesses and their senior executives to survive and thrive (Hartono et al. 2019). A cascade of business failures in the construction industry might have a detrimental impact on the entire economy.

Furthermore, construction contractors are working in an industry that has been profoundly altered by the pandemic's public health and economic repercussions. The epidemic is prompting concern and significant changes in the construction and housing markets, particularly in terms of the touring, building, financing, and settlement processes.

Research Gap

Literature Review of Existing Studies and Identification of Research Gap This subsection provides an extensive literature review of existing studies related to the topic of this research to better identify and position the research gap. Industry Insights and ASCE performed recent surveys to provide updated and useful information and background on COVID-19 in the construction industry with input from more than members. According to these surveys;

- (2) Up to 63% of the organizations perceive that stay at home and social distancing measures are very important, and respondents in the Northeast expressed the most concerns;
- (3) 20% of the organizations have rescinded offers to entry-level employees and interns;
- (4) 14% of the organizations are facing potential contract penalties due to project delays;
- (5) organizations are facing negative consequences including cancelation or delay of contracts, cash flow challenges, hiring freezes, absenteeism, supply chain shortages, layoffs, and furloughs (unpaid);
- (6) despite the gradual reopening of the national economy, the percentage of companies expressing moderate to major concerns over their long-term viability increased from 16% to 29%, and the smallest organizations (less than 20 employees) and the largest organizations expressed the most concern over their long-term viability;
- (7) 50% of the companies have experienced coronavirus-related delays in receiving material and products from suppliers;

(8) workforce reductions were experienced because one-quarter of the companies have furloughed, laid-off, and terminated their employees since March 1, 2020;

(9) A large percentage (41%) of the organizations reported that they did not apply for funds provided by the Pay check Protection Program, and the reason was speculated to be related to their size, because 35% of the companies had 500p employees, which made them ineligible for the program; and

(10) In the most recent survey, companies were realizing that their operations likely will not return to normal until, and expectations for participation in large group activities, organizational travel, and a return to normal inoffice work have been pushed back significantly.

1.2 Problem Definition

To study the increased requirement Delay factors can be minimized by proper decision-making throughout the construction process but further research is required. This could include research into the communication of decisions, the content of training programmes for construction site managers, the value of apprenticeship schemes to provide a more skilled workforce, the possibilities of greater use of pre-cast materials etc. this study identified the causes of delays on construction projects in India during covid-19.

1.3 Need For Construction

Further research can be conducted through case studies in construction projects and this will help to identify the other factors that may be causes of delay factors as well as to identify what procedures could be used to minimize the factors causing delays on construction Projects in India during covid-19, and beyond

1.5 Aims and Objectives

1. To study an Economic, environmental and social attributes, while the factors which stimulate through the satisfaction, were incorporated into this methodology
2. To study the cost-benefit analysis process through some High-rise projects.
3. To evaluate the factors based on the questionnaire & Case Study through various programs. This includes identifying different parameters for delay & cost overruns in view of respondents & comparing them.
4. Evaluate the impact of advance technology to improve construction activities that relate to time.
5. To find the factor that delays in construction activity in case of emergency and to overcome this factors with advance construction technology

II. RESEARCH METHODOLOGY

Research Methodology will be designing a questionnaire survey by which we can find out the factor affecting the construction cost which directly related with material use in construction projects in pandemic situation.

By operating advance technology at construction project reduce delay in transporting of material and increase efficiency of work that ultimately reflect of time and cost.

From literature found that because of frequent change of project managers, Appointment of staffs in the site who are not experienced

and also Non sequential progress of works and that Work was not followed as per procedure instead it was followed as per availability of resources caused delays in construction project on pandemic situation

Unavailability of adequately trained health workers and lack of experience in managing an unprecedented emergency; the pandemic and the confinement measures created a psychosocial burden for the population and, especially, the wellbeing of the health workforce.

The construction industry is the vehicle through which physical development is achieved, and this is truly the locomotive of the national economy. The more resources, engineering know-how, labor, materials, equipment, capital, and market exchange provided from within the national economy, the higher the extent of self-reliance. The increasing complexity of infrastructure projects and the environment, within which they are constructed, place greater demands on construction managers to deliver projects on time, within the planned budget and with high quality.

Therefore, improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for the country as a whole. Efforts directed to cost and time effectiveness were associated with managing time and cost.

It also aims to identify the main factors that lead to project delays and to suggest recommendations on how to overcome or mitigate effects of the problem. Data is gathered from responses from questionnaire survey and interviews with those involved in construction project.

The surveys and research findings indicate that delay incidents occur mainly during the construction phase of a project and one or more parties usually contribute to delay. This paper highlights the importance of having more experienced and capable construction managers as well as skilled labourers to enable the industry to develop at a faster rate either nationally or internationally.

A questionnaire and personal interviews have formed the basis of this research. Factor analysis and regression modelling were used to examine the significance of the delay factors. From the factor analysis, most critical factors of construction delay were identified as

- Lack of commitment;
- Inefficient site management;
- Poor site coordination;
- Improper planning;
- lack of clarity in project scope;
- lack of communication; and
- Sub-standard contract.

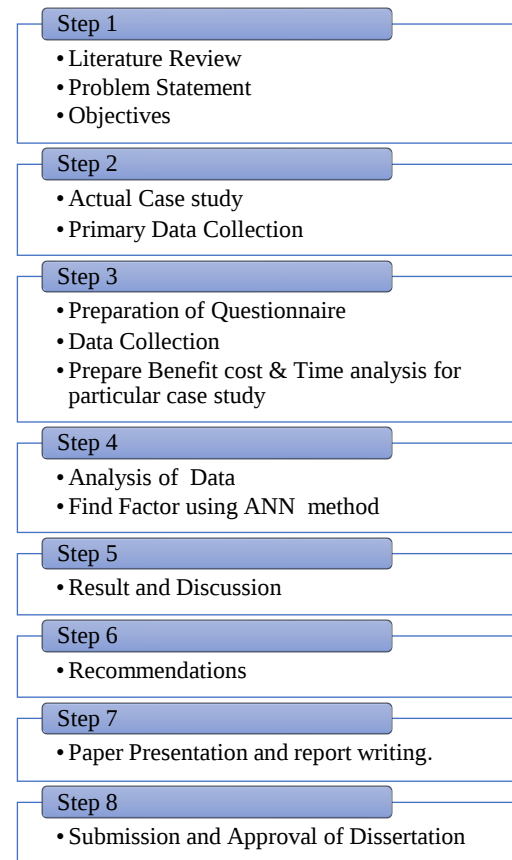


Figure1.1: Methodology chart

Questionnaire construction

A questionnaire survey approach was used for this project to determine the impact of various factors affecting the project's cost. The questionnaire's design philosophy was based on the fact that it needed to be simple, clear, and understandable for the respondents while also being easily interpreted by the researcher.

Using a literature review

In terms of structure, it can be seen that a significant amount of research has already been done. In India, there is a scarcity of data on the use and the factors that influence the construction industry. As a result, preliminary research into various literatures around the world resulted in the creation of a preliminary list of factors affecting project cost and timeliness.

A preliminary survey of the sites was conducted.

Following the identification of the fundamental factors through literature review, a preliminary survey of various sites was conducted to determine the nature and relative importance of those factors in Indian working conditions. The survey linked the effectiveness of global factors to the effectiveness of Indian sites, as well as providing practical insight into a few additional factors, though they are area specific.

III) METHODS & ANALYSIS

ANN Model

Language And Library Used For Executing ANN Model:
Programming Language Used : Python

Python is a computer programming language often used to build websites and software, automate tasks, and conduct data analysis. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems.

Library Used:

1) NumPy:

- It is a Python library used for working with arrays.
- NumPy = Numerical Python.
- Additional linear algebra, Fourier transform, and random number capabilities.
- "import numpy as np"
- To use any package and library in your code, it needs to be made accessible.
- We can start using NumPy and its available functionalities using the import statement.
- We import it as np to save time & for modification of the code.

2) Pandas:

- Software applications that render information in a visual format such as a graph, chart, or heatmap for data analysis purposes.
- (CSV = Comma-separated values (CSV) file contains tabular data (numbers & text) in plain text form (acquainted)).
- Through pandas, you get informed with your data by cleaning, transforming, and analyzing it.
- For example, you say you want to explore a dataset stored in a CSV on your computer. Pandas will extract the data from that CSV into a data frame (a table), basically then let you do things like:
- Calculate statistics and answer questions about the data like:-
 - What's the average, median, max, or min of each column?
 - Does column A correlate with column B? or What does the distribution of data in column C look like?
 - Clean the data by doing things like removing missing values and filtering rows or columns by some criteria.
 - Visualize the data with help from Matplotlib. Plot, bar, lines, histograms, bubbles, and more.
 - Store the cleaned, transformed data back into a CSV, other files, or database.
 - Before you jump into the modelling on the complex visualizations, you need to have a good understanding of the nature of your dataset & pandas is the best avenue through which to do that.

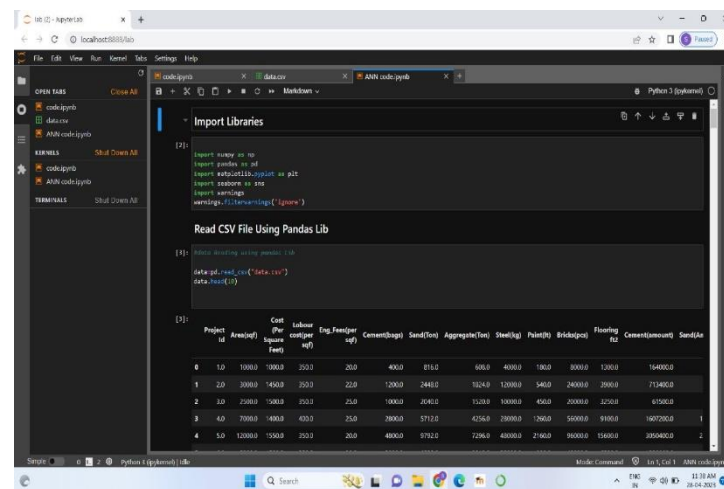
3) Seaborn:

- It is a library that uses Matplotlib underneath to plot graphs. It will be used to visualize random distributions.
- Seaborn is a Python data visualization library based on Matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics.

4) Matplotlib:

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.

- Create [publication quality plots](#).
- Make [interactive figures](#) that can zoom, pan, update.



- Customize [visual style](#) and [layout](#).
- Export to [many file formats](#).
- Embed in [Jupyter and Graphical User Interfaces](#).
- Use a rich array of [third-party packages](#) built on Matplotlib.

Framework: Tensor Flow & Streamlit:

1) Tensor Flow:

- TensorFlow is a Python library for fast numerical computing created and released by Google.
- TensorFlow allows you to create dataflow graphs that describe how data move through a graph.
- The graph consists of nodes that represent a mathematical operation.

2) Streamlit:

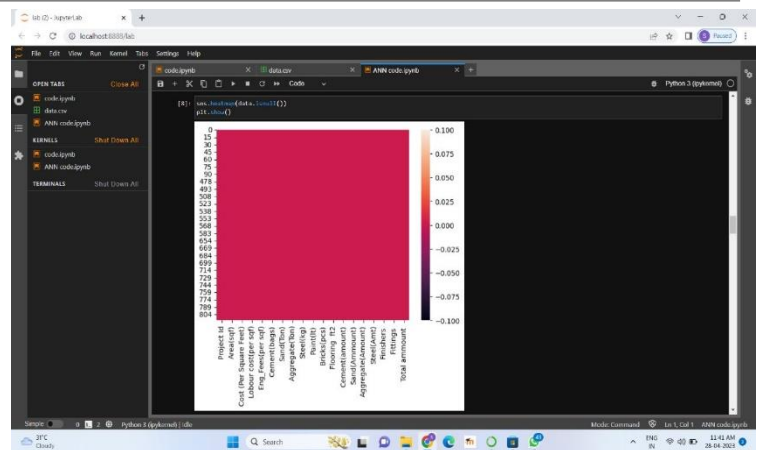
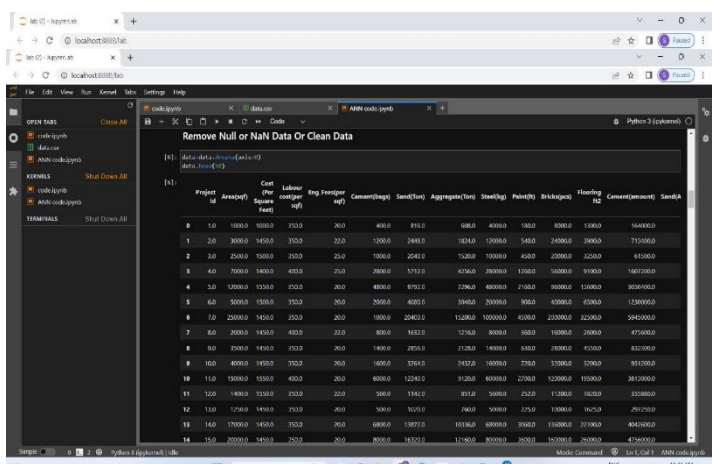
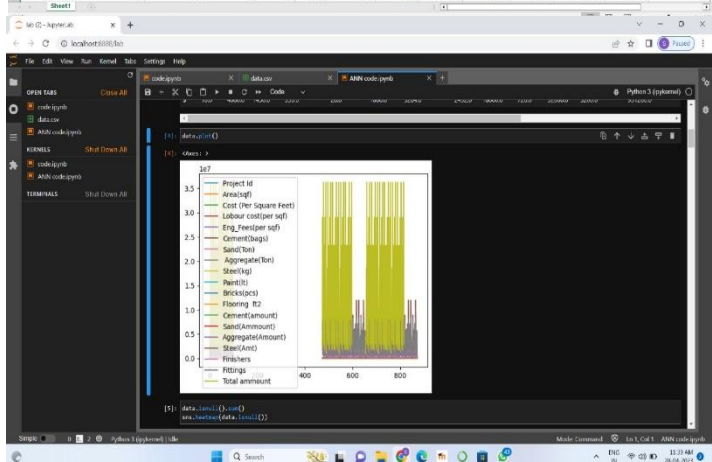
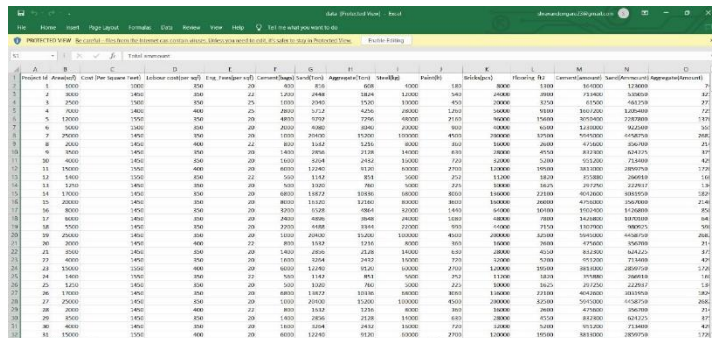
- It is an open-source tool to build & deploy data applications with less coding compared to other front-end technologies like HTML, CSS, JS.
- Streamlit is built on Python and currently only supports the Python programming language.

Steps Involved In Creating ANN Model:

a) Data collection

- b) Data preprocessing
- c) Remove Null /NaN Data /Clean Data
- d) Data incoding
- e) Feature Selection: 1. Selection input
2.Output Features
- f) Data splitting: 1. Train Data
2.Test Data
- g) Model training
- h) Model testing
- i) Model performance
- j) Model saving
- k) ANN model to Graphical User Interface (GUI)

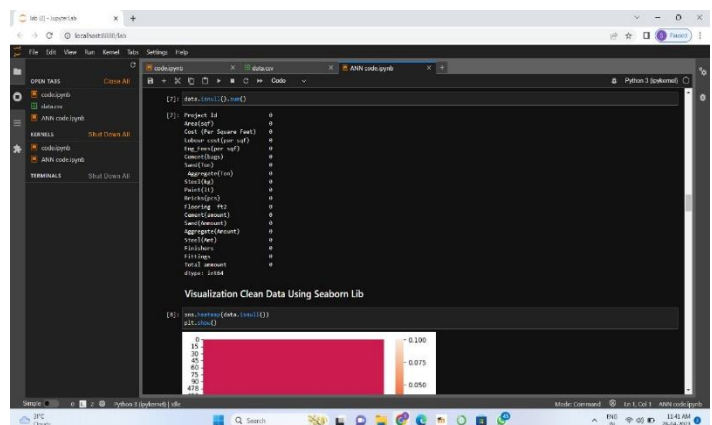
A) Data collection:



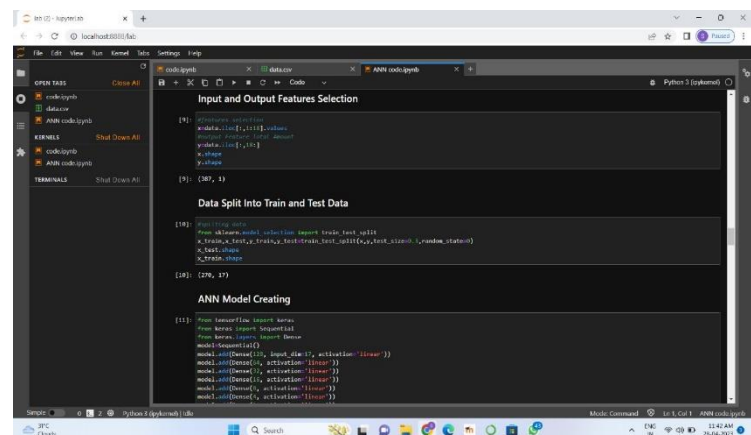
B) Data Pre-processing:

C) Remove Null /NaN Data /Clean Data:

D) Data incoding:



E) Features Selection:



Enter the Area In Square Foot

3000

Enter the Cost Per Square foot

1450

Enter the Labour Cost Per Square Foot

350

Enter the Engineer Fees Per Square Foot

22

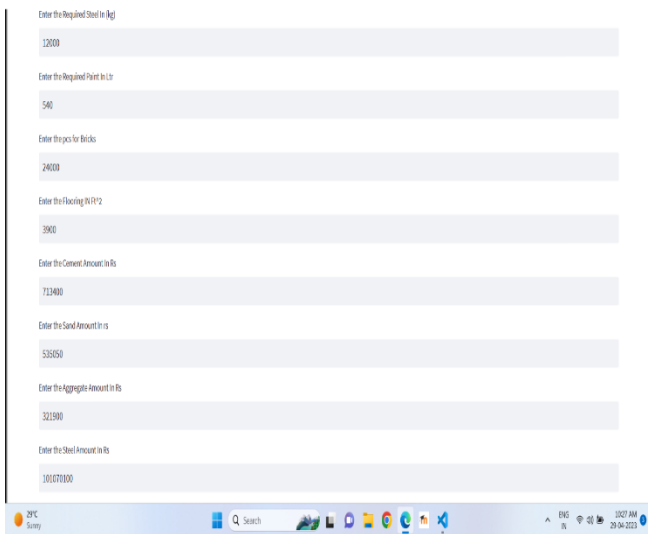
Enter the bags of cement

1200

Enter the Sand Value in Ton

2448





Enter the Required Steel in kg
12000

Enter the Required Paint in Lit
540

Enter the price for Bids
24000

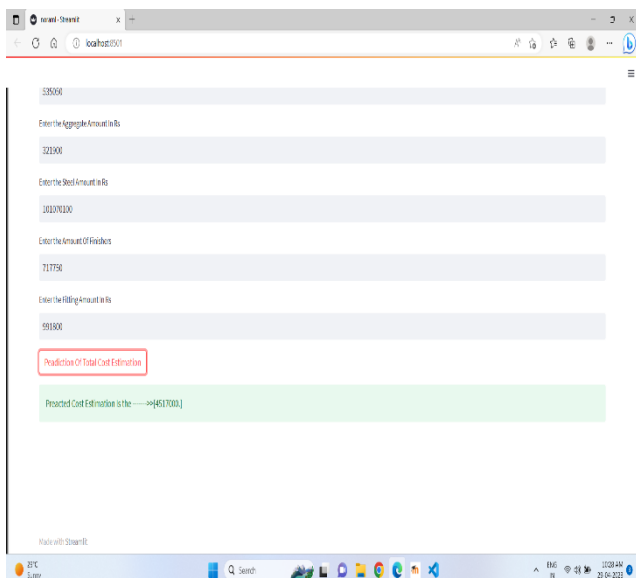
Enter the Flooring R/P/2
3900

Enter the Cement Amount in Rs
712400

Enter the Sand Amount in Rs
532550

Enter the Aggregate Amount in Rs
321590

Enter the Steel Amount in Rs
100670000



Enter the Aggregate Amount in Rs
321590

Enter the Steel Amount in Rs
100370000

Enter the Amount of Finishes
711750

Enter the Filling Amount in Rs
591800

Prediction Of Total Cost Estimation

Predicted Cost Estimation is the —→ ₹4517000

CONCLUSION

- [1]. The investigation of various factors influencing productivity is crucial for enhancing productivity levels in construction projects and ultimately improving the overall performance of the sector.
- [2]. The primary objective of this study was to synthesize the factors that impact cost estimation performance in construction projects and propose future directions for improving cost estimation based on these factors.
- [3]. To achieve these objectives, an Artificial Neural Network (ANN) model was developed, and accuracy was attained through a trial and error method using training and testing data.
- [4]. The findings suggest that the ANN-based modeling technique can serve as a valuable auxiliary tool in project pricing, thereby enhancing the planning process for public agencies involved in construction or renovation projects.
- [5]. Utilizing the ANN Model for cost estimation offers numerous advantages, including time savings, ease of use, and convenience when compared to traditional methods such as Excel Sheets. This is primarily because the ANN Model takes into account various influencing factors in cost estimation.
- [6]. Overall, the utilization of ANN models in construction project management holds great potential for streamlining processes, enhancing accuracy, and improving overall performance in the construction sector.

FUTURE SCOPE:

- [1]. Artificial neural network has a wide range of applications in the analogous field of cost estimation. It shows accurate results when the data sets, comprising of a large number of independent variables, have a non-linear structure or functional discontinuities.
- [2]. Given the accurate results after successful training, the ANN can be considered as an alternative for parametric cost estimating especially during the earlier stages of the project. It is a great tool if we have a reliable historical data set. However the most tedious and expensive task in this process is to gather the right data for training and testing.
- [3]. Artificial Neural Networks are yet to be used for live projects and a standard benchmark needs to be developed in order to determine the accuracy of the predicted results through ANN. They cannot be used where little or no information is available and they cannot be used for precise and arithmetic calculations.
- [4]. Apart from the early stage cost estimation of projects, the ANN can also be used to find the lowest estimated bid of a supplier or the cost of insurance.

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