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# DEVELOPMENT OF SPREADSHEETS FOR SMALL AND MEDIUM ENTERPRISES IN MANAGING CONSTRUCTION PROJECTS

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## Abstract -

*The successful performance and completion of construction projects is strongly dependent on the project activities being scheduled in a timely manner. The goal of the study is to create a simple, economical, and powerful computer application enabling small construction companies to plan, design, and manage their projects. The creation of a package for the study and design of civil engineering structures is an important project that makes good use of the MS EXCEL environment. The primary goal of building a computerization system is to eliminate paper work and save time in management, hence increasing efficiency and reducing workload. It allows us the flexibility of creating required documents on screen as needed. Because a building comprises many structural parts such as beams, columns, and footings, each of which is designed according to Indian standards, we must individually estimate each element when evaluating materials and project costs, which is time demanding. There are different softwares available on the market for calculating the quantity of material necessary, but these softwares are expensive and require a higher level of competence to operate. One must have their own computer software, design aids, or spreadsheet to save time while estimating various structural elements. In this study, we created an excel programme spreadsheet for estimating quantity and material costs and designing various structural parts such as footings, beams, columns, and slabs, which allows us to make faster calculations during the design process.*

**Index Terms-** Microsoft excel, Construction, Spreadsheets, Project Management, Designing, Estimation.

## I. INTRODUCTION

Since the dawn of civilisation, civil engineers have been involved in the planning, design, and construction of constructions such as buildings, bridges, and dams. Engineers have devised new strategies to build structures of choice using new materials such as R.C.C., Prestressed concrete, and other materials as science and technology has progressed. A structure is made up of a collection of interconnected pieces that work together to support a load.

Tie rods, beams, and columns are some of the elements that constitute a structure. A structural system is the combination of structural elements and the materials from which they are made. The design, analysis, and construction of these structures is a science in and of itself. The basic objective of any structure is to support the loads that are placed on it by transferring them to the foundation in a correct manner.

Because of their investment and personnel constraints, small and medium-sized contractors (SMCs) face this problem. SMCs, on the whole, do not invest in sophisticated project control software and do not have a cost control department. They, in particular, require an efficient cost-control mechanism. SMCs are a key part of the construction sector in many countries, and it is vital to introduce and educate them on how to properly manage construction projects. As a result, the performance of small construction businesses in managing construction projects may be improved, as could the performance of the Indian construction industry.

In civil engineering, a course in computer programming is being offered. The programming ideas are demonstrated using real-world civil engineering situations.

This article covers design, planning, estimating, and other civil engineering topics that can be carried out using Microsoft Excel sheets (Design sheets).

## II. Types of Spreadsheets -

### Design Sheets -

Design sheets were among the first software inventions to have a significant impact on the widespread use of personal computers. The in-built cell-based structure of design sheets, as well as the basic boundary that is easy to use even for first-time users, are two of its strongest qualities. The creation of a package for the study and design of civil engineering structures is an important project that makes good use of the MS EXCEL environment. The following are some design sheet examples:

- Two Way Slab
- Design of Axially Loaded Column
- Design of Axially loaded Short columns
- Design of Axially loaded Long columns
- Design of Singly reinforced Beam
- Design of one way cantilever slab
- Design of one way slab

### Estimation Sheets-

In the building industry, cost estimation is crucial. The accuracy of a project's estimation determines its success and quality. The estimate is the most reliable source of information for determining a project's pricing, and it aids in correctly planning and organizing the construction process. In almost every firm, cost estimate is useful and necessary. It is especially critical for companies that work on large, complex projects. It is hard to budget for a project or manage expenses as the project progresses without a process in place to accurately estimate project costs. Almost every construction firm owns a computer. For those who utilize it, it has evolved into a powerful tool. . The issue is that many builders do not take the time to learn how to use this fantastic technology. Estimation sheets can be found in the following places:

- Quantity of Brickwork
- Rate analysis

### Management sheets -

#### Managing Projects

As the complexity of a construction project grows, so does the importance of how a project manager controls the project's resources. Meanwhile, the construction sector must respond to the issues of assisting in the development of new infrastructure as well as the maintenance of current infrastructure. As a result, contractors' capacity to undertake construction more efficiently and effectively by implementing solid project management practices is an evident requirement.

- Dynamic Gantt Chart
- Automatic Work Breakdown Structure
- Construction Budget Template.

### III. SCOPE AND OBJECTIVES

- Create a project management software prototype using a spreadsheet application, such as Microsoft Excel.
- Preparing various programs utilizing computer tools such as Microsoft Excel spreadsheets for faster quantity survey calculations of various structural elements such as PCC, RCC, brickwork, plastering, excavation, and other materials.
- To develop an excel-based standardized technique for calculating the quantity and cost of sand, brick, aggregate, cement, and steel for building projects.
- Quantity survey and cost estimation of various structural parts of the complete building according to the most recent rate schedule.
- Microsoft Excel may be customized to present data using a variety of graphics and to evaluate certain tasks using add-ins like statistics.
- For proper material selection and work quality.
- Errors in manual calculations are no longer an issue.
- The goal of the project is to create a simple, economical, and helpful spreadsheet application for small construction companies to plan and control their projects.
- Developing a computerization system has the goal of reducing paper work and saving time in management.

### IV. Methodology

A large amount of documented data is necessary for the investigation. Work out quantities of various works and then determine the cost of each item while preparing an Excel sheet for a detailed estimate of building works. There are three steps to preparing this dish.

For [1] Foundations and their types, analysis and design will be carried out. [2] Slabs and their various kinds [three] columns [4] Beams and their various sorts Staircases

2) Data Required for Excel Sheet and Detailed Estimate Preparation:

1. Microsoft Excel 2. Sketching 3. Detailed information 4. Measuring Method 5. Interest Rates 6. Function and Formula.

MS-Excel -Excel is a spreadsheet tool for organising, manipulating, and analysing data. Excel is frequently used in the workplace to keep track of statistics, generate sales reports, perform financial modelling, perform scientific engineering, and make charts and illustrations. It can, however, be used to establish budgets at home. Excel is a sophisticated and versatile tool that has a lot to offer. This paper requires you to create a template for numerous construction projects.

Drawing- When preparing estimates, a detailed drawing is required. It is the process of calculating quantities of various items of work using dimensions from the plan, elevation, and section. Drawings aid in determining the structure's height, the depth to which hard strata are available, the thickness of walls and slabs, and so on.

Specifications- The description of the material to be used, its quality, and the precautions to be utilised for concreting can all be found in the specification. The specification aids us in getting a closer estimate to the actual cost.

Measuring Technique These are useful for determining quantities. These are units of measurement that are used to describe the amount of labour that goes into an object. These measuring modes are based on IS-1200.

Rates- It is vital to know material and labour rates in order to make an appropriate estimate. Rates for equipment, tools, and plant are also available. These prices are offered in DSR (District schedule rate) or CSR (Consolidated schedule rate)

(Current Schedule Rate). The rates differ from one location to the next.

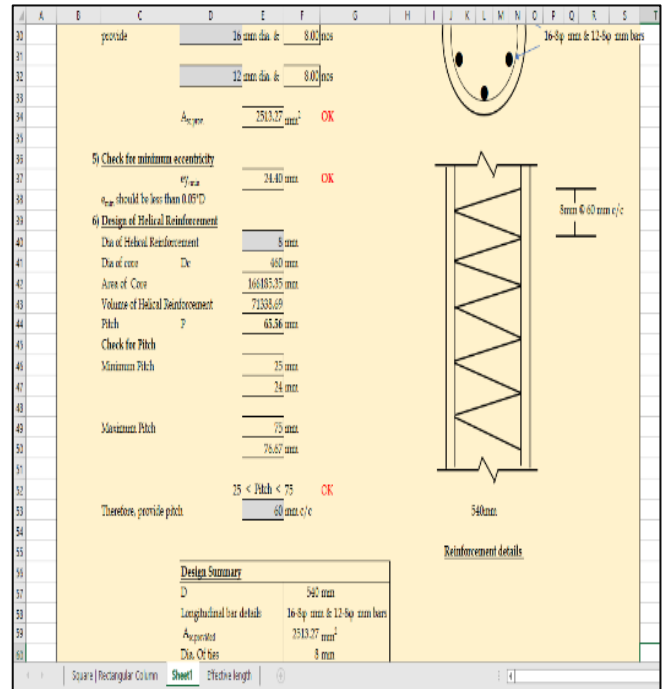
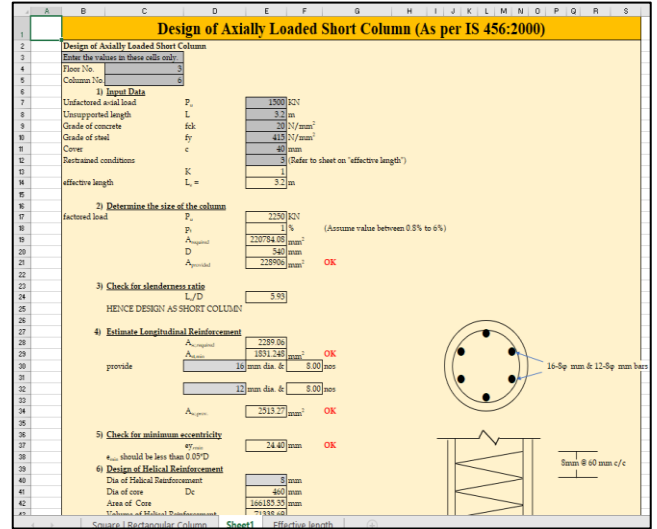
Formulas and Functions - A formula is an algebraic statement made up of values (numbers or cell references) and mathematical operators. On a worksheet, functions are used to simplify and shorten formulas, particularly those that conduct long or difficult calculations. Each range of cells in the function is referred to as an argument in Excel. It may be essential to use as many as 3 or 4 arguments for sophisticated calculations.

❖ **PROCEDURE**

A sample of three sheets is offered in this paper to demonstrate the use of sheets in various elements of building work.

When a design sheet is employed, the first example shows how to use Excel to improve the design and analysis of a Column. The creation of Axially loaded short column subjected to axial load of 1500kN (FIG 1) is used to exemplify the concept and to show that using a design sheet reduces arithmetic errors and saves time when doing tedious calculations.

The approach for Column design can be broken down into the following steps: 1.) Given  $P_u$ ,  $L$ , Cover, concrete grade, and steel grade 2.) Calculate the length of a short column. 3.) Determine the Slenderness Ratio. 4.) Calculating the amount of longitudinal reinforcement to be provided in Column. 5.) Using a suitable equation based on minimum eccentricity requirements, determine the area of steel for longitudinal reinforcement. 6.) Design of Helical Reinforcement and provision of a pitch check. 7.) Detailing.



The second example shows rate analysis for various construction components such as plastering, brickwork, excavation, and R.C.C. work. The Ratio of Plaster, the Thickness of Plaster, and the Area of Plastering are all required in the Procedure for Rate Analysis of Plastering Work. The following are the results of the Excel calculations: 1) Total Material

Cost depending on Rate and Quantity 2) Wage cost calculated on a daily basis. 3) The total cost of the plastering job.

Similarly, for R.C.C work rate analysis, the amount of shuttering necessary is calculated.

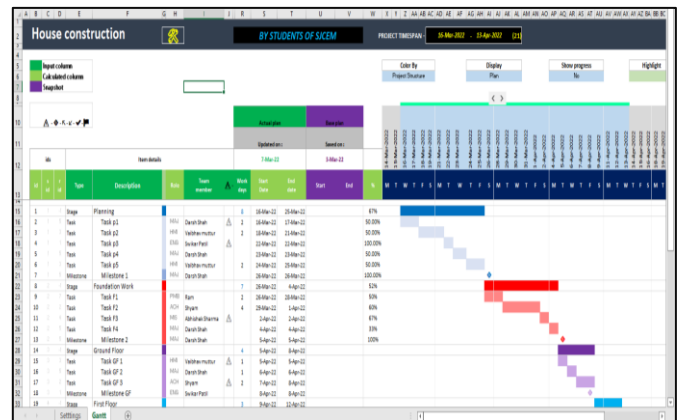
Rate Analysis for Plastering Work		Description					
Put values in these		Unit	Quantity	Rate	Per	Amount	
Ratio of Plaster		Material Cost					
cement	1	Cement	BAG	19.70	400	Bag	₹ 7,879.68
sand	6	Sand	CUM	4.10	1200	Cum	₹ 4,924.80
Thickness of plaster		Total					
12 mm		₹ 12,804.48					
Area of Plastering		Labour Cost					
300 m <sup>2</sup>		Mason	DAY	4	550	Day	₹ 2,200.00
Sum of Ratio		Mazdoor	DAY	6	400	Day	₹ 2,400.00
7		Beldar	DAY	4	350	Day	₹ 1,400.00
Wet Volume of Plaster		Bhisti	DAY	2	300	Day	₹ 600.00
3.6 m <sup>3</sup>		Total					
Dry Volume of plaster		₹ 6,600.00					
4.8 m <sup>3</sup>		Overall total cost					
Quantity of cement		₹ 19,404.48					
0.684 m <sup>3</sup>		Add	1.5% water charges of overall total c			₹ 291.07	
Weight of cement		Add	5% contractor charges			₹ 970.22	
994.96 kg		Grand Total					
Number of bags		₹ 20,665.77					
19.6992 nos		Rate of plaster per SQM					
Quantity of sand		₹ 68.89					
4.104 m <sup>3</sup>							

S.No	Description	Unit	Quantity	Rate	Per	Amount
<b>A</b>						
Material						
1	Cement	Bag	18,144	350	Bag	₹ 6,350.40
2	Sand	Cum	0.945	450	Cum	₹ 425.25
3	Aggregate	Cum	1.89	550	Cum	₹ 1,039.50
4	Steel	Kg	176.625	82	Kg	₹ 14,483.25
5	Binding wire	Kg	1,766.25	65	Kg	₹ 114.81
6	Shuttering	SQM	106	30	SQM	₹ 3,180.00
<b>B</b>						
Labour						
For Laying Reinforced Concrete						
1	Beldar	Day	15	300	Day	₹ 4,500.00
2	Mazdoor	Day	15	350	Day	₹ 5,250.00
3	Bhisti	Day	8	400	Day	₹ 3,200.00
4	Mason	Day	3	550	Day	₹ 1,650.00
For Centering & Shuttering						
1	Beldars	Day	45	300	Day	₹ 13,500.00
2	Carpenters	Day	45	400	Day	₹ 18,000.00
Reinforcement work for Component						
1	Blacksmith	Day	12	400	Day	₹ 4,800.00
2	Beldars	Day	12	300	Day	₹ 3,600.00
<b>Total</b>						
						₹ 80,093.21

The Third example is of Dynamic Gantt Chart with has a lot of same features as Microsoft project.

### Features

- Smart Project Structure with Stages (S), Tasks (T), and Milestones (M)
- Dependency Engine with 4 Dependency Connection Types (FS, SS, SF, FF)
- Auto-Coloring Engine with 4 Color Modes
- Plan vs. Base Comparison
- Intuitive Progress Tracking
- Dynamic and Static Date Highlighting



### Creating Detail Sheets

Detail sheets are pages that indicate the actual amounts and unit pricing for each building category. We had to enter specifications of the item of work such as length, width, depth, thickness, and material grade in order to calculate the amount of the item. Formulas can be readily entered to complete the calculations that take up so much of a builder's time when estimating by hand. Once the information sheets are completed, the estimator merely needs to fill in the numbers for the various goods. The quantities are easily approximated using the formula you establish. Totals for line items and categories are computed automatically. It is simple to update if any changes are required.

## V. Conclusion-

- Design sheets are slowly gaining popularity as a useful tool, and they are regarded as one of the first software developments to have a significant impact on the mainstream usage of personal computers.
- The inherent cell-based structure of design sheets, as well as the simple, easy-to-learn interface, are two of their strongest advantages.
- This is due to its extensive programming capability. The major goal of developing a computerization system is to eliminate paper work and save time in management, which promotes efficiency and reduces work load.
- For calculating quantities and costs of structural elements, it is cost-effective and simple to use. It is capable of generating graphical or visual representations of your data.
- The examples demonstrate spreadsheets' simple yet powerful features, as well as their capacity to solve Civil Engineering challenges.
- Civil engineering students can use these examples as templates/models to address related problems or construct models to solve different challenges.
- Organizations can also use the model of a thorough cost estimate to improve the performance of their estimators and ensure more accuracy.
- The use of an excel spreadsheet to estimate the quantity of each structural element for the entire building is more accurate than the manual method. It also took less time. This is a low-cost method of estimating the number of various pieces of work.

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