Short Communication

Integrating Various Softwares for Planning Analysis and Design

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ABSTRACT

Every stage in construction, starting right from planning till turning the key to the project requires a lot of drafting and note making. If done the conventional way, it will take a lot of time and will be very tedious to understand even. A simple calculation of the paint area will take a very long time and effort. Volume calculation will also be the same. To prevent wastage of time and to make the workflow more optimized, a list of software can be used which can keep a log on all the progress and give the required results in a less time. This paper shows how 3 different softwares can be used to plan, analyze and design a group of houses. The quantity take-offs of the structural members and other entities can be done just with a few clicks. The software used are SketchUp, Staad Pro and Microsoft Excel. The result was a very fast procurement of the required values.

Keywords: Civil design, Optimization, STAAD Pro, Microsoft Excel, SketchUp, Planning, Design

I. INTRODUCTION

The basic principle of any Programming language is writing an Algorithm. This algorithm can be repeated for 'n' number of times. And thus, using any machine, be it a Smartphone or Personal Computer, upon writing a program to do the frequently repeating procedure, it can do so in fractions of seconds. Thus, employing a simple smartphone or a low configuration PC, an engineer can speed up the work, amount for more calculations in a short interval of time, thus saving a lot of time and hard-work. If such an algorithm is written with every minute detail in mind, then there will not be an error in the final result obtained.

For all engineering works it is required to know beforehand the probable cost of construction known as the estimated cost. If the estimated cost is greater than the budget available, then attempts are made to reduce the cost by reducing the work or by changing the specifications. This means the same work will have to be repeated again and upon further requests it will be repeated further.

On a whole, 6 houses have been completely planned, designed, analyzed and estimated. These 6 types of houses have been repeated in a master plan which bears all the houses. The number of houses being >1500. The planning of the whole area has been done with strict following of the National Building Code (NBC).

II. Investigation

The National Building Code gives the specifications of all types for all the types of buildings. But here, the provisions only for some elements such as walls, slabs, beams, columns etc. only is followed. Fireproofing, Plumbing, air-conditioning, Lighting etc. have not been done.

Works relating to Earthwork, Electrical, Mechanical, Transportation, Water Resource Management, Road laying and Plumbing have not been done in this project. However, the type of roads as per the Indian Road Congress (IRC) have been followed and the respective spacing for kerbs, future

widening etc. have been given. The spacing in between buildings, the avenues etc. are given as per the code so that good air flow is maintained overall.

The design includes
1. Design of beam
2. Design of column
3. Design of slab
4. Design of footing
5. Design of Staircase
6. Estimation of Quantities

III. List of software

SketchUp Pro — SketchUp is a 3D modelling computer program for a wide range of drawing applications. The program includes drawing layout functionality, allows surface rendering in variable "styles" and enables placement of its models within Google Earth.

Bentley STAAD Pro V8i — STAAD Pro is a structural analysis and design computer. It is one of the most widely used structural analysis and design software products worldwide. It supports various steel, concrete and timber design codes of different countries.

Microsoft Excel — Microsoft Excel is a spreadsheet using a grid of cells arranged in numbered rows and letter-named columns to organize data manipulations like arithmetic operations. It has a programming aspect, Visual Basic for Applications, allowing the user to employ a wide variety of numerical methods.

IV. Stages of work

The steps involved are
1. Planning — Done using references such as NBC
2. Drafting — Done using Google SketchUp
3. Analysis — Using Staad Pro
4. Design — Using Staad Pro and Manual Design assisted with Excel Sheets.
5. Estimation — Using Google SketchUp and Excel

The planning is done as per National Building Code 2005.
The structural design is as per IS 456 2000.

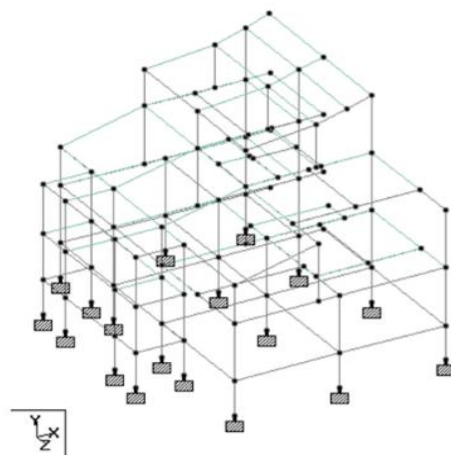Figure 1: Type 1 (Rendered View in SketchUp)

Figure 1 shows the Type-1 house drafted in SketchUp; analyzed and designed in STAAD Pro.
Figure 2 shows the Type-1 house frame being analyzed and designed in STAAD Pro.
Figure 3 shows the Type-2 house drafted in SketchUp.

Figure 2: Type 1 (View in STAAD Pro)

Figure 3: Type 2 (Rendered View in SketchUp)   *Figure 4: Type 3 (Rendered View in SketchUp)*

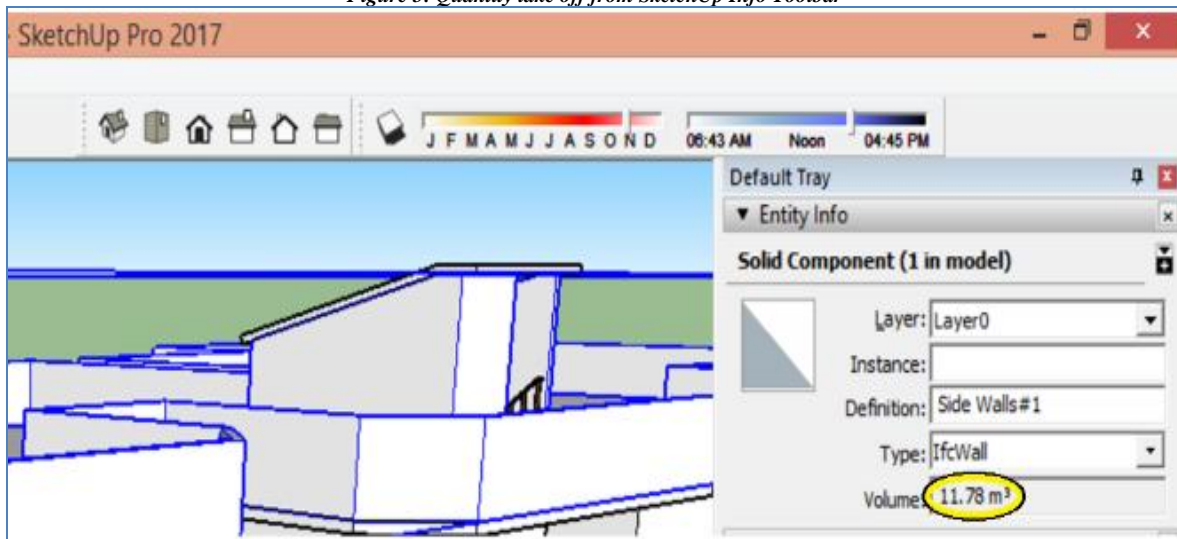*Figure 5: Quantity take off from SketchUp Info Toolbar*

Figure 4 shows the Type-3 house drafted in SketchUp.

Figure 5 shows the Quantity take-off from the info toolbar in SketchUp. From this toolbar, the volume and areas can be taken for easy calculation.

Figure 6, Figure 7 and Figure 8 show the model calculations done in Microsoft Excel.

Figure 9 gives the total required quantities from Excel.

Figure 7: Model Plastering Calculation

Table for Plastering Calculations				
		First Coat volume	Second coat volume	
Area of Plastering outside	313.15	1.8789	0.93945	
Volume of Sand	1.25	2.348625	1.1743125	m3
Volume of Cement	0.417	0.7835013	0.39175065	
	No of bags	22.56483744	11.28241872	bags
		First Coat volume	Second coat volume	
Area of Plastering Inside	2515.88	15.09528	7.54764	
Volume of Sand	1.25	18.8691	9.43455	m3
Volume of Cement	0.417	6.29473176	3.14736588	
		181.2882747	90.64413734	bags

Figure 6: Model Volume calculation

Table for volume of concrete			
Volume of Concrete	per m3	Total	units
Volume of sand in M30	0.46	48.86488	m3
Volume of Aggregate in M30	0.92	97.72976	m3
Volume of cement in M30	0.613	65.117764	
(1440 kg cement is 1m3)	Bags of cement	1875.391603	bags
Table for Brickwork Volume			
using 1:3 mix cement:sand	per m3		
Volume of sand	0.2	11.086	m3
Volume of cement	0.066	3.65838	m3
	Bags of cement	105.361344	bags
Brick volume	0.734	40.68562	
	Number of bricks	24615.98499	

Figure 9: Total quantities

TOTAL SAND	91.7774675	m3
TOTAL AGGREGATE	97.72976	m3
TOTAL CEMENT BAGS OF 50KG	2286.532615	Bags
TOTAL BRICKS	24615.98499	

Figure 8: Model of Overall Calculation

Volume of Concrete		
Slab		25.35
Roof		15.248
Columns		16.41
Beams		25.22
Footings		24
	Total	106.228
Volume of Brickwork		
Walls		54.72
Terrace Wall		0.71
	Total	55.43
Surface areas of walls		
Wall (outside)		313.15
Wall (Inside)		2515.88
	Total	2829.03
Area of Flooring		
Ceiling		290.3
Floor		471.34
	Total	761.64
Area of Shuttering		
Ceiling		290.3
Beams		312
Columns		203
Footings		4.8
	Total	810.1
Area of Water Proofing		
Footings		8.8
Beams		19.51
	Total	28.31

V. CONCLUSION

All the values were obtained very quickly when compared to the manual method. The beams and columns have been optimized to not let any confusion for the labor. As the unskilled labor has a high chance of getting confused about the detailing, this has been considered necessary.

Due to optimization, a lot of hassle for the site engineers has been decreased.

The above available data can directly be used for Rate Analysis and will decrease the need for constant repetition of steps in the procedure of finding the values.

Overall, a lot of time was saved by using this software together. The result was neat and optimized data ready for transfer to other departments which can start working immediately.

VI. REFERENCES

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