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Comparative study of manual and software-based design of G+1 building

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ABSTRACT

Today, technology is circulating in almost every field of humans' life, Now this is the time, the life will become much more difficult without the use technology in our lives. So, keeping the involvement of technology in mind, we will try to cover some of uses of computer technology in different areas of civil engineering.The project deals with different softwares used in civil engineering like AUTOCAD, STAAD PRO.Which are used for different purposes during the completion of the project. The AutoCAD is used for drafting the 2D plan and to do more accurate and fast work. Later the plan can be made in 3D with the help of Autocad so it will give more details about the plan then design and analysis is done with Staad Pro. After that we can cross check all the calculations manually so we will know how fast and time saving these software.

Keywords: *AUTOCAD, STADD PRO, Manual, Design*

1. INTRODUCTION TO PROJECT

As we already discussed importance of buildings and we already know the traditional way to built one here the project is about constructing a building with the help of software by which one will get the basic idea of the look of a building, problems in constructing it, excepted cost, etc. here is the information of few software we are going to use in the project.

1.1 AUTOCAD

The meaning of AutoCAD is "Automatic Computer-Aided Design". The AutoCAD software is made for design and draft. The AutoCAD offers a civil engineer to the analysis of the ideas of a creative structure. It is proposed a civil engineer for designing products and also for creative structures. It helps us to perform rapid design calculations. The AutoCAD also allows us to simulations in the field of civil. In the field of Civil, AutoCAD offers a lot of benefits. AutoCAD saves some money and some time for us. It is reduces drafting errors and produces better content.

1.2 STAAD PRO

STAAD or (STAAD Pro) is a structural analysis and design computer program originally developed by Research Engineers International at Yorba Linda, CA in 1997. Design any type of structure and share your synchronized model data with confidence among your entire design team, using STAAD Pro**.** Ensure on time and on budget completion of your steel, concrete, timber, Aluminium, and cold-formed steel projects, regardless of complexity. You can confidently design structures anywhere in the world using over 80 international codes, reducing your team's need to learn multiple software applications.

1. STAAD Pro is capable of 1429D analyzing and designing civil engineering structures such as buildings, bridges, and plane and space trusses.
2. This software can generate loads (wind and earthquake) as per building codes of selected countries.
3. Design of steel and reinforced concrete buildings as per the codes of selected countries can also be carried out with STAAD Pro.
4. It can carry out linear elastic (static and dynamic) and nonlinear dynamic analysis (although I am not sure how good the nonlinear analysis algorithms are, not having used those features).

2. LITERATURE REVIEW

The research about "engineering design norms are implemented based on CAD platform" is successfully finished, so intended purpose is achieved. Four parts, catalogue, index, search, bookmarks, are included in the system. The secondary development under the environment of AutoCAD is that the norms of the highway project as the custom menu are added into help document library of various editions AutoCAD. Then project planner can quickly find what they need, saving much time and increasing portability, as the same time increasing productivity and design efficiency.(1)

Drawings are created automatically in AutoCAD by means of database, diameter, number, length, provided by engineer. Depending on the floor, up to which data input column is designed automatically for each floors together with names of beams connected with the column, length of reinforcement at the floor and other details. Thus, a ready drawing is created, which means that the task is fulfilled within a minimum time span. Therefore, the work, which can be performed by a highly qualified design engineer in 1-1.5 hour for each floor in AutoCAD, is done by an inexperienced operator in 15-20 minutes in the end the tasks performed onAutoCAD are similar or even better than the ones which are performed manually. (2)

The system combines the computerized drawing and drawings management together and managing drawings once the system is based on the AutoCAD software, it enables the drawing and filing to be carried out in the same environment, and the users can search, view and file drawings at any time. In this way, the designing and managing of drawings will not be separated. The computerized drawings management system allows different permission to different user level, and limits the using according to different period of using. If we give enough data to the software and one knows all the basic codes with the help of which a plan has to be draw we can draw a required plan.(3)

The use of computer software and its tools in structural analysis and design is tested my many and it is has given promising results. The work efficiency of performing the same task manually is significantly reduced. The comparison of results between STAAD PRO and manual computation is checked and the failures due to shear force, deflection, bending moment are always indicated by these software. so they helped a lot for selection of better section. The software like this can also cause a huge loss that include lives of people so while using such tools one must know all the basics and risks of using such tools. One can also check the calculations manually just to be sure by that way we can prevent the potential damage.(4)

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion. Design for Flexure is maximum sagging (creating tensile stress at bottom face of beam) and hogging at the top of beam and these are can be calculated at all active load cases at required sections. And each section can be designed to resist this critical sagging and hogging moment. Design for shear so that it can resist both shear and torsion moment all major criteria for selecting longitudinal and transverse reinforcement as in IS456 can be designed by STAAD PRO. (5)

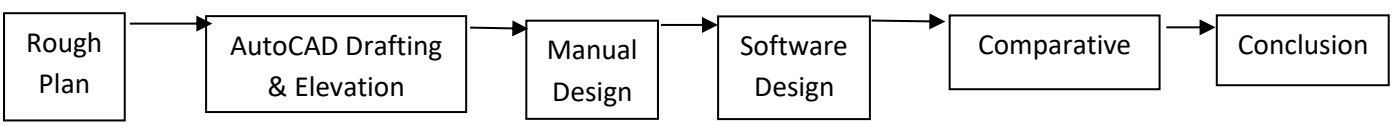
The construction these days is the most developing sectors. With development of country the development of residential building takes place. The working stress method is widely used in India for which the factor of safety is 3 for concrete and 1.7 for steel. It means 200% more concrete and 70% more steel. So the bigger areas can be seen in working stress method we can reduce out area by limit state method hence it is economical. The design follow the study of AutoCAD and analysis by Staad Pro to found out the structure is safe in deflection, stress and loads. The aspects and prospects are made according to NBC of India. (6)

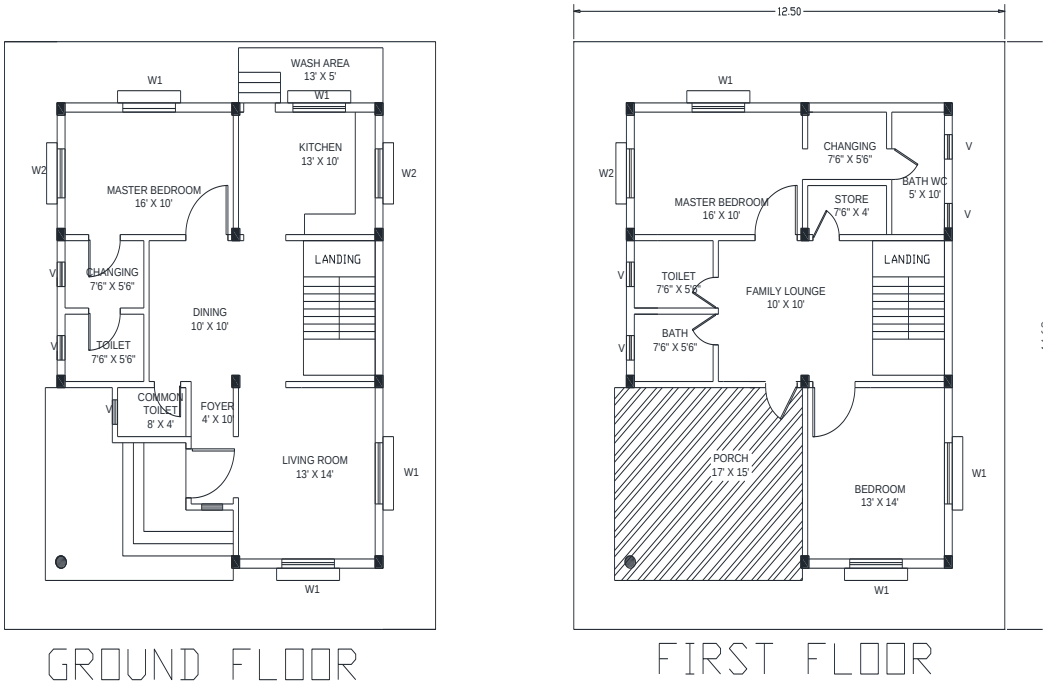
Concluding remark

The study of various research papers helped us to understand the use of various softwares used in civil engineering and how they can be used to achieve many difficult and complicatedtasks with the help ofthis software. Some of them also show the difference between manual and software based calculations. The papers also helped us to understand the different work related to civil engineering which is going on in the world.

3. METHDOLOGY

- **Flowchart for the Project**





2D plan designed in AutoCAD

Table 1: Details of Plan

S No.	Specifications	Area (sq.feet)
1	Plot area	1968
2	Greenery	607
3	**GROUNDFLOOR**	
	Built up	1003
	Carpet	727.5
4	**FIRST FLOOR**	
	Built up	1177
	Carpet	697

4. RESULTS OF MANUAL AND SOFTWARE DESIGN

Table 2: Results obtained after design of slab

S no.	Element Name	Manual Design		Software Design	
		Shorter Direction	Longer Direction	Shorter Direction	Longer Direction
1	Slab-1	10Ø - 260mm c/c	8Ø - 200mm c/c	T8 @ 275	T8 @ 275
2	S2	10Ø - 300mm c/c	8Ø - 300mm c/c	T8 @ 225	T8 @ 275
3	S3	10Ø - 300mm c/c	8Ø - 300mm c/c	T8 @ 275	T8 @ 275
4	S4	10Ø - 300mm c/c	8Ø - 280mm c/c	T8 @ 275	T8 @ 275
5	S5	10Ø - 300mm c/c	8Ø - 300mm c/c	T8 @ 275	T8 @ 275
6	S6	10Ø - 180mm c/c	8Ø - 150mm c/c	T10 @ 275	T8 @ 100
7	S7	10Ø - 300mm c/c	8Ø - 250mm c/c	T8 @ 200	T8 @ 200
8	S8	10Ø - 300mm c/c	8Ø - 280mm c/c	T8 @ 275	T8 @ 275

Table 3: Results obtained after design of beam

Element									
	Manual Design	Top	Main Reinforcement			Shear Reinforcement			Additional
		Bott							
	Software Design	Top	left	mid	right	left	mid	right	-
		Bott							
B1	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			-
		Bott	8Ø - 2						
	Software Design	Top	3-T16	2-T10	3-T10	2L-T8 @ 225	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	3-T8	3-T8	3-T8				
B2	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			20Ø - 1
		Bott	12Ø - 3						
	Software Design	Top	3-T16	2-T16	3-T16	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T16	3-T16	2-T16				

B3	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	3-T16	3-T8	3-T16	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T12	3-T12	2-T12				
B4	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			20Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	2-T16	2-T16	2-T16	2L-T8 @ 100	2L-T8 @ 225	2L-T8 @ 100	-
		Bott	2-T10	3-T10	2-T10				
B5	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	2-T25	2-T16	2-T16	2L-T8 @ 225	2L-T8 @ 225	2L-T8 @ 225	-
		Bott	2-T10	3-T10	2-T10				
B6	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			20Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	2-T25	2-T10	2-T25	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T20	2-T20	2-T20				
B7	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			-
		Bott	8Ø - 2						
	Software Design	Top	3-T10	3-T8	3-T8	2L-T8 @ 100	2L-T8 @ 225	2L-T8 @ 100	-
		Bott	3-T8	3-T8	3-T8				
B8	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			
		Bott	8Ø - 2						
	Software Design	Top	3-T16	2-T10	3-T10	2L-T8 @ 225	2L-T8 @ 225	2L-T8 @ 225	-
		Bott	3-T8	3-T8	3-T8				
B9	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	3-T12	3-T8	3-T16	2L-T8 @ 100	2L-T8 @ 225	2L-T8 @ 100	-
		Bott	2-T12	3-T12	2-T12				
B10	Manual Design	Top	25Ø - 3			8Ø - 300mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	3-T16	3-T8	3-T16	2L-T8 @ 100	2L-T8 @ 225	2L-T8 @ 100	-
		Bott	2-T12	3-T12	2-T12				
B11	Manual Design	Top	20Ø - 3			8Ø - 250mm c/c			-
		Bott	8Ø - 2						
	Software Design	Top	3-T16	3-T8	3-T12	2L-T8 @ 225	2L-T8 @ 225	2L-T8 @ 100	-
		Bott	2-T10	3-T10	2-T10				
B12	Manual Design	Top	25Ø - 3			8Ø - 300mm c/c			25Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	2-T25	2-T16	2-T32	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T25	2-T25	2-T25				
B13	Manual Design	Top	25Ø - 3			8Ø - 250mm c/c			25Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	2-T32	2-T10	2-T25	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T25	2-T25	2-T25				
B14	Manual Design	Top	25Ø - 3			8Ø - 300mm c/c			25Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	2-T32	2-T20	2-T32	2L-T10 @ 100	2L-T10 @ 100	2L-T10 @ 100	-
		Bott	2-T25	2-T25	2-T25				
B15	Manual Design	Top	25Ø - 3			8Ø - 250mm c/c			25Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	2-T32	2-T10	2-T25	2L-T10@100	2L-T10@100	2L-T10@100	-
		Bott	2-T25	2-T25	2-T25				
B16	Manual Design	Top	25Ø - 3			8Ø - 300mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	2-T25	2-T10	2-T25	2L-T8@100	2L-T8@100	2L-T8@100	-
		Bott	2-T16	3-T16	2-T16				
B17	Manual Design	Top	25Ø - 3			8Ø - 250mm c/c			25Ø - 1
		Bott	12Ø - 2						
	Software	Top	2-T25	2-T10	2-T16				-

	Design	Bott	2-T10	3-T10	2-T10	2L-T8 @ 225	2L-T8 @ 100	2L-T8 @ 100	
B18	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			20Ø - 2
		Bott	12Ø - 2						
	Software Design	Top	3-T12	2-T12	3-T12	2L-T8 @ 100	2L-T8 @ 100	2L-T8 @ 100	-
		Bott	2-T16	3-T16	2-T16				
B19	Manual Design	Top	25Ø - 3			8Ø - 200mm c/c			20Ø - 1
		Bott	12Ø - 2						
	Software Design	Top	3-T10	2-T10	3-T10	2L-T8 @ 225	2L-T8 @ 225	2L-T8 @ 225	-
		Bott	2-T16	2-T16	2-T16				
B20	Manual Design	Top	20Ø - 3			8Ø - 200mm c/c			20Ø - 1
		Bott	8Ø - 2						
	Software Design	Top	3-T10	3-T8	3-T8	2L-T8@100	2L-T8@225	2L-T8@225	
		Bott	2-T12	3-T12	3-T12				

Table 4: Results obtained after design of column

S no.	Element Name	Manual Design		Software Design	
		Main Reinforcement	Links	Main Reinforcement	Links
01	Column-1	12Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
02	C2	12Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
03	C3	12Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
04	C4	12Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
05	C5	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
06	C6	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
07	C7	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
08	C8	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
09	C9	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
10	C10	12Ø - 6	6Ø - 190mm c/c	6-T12	T8@175
11	C11	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175
12	C12	16Ø - 4	6Ø - 190mm c/c	4-T12	T8@175

Table 5: Results obtained after design of footing

S no.	Name	Design	Size of footing	Reinforcement	
				Longer	Shorter
1	F1	Manual	1500x1500x255	10Ø - 10	10Ø - 10
		Software	1100x1050x300	5-T10@265	5-T10@300
2	F2	Manual	1800x1800x255	10Ø - 10	10Ø - 10
		Software	1400x1350x325	7-T10@225	8-T10@200
3	F3	Manual	1600x1600x255	10Ø - 10	10Ø - 10
		Software	1150x1150x300	5-T10@290	5-T10@290
4	F4	Manual	1800x1800x255	10Ø - 10	10Ø - 10
		Software	1300x1250x300	6-T10@250	7-T10@220
5	F5	Manual	2500x2500x355	12Ø - 10	12Ø - 10
		Software	1750x1700x400	12-T10@160	13-T10@150
6	F6	Manual	1800x1800x255	10Ø - 10	10Ø - 10
		Software	1400x1350x325	7-T10@225	8-T10@200
7	F7	Manual	1800x1800x255	10Ø - 10	10Ø - 10
		Software	1200x1150x300	5-T10@290	5-T10@300
8	F8	Manual	2500x2500x355	12Ø - 10	12Ø - 10
		Software	1600x1550x375	10-T10@175	11-T10@160
9	F9	Manual	1800x1800x255	10Ø - 10	10Ø - 10
		Software	1300x1250x300	6-T10@250	7-T10@220
10	F10	Manual	1500x1500x255	10Ø - 10	10Ø - 10
		Software	1000x950x300	5-T10@300	5-T10@300
11	F11	Manual	1500x1500x255	10Ø - 10	10Ø - 10
		Software	1250x1200x300	5-T10@300	6-T10@250
12	F12	Manual	1500x1500x255	10Ø - 10	10Ø - 10
		Software	1050x1000x300	5-T10@300	5-T10@300

Concluding remarks for comparison

After completing designs by both manual and software based method we found that the design in Software is more accurate.we get to know the actual amount of steel required which is both time and money saving .no need to provide development length as software always take it in consideration .if any member fails we don't need to start from scratch as in Staad pro dimensions can be changed instantly and we get a redesign within seconds.

4. CONCLUSIONS

- While working on the project we get the complete and detailed information about software used in the civil engineering.
- While completing the given project we encountered with many useful codes and techniques by which we can solve many complex problems in short time with the help of software.
- The project gives you the detailed explanation about the manual calculations and the automatic(software) based calculations.
- The projects teaches us about how technology can be used to save time and make work efficient
- The project is a part of group activity so one will have a great experience about working together.

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