

Analysis and Design of Educational building using SAP2000

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Abstract - The prime objective of this project is the analysis and design of multi-storey college building (G+3) by SAP2000 software. STRUCTURAL ANALYSIS PROGRAMMING in short SAP2000 is used to analyze concrete structures, steel structures, all types of garages, low and high raise buildings, and portal frame design of multi-storey RCC collage building of G+3 i.e. ground floor plus 3 more floors. SAP2000 is used for modelling of this framed RCC G+3 structure. By using this software post analysis of this structure, bending moments, maximum shear force, and maximum member displacement are computed. The Indian Standard codes which are used for the purpose of designing of structural elements are.

Index Terms - SAP2000, RCC Frame, Shear force, Bending Moment, IS456:2000, structural elements.

1.INTRODUCTION

SAP2000 is a software which is ideal for civil-engineering analysis and design of any type of structural system, including multistoried buildings, stadiums, towers, industrial plants, offshore structures, piping systems, skyscraper, dams, soils, machine parts and many others.

For last 30 years SAP has been another name for state-of-the-art analytical methods. This software provides very versatile user interface due to its unique analysis engine and tools used for designing by engineers who works on different sectors and industries like transportation, public works, sports, etc. It is a very sophisticated and very easy to use software. Not only this software is used for the computation of new structures but also it is use to check the inadequacy of the existing building, and help to determine its potential.

The science of designing includes a safe, serviceable, a durable structure which is economically and elegantly secured is called as Structural design. The

whole process of Structural planning and proper designing not only requires imagination and conceptual thinking but also a deep knowledge of structural engineering science and knowledge of practical aspects. Some relevant design codes and byelaws should also be there in mind.

For this a sound knowledge of structural analysis is required, because there will be designing of many structural elements. Hence designing of these will be helped by a computer application and software SAP2000. This software is designed in such a way that it can work perfectly and can have fully integration in Microsoft windows. In terms of productivity and ease-of- use this software is completely capable of giving powerful user interface.

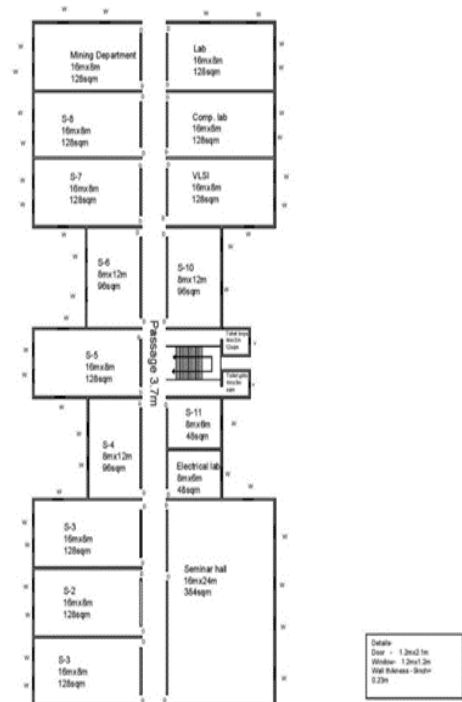


Fig-1: AutoCAD Plan

1.1. Objectives

Everyday different techniques are been developing for construction of any structure economically, faster and also have tendency to fulfill requirements. Layouts, design work and planning of any structure is been done by Engineers and architects. Designing any structure which is a simple one, in earlier times it would take many days. Hence designing of any complicated structures would have taken weeks. But now designing of even a complicated structure can be done within a week, which will have more accuracy by using certain software and their capability to design the accurate things. SAP is one of the best software among them.

The main purpose of this project is:

1. To create a structural plan of structure.
2. To create a model of the structure
3. To check the proper analysis of every loading condition which includes dead load, live load and wind load.
4. Analysis of the structure.
5. Design of building using IS-456.

1.2 Types of structure-

SAP 2000 is equipped for examining and planning structures comprising of casing, plate/shell and strong components. Practically any sort of construction can be dissected by SAP 2000, viz, SPACE, PLANE, TRUSS.

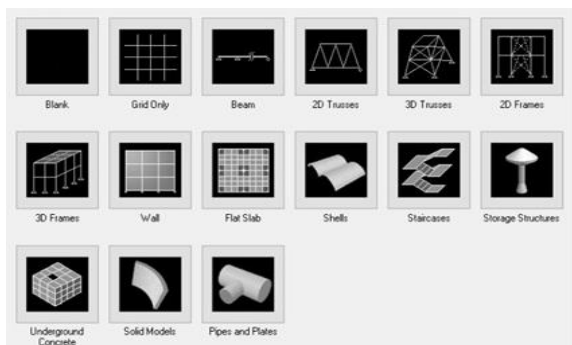


Fig-2: Types of structure

1.3 Analysis of load using SAP 2000:

- Joint Loads: Joint loads, the two forces and moments, may be applied to any free joint of a construction. These heaps act in the worldwide organize arrangement of the design. Positive powers act in the positive organize headings. Any number of burdens might be applied on a solitary joint, in which case the heaps will be added substance on that joint.

- Area/Floor load: Many a times (bound by X-Z plane) is exposed to a consistently circulated load. It could require a great deal of work to ascertain the part load for singular individuals around there.
- Fixed end member load: Load impacts on a part may likewise be indicated regarding its fixed end loads. These loads are given as far as the part arrange framework also, the bearings are inverse to the real burden on the part.

2. METHODOLOGY

2.1 Design and Analysis steps in SAP 2000:

1. In SAP2000 window > New Project> Change units in the drop-down box shown, to kN, m, C.
2. Define menu> Section Properties> Frame section.
3. Various parameters are defined in boxes. Here M25 and Fe500 have been considered. Define>Frame Sections is clicked. Second drop-down box of “Choose Property Type to Add” Add Rectangular >Add New property Rectangular Section. Section name for Beam is given; parameters in boxes, and also Concrete Reinforcement is defined. Similarly, same things is done for Columns. To use cracked section, Set Modifier is clicked to change stiffness of members to account ofor cracked section >OK.
4. Draw button is clicked to draw Frame/Cable/Tendon. A dialogue box will open, click on Section to find appropriate section. Draw section on GUI by clicking on nodes. In this problem draw only ground floor beams and columns. Note: View can be changed by designer at any time while drawing sections.
5. After drawing sections again go to drop down menu. Define>Load Case> a dialogue box Define Loads will open as shown. It can be observed that a load named Dead is already defined with a self-weight multiplier 1, this case is for self-weight of members drawn in previous steps.
6. To distribute various loads on slab to beams, yield line pattern of loading is used.
7. To define all members in model, replicate command is used. This command replicates all members.
8. To assign support, select all the nodes at bottom most grid line either by clicking or by window Go to drop down menu Assign>Joint>Restraints>a

dialogue box Joint Restraints will open > assign degrees of freedom>OK

9. Assign>Joint>Constraints >Diaphragm in box .Choose type of constraints> Add New Constraints.
10. Define>Functions>Response Spectrum >a dialogue box Define Response Spectrum will open Choose Function Type to Add>Spectrum from File>Add New Function.
11. Go to drop down menu Define>Analysis Cases>a dialogue box Analysis Cases will open. Click to Addnew Case, Another dialogue box will open, as shown>Analysis Case Type>Response Spectrum.
12. Define>Mass Source, A dialogue box will open, Define Mass source from LOADS.
13. Analyze > Run Analysis.
14. Click Run Now.
15. After finishing the analysis, Display >Show Tables to display and print analysis results
16. Animations can also be obtained by clicking start animation button at the lower right corner.
17. Display > Deformed shape to show the deformed shape of the structure.
18. To view shear force and bending moments show Shear/ Stresses toggle button is clicked.
19. Shear or Moment radio button > OK.
20. After successful Analysis of the structure, for concrete Design: Design> Concrete Frame Design> View/Revise Preferences. Select Design code as India (IS456-2000)>OK.
21. Design> Concrete Frame Design> Set Design Combo>check Automatically Generate Code-Based Design Load Combination> OK.
22. Design> Concrete Frame Design> Start Design / Check of the structure.
23. After competition of Design right Click on a member> Summary > to Display the Design Results as shown below.
24. Click on Tabular Data to view Design Data in Tabular format.

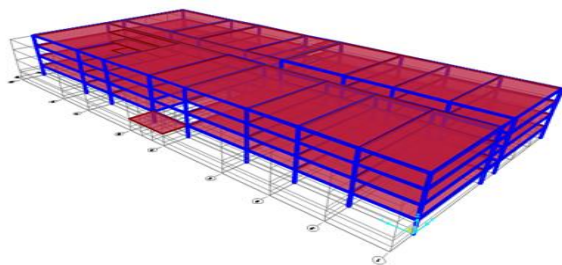


Fig -3: Modelling in SAP 2000

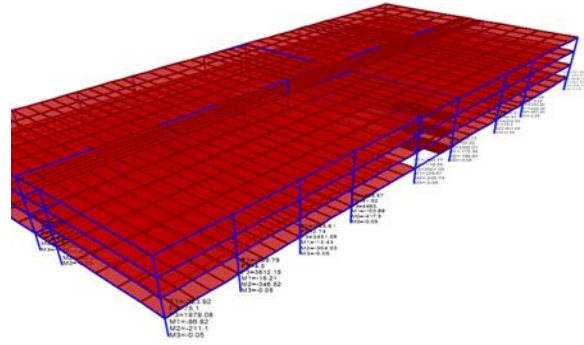
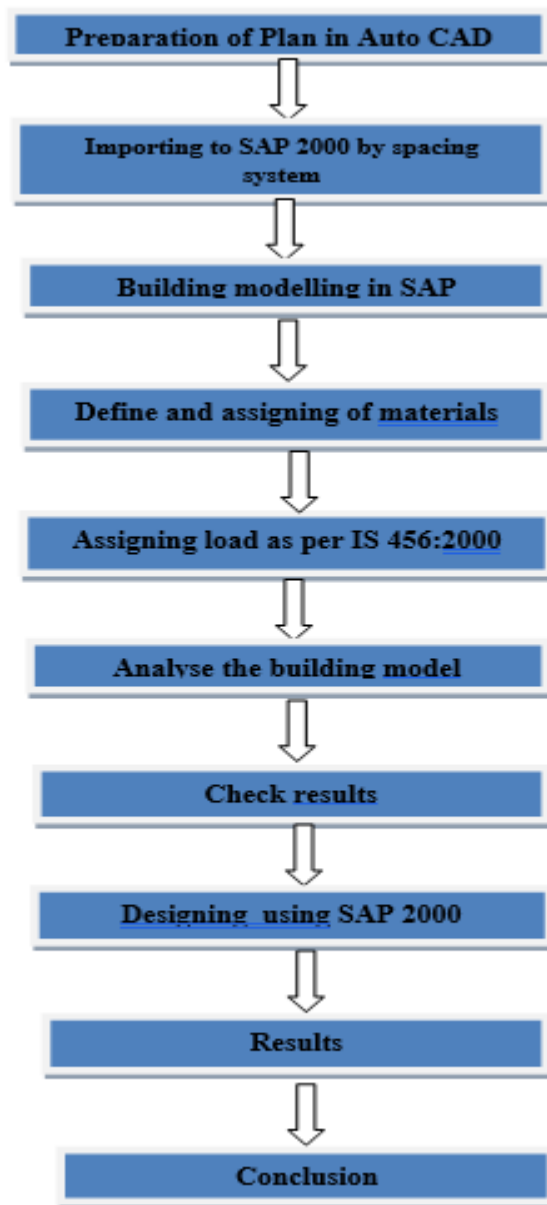


Fig-4: Moment and Reaction in support

2.2 Flow Chart:



3. LITERATURE REVIEW

P.Jayachandran (2006):The design & analysis of multistoried G+4 building at Salem, Tamilnadu, India. The study includes design & analysis of footings, columns, beams, and slabs by using two softwares named as SAP2000 & AUTOCAD.

Ishabedi, Girish Sharma, Abhishek Gupta (2017): - They proposed a comparative study of RCC framed structure using STAAD Pro, ETAB and SAP. From the proposed research analysis, we conclude that STAAD Pro is more efficient. The value of force derivative are low as compared to ETAB and SAP. The maximum value of force derivative will result in the maximum difference between values of STAAD pro, ETAB and SAP.

Aman, Manjunath, Nalwatgi, Vtshal T, Gajendra (2016): - Aimed and analysis and design of multistoried building by using SAP for the G+5 commercial building and shows short term deflection, structure is safe in shear and flexure, amount steel provided is economic and so on.

Arindam Sahu, Rohit Bose, Indrasish Mukherjee and Sahil Hossain Mondal (2016): - Design & Analysis of Multi-Storied Building using Sap 2000. They conclude the SAP 2000 is most useful and realistic for education.

D.Ramya, A.V.S. Sai kumar (2015):- A comparative study on design of G+10 building by STAAD pro and SAP. The paper focuses to conclude the effectiveness of use of a structure software between these two.

4. RESULT

As the analysis of building using SAP200 has been done, a report will be comprising ever test result will be mentioned and then only the discussion will made if problems are there or not.The system runs according to data and following test results are obtained after analyzing the structure in SAP2000.The result is obtained for Shear Force and Bending Moment and Deflection.

Shear Force = 63.8 kN

Bending Moment = -46.62 kN-m

Deflection = 36mm

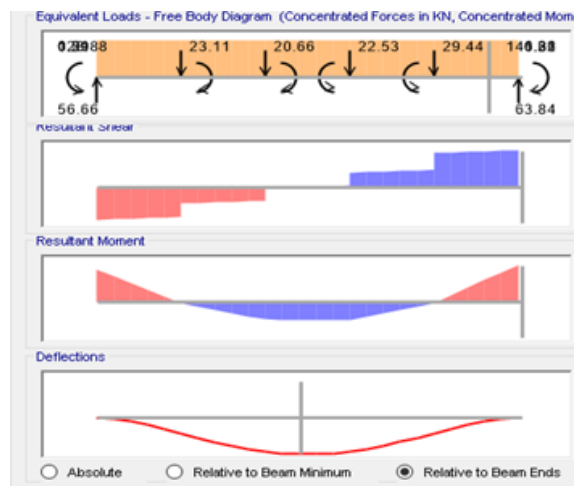


Fig-5: BMD, SFD and Deflection diagram

5. CONCLUSION

Primary examination contains the arrangement of actual laws and science needed to contemplate and predicts the conduct of designs. To play out a precise investigation an underlying engineer should decide such data as primary loads, calculation, support conditions, and materials properties.

SAP2000 is the ideal programming instrument for clients of any experience level, planning any primary framework.

6. FUTUTE SCOPE

1. This project makes us ready to effortlessly embrace comparable sort of works sooner rather than later.
2. Analysis of the structure assists with knowing different responses on the primary segments of the structure. The size of the segments and the measure of support relies upon the greatness of these responses.
3. Design of underlying segments of the structure gives us information on system of the structure into which the structure is to be casted.

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