DESIGN OF STILT+3 FLOOR BUILDING USING STAAD Pro

ABSTRACT

This project describes design and analysis of a S+3 floor building using Staad pro.The design and analysis will be carried out with Staad pro software. The main consideration for designing a building is the structural design which plays a major role for specifying the shape and size of the structural members which are designed for different loads and moments acting on the structure. These loads and moments are to be distributed to each and every structural members like beams which transfer loads to the columns and then transferred to footings.

STAAD Pro is an advanced software developed by “BENTLEY” which is used for designing structural elements in various aspects with accurate results saving the time.

My project is to DESIGN OF STILT +3 FLOOR BUILDING USING STAAD Pro considering all loading conditions using Stand pro.

What method /methodology was used ? What sample was/were used? what result was obtained?

1. INTRODUCTION:

General:

Abuildingisaman-madestructurewitharoofandwallsstandingmoreorlesspermanentlyinone place. Buildings come in a variety of shapes, sizes and functions, and have been adapted throughout history for a wide number of factors, from building materials available, to weather conditions, to land prices, ground conditions, specific uses and aestheticreasons.

Slabs:

Slab is an important structural element which is constructed to create flat and useful surfaces such as floors, roofs, andceilings.

Load Transfer Mechanism inSlabs:

The forces transfer from slab to beams occur either in one way or in two ways. The total system completely counts on the geometrical dimensions of the slab.

Beams:

Beam is a horizontal structural element that withstand vertical loads, shear forces and bending moments. The loads applied to the beam result in reaction forces at the support points of the beam.

Fig.1: Reinforcedconcretebeam **Fig.2: Transfer loads from beams tocolumn**

Load Transfer Mechanism inBeams:

They transfer loads imposed along their length to their end points where the loads are transferred to columns or any other supporting structural elements.

Columns:

Column is a vertical structural member that carry loads mainly in compression. It is assumed to be themostcrucialstructuralmemberofabuildingbecausethesafetyofabuildingrestonthecolumnstrength.

Fig 3: Reinforcedconcretecolumn **Fig 4: Load transfer mechanism from column tofooting**

Loads Transfer Mechanism incolumn:

Since the columns are supported by foundation; the load relocated from the all components to the columns. Then, it will be transferred from the column through the column necks adjacent to the footing in the form of axial force.

Footings: Footings are structural elements that transmit load of entire superstructure to the underlying soil below thestructure.

Load Transfer Mechanism in Footing: Soil is the root support of the footing. All the forces that come in contact with the footings will be transferred to the soil.The soil shall bear these loads by the aspect known as bearingcapacity.

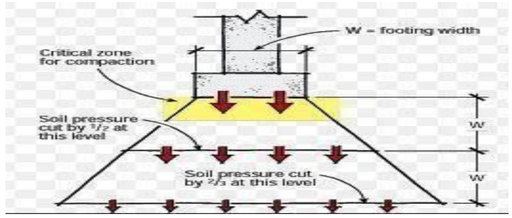

Fig. 5: Dissipating loads of footing in underlying soil

2. DESIGNMETHOD:

WORKING STRESSMETHOD:

This was the traditional method of design not only for reinforced concrete, but also for structural steelandtimberdesign.Themethodbasicallyassumesthatthestructuralmaterialbehavesasa linearelastic manner, and that adequate safety can be ensured by suitably restricting the stresses in the material induced bytheexpected**"workingloads"**onthestructure.Asthespecifiedpermissiblestressesarekeptwellbelow the material strength, the assumption of linear elastic behaviour is consideredjustifiable.

ULTIMATE LOADMETHOD:

With the growing realization of the shortcomings of working stress method in reinforced concrete design, andwithincreasedunderstandingofthebehaviour ofreinforcedconcreteatultimateloads,theultimateload of design is evolved and became an alternative to working stressmethod.

LIMIT STATEDESIGN:

A Civil Engineering Designer has to ensure that the structures and facilities he designs are designs are (i) fit for their purpose (ii) safe and (iii) economical and durable. Thus safety is one of the paramount responsibilities of the designer. However, it is difficult to assess at the design stage how safe a proposed design will actually be.

IMPORTANCE OF LIMIT STATEDESIGN:

Limitstatemethodusesmultiplesafetyfactorformatthathelpstoprovideadequatesafetyatultimateloads and adequate serviceability at service loads, by considering all possible **limitstates.**

- The **limit state function** for estimating the failure probability may be definedas
  (7.28) g (X) = R − L. where R is the platform capacity in terms of maximum lateral load that the platform can withstand before system failure or collapse.

- In Working Stress Method you treat dead and live loads equally, i.e. the factor of safety would be same irrespective of the type of load(dead or live). Here, youtake thetotalloadsthatyouexpectonthestructureandapplyasinglefactorofsafetytothemembers (say 1.5) regardless of the nature of theload.

- Limit State Method recognizes the inherent unpredictability of loads and assigns a much higher factorofsafetytoliveloads(weincreasethemby1.5-1.6),whereasitrecognizesthatdeadloads are much closer to what we calculate (we only multiply dead loads by1.2).

- Limit State Method also recognizes the uncertainty of different failure modes. For example, flexural capacity of a concrete beam is fairly predictable; Therefore we count on 90% of the theoretical value. Shear in concrete, on the other hand is much less predictable; therefore, we only count on 70% of thevalue.

- InWorkingstressmethod,themembersaredesignedtonever gobeyondtheirelasticrange.The max. load a member can take is thus limited and the plastic range is not explored atall.

- Limit state method uses the ultimate strength of the member beyond the initial yielding and allows plastic deformation to a certain extent.

3. BUILDING ANALYSIS USING STADDPro:

STAADPro:

STAAD Pro is a structural analysis and design software application originally developed by Research Engineers International in 1997. In late 2005, Research Engineers International was bought by Bentleysystems.STAADProisoneofthemostwidelyusedstructuralanalysisanddesignsoftwareproducts worldwide. It supports over 90 international steel, concrete, timber & aluminium designcodes.

It can make use of various formsof analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis) or a buckling analysis. It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response spectrum analysis feature is supportedfor both user defined spectra as well as a number of international code specifiedspectra.

Additionally, STAAD Pro is interoperable with applications such as RAM Connection, Auto PIPE, SACSandmanymoreengineeringdesignandanalysisapplicationstofurtherimprovecollaborationbetween thedifferentdisciplinesinvolvedinaproject.STAADcanbeusedforanalysisanddesignofalltypesof structural projects from plants, buildings, and bridges to towers, tunnels, metro stations, water/wastewater treatment plants and more.

Advanced Concrete Design:

TheAdvancedConcreteDesignworkflowprovidesdirectaccessforSTAAD.Promodelstoleverage the power of the RCDC application. This is a standalone application, which is operated outside the STAAD.Pro environment, but requires a model and results data from a suitable analysis. The model should typically be formed from beams and columns (plates are currently not supported). RCDC can be used to design the following objects: Pile Caps, Footings, Columns and walls, Beams,Slabs.

As the projects progresses, each design created in RCDC is retained and displayed when RCDC is re-entered, so that previous designs can be recalled and/or continued. Detailed drawings and BBS of excellent qualitycanbegenerated asrequiredandtheyarequitereadytobe sentforexecution

Advanced SlabDesign:

TheSTAADPROAdvanced SlabDesignworkflowisanintegratedtool thatworksfromwithinthe STAADPROenvironment.Concreteslabscanbedefined,andthedatacanbetransferredtoRAMConcept. The data passed into RAM Concept includes the geometry, section and material properties, loads and combination information, and analysisresults.

EarthquakeMode:

Essentially, these fundamental requirements have been provided to ensure that the structures can sustain the seismic loads without collapse and also – where required– avoid suffering unacceptable damage and can continue to function after an exposure to a seismic event. This STAAD PRO workflow is used to check if the structure conforms to the basic geometric recommendations made in Eurocode 8 (EC8). This workflow is in addition to the normal post-processing workflow which gives the various analysis results. These checks are intended to give you a "feel" for the structure and are not mandatory to proceed to the design phase.

Table: 1 :Statement of the project☹ not statement)

Structural Part	Dimensions
Type of building	Commercial building
Plan dimensions	12mx16m
Number of floors	3
Length in X-direction	12m
Length in Y-direction	16m
Floor to floor height	3m
Bottom floor height	2m
Total height of building	14m
Slab thickness	125mm
Column size	300x600mm
Beam size	300x600mm
Zone	II
Seismic intensity	Low
Importance factor(I)	1.5
Response reduction factor	3 for SMRF
Soil type	TYPE II (Medium soil)
Grade of concrete	M25
Reinforcement	Fe500
Unit weight of concrete	25kN/m3

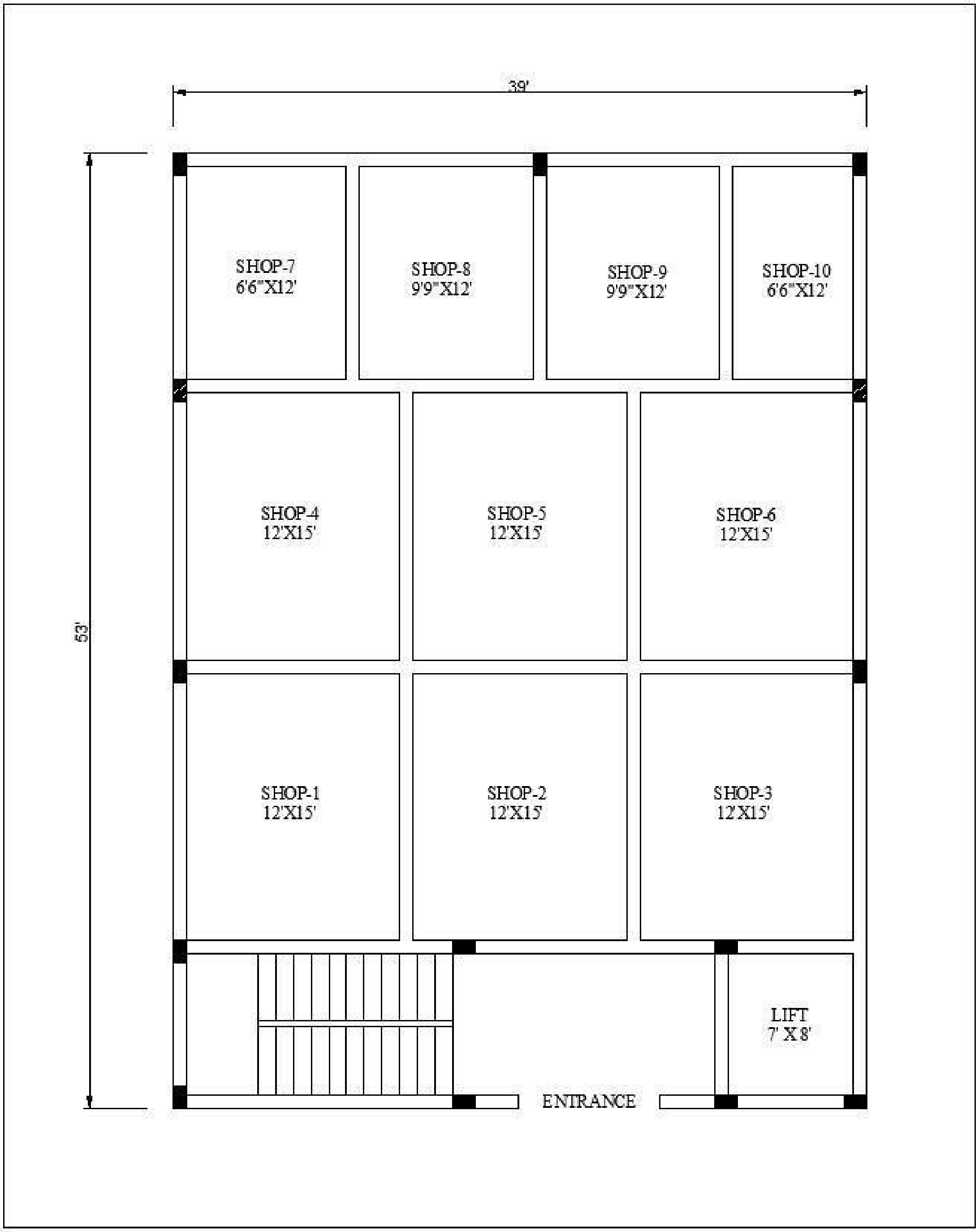

Fig.6 : Buildingplan

STADD ProMODEL:

Fig 7: Building model (isometric view)(professionally not visible)

Behavior of structure under lateralloads:

Recently there has been a considerable increase in the number of tall buildings, both residential and commercial, and the modern trend is towards taller and more slender structures. Thus the effects of lateral loads like wind loads, earthquake forces and blast forces etc, are assigning importance and almost every designer is faced with the problem of providing adequate strength and stability against lateral loads. This is a new development, as the earlier building designers usually designed for the vertical loads, and as an afterthought, checked the final design for lateral loads as well.

Types ofloads:

Thebuildingsaresubjectedtobothverticalandhorizontalloads.Atthepreliminarydesignstageallthecomponents of buildings are designed for vertical loads only. Ideally an efficient system should not require an increase in the sizes of memberswhentheeffectoflateralloadisalsoincorporated.Suchdesignersareknownas'premiumfree'designersand may be different toachieve.

No methodology, no sample selection method, no approaches, and no literature review are seen
Formatting, approaching, and analysis are not seen
Does not follow scientific research writing technique

LOADAPPLICATION:

Fig 8: Application of self weight of the structure andwallload

Fig 9: Application of Wind loads on allsides

Fig 10: Application of floor load onresidentialslot

Fig 11: Application of seismicload

No discussion and comments

4. RESULTS ANDDISCUSSION:

Table 2 : Displacementsummary:

			Horizontal	Vertical	Horizontal	Resultant	Rotational		
	Node	L/C	X mm	Y mm	Z mm	mm	rX rad	rY rad	rZ rad
Max X	125	7LOAD CASE7	9.785	0.059	0.269	9.789	0	0	0
Min X	125	9LOAD CASE9	-9.785	-0.059	-0.269	9.789	0	0	0
Max Y	39	9LOAD CASE9	-3.482	0.549	0.094	3.526	0	0	0
Min Y	19	3 1.5 (DL + LL)	0.043	-37.099	0.684	37.106	0	0	-0.002
Max Z	155	8LOAD CASE8	-0.812	-0.098	12.707	12.733	0	0	0
Min Z	155	10LOAD CASE10	0.812	0.098	-12.707	12.733	0	0	0
Max rX	124	3 1.5 (DL + LL)	-0.063	-4.792	4.637	6.669	0.003	0	0
Min rX	107	3 1.5 (DL + LL)	0.95	-18.756	2.325	18.923	-0.006	0	0.003
Max rY	141	3 1.5 (DL + LL)	1.521	-8.352	3.9	9.342	-0.001	0	0.001
Min rY	129	3 1.5 (DL + LL)	0.289	-24.704	4.049	25.036	0	0	-0.004
Max rZ	105	3 1.5 (DL + LL)	0.719	-17.882	2.332	18.047	0	0	0.006
Min rZ	101	3 1.5 (DL + LL)	0.606	-13.176	2.419	13.409	0	0	-0.006
Max Rst	19	3 1.5 (DL + LL)	0.043	-37.099	0.684	37.106	0	0	-0.002

CONCLUSION:

1. In this study we carried out the analysis on various structural elements using stead pro software and foundthe significance results for the different loads and theircombinations.

2. It is observed that the tie for analysis is reduced significantly withaccurateresults.

3. All the structural elements passed the checks carried out on them including maximum relative displacements, reactions, shearforce,bendingmoments.

4. Therefore, it can be concluded that the structure has fulfilled the ultimate limit state and serviceability limit state requirements

5. In high rise buildings, the parameters like strength and stiffness are more important. So, forthis purpose bracing system are adopted to enhance both theseparameters.

6.. To best incorporate sustainability considerations in the ground improvement method selection and implementation

7. Developmentofpractical,economicalandenvironmentallysafebiogeochemicalmethodsforsoilstabilization

8. Developement of data bases for variability of soil and material parameters required in the design of the ground improvement and soilstabilization

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