Design of a Residential Building Using STAAD

Silpa Caroline James
Assistant Professor
Mangalam College of Engineering

***Abstract*— Residential building is one of the major work which shows the social progress of the county. For fulfilling the requirements of the community new techniques and methods are being developed daily. Engineers are the one who is responsible for planning, designing and executing the work on time.Structural Design involves the investigation on stability, strength and rigidity of structures. A structural Engineer designs a structure based on the loading conditions including dead load, live load and seismic or wind load.**

***Keywords*— Analysis, Design, STAAD Pro,Residential Building**

I. INTRODUCTION

A multi-storey, multi-panelled frame is a complicated statically intermediate structure. Design of a 3storey reinforced concrete building is taken as the project. There are total 17 number of columns. The design is done using software the software STAAD Pro. This software computes the loads, moments, shear forces, deflection etc.

Residential requirement accommodation depends up on the income, status and classes of people. A poor man may be satisfied with a single room house but a highly rich family needs a luxurious building. A standard residential building of bungalow type will have drawing room, dining room, guest room, kitchen, store, dressing room, bath room, front verandah, stair etc., while for other house the number of rooms may be reduced according to the requirements. Here the building considered is a 3 storey residential building of bungalow type .

II. REQUIREMENTS

Requirements of the building are:

Ground floor: Sitout, Drawing room**,** Dining room, Kitchen, Guest bed room, Store, Toilet, Work area, Servants room, Porch.

First floor: Living room, Balcony, Three bath attached bedrooms along with dressing room

Second floor: Living room, Library, One bath attached bedroom along with dressing room**,** Balcony

Staircase and lift room connecting all the three floors are also required.

III. BUILDING PLAN

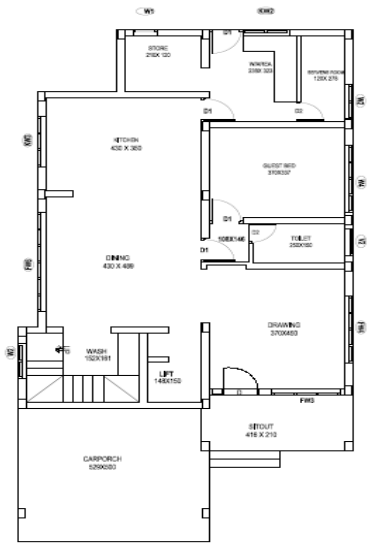

Fig.1. Building Plan - Ground Floor

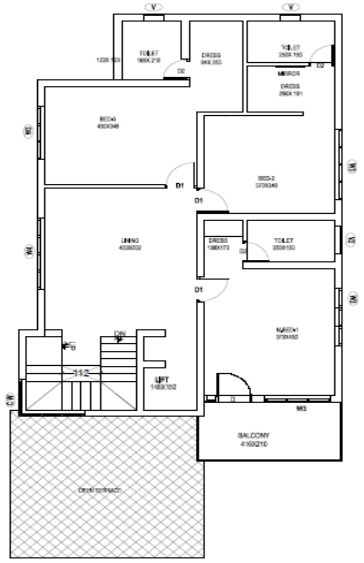

Fig. 2. Building Plan - First Floor

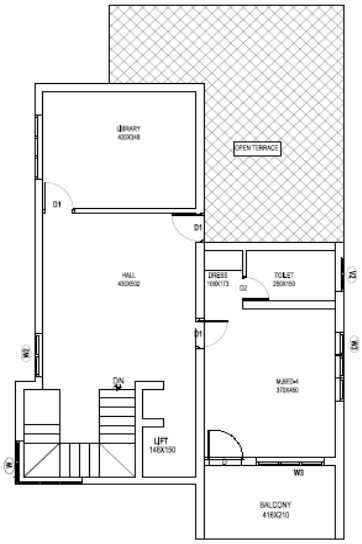

Fig. 3. Building Plan - Second Floor

IV. ANALYTICAL INVESTIGATION

The loads are calculated partially manually and partially by using STAAD.Pro load generator. The loading conditions included are self weight , dead load , live load and seismic load [4] .

A. Self Weight

The self weight command in the load case column can be used to compute the self weight of the structure in the STAAD.Pro software .

B. Dead Load from Slab

Dead load from slab is also generated from the software by mentioning the floor thickness and the load per sq m acting on the floor. Weight of the beam ,Column, slab, walls, terracing and parapet is considered for calculating deadload per sq m.

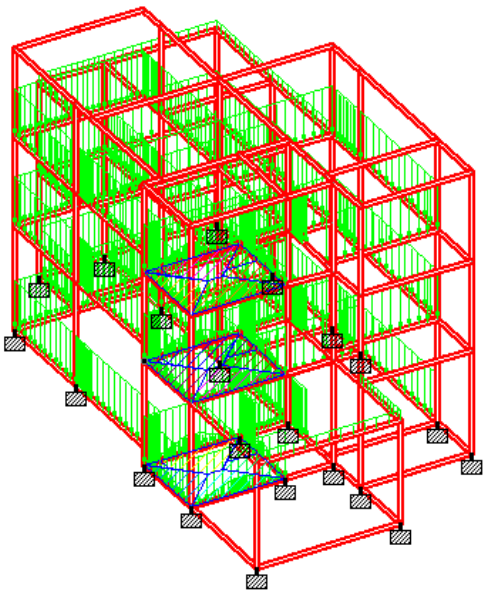

Fig. 4. Structure under Application of Dead Load

C. Live Load

For each floor ,3kN/m^2 load is considered as live load. For staircase, live load taken is 3kN/m^2. The live loads are computed in the same manner as done in case for dead load .

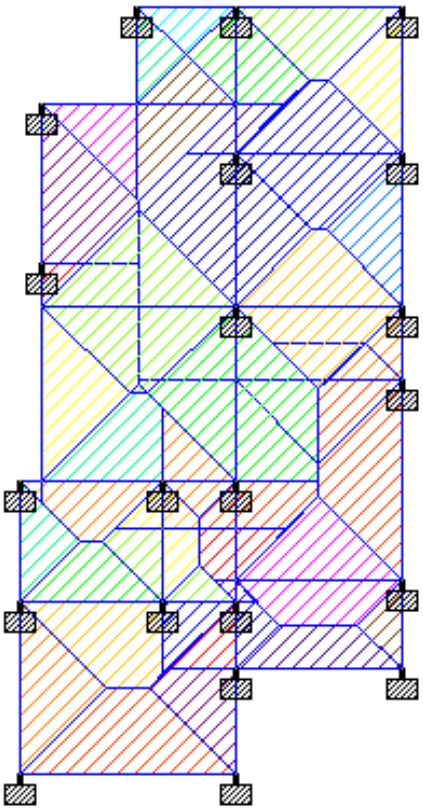

Fig.5. Structure under Application of Live Load

D. Load Combination

The structure is being analyzed for load combinations considering all the mentioned loads in proper ratio. Load combinations considered are 1.5(DL + LL) ,1.5DL + EL,1.2(DL + LL + EL) [2].

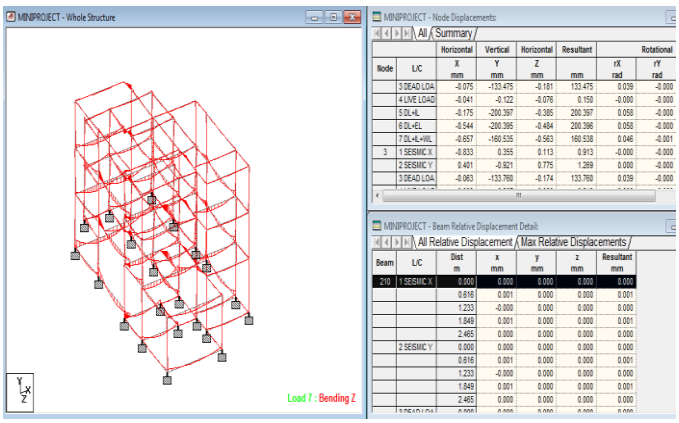

Fig .6. Bending Moment Diagram - 1.2(DL + LL + EL).

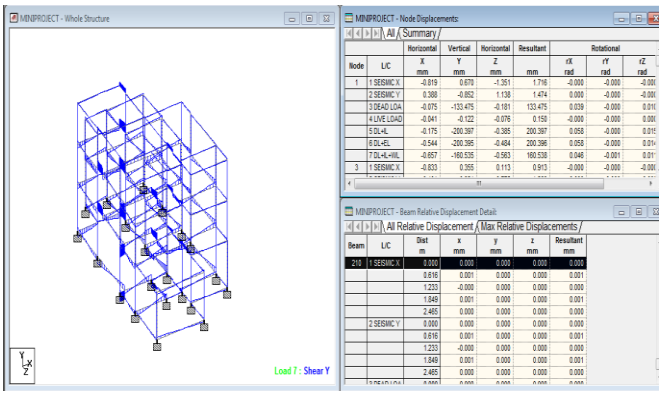

Fig. 7. Shear Force Diagram -1.2(DL + LL + EL).

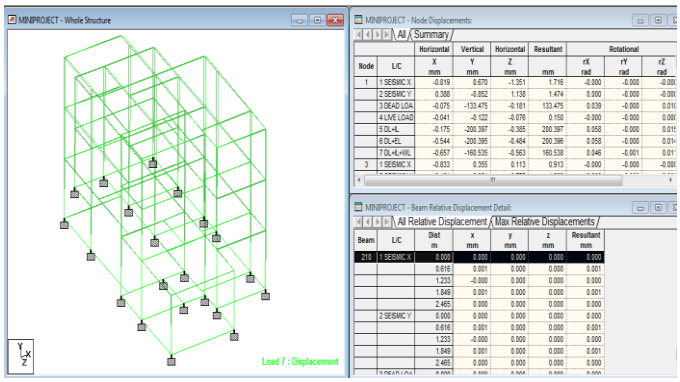

Fig. 8. Deflection Diagram - 1.2(DL + LL + EL).

V. RESULTS

A. Structural design

The structure was designed for concrete as per IS 456. The following parameters were specified in the input window.

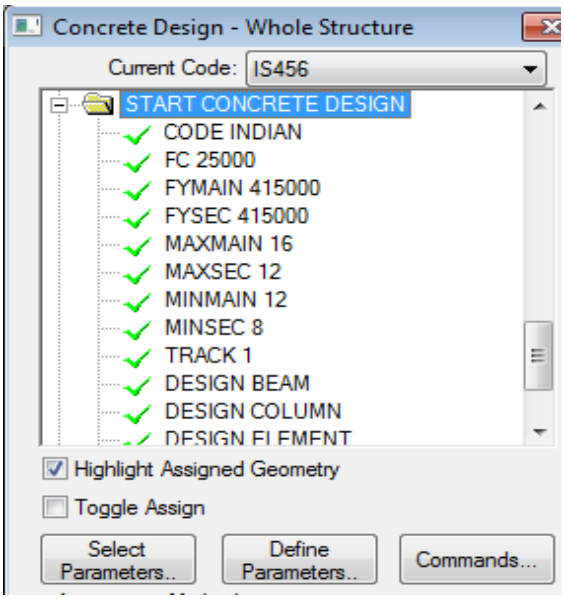

Fig. 9. Design Parameters in STAAD Pro

B. Design of Beam

Design result for beam number 27 which is at the roof level of first floor is shown below.

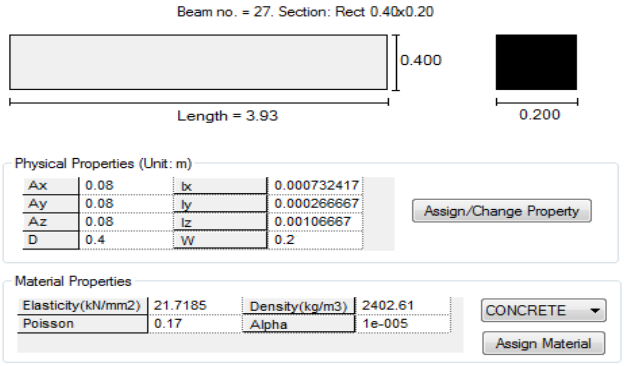

Fig. 10. Properties of Beam

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                    SUMMARY OF REINF. AREA (Sq.mm)
-------------------------------------------------------------------------------
SECTION      0.0 mm      982.5 mm     1965.0 mm     2947.5 mm     3930.0 mm
-------------------------------------------------------------------------------
 TOP         166.81       151.16       151.16         0.00        198.40
REINF.     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)

BOTTOM      151.16       151.16       242.63       151.16       151.16
REINF.     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)     (Sq. mm)
-------------------------------------------------------------------------------


                  SUMMARY OF PROVIDED REINF. AREA
-------------------------------------------------------------------------------
SECTION      0.0 mm      982.5 mm     1965.0 mm     2947.5 mm     3930.0 mm
-------------------------------------------------------------------------------
 TOP        2-12í        2-12í        2-12í        2-12í        2-12í
REINF.   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

BOTTOM     2-12í        2-12í        3-12í        2-12í        2-12í
REINF.   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)   1 layer(s)

SHEAR   2 legged 8í  2 legged 8í  2 legged 8í  2 legged 8í  2 legged 8í
REINF.  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c  @ 120 mm c/c
-------------------------------------------------------------------------------
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Fig .11. Summary of Reinforcement of Beam

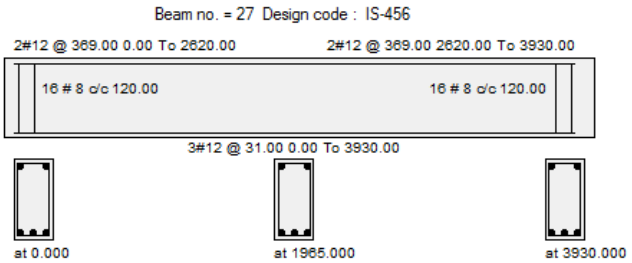

Fig. 12. Reinforcement Details of Beam

C. Design of Column

Design result for column number 53 which is at first floor is shown below.

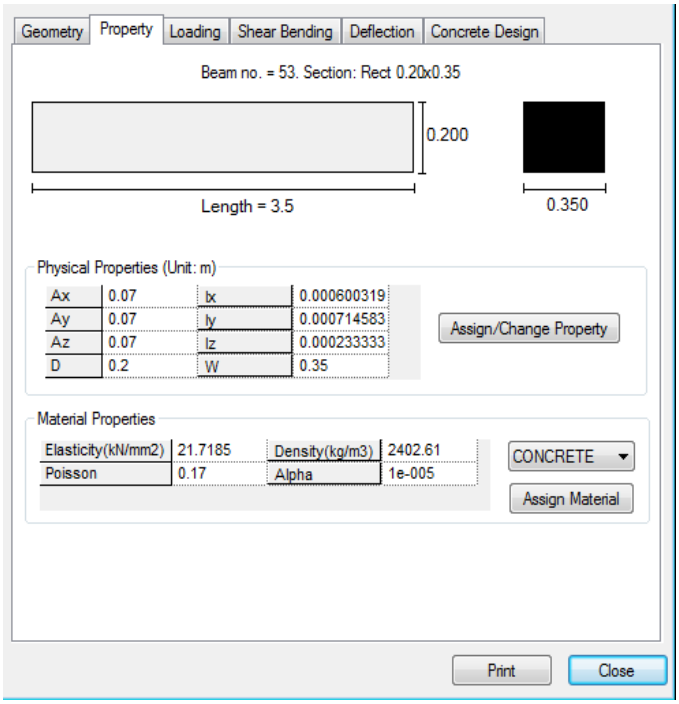

Fig. 13. Properties of Column

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                                        About Z          About Y
INITIAL MOMENTS                  :       0.68             14.73
MOMENTS DUE TO MINIMUM ECC.      :       3.50              3.50

SLENDERNESS RATIOS               :      17.50             10.00
MOMENTS DUE TO SLENDERNESS EFFECT :      5.35              0.00
MOMENT REDUCTION FACTORS         :       1.00              1.00
ADDITION MOMENTS (Maz and May)   :       5.35              0.00

TOTAL DESIGN MOMENTS             :       8.85             14.73

REQD. STEEL AREA  :      188.14 Sq.mm.
REQD. CONCRETE AREA:    23517.86 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 12 dia. (0.65%,    452.39 Sq.mm.)
                     (Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
-----------------------------------------------------------
Puz :    843.94   Muz1 :     16.90   Muy1 :     31.06

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
-----------------------------------------------------------
WORST LOAD CASE:     7
Puz :    923.22   Muz :     22.05   Muy :     44.18   IR: 0.73
=====================================================================
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Fig .15. Design Results of Column

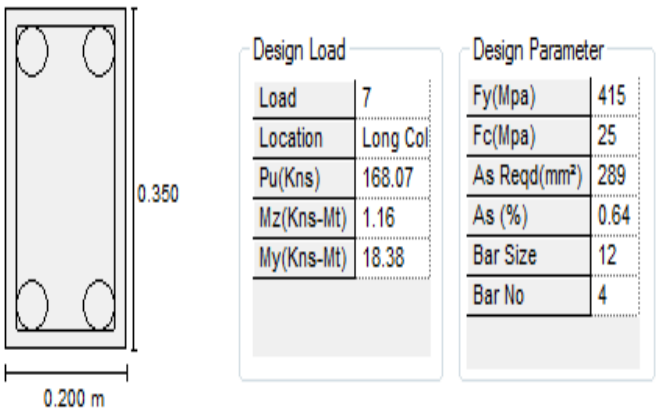

Fig .14. Reinforcement Details of Column

VI. CONCLUSION

The structural design for the residential building is computed. The reinforcement needed for any concrete section can be calculated using the STAAD Pro software. The software STAAD Pro. deals with a number of parameters which are designed according to IS 456:2000. The Beams are designed for flexure, shear and torsion while the columns are designed for axial forces , biaxial moments and shear forces[4].

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