# DESIGN OF ISOLATED FOOTING OF MULTISTOREY BUILDING USING STAADPRO G+10

**Mohammad Faizanuddin, Thatikonda Sai Prashanth, Mekala Sanjeev Kumar, Basagalla Naveen Kumar, M Naveen, Dr. Aftab Tanveer**

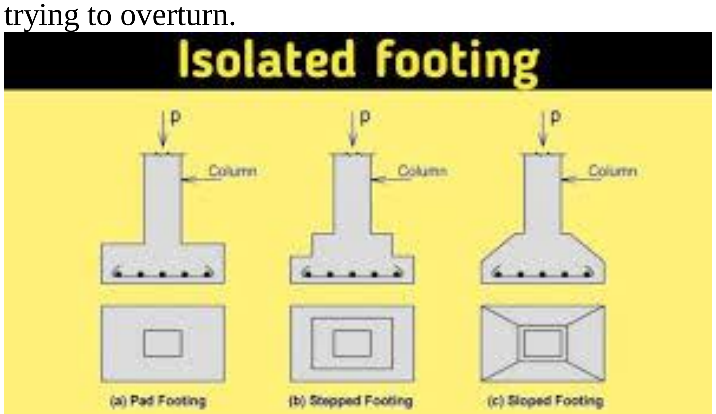
Dept. of Civil Engineering, SVITS, Mahbubnagar, Telangana, India.

**Abstract:** *The main objective of this project is to Superstructure loads are transmitted to the underlying soil strata through a suitably designed foundation. Therefore, the foundation of a structure is considered the most crucial structural element in a building. The foundation may be classified into two main categories, shallow and deep foundations. Shallow foundation comprises isolated footings, combined footings and reinforced concrete mat. The design of isolated column footing is accomplished through the application of geotechnical and structural analysis concepts. So that, the input into isolated column footings comes from two different disciplines, geotechnical and structural. This may be one of the main causes that attributed to the limited research input to the subject. Therefore, the structural design of isolated column footings is based on empirical rules and the calculations of bending moments (BM) and shearing forces (SF) induced in a footing are based on the rules of beam theory.*

*The isolated footing is used to support individual columns. They can be either of steeped type or have projections in the concrete-base. In the case of heavily loaded columns, steel reinforcement is provided in both the directions in a concrete bed. The structural loads are calculated by STAADPRO software for the multistory structure.*

## I- INTRODUCTION

Isolated foundations are structural components often used to distribute and deliver loads of individual columns to the soil and without exhausting its bearing capacity, in addition to avoiding undue settling and as well as ensuring sufficient protection against both slipping and trying to overturn.

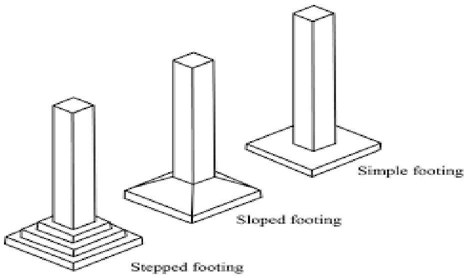



Isolated footing is a foundation that carries a single column. It distributes the column load to an area of soil around the column. Spread foundation may be circular, square, or rectangular. They usually consist of a block or slab of uniform thickness, but they may be stepped or hunched if they are required to spread the load from a heavy column. Figure 1.2 shows spread foundations.

These are often used in the presence of light column loads, where columns are never closely spaced, even in the case of strong homogeneous soil. A 15 cm offset is usually given on all sides of the concrete bed. In the situation of brick masonry columns, an offset of 5 cm is often given on all 4 sides in usual layers. Where the base of concrete columns is a slab, steeped, or slope style An isolated, or single-column footing, is used to support the load of a single column. They are the most common footings, particularly where the loads are relatively small and the columns are not closely spaced.

### 1.1 TYPES OF ISOLATED FOUNDATIONS

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363




Different types of isolated foundations are as follows.

- Pad Isolated Foundation.
- Sloped Isolated Foundation.
- Stepped Isolated Foundation.
- Combined Foundation.
- Shoe or Eccentric Foundation.

### 1.2 SHAPE OF ISOLATED FOUNDATIONS

- Square From Foundation.
- Rectangular From Foundation.
- Circular From Foundation.

**1. Square From Foundation**: This form of the foundation has a square form. They're growing on stable soil. When you've got a square shape, use this kind of foundation.

**2. Rectangular From Foundation:**
This would be the form of an isolated foundation. This form is rectangular in shape. Whenever we need a rectangular shape, use this kind of form.

**3. Circular From Foundation:**
This is also the form of an isolated base. This form is oval in shape. We need a circular column form, so we need to use this type of shape.

### 1.3 OBJECTIVES OF THE PROJECT

The main objective of the project is to design isolated footing and analyze a multi-storey building using STAAD.Pro. Because of the growing population and less availability of land, construction of multi-storey buildings is coming into play to serve commercial spaces in limited area.

## II - LITERATURE SURVEY

**Nethercot (2003)** reviewed that application of composite construction as early as 1894 which concrete encased beams were used in a bridge in Iowa and a building in Pittsburgh. Later on, other places such as Japan and Europe were seen of such practice in their construction. Documentation to govern the composite construction practice were documented since 1948 in BS 449 code and further extended in CP 117 code, and later replaced by BS 5950-3:1990. Composite construction in Malaysia is currently being popularised under government effort by introducing comprehensive national Industrialised Building System (IBS) by the Construction Industry Development Board Malaysia (CIDB). Badir-Razali building system classified composite construction system (Badiretal., 1998).

**Abdul Kadiret al. (2006)** found significant improvement in labour productivity using IBS rather than conventional building system by up to 70%. Badiret al. (2002) found that quality, speed of construction, and cost savings are themain advantages of IBS. However, Abdul Kadiret al. (2006) pointed out that IBS is still not preferred because of cost factors.

**Haronetal. (2005)** which reported cost per gross floor area (m2 ) of conventional construction system is lower as compared to composite construction system of single storey low cost house. Oehlerset al. (1994) tried to formulate simple design procedure for their profiled beams. As the flexural behaviour of composite profiled beams is unique, the buckling of the profiled sheet in composite profiled beams is not behave as the standard forms of buckling of thin-plate elements. The steel plate is restricted to deform outwards from the concrete, and the fold lines act as fully fixed support. A procedure was developed to determine the onset of this type of buckling. This form of buckling permits the increase in the width of the plate up to 70%.

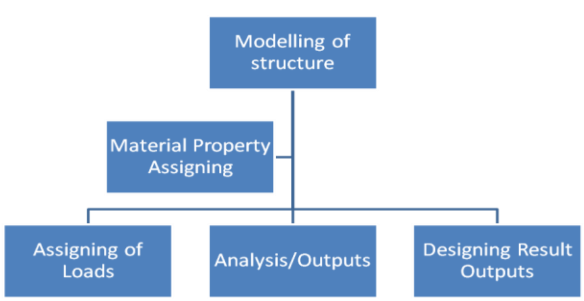
**Dunnala Lakshmi Anuja, et.al (2019):** Planning, Analysis and Design of commercial Building (G+5) By using STAAD Pro.: Frame

IJMTARC – VOLUME – IX – ISSUE – 38, APR - JUN, 2022 ISSN: 2320-1363

analysis was by STAAD-Pro. Slab, Beams, Footing and stair-case were design as per the IS Code 456-2000 by LSM. The properties such as share deflection torsion, development length is with the IS code provisions. Design of column and footing were done as per the IS 456-2000 along with the SP-16 design charts. The check like one way shear or two-way shear within IS Code provision. Design of slab, beam, column, rectangular footing and staircase are done with limit state method. On comparison with drawing, manual design and the geometrical model using STAAD Pro.

**Bandipati Anup et al., (2016)** this paper deals with evaluate and plan a multi-storeyed building [G + 2 (3- dimensional frame)] adopting STAAD Pro. The technique used in STAAD.Pro is limit state technique. Initially they have created 2-D frames and cross checked with physical calculations. The exact result should be proved. We tested and created a G + 2 storey building [2-D Frame] instantly for all feasible load combinations. The work has been finished with some more multi-storeyed 2-Dimensional and 3-Dimensional frames beneath various load combinations.

## III - FLOW CHART FOR THE PROPOSED PROJECT




### 3.1 METHODOLOGY

A multistory building frame is a three-dimensional structure or a space structure. It is idealized as a system of interconnected two-dimensional vertical frames along the two mutually perpendicular horizontal axes for analysis. These frames are analyzed independently of each other. In frames where the columns are arranged on a rectangular grid, loading patterns giving biaxial bending need not be considered except for corner columns.

The degree of sophistication to which a structural analysis is carried out depends on the importance of the structure. A wide range of approaches have been used for buildings of varying heights and importance, from simple. Approximate methods which can be carried out manually, or with the aid of a pocket calculator, to more refined techniques involving computer solutions. Till a few years ago most of the multistory buildings were analyzed by approximate methods such as substitute frame, moment distribution, portal and cantilever methods.

In this project a commercial building plan was developed in Auto CAD and them later the geometry of the site was developed in Staad pro in order to get the required design outputs. The steps are as follows:

- Developing floor plans in Auto CAD which includes grid plan, Beam and column Orientation.
- Developing plan geometry in STAADPro
- Assigning Material Properties to the structure.(For all structural Elements)
- Assigning of Loads as per IS standards.
- Analysis of structure.
- Analysis results.
- Design outputs of the structure.

## IV - LAYOUT OF G+10 STRUCTURE USING AUTOCAD

### 4.1 General

AutoCAD or Computer Aided Design is a very helpful tool in drafting and designing any structure. AutoCAD uses a Graphical User Interface for the purpose of drafting and designing any structure. The software has various inbuilt tools for complex drafting. Also AutoCAD can be used for 2D, 3D and for perspective design.
With the help of AutoCAD all the drafting for the project has been done.

### 4.2 Details of the Project:

The plot size for the project was different dimension in mts accordingly the building has been laid in the centre of the plot leaving ample space on all the sides for landscaping and pathways for cars and for visitors parking.
The complete structure is of 350.00 sqyards and the numbers of floors are G+10 with column orientation, beam placements and slabs as per different floors.

### 4.3 Layout Using AutoCAD

The layout has been mostly completed using the Line command. The unit for the layout is metres with accuracy of "0.000". Below is a screen shot of the line diagram showing the centre line for beam and column layout.

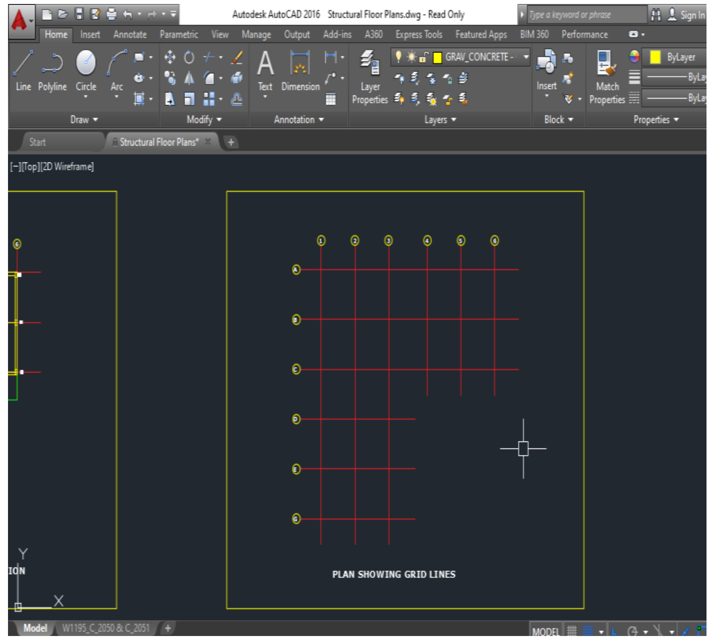



**Fig 1 Shows grid lines of the building**

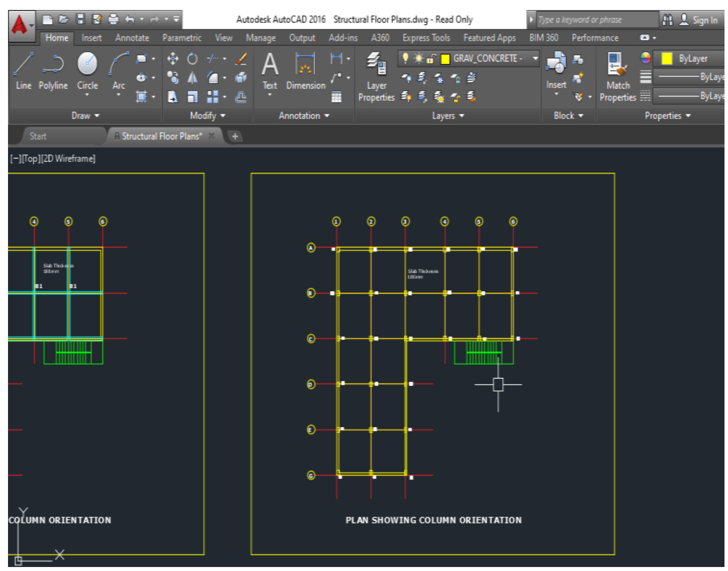



**Fig 2 shows the column orientation of the building**

ISSN: 2320-1363

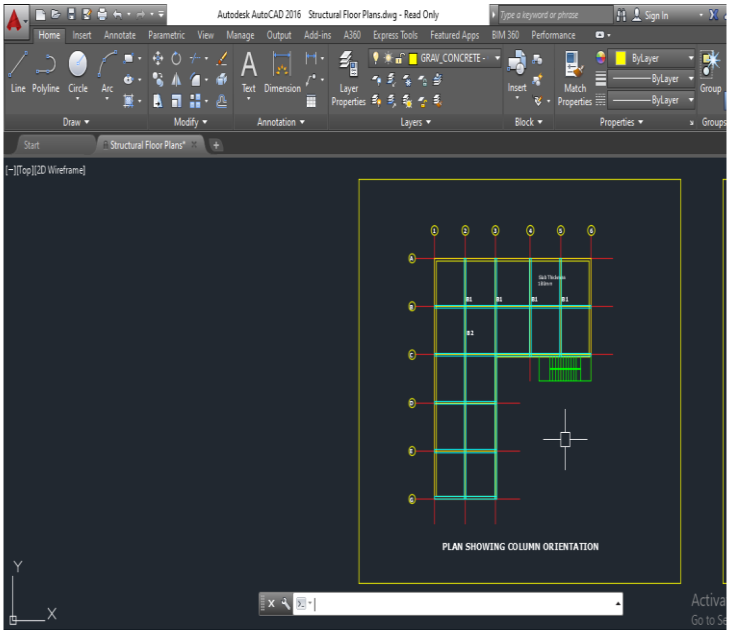



**Fig 3 shows the beam orientation of the structure.**

## V - DESIGN PARAMETERS

### 5.1 Staad pro Inputs

Concrete Grade = M25
Clear Cover = 25mm
Fc = 20mpa
Fy main = 500mpa
Fy Section/ Stirrups = 500mpa
Density of Concrete = 24 Kn/$m^3$

**Loading Considerations for elements**

Consider Finishes of 75mm with 20 Kn/$m^3$ Density of concrete

Brick wall/Partition walls Moderate Grade = 20 Kn/$m^3$

Live Load = 2.0Kn/$m^2$ & 2.50Kn/$m^2$ for commercial

### 5.2 Properties of elements

**a). Beam Sizes**

**300 mm × 400 mm** G.F to 3rd Floor
**250 mm × 350 mm** 4th to 9th Floor
**225 mm × 300 mm** Roof

**b).Column Sizes**

**250 mm × 400 mm** G.F to 3rd Floor
**230 mm × 400 mm** 4th to 9th Floor
**230 mm × 350 mm** Roof

**c). Slabs Thickness**

**Floors G to 3rd** = 180mm
Floors 4th to 8th Slab = 150mm
Roof Slab = 125mm

**d). Wall Thickness**

Partition wall = 115mm
Outer Main wall = 230mm
Parapet wall = 75mm thick / Height= 1.2m

## VI - ANALYSIS OF STRUCTURE ANALYSIS OF STRUCTURE

### 6.1 Modelling of structure

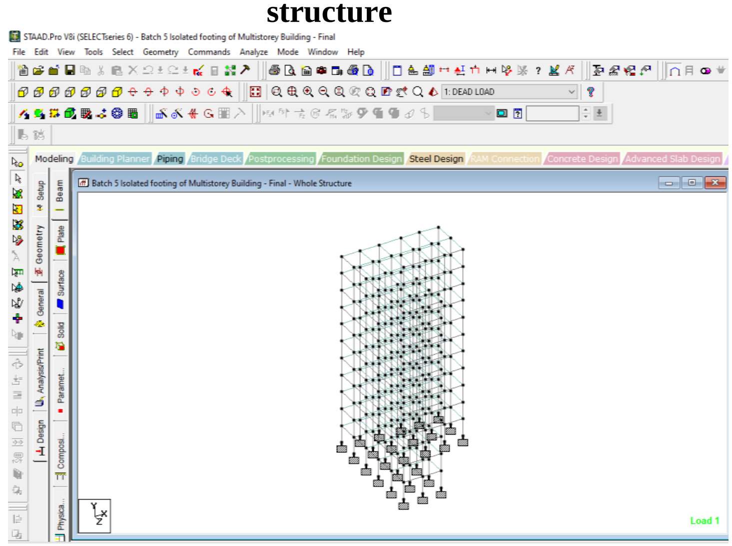



**Fig 4 shows the geometry of the structure.**

### 6.2 Member property assigning to the structural elements

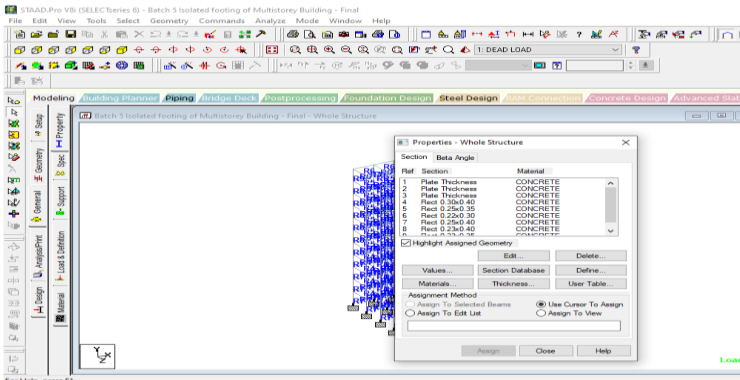


**Fig 5 shows the member property of the elements.**

## 6.3 Assigning of Loads

- Dead Load
- Live Load
- Floor Finishes
- Brick Wall Load
- Inner Partition Wall Loads
- Roof Loads

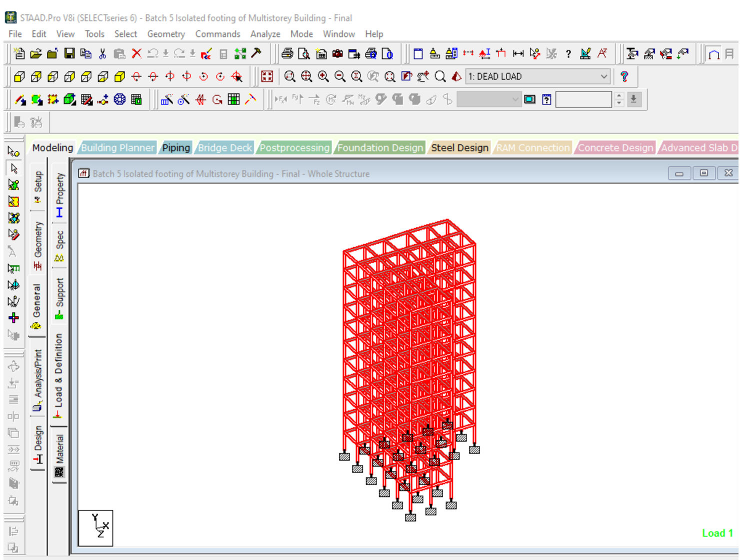


**Fig. 6 computed self weight assigned**

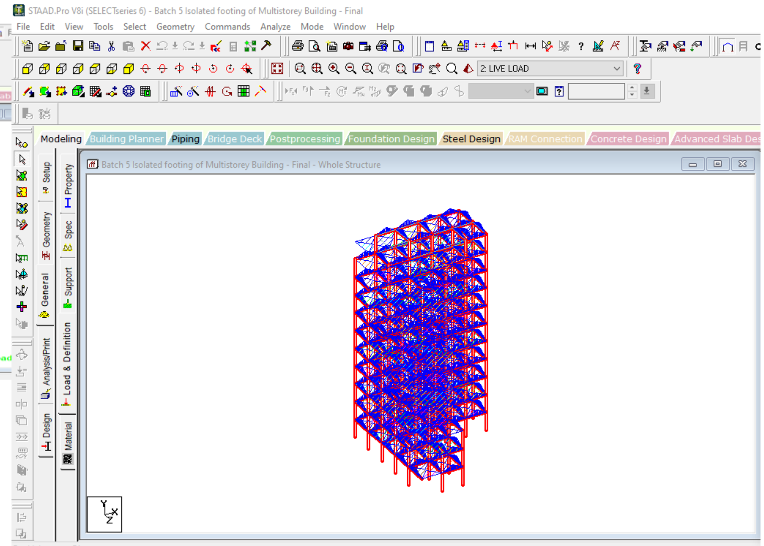


**Fig.7 computed Live Load assigned**

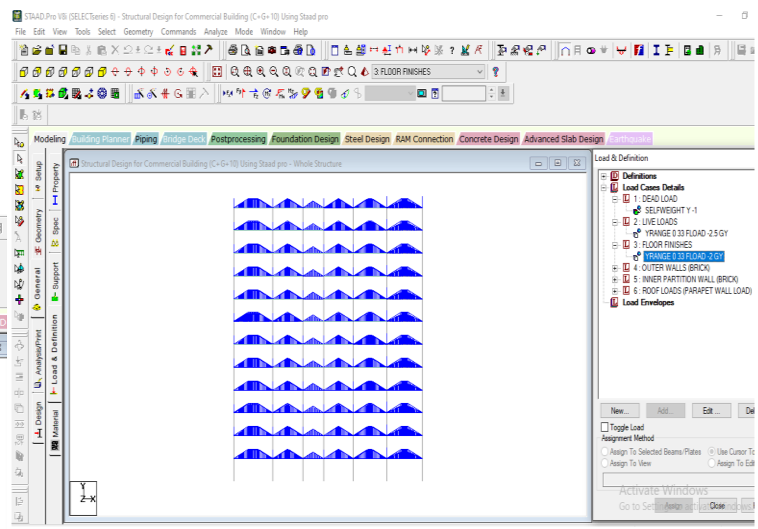


**Fig.8 computed Floor Finishes Load assigned**

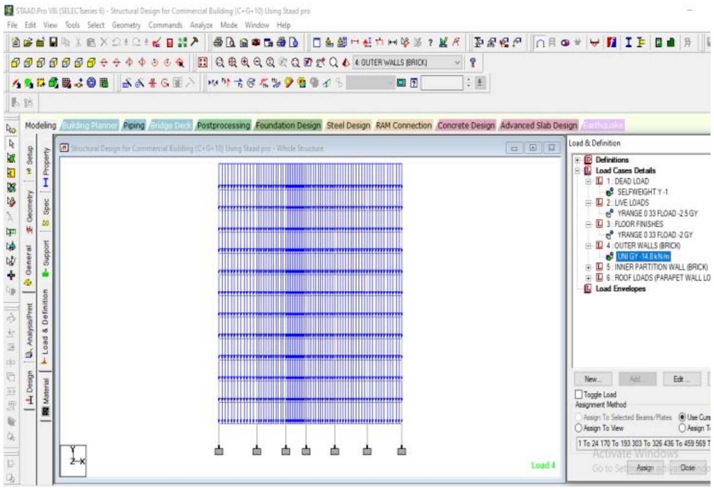


**Fig.9 computed outer wall Load assigned**

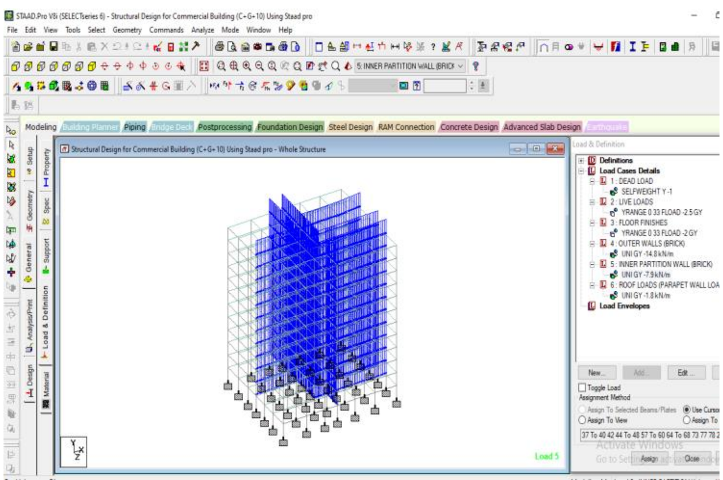
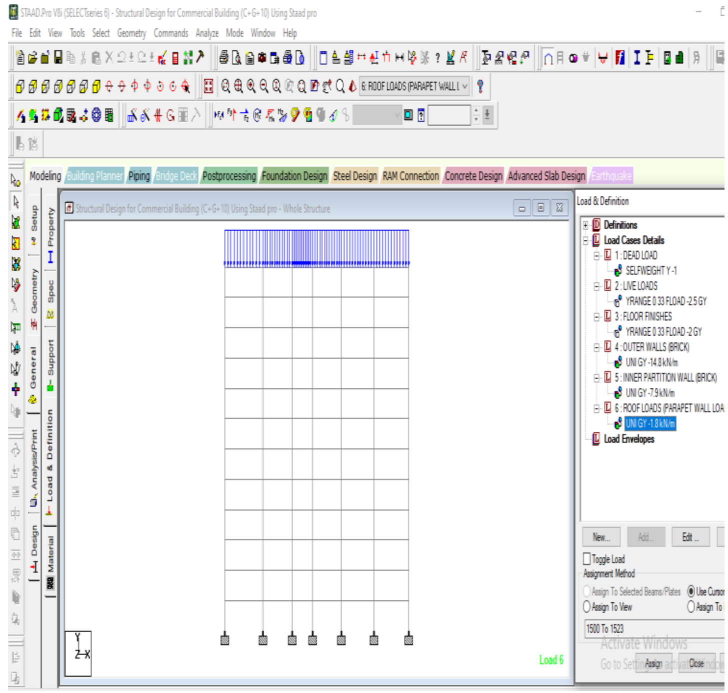


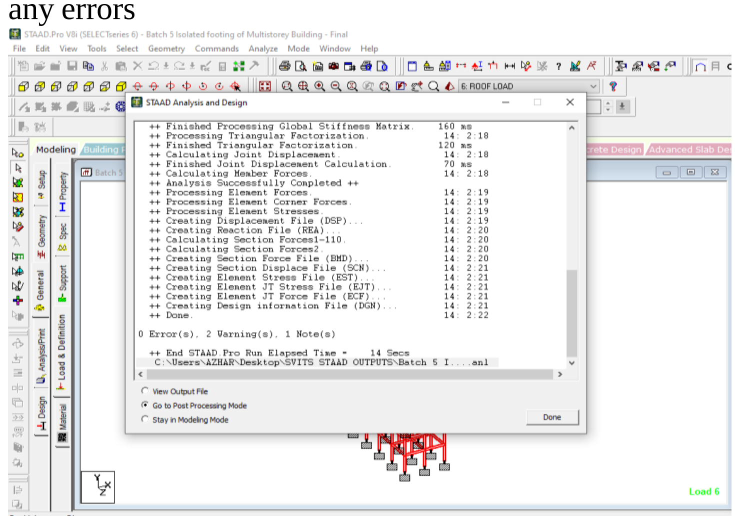
**Fig.10 computed Internal wall Load assigned**



## VII - STAAD PRO RESULTS

### 7.0 Staad result output.

The analysis done from considering all the above parameters state that the structure is safe without any errors



### 7.1 Bending Moments Output

ISSN: 2320-1363

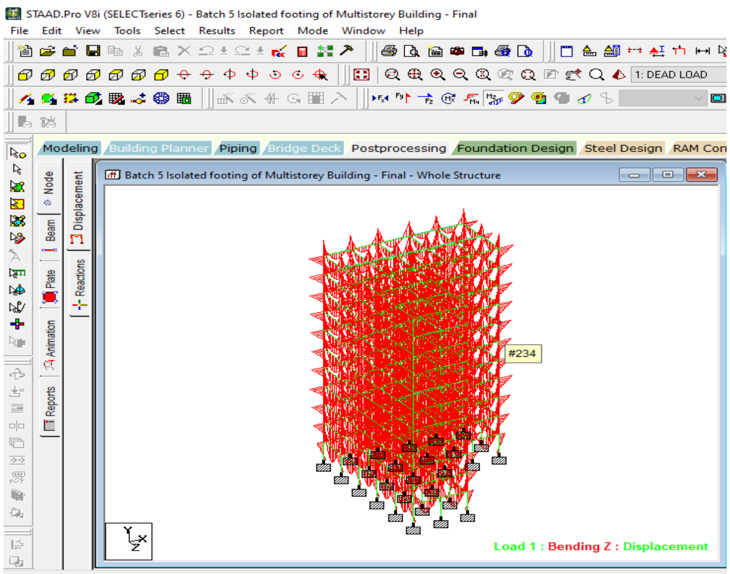



**Fig 11 showing Bending moment diagram of the structure**

## 7.2 Shear Forces Output

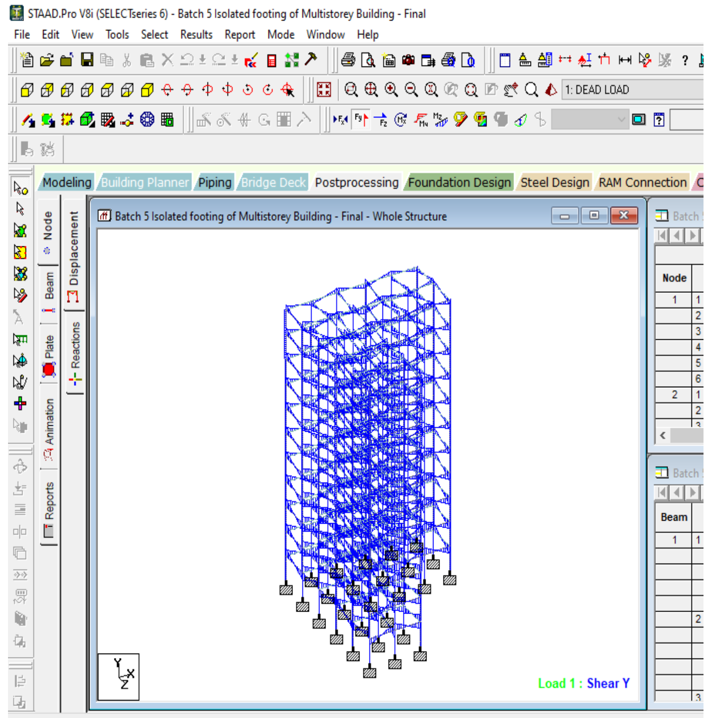



**Fig 12 showing Shear Force diagram of the structure**

## 7.3 Displacements Outputs

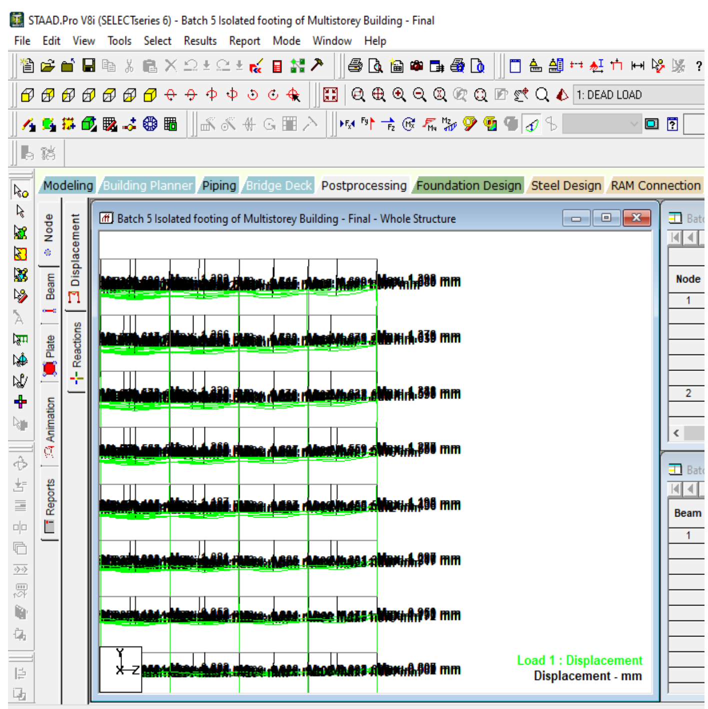



**Fig 13 showing Displacements of the structure**

ISSN: 2320-1363

## 7.4 FOUNDATION DESIGN OF ISOLATED FOOTING

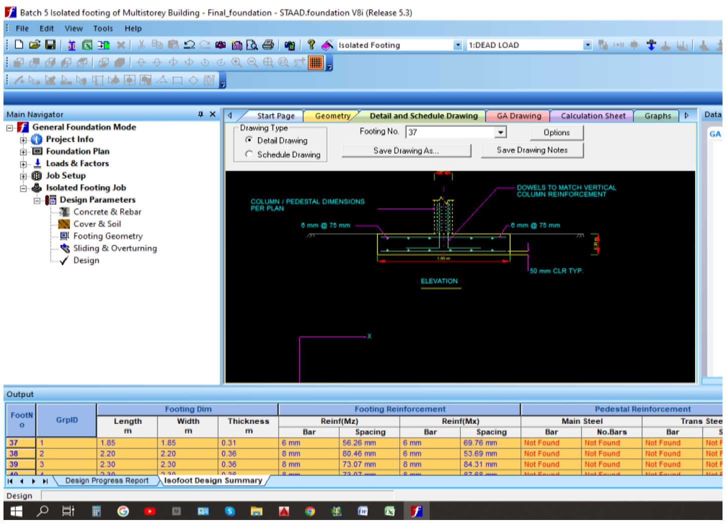
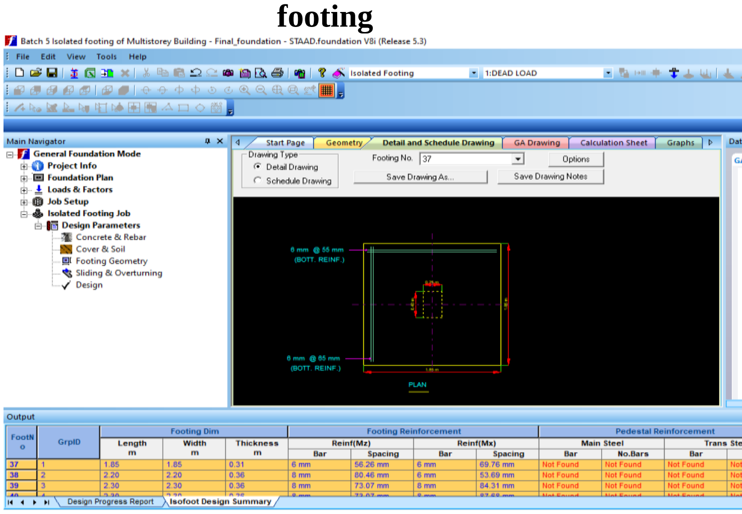



Fig 15 showing Reinforcement details of footing



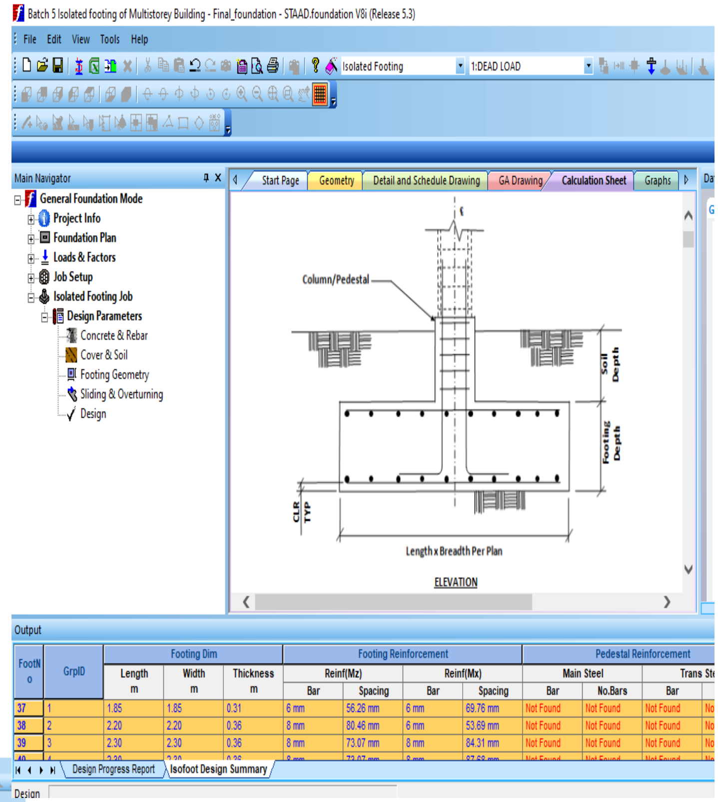
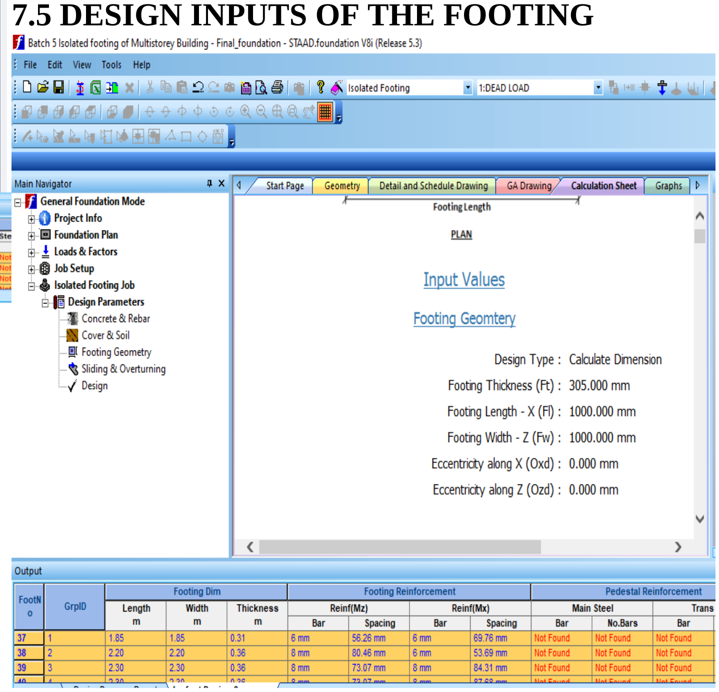
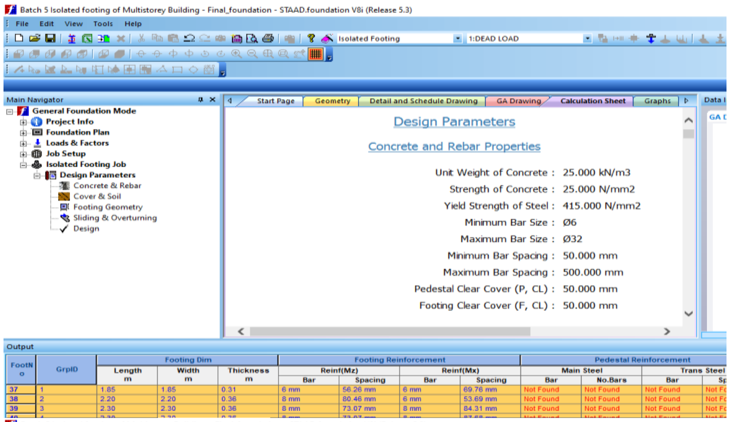
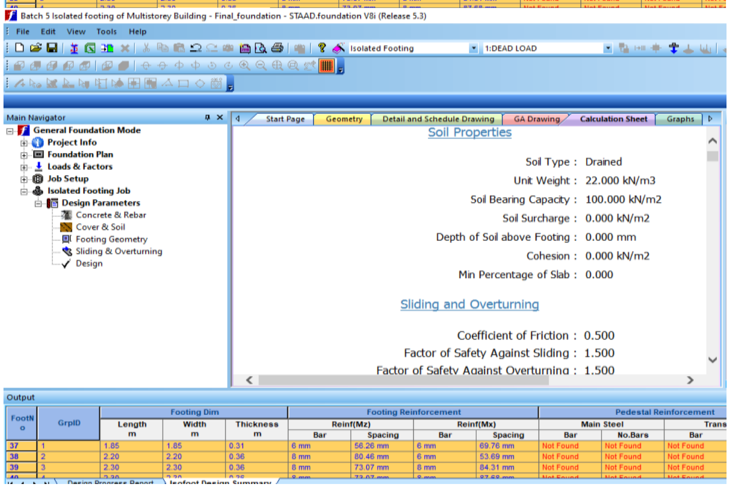



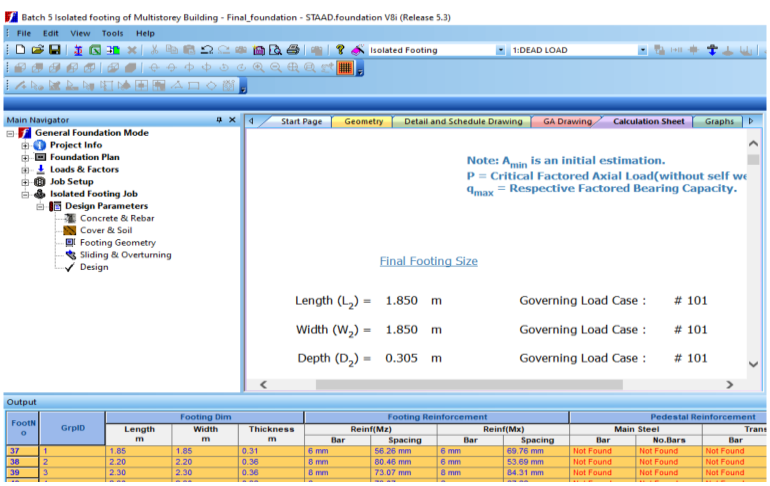

Fig 16 showing Design Summary details of footing

## 7.5 DESIGN INPUTS OF THE FOOTING






## VIII - CONCLUSION

As Isolated foundation transfers building load very near to the earth surface. Also design of footing is very important with respect to other design because finally all load from super-structure goes to the foundation and from foundation to the soil. So once design completed there will not be any expansion.

Building plan was develop and draft in Auto-CAD with required dimension. During designing G+ 10 storeys commercial building structure is capable to sustain all loads acting on building. The design of slab, beam, column, rectangular footing and staircase is done with IS 456-2000 as limit state method in addition to that IS code 875 were also used for other loading parameters.

In accordance with the building design isolated footings are designed as a foundation using STAAD.Pro as it has the ability to calculate the Reinforcement needed for any concrete section. The design output gives the reinforcement quantity of the complete structure as output and as per result; structure is safe without any errors as per output given by staad pro.

## REFERENCES


- Tafreshi S.N. Moghaddas, MehrjardiGh. Tavakoli, Ahmadi M.; "Experimental and numerical investigation on circular footing subjected to incremental cyclic loads. "International Journal of Civil Engineering, Vol. 9, No. 4, December 2011.
- K.V. Manoj Krishna, H. N. Ramesh; "Strength and F O S performance of black cotton soil treated with calcium chloride." IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE) ISSN: 2278- 1684 Volume 2, Issue 6 (Sep-Oct 2012), PP 21-25.
- R.K. Tripathi, Laxmikant Yadu; "Bearing Capacity of Square Footing on Soft Soil Stabilized with Rice Husk Ash–An Experimental Study" International Conference on Emerging Trends in Engineering and Technology

(ICETET'2013) Dec. 7-8, 2013 Patong Beach, Phuket (Thailand).

- Indian standard codal IS 875: Part 3 for wind load considerations. "Code of practice for Design loads (other than earthquake) for buildings and structures."
- Indian standard codal 456: 2000, "Indian Standard code of practice for general structural use of plain and reinforced.
- Design of R.C.C. Structures by Nirali Prakashan.
- Bandipati Anup, Dr. Dumpa Venkateswarlu, 'Comparison between Manual Analysis and STAAD PRO. Analysis of Multi Storey Building', International Journal of Research Sciences and Advanced Engineering, Volume 2, Issue 15, PP: 216 - 224, SEPTEMBER' 2016.

## AUTHOR PROFILE

**Mohammad Faizanuddin** B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

**Thatikonda Sai Prashanth** B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR

**Mekala Sanjeev Kumar** B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

**Basagalla Naveen Kumar** B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR.

**M Naveen** B.Tech student in the Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR

**Dr. Aftab Tanveer PROFESSOR & HOD** Civil Engineering from Sree Visvesvaraya institute of technology and science, MBNR