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# DESIGN AND ANALYSIS OF MULTI-STORIED  BUILDING

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## ABSTRACT

Hyderabad is the fifth largest city in our country. As it is rapidly developing in the field of construction in the city is very costly. The design process of structural planning and design requires not only imaginations and conceptual thinking but also a sound full knowledge on how a structural engineer can economies the structure besides the knowledge of practical aspects, such as recent design codes, bye laws, experience, intuition and judgment. The main purpose of the project is to ensure and enhance the safety, keeping careful balance between economy and safety (i.e. Most economical column method).

The present project deals with the analysis and design of a multi storied residential building of (ung-2+g+10) by using most economical column method. The dead load &live loads are applied and the design for beams, columns, footing is obtained etabs with its new features surpassed its predecessors, and compotators with its data sharing.our main aim is to complete a multi-storey building is to ensure that the structure is safe and economical against all possible loading conditions and to fulfill the function for which they have built.safety requirements must be so that the structure is able to serve it purpose with the maintain cost.detailed planning of the structure usually comes from several studies made by town planners, investors, users, architects and other engineers .on that, and a structural engineer has the main influence on the overall structural design and an architect is involved in aesthetic details.for the design of the structure, the dead load, live load, seismic and wind load are considered. The analysis and design for the structure done by using a software package etabs.in this project multistoried construction, we have adopted limit state method of analysis and design the structure. The design is in confirmation with is 456-2000.the analysis of frame is worked out by using etabs

## 1. Statement of The Project:

Salient Features: The design data shall be as follows.

1. Utility of Buildings: Residential Building
2. No of Storey: **(UNG-2 +G+10)**
3. Shape of the Building: Rectangular
4. No. Of Staircases: ONE
5. No. Of Lifts: One
6. Types of Walls: Brick Wall
7. Geometric Details
   a) Ground Floor (G-2, G-1): 3.2 M
   b) Floor-To-Floor Height: 3.0 M
   c) Height of Plinth: 0.6 M above G.L
   d) Depth of Foundation: 2 M below G.L
8. Material Details
   a) Concrete Grade: M30, M25 (COLUMNS AND BEAMS)
   b) All Steel Grades: HYSDREINFORCEMENT of Grade Fe415
   c) Bearing Capacity of Soil: 200 KN/M2

9. Type Of Construction: R.C.C FRAMED
10. Structure

11. General

Major advances in both design and new material assisted roman architecture. Design was enhanced architectural developments in the construction of arches and roof domes. Arches improved the efficiency and capability of bridges and aqueducts (fewer supports columns were needed to support the structure), while domed roofs not only permitted the building of larger open areas undercover, but also lent the exterior an impressive. . he social unit that lives in a house is known as a household. Most commonly, a household is family unit of a same kind, though households can be other social groups, such as single person, or groups of unrelated individuals.

Settled agrarian and industrial societies are composed of household units living permanently in housing of various types, according to a variety of farms of lands tenure. English-speaking people generally call any

Most modern-day definition of "good buildings" recognize that because architecture does not exist in a vacuum, architectural form cannot be merely a completion of historical precedent, fictional necessities ; and socially aware concerns, but most also be a trance dents synthesis of all of the former and a creation of worth in and of itself As Nunziarodanini stated, "through its aesthetic dimension architecture goes beyond the functional aspects that it has in common with other human sciences…through its own particular way of expressing values, architecture can stimulate and influence social life without presuming that, in and of itself, it will promote social

building there routinely occupy "home".Many people leave their houses during the day for work and recreation, and return to them to sleep or for other activities.

### Surya Prakash:

He was formerly the head of the Department of Civil Engineering (both post-graduate and under-graduate studies) at BMS College of Engineering in Bangalore. In addition to his experience in academics, he has extensive experience in designing high-rise towers and buildings, bridges, and other structures. As a senior structural engineering consultant at GERAME structural engineers in Bangalore, he made significant

contributions to the structural design of the 238-metre tall New Delhi TV tower, several multi-storied buildings, movie theaters, and many other structures. He has also published several papers in international conferences and symposiums.

## ARCHITECTURE LAYOUT DRAWING: DATA COLLECTION, ANALYSIS
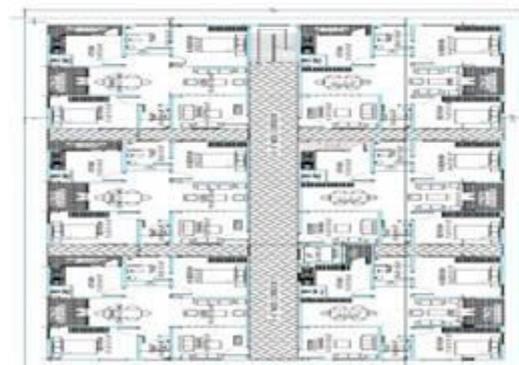


### DATA COLLECTION, ANALYSIS AND DESIGN
### 4.1 GENERAL PRINCIPLES OF SITE SELECTION:

Site selection has an important bearing on planning and designing of buildings. Generally, therefore an architect has either to

make a choice of suitable site or to plan his building structure to suit the available site. Natural defects of a site will involve considerable expenditure on construction and maintenance of the building.

1. A site which comes within the limits of an area where the by-laws of the local authority enforce restrictions regarding proportions of plots to built up, vacant spaces  to be left in front and sides, heights of buildings etc. should be preferred.
2. The site should be situated on an elevated place and also leveled on with uniform slopes from one end to the other so as to provide good and quick drainage of rain water.
3. The soil surface of the site should be good enough to provide economical foundations for the intended building without causing any problem. Generally for most satisfactory instructions, the site should have rock, sand or firm soil below 60 to 120cm. layer of light or even black cotton soil.
4. The situation of the site should be such as to ensure unobstructed natural light and air.
5.  The site should have a good land  scope but away from quarries, kilns, factories etc.

## TYPES OF LOADS:

Loads are primary consideration in any buildings design because they define the nature and magnitude of hazards or external forces that a building must resist to provide reasonable performance (i.e.; safety and serviceability) throughout the structure's useful life.The anticipated loads are influenced by a building's intended use (occupancy and function), configuration (shape and size) and location (climate and site conditions). Ultimately, the type and magnitude of the design loads affect critical decisions such has the Material selection, construction details, and architectural configuration.

Thus to optimize the value (i.e. performance versus economy) of the finished product, it is essential to apply design loads realistically. While the building consider in this guide are primary single-family detached and attached dwellings, the principles and concepts related to building loads also apply to other similar types of construction, such as low-rise apartment's buildings.

In general, the design loads recommended in this guide are based on:

1. Dead load

2. Live load
3. Imposed loads
4. Wind loads
5. Earth Quake load

### DEAD LOADS:

This is the permanent of the stationary load like self-weight of the structural elements.

This include the following

a) Self-weight
b) Weight of the finished structure part.
c) Weight of partition walls etc.

Dead loads are based upon the unit weights of elements, which are established taking in account materials specified for construction, given IS 1911-1967

Dead loads consists of the permanent construction material loads compressing the roof, floor, wall, and foundation system, including claddings finishes and fixed equipment. Dead load is the total load of all of the components of the building that generally do not change over time, such as

the steel columns, concrete floors, bricks, roofing material etc.

## LIVE LOADS:

These loads are not permanent or moving loads. The following loads includes in this type of loading: imposed loads(fixed) weight of the fixed seating in auditoriums, fixed machinery, partition walls these loads through fixed in positions cannot be relieved upon to act permanently throughout the life of the structure.

Imposed loads (not fixed) these loads change either in magnitude or position very often such as the traffic loads, weight of the furniture etc.

Live loads are produced by the use occupancy of the building. Loads include those from human occupants, furnishings, no fixed equipment, storage, and constriction and maintenance activities. As required to adequately define the loading condition, loads are presented in terms of uniform are loads, concentrated loads, and uniform line loads

## LOADING STANDARDS:

The loads that are considered in the design are based on IS-875-1964.

1. **The Dead Loads:**

   RCC   $25kN/m^3$

   PCC   $24 kN/m^3$

   Brick masonry   $19 kN/m^3$

   Floor finishes   $1 kN/m^3$

2. **The Live Loads:**

   On floors   $4 kN/m^2$

   On roofs   $3.5 kN/m^2$

   On stairs   $5 kN/m^2$

## IMPOSED LOADS:

Loads produced by intended use occupancy of a building including the weight movable portions distributed concentrated loads and loads that vibration and impact called imposed loads estimated by IS 456-2000.

## WIND LOADS:

The effects of wind on structures are still not perfectly understood and our knowledge in this area is constantly improving with the periodic revisions of the applicable wind code provisions. High winds can cause four types of structural damages which are stated as

1. Collapse
2. Partial collapse
3. Over damage
4. Sliding

Often partial damage occurs most frequently. Wind forces are applied perpendicular to all roofs and walls and both internal and external wind pressures are considered. Wind is not constant with height or with time, is not uniform over the side of the structure and does not always cause positive pressure. Both the wind pressure and the wind suction must be taken into account during the structural analysis.

The deviating effect, called Carioles force (isobars), is small and is usually disregarded except in the atmosphere and ocean. Certain periodic gusts within the spectrum of gustiness in wind may find resonance with natural vibration frequency would be much less than the static design

load for the structure, dangerous oscillations may be set up.

Pressure coefficients used in the practice

have usually been obtained experimentally by testing models of different types of structures in wind tunnels. When wind interacts with a structure, both positive and negative pressures occur simultaneously.

### EARTH QUAKE LOAD:

Seismic motions consist of horizontal and vertical ground motions, with the vertical motion usually having a much smaller magnitude. The factor of safety provided against gravity loads usually can accommodate additional forces due to vertical acceleration due to earthquakes. So, the horizontal motion of the ground causes the most significant effect on the structure by shaking the foundation back and forth.

However in practice all structures are flexible to some degree but a very flexible structure will be subjected to a much longer force under repetitive ground motion. This shows the magnitude of the lateral force on a structure is not only dependent on the acceleration of the ground but it will also depend on the type of structure (F=Ma). The earthquake load is estimated by response spectrum

method in the project and is as specified by the provisions in IS 1893.

In the earthquake resistant design focus is on the ductility and energy absorption by the material used (steel) for construction. It was shown repeatedly that no static analysis can assure a good dissipation of energy and favorable distribution of

damage in irregular structures and in general the more slender a structure, the worse the overturning effect of an earthquake

Seismic load can be calculated taking the view of acceleration response of the ground to the super structure. According to the severity of earthquake intensity they are divided into 4 zones.

1. Zone I and II are combined as zone II.
3. Zone III.
3. Zone IV.
4. Zone V.

### LOAD COMBINTION:

1. For seismic load analysis of a building the code refers following load combination.

1. $1.5(DL + IL)$
2. $1.2(DL + IL \pm EL)$
3. $1.5(DL \pm EL)$
4. $0.9\,DL \pm 1.5\,EL$

2. For wind load analysis of a building the code refers following load combination.

1. DL +LL
2. DL+WL
3. DL+0.8LL+0.8WL

Both WL and EL are applied in X and Z direction. These loads are also applied further in negative X and Z direction.

So for Seismic analysis there are 18 load combinations and for Wind load analysis there are 11 load combinations.

### STRUCTURAL ANALYSIS:

The procedure of structural analysis is simple in concept but complex. In detail. It involves the analysis of a proposed structure to show that its resistance or strength will meet or exceed a reasonable expectation. This expectation is usually expressed by a specified load or the demand and an acceptable margined of safety that constitutes a performance goal for a structure. The

performance goals structural design is multifaceted. Foremost, a structure must perform its intended function safely over its useful life.

The concept of useful life implies consideration of durability and established the basis for considering the cumulative exposure to time varying risks (i.e. corrosive environments, that performance is inextricably linked to cost, owners, builders, and designer must considers economic limit to the primary goal of safety and durability.

In the view of the above discussion, structural designer may appear to have little control

over the fundamental goals of structural design except to comply with or exceed the minimum limits established by law. While this is generally true, a designer can still do much to optimize the design through alternative means and methods that can for more efficient analysis techniques, creative design detailing, and the use of innovative construction materials and methods. In summary the goal of structural design are defined by law and reflect the collective interpretation of general public welfare by those involved in the development and local adoption of building could.

### DESIGN OF SLABS:
Assume:

$$f_{ck} = 20 \text{ N/mm}^2$$
$$f_y = 415 \text{ N/mm}^2$$

Dimensions of slab: 4.39 × 3.65m Let Short span = $L_x$ = 3.65m

Longer span = $L_y$ = 4.39m

$L_y/L = 4.39/3.65 = 1.20 < 2$

Hence, te slab is to be designed as a Two way slab

### Thickness of slab
Effective depth d=Span/28
= 3650/28
=130.35mm
Let take max depth =
140mm Total effective
depth =140mm Overall
depth = 165mm

### Effective spans
$L_x$ = 3.65+0.14 = 3.8m
$L_y$ = 4.39+0.14 = 4.53m

$L_y/L_x$ = 4.53m/3.8m = 1.20< 2 (Two way slab)

### Loads on slab
Dead load = 0.165 x1x 25 = 4.125 KN/m$^2$
Live load = 5.0 KN/m$^2$
Floor finish =1 KN/m$^2$
Total load = 4.125+5.0+1 = 10.125 KN/m$^2$
Factored load ($w_u$) = 1.5 x 10.125 = 15.187 KN/m$^2$

**Design moments and shear forces**

$$M_{ux} = \alpha_x w L_x^2$$
$$M_{uy} = \alpha_y w L_x^2$$

Where $\alpha_x$, $\alpha_y$ are the bending coefficients for two way slabs for the one long edge and one short edges are discontinued and negative.

For

$Ly/Lx=1.2$

$0$ $\alpha_x$ (-ve) = 0.060 $\alpha_x$ (+ve) =0.045

$\alpha_x$ (-ve) = 0.047

$\alpha_x$ (+ve) =0.035

$M_{ux}$ (-ve)= $\alpha_x$ (-ve) $\times$ w $(lx)^2$

=0.060 $\times$ 15.182 $\times 3.8^2$

$M_{ux}$(-ve)= 13.15 KN-m

$M_{ux}$(+ve) = $\alpha_x w L^2$

=0.045 $\times$ 15.187 $\times 3.8^2$

$M_{ux}$(+ve)= 9.86 KN-m

$M_{uy}$(-ve)= $\alpha_y$(-ve) $\times$ w$(lx)^2$

=0.047 $\times$ 15.187 $\times 3.8^2$

=10.37 KN-m

$M_{uy}$(+ve)= $\alpha_y$(+ve) $\times$ w$(lx)^2$

= 0.035 $\times$ 15.187 $\times 3.8^2$

$M_{uy}$(+ve)= 7.67 KN-m

Shear force $V_u$= $w_u$ lx /2

= (15.187 x 3.8)/2

= 28.85 KN

**Min depth required**

$M_u$ = $0.138 \times f_{ck} \times b \times d^2$

$13.15x10^6$ = $0.138 \times 20 \times 1000 \times d^2$

d =69.05

**Equation**

d = 69.05<140

Hence provided depth is adequate

**Reinforcement**

Along x-direction (short span)

$M_{ux}$ = 0.87 $f_y$ $A_{st}$ d{1 –( $F_y$ $A_{st}$/ $F_{ck}$ b

d)}

$13.15x10^6$ = 0.87x 415x $A_{st}$x140 {1 – (415 $\times A_{st}$/20x1000x140)}

$A_{st}$ = 271.03mm$^2$

Using 10mm dia bars

**Spacing of bars**

S = ($a_{st}$ /$A_{st}$ ) $\times$ 1000

= $((\pi/4\times10)^2$ /271.03) $\times$ 1000

=289.77mm = 280mm

**Max spacing**

i. 3×d = 3×140

= 420 mm ₓ

ii. 300 mm

Whichever is less

Hence provide 10mm dia bars @ 280mm spacing Along y-direction (longer span) These bars will be placed above the bars in x-direction

d= 140-10 = 130mm

$M_{uy}$ = 0.87 $f_y$ $A_{st}$d {1 – ( $F_y$ $A_{st}$/ $f_{ck}$bd)}

$10.37x10^6$ = 0.87 $\times$ 415 $\times$ $A_{st}$×130 {1- (415 $\times$ $A_{st}$/20×1000×130) }

$A_{st}$ = 229.32 mm$^2$ Using 10 mm dia bars

**Spacing of bars**

S=( $a_{st}$ /$A_{st}$ ) $\times$ 1000

= { ( $(\pi / 4)\times 10^2$)/229.32 } $\times$ 1000

S = 343.10 mm≈300mm

**Max spacing**

i. 3×d = 3×140

= 420 mm

ii.300mmWhichever is

less

Hence provide 8 mm dia bars at 300mm spacing

### Check for shear

$$\tau_v = (V_u/(b \times d))$$

$$= \{ (28.85 \times 10^3)/(1000 \times 140) \}$$

$$\tau_v = 0.20 \text{ N/mm}^2$$

$$\%\text{of steel} = \{ (100 \times A_{st})/b \times d \}$$

$$= \{ (100 \times 243.13)/(1000 \times 140) \}$$

$$= 0.17$$

As per IS code for M20 concrete

$$\tau_c = 0.299 \text{ N/mm}^2$$

$$\tau_v < \tau_c$$

$$0.20 < 0.299$$

Hence provided slab is safe

### 4.7 BEAM DESIGN:

A reinforced concrete beam should be able to resist tensile, compressive and shear stress induced in it by loads on the beam.

### ETABS MODELING, ANALYSIS AND DESIGN PROCEDURE GENERAL:

ETABS is a special-purpose computer program developed specifically for building structures. It provides the Structural Engineer with all the tools necessary to create, modify, analyze, design, and optimize building models. These features are fully integrated in a single, Windows-based, graphical user interface that is unmatched in terms of ease-of- use, productivity, and capability.

The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. Incorporating 40 years of continuous research and development, this latest ETABS offers unmatched 3D object based modeling and visualization tools, blazingly fast linear and nonlinear analytical power, sophisticated and comprehensive design capabilities for a wide-range of materials, and insightful graphic displays, reports, and schematic drawings that allow users to quickly and easily decipher and understand analysis and design results.

From the start of design conception through the production of schematic drawings, ETABS integrates every aspect of the engineering design process. Creation of models has never been easier - intuitive drawing commands allow for the rapid generation of floor and elevation framing. CAD drawings can be converted directly into ETABS models or used as templates onto which ETABS objects may be overlaid. Design of steel and concrete frames (with automated optimization), composite beams, composite columns, steel joists, and concrete and masonry shear walls is included, as is the capacity check for steel connections and base plates. Models may be realistically rendered, and all results can be shown directly on the structure. Comprehensive and customizable reports are available for all analysis and design output, and schematic construction drawings of framing plans, schedules, details, and cross-sections may be generated for concrete and steel structures.

ETABS provides an unequaled suite of tools for structural engineers designing buildings, whether they are working on one-story industrial structures or the

tallest commercial high-rises. Immensely capable, yet easy-to-use has been the hallmark of ETABS since its introduction decades ago, and this latest release continues that tradition by providing engineers with the technologically-advanced, yet intuitive, software they require to be their most productive.

## FINITE ELEMENT METHOD (FEM):

The Finite Element Method (FEM) is a numerical technique to find approximate solutions of partial differential equations. It was originated from the need of solving complex elasticity and structural analysis problems in Civil, Mechanical and Aerospace engineering. In a structural simulation, FEM helps in producing stiffness and strength visualizations. It also helps to minimize material weight and its cost of the structures. FEM allows for detailed visualization and indicates the distribution of stresses and strains inside the body of a structure. Many of FE software are powerful yet complex tool meant for professional engineers with the training and education necessary to properly interpret the results. Several modern FEM packages include specific components such as fluid, thermal, electromagnetic and structural working environments. FEM allows entire designs to be constructed, refined and optimized before the design is manufactured. This powerful design tool has significantly improved both the standard of engineering designs and the methodology of the design process in many industrial applications. The use of FEM has significantly decreased the time to take products from concept to the production line. One must take the advantage of the advent of faster generation of personal computers for the analysis and design of engineering product with precision level of accuracy

## ETABS OVERVIEW:

➢ Concurrent Engineering" based user environment for model development, analysis, design, visualization and verification.

➢ Pull down menus, floating toolbars, tool tip help.

➢ Flexible Zoom and multiple views.

➢ Isometric and perspective views 3D shapes.

➢ Built-in Command File Editor.

➢ Simple Command Language.

➢ Graphics/Text input generation.

➢ State-of-the-art Graphical Pre and Post Processor.

➢ Rectangular/Cylindrical Coordinate systems.

➢ Joint, Member/element, Mesh Generation with flexible user-controlled numbering.

➢ Efficient algorithm minimizes disk space requirements.

➢ FPS, Metric or SI units.

Presentation quality printer plots of Geometry and Results as part of run analysis

## ETABS ANALYSIS AND DESIGN PROCEDURE:

▪ Define Plan Grids and Story Data
▪ Define Material Properties
▪ Define Frame Sections
▪ Define Slab Sections
▪ Define Load Cases
▪ Draw Beam Objects (Frame Members)
▪ Draw Column Objects (Frame Members)
▪ Assign Slab Sections
▪ Assign Restrains
▪ Assign Slab Loads
▪ View Input Data in Tabular Form
▪ Run the Analysis
▪ View Analysis Results Graphically
▪ Design Concrete Frame Element

## MATERIAL PROPERTIES AND LOADS:

This work has been analyzed using ETABS software. For the analysis the material properties like grade of concrete, steel, density, modulus of elasticity must be define initially. And also the various loads like dead, live, SDL, wind, seismic needs to be define earlier.

Grade of concrete        : M20
Grade of steel                : Fe
500 Modulus of elasticity E    : 2x105

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N/mm2 Live loads : 5kN/m2

SDL : 3.5kN/m2

## 5.4.1 BUILDING PLAN:



FIG 5.1 BUILDING VIEW OF PLAN STRUCTURE DATA

This chapter provides model geometry information, including items such as story levels, point coordinates, and element connectivity.

### STORY DATA

**Table 6.1.1 - Story Data**

### GRID DATA

| Name | Height mm | Elevation mm | Master Story | Similar To | Splice Story |
|---|---|---|---|---|---|
| Story12 | 3000 | 36000 | Yes | None | No |
| Story11 | 3000 | 33000 | No | Story12 | No |
| Story10 | 3000 | 30000 | No | Story12 | No |
| Story9 | 3000 | 27000 | No | Story12 | No |
| Story8 | 3000 | 24000 | No | Story12 | No |
| Story7 | 3000 | 21000 | No | Story12 | No |
| Story6 | 3000 | 18000 | No | Story12 | No |
| Story5 | 3000 | 15000 | No | Story12 | No |
| Story4 | 3000 | 12000 | No | Story12 | No |
| Story3 | 3000 | 9000 | No | Story12 | No |
| Story2 | 3000 | 6000 | No | Story12 | No |
| Story1 | 3000 | 3000 | No | Story12 | No |
| Base | 0 | 0 | No | None | No |

### Table 6.1.3 - Grid Lines

| Column | I-End Point | J-End Point | I-End Story |
|---|---|---|---|
| C1 | 1 | 1 | Below |
| C2 | 2 | 2 | Below |
| C3 | 3 | 3 | Below |
| C4 | 4 | 4 | Below |
| C5 | 5 | 5 | Below |
| C6 | 6 | 6 | Below |
| C7 | 7 | 7 | Below |
| C8 | 8 | 8 | Below |
| C9 | 9 | 9 | Below |
| C10 | 10 | 10 | Below |
| C11 | 11 | 11 | Below |
| C12 | 12 | 12 | Below |
| C13 | 13 | 13 | Below |
| C14 | 14 | 14 | Below |
| C15 | 15 | 15 | Below |
| C16 | 16 | 16 | Below |
| C17 | 17 | 17 | Below |
| C18 | 18 | 18 | Below |
| C19 | 19 | 19 | Below |
| C20 | 20 | 20 | Below |

| Grid Syste | Grid Directi | Grid | Visibl | Bubble Locatio | Ordina te m |
|---|---|---|---|---|---|
| G1 | X | A | Yes | End | 0 |
| G1 | X | B | Yes | End | 6.4.69 |
| G1 | X | C | Yes | End | 16.1.46 |
| G1 | X | D | Yes | End | 17.3 |
| G1 | Y | 1 | Yes | Start | 0 |
| G1 | Y | 2 | Yes | Start | 6.2.85 |
| G1 | Y | 3 | Yes | Start | 6.4.81 |
| G1 | Y | 4 | Yes | Start | 7.62 |
| G1 | Y | 5 | Yes | Start | 9.7 |
| G1 | Y | 6 | Yes | Start | 16.3.52 |
| G1 | Y | 7 | Yes | Start | 17.45 |

### POINT COORDINATES

### Table 6.1.4 - Joint Coordinates Data

| Label | X mm | Y mm | ΔZ Below mm |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 3850 | 0 |
| 3 | 0 | 5810 | 0 |
| 4 | 0 | 7620 | 0 |
| 5 | 0 | 9700 | 0 |
| 6 | 0 | 14520 | 0 |
| 7 | 0 | 17450 | 0 |
| 8 | 5690 | 0 | 0 |
| 9 | 5690 | 3850 | 0 |
| 10 | 5690 | 5810 | 0 |
| 11 | 5690 | 7620 | 0 |
| 12 | 5690 | 9700 | 0 |
| 13 | 5690 | 14520 | 0 |
| 14 | 5690 | 17450 | 0 |
| 15 | 11460 | 0 | 0 |
| 16 | 11460 | 3850 | 0 |
| 17 | 11460 | 5810 | 0 |
| 18 | 11460 | 7620 | 0 |
| 19 | 11460 | 9700 | 0 |
| 20 | 11460 | 14520 | 0 |
| 21 | 11460 | 17450 | 0 |
| 22 | 17300 | 0 | 0 |
| 23 | 17300 | 3850 | 0 |

| Label | X mm | Y mm | ΔZ Below |
|---|---|---|---|
| 24 | 17300 | 5810 | 0 |
| 25 | 1730 | 7620 | 0 |
| 26 | 17300 | 9700 | 0 |
| 27 | 1730 | 1452 | 0 |
| 28 | 17300 | 17450 | 0 |

## 6.1.4 LINE CONNECTIVITY
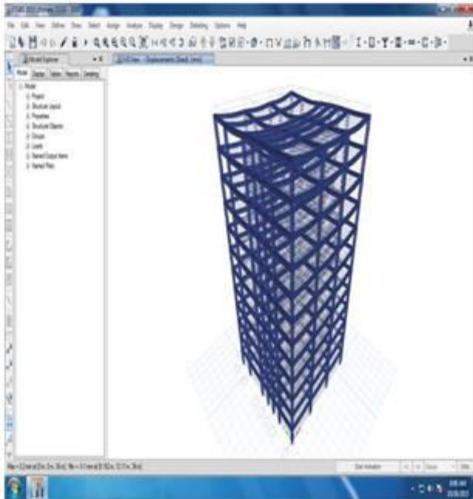
Table 6.1.5 - Column Connectivity Data



FIGURE 6.2 COLUMN AND BEAM REINFORCEMENT DETAILS

FIGURE 6.3 COLUMNS AND BEAMS DETAILS

### FIGURE 6.4 3D VIEW OF WHOLE STRUCTURE

### 7.1 RECOMMENDATIONS:

After completing this main project, based on our experience the following recommendations are made.

1. One cannot ignore the importance of the geotechnical engineering report which indicates the estimation of soil bearing capacity.
2. The engineering who is involved in analysis and design of multistoried building should have the proper back ground in the following technical areas.
   a. Engineering mechanics
   b. Engineering drawing
   c. Strength of materials
   d. Structural analysis
   e. Structural design of RCC and steel
3. In addition to the technical skill one should have the following basic skills.
   a. Communication skills
   b. Report writing skills
   c. Microsoft office
   d. AUTOCAD
   e. Structural engineering soft wares
   f. Architectural soft wares
3. The design engineer should have the basic background in electrical and plumbing engineering also.

4. A design engineer may use our main project report as a guide line.

## CONCLUSION:

### CASE-1

Provision of bracing or provision of shear wall or tube system can be used as a new technique.

### CASE-2

Economizing the column by means of area of steel as per code, the min percentage of steel is 0.8%gross cross sectional area and max: 6% as per code.

### CASE-3

Economizing the column by means of column orientation is longer span longer direction will reduce the amount of bending as a result the area of steel is also reduced

### CASE -4 (SCOPE FOR FUTHER STUDY)

If the height of the structure is increased, the stiffness phenomenon (slenderness effect) i.e. long column effect will come in to the picture. As a result the amount of deflections are far greater than the codal provisions (Is - 456).

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9.- Dead loads.

IS-875-1987: Code of practice for design loads for buildings and structures - Impose Loads. As our project deals with the most economical column method in this project we have design the structure in an economical way by reducing the sizes in the sections. As the load is more at the bottom when compared to the top floors, there is no need of providing large sizes at the top.

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10.