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ANALYSIS AND DESIGN OF EARTHQUAKE RESISTANT BUILDING (C+G+2) USING ETABS & MANUAL DESIGNING

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Abstract: Earthquake is known to be one of the most destructive phenomenon experienced on earth. It is caused due to a sudden release of energy in the earth's crust which results in seismic waves. When the seismic waves reach the foundation level of the structure, it experiences horizontal and vertical motion at ground surface level. Due to this, earthquake is responsible for the damage to various man-made structures like buildings, bridges, roads, dams, etc. 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.In the present work a C+G+2 Residential building is analyzed in Etabs considering both gravity loads as well as lateral loads as it is a high rise building. The various IS codes considered are IS 875 Part 1 for Dead loads, IS 875 Part 2 for Live loads , IS 1893-2002 for Earthquake, IS 456-2000 for Design of RCC members and SP -16 Curves for the design of columns. The building considered is situated in Hyderabad, Telangana which comes under Zone 2 as per IS 1893 – 2002 . The grade of concrete considered is M25 and Grade of steel considered is Fe415. The design results will be extracted from Etabs, while manual calculations will also be carried out to get complete knowledge on manual design of RCC structures.

INTRODUCTION

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength and/or ductility. The reinforcement is usually, though not necessarily, steel reinforcing bars (rebar) and is usually embedded passively in the concrete before the concrete sets. Reinforcing schemes are generally designed to resist tensile stresses in particular regions of the concrete that might cause unacceptable cracking and/or structural failure. Modern reinforced concrete can contain varied reinforcing materials made of steel, polymers or alternate composite material in conjunction with rebar or not. Reinforced concrete may also be permanently stressed (in compression), so as to improve the behavior of the final structure under working loads.

In the United States, the most common methods of doing this are known as pre-tensioning and post-tensioning.

For a strong, ductile and durable construction the reinforcement needs to have the following Properties at least:

a. High relative strength

b. High toleration of tensile strain

c. Good bond to the concrete, irrespective of pH, moisture, and similar factors

d. Thermal compatibility, not causing unacceptable stresses in response to changing temperatures.

e. Durability in the concrete environment, irrespective of corrosion or sustained stress for example

Reinforced concrete is widely used for construction on a large scale due to its desirable mechanical properties. Types of steel and non-steel concrete reinforcement are described. Corrosion has an adverse effect on the embedded steel if structures are not properly designed and constructed.

PERFORMANCE OF REINFORCED CONCRETE

Concrete consists of a cement and stone aggregate mixture that forms a rigid structure with the addition of water. When steel that has a high tensile strength is embedded in concrete, the composite material withstands compression, bending, and tensile stresses. Such a material can be used for making any size and shape, for utilization in the construction.

The main quality of reinforced concrete is similarity of its coefficient of thermal expansion with that of steel, due to which the internal stresses initiated due to variation in thermal expansion or contraction are eliminated.

Secondly, on the hardening of the cement paste inside the concrete, it corresponds to the surface features of the steel, allowing the stresses to be efficiently transmitted between the two materials. The cohesive characteristics between the steel and concrete are enhanced by the roughening of steel bars.

OBJECTIVES

For every RCC structures the following listed objectives are required

a. Reinforcement Cement Concrete

b. Reinforced cement concrete cover is provided and where it is.

c. The behavior of RMC in concrete used in large scale.

d. Precautionary measures in placing reinforced cement concrete.

e. Form work for construction of reinforced cement concrete structure.

f. Removing of form work used in reinforced cement concrete structure.

METHODOLOGY

DIFFERENT LOADS ACTING ON BUILDING

The determination of the loads acting on a structure is a complex problem. The nature of the loads varies essentially with the architectural design, the materials, and the location of the structure. Loading conditions on the same structure may change from time to time, or may change rapidly with time.

Loads are usually classified into two broad groups: dead loads and live loads. Dead loads (DL) are essentially constant during the life of the structure and normally consist of the weight of the structural elements. On the other hand, live loads (LL) usually vary greatly. The weight of occupants, snow and vehicles, and the forces induced by wind or earthquakes are examples of live loads. The magnitudes of these loads are not known with great accuracy and the design

values must depend on the intended use of the structure. In structural analysis three kinds of loads are generally used:

1. Concentrated loads that are single forces acting over a relatively small area, for example vehicle wheel loads, column loads, or the force exerted by a beam on another perpendicular beam.

2. Line loads that act along a line, for example the weight of a partition resting on a floor, calculated in units of force per unit length.

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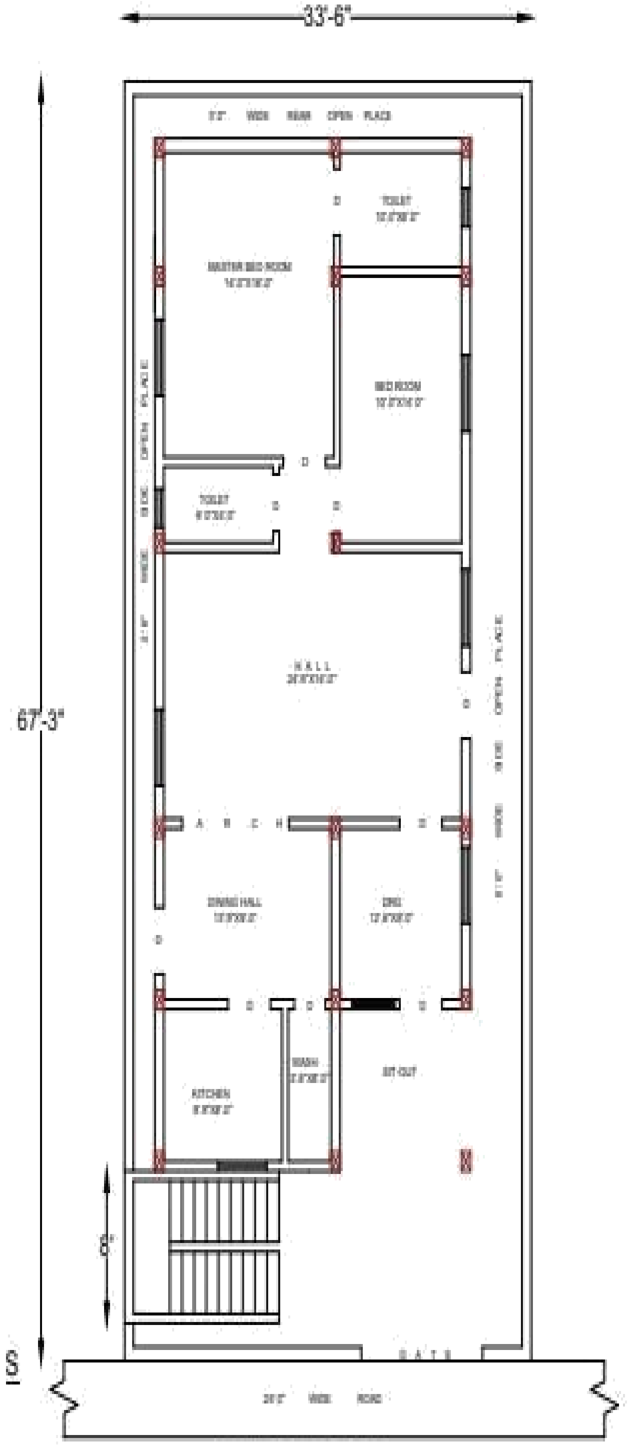
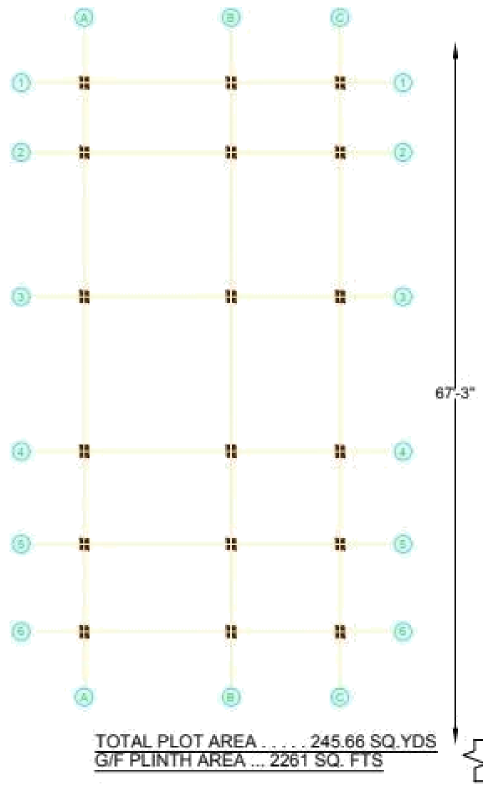
3. Distributed (or surface) loads that act over a surface area. Most loads are distributed or are treated as such, for example wind or soil pressure, and the weight of floors and roofing materials

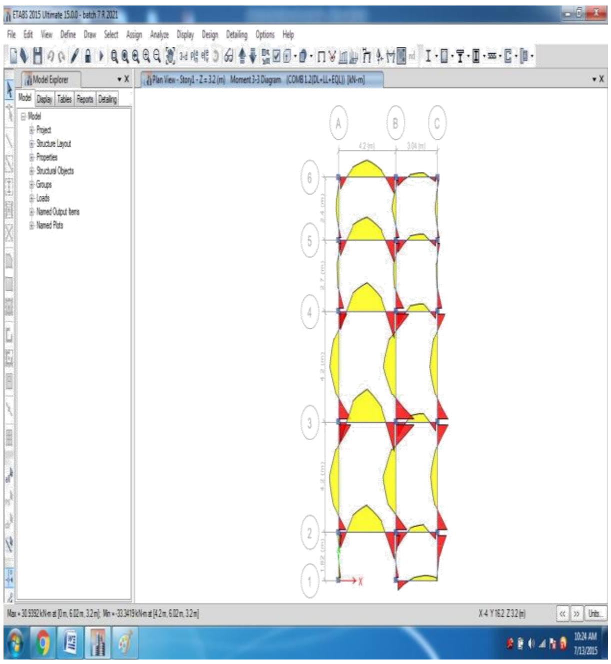
ARCHITECTURAL PLANS



GROUND FLOOR PLAN



Typical Floor Plan



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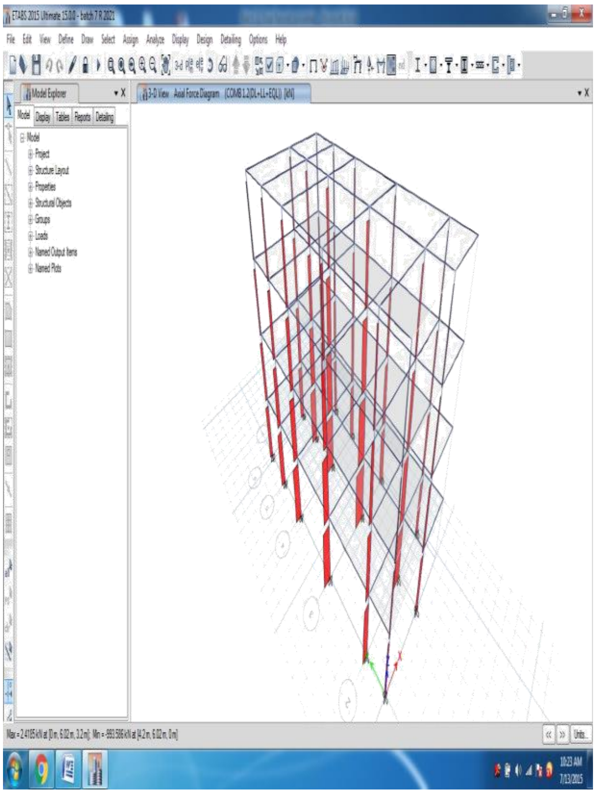
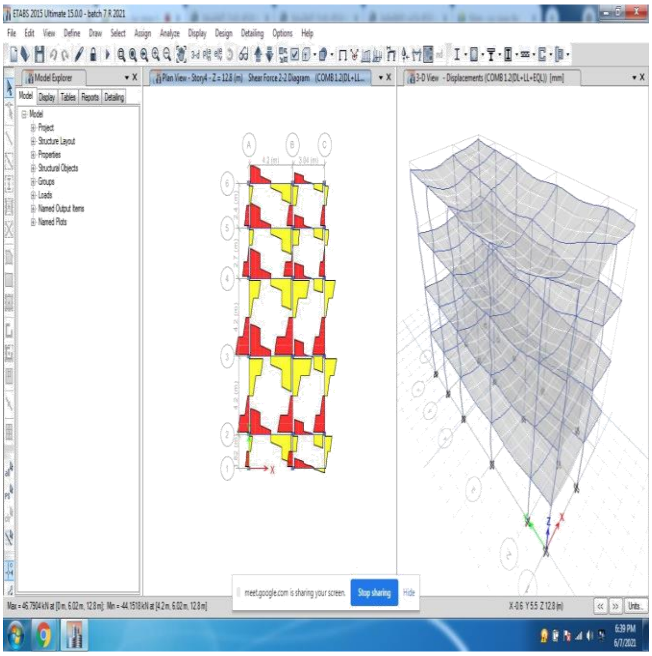
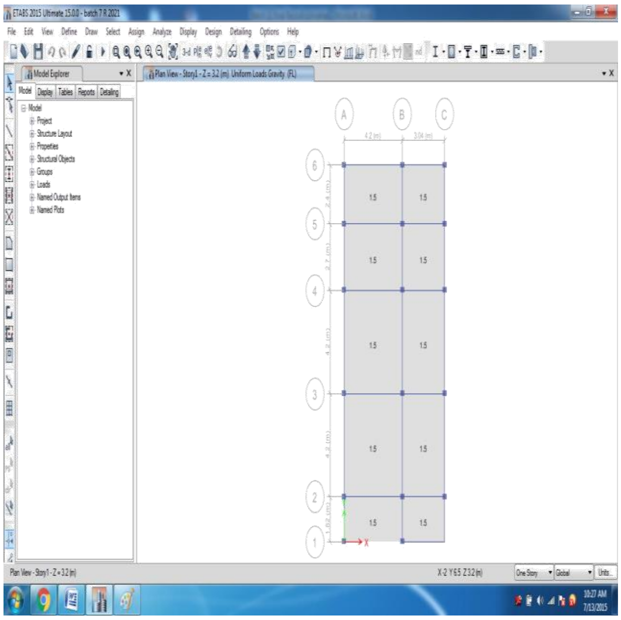




Floor Finish On Slabs

ETABS Design 3D Model –Axial Force Diagram



Shear force diagram

CONCLUSION

A C + G + 2 commercial building has been analyzed on ETABS and using the analysis results the design has been carried out manually. Loads were applied on the ETABS design model as per IS 875 Part I and Part II. Recommendations from IS 456 were strictly followed for design of each RCC member.

Analysis of beams and columns can be performed using Softwares such as ETABS, the analysis results can be extracted in much less time compared to manual analysis. Details of each and every member can be obtained except footing and

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staircase using ETABS.All the List of failed beams and column can be obtained by the software.Accuracy is improved by using software.

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