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ANALYSIS AND DESIGN OF MULTISTORIED BUILDING (G+6) USING E-TABS AND SLOPE DEFLECTION METHOD

Addanki Manikya Gopichand[1], Mr.M. Jugal Kishore M.Tech (Ph.D.)[2]

[1]M.Tech Scholar, Civil Engineering Department, Kallam Haranadhareddy Institute of Technology, Chowdavaram, Guntur, Andhra Pradesh, India.
[2]Associate Professor, Civil Engineering Department, Kallam Haranadhareddy Institute of Technology, Chowdavaram, Guntur, Andhra Pradesh, India.

ABSTRACT:- The equations found for use in the Slope Deflection Method connect the rotations and displacements of a beam to the moments that are induced at its ends through forces. The elastic curve of a beam under a set of arbitrary forces is used to compare the differences in rotation of the beam to the angle of the chord.

In this project slope deflection equations are applied to solve the statically indeterminate frames without sideway. In frames axial deformations are much smaller than the bending deformations and are neglected in the analysis. With this assumption the frames will not sideway. The frames will not be displaced to the right or left. The frames are properly restrained against sideway. The methods of three moment equation, and consistent deformation method are representing the force method of structural analysis, the slope deflection method use displacements as unknowns, hence this method is the displacement method. In this method, if the slopes at the ends and the relative displacement of the ends are known, the end moment can be found in terms of slopes, deflection, stiffness and length of the members. In order to compete in the ever growing competent market it is very important for a structural engineer to save time. As a sequel to this an attempt is made to analyze and design a multi-storeyed building by using a software package E-TABS.

For analyzing a multi -storied building one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. There are several methods for analysis of different frames like kani's method, cantilever method, portal method, and Matrix method.

The present project deals with the analysis and design of a multi storied residential building of G+6 the dead load &live loads are applied and the design for beams, columns, footing is obtained.

KEY WORDS: E-Tabs 2015, IS Codes, Auto Cad 2016.

I. INTRODUCTION

A. Overall

In each characteristic of human development we desirable structures to live in or to get what we need. But it is not only Structure structures but to build efficient constructions so that it can fulfil the main persistence for what it was made for. Constructions derived in overall quantity of outlines and persistence's, and have been improved during past for a wide number of factors, from Structure constituents presented, to with stand situations, to land-dwelling values, ground conditions, specific uses and aesthetic reasons. Assembly that has several floors above ground in the Structure Multi-storey Structures aim to advance the level area of the Structure without snowballing the area of the land the construction is built on, hence saving land and, in greatest cases, currency (contingent on material used and land prices in the area). The design process of multi-stored Structure requires not only imagination and academic discerning but also sound knowledge of science of structural engineering besides the knowledge of real-world aspects, such as recent design codes, bye laws, sponsored up by ample experience, intuition and judgment. The persistence of values is to guarantee and improve the safety, possession suspicious stability between economy and safety. In the modern study G plus 6 storey's Structure at Vidyanagar, Hyderabad, India is premeditated (Slabs, Beams, Columns and Footings) using E-Tabs software.

B. Introduction of Examination and Design

Examination: Examination of the structure means to determination of the internal forces like axial compression bending moment, shear force etc. in the constituent associate aimed at which the associate are near be calculated below the accomplishment of given external load.

Design: The design is process of section percussion from the examination results by using suitable examination method. The purpose of design is to accomplishment of a

satisfactory likelihood that erections being premeditated will perform satisfactorily during their intended life.

C. Objectives of Thesis

This thesis aims for relearning of concept of structural design by the assistance of processor aids. Momentarily we must go concluded sub sequent opinions over the proposition graft.

- Sympathetic of project and specifying idea.
- Main detached i.e. learning of E-Tabs software package.
- Learning of examination and design methodology which can be very useful in the field.
- Sympathetic of tremor confrontation project notion.
- Method for specialized rehearsal in the arena of organizational manufacturing.
- Carrying out a complete examination and design of the main structural elements of a multi-storey Structure including slabs, columns, shear walls.

II. LITERATURE REVIEW

Broad View: Technique of inspection of statistically uncategorized portal frames:

1. Method of flexibility coefficients.
2. Gradient dislocations procedures (iterative methods)
3. Instant circulation technique
4. Kane's method
5. Cantilever method
6. Portal method
7. Matrix method

Method of flexibility coefficients: The scheme of checkup is covers reducing the hyper static building to a determinate structure form by Removing the redundant sustenance (or) presenting satisfactory scratches (or) cruxes.

Limitations: It is not applicable for gradation of severance>3

Slope Displacement Comparisons: It is valuable when kinematic indeterminacy <standing indeterminacy. This process was principal expressed by pin binge in 1914 founded on the requests of compatibility and symmetry circumstances. The technique originates its appellation after the detail that provision slopes and movements are openly comported. Set up immediate reckonings is shaped the explanation of these limits and the combined instant in each component or calculated from these standards.

Limitations: A solution of simultaneous equations makes methods tedious for manual computations. This technique is not optional for borders superior than too bays and two storeys.

Iterative approaches: These procedures include allocating the recognized secure and instants of the organizational associate to head-to-head associates at the junctions in order content the circumstances of compatibility.

Boundaries of resistant irritated process:

It offerings certain problems once practical to unbending edge particularly when the edge is vulnerable to side power. The technique cannot be functional to constructions with in-between joints.

Kani's technique: These techniques ended originates particular of the detriments of enduring irritated technique. Kani's method is alike to H.C.M to that degree it too comprises recurrent delivery of instants at consecutive joins in edges and endures beams. Though here is a main change in dissemination procedure of two approaches. H.C.M allocates only the total combined instant at any phase of restatement. The greatest important mouth of kani's technique is that procedure of repetition is self-corrective. Any mistake at any phase of repetitions corrected in following adders so skipping a few ladders fault at any period of iteration is corrected in subsequent consequently prancing a few ladders of repetitions either by over vision of by meaning fixes not lead to fault in last end instants.

Compensations: It is used for side way of frames.

Boundaries: The turning of columns of any storey ought to be operative a sole rotation charge of equivalent storey. The beams of storey must not experience revolution once the column experiences paraphrase. That is the column should be parallel. Borders through in-between hinges cannot be inspection

Approximate method: Approximate examination of hyper static structure provides humble incomes of procurement a fast. Explanation for initial project it types certain abridging molds regarding Organizational conduct so to get a rapid explanation to multifaceted constructions. The typical procedure includes plummeting the assumed unknown formation to a control structural scheme by presenting passable not at all of pivots. It is imaginable to draught the bounced outline of the construction for the given loading and hence by

locates the print modulation

Subsequently each point of modulation agrees to the position of zero instant in the constructions. The modulation opinions can be imagined as fulcrums for the determination of inspection. The solution of structures is split unassuming after the variation ideas are placed. The stacking belongings are ascending in multistoried edges specifically flat and perpendicular charging. The inspection approved out unconnectedly for these two cases.

Flat Circumstances: The performance of a construction exposed to flat forces is contingent upon its statures to breadth relation amid their issue. It is compulsory it distinguish among little rise then high rise edges in this circumstance.

Stumpy rise Constructions:

Height < width

It is considered predominately by shear distortion.

High rise Constructions

Height > width

It is conquered by round about act

Matrix examination of frames: The different essentials of mounts are afraid per in changed instructions different persons of lasts rays so their inspection is additional multi-faceted not ever the fewer the elementary suppleness and trouble methods are applied to frames stiffness method is more useful since its adaptability to computer software design stiffness method is used when degree of joblessness is better than grade of freedom. Though difficulty technique is rummage-sale grade of liberty is better than grade of joblessness especially for computers.

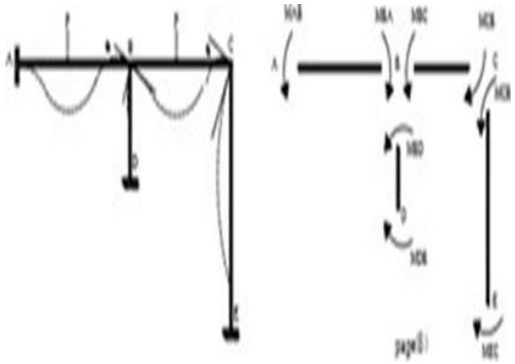
III. METHODOLOGY & MATERIAL

The procedures of three moment equation, and dependable distortion technique are characterizing the FORCE METHOD of organizational inspection, the Slope Deflection method use displacements by way of nonentities, henceforth this technique is the displacement method. In this technique, if the slopes at the conclusions and the comparative displacement of the ends are acknowledged, the end moment can be start in relations of slopes, deflection, stiffness and measurement of the members. In- the slope-deflection method the turnings of the links are dried as strangers. On behalf of someone follower bounded by two intersections the end moments can be articulated in terms of revolutions. In this method all joints are considered rigid; i.e. the view point a midaffiliates at the joins are measured not-to change in charge as loads are functional, as shown in fig 1.

Joint conditions: to get θ_B & θ_C

MBA+MBC+MBD = 0

MCB+MCE = 0



A. Conventions in the Slope Deflection Method. This system is founded on the subsequent basic expectations. All the intersections of the edge are rigid, i.e, the angle between the associates at the joints do not alteration, when the associates of edge are encumbered. Falsification, owed to axial and shear stresses, presence very small, are mistreated.

Degree of Freedom: The number of junction's rotation and independent joint translation in a structure is called the degrees of freedom. Two types for degrees of freedom.

In rotation

For beam or frame is equal to D_r.

$$D_r = j\text{-}f$$

Where:

D_r = degree of freedom.

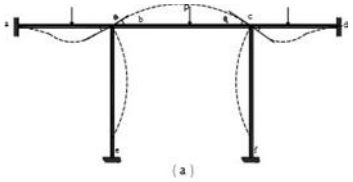
j = no. of joints including supports. F = no. of fixed support.

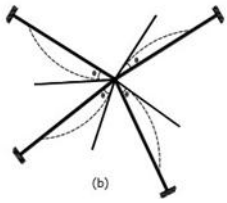
The slop defection technique is appropriate for beams and frames. It is useful for the inspection of highly statically unknown structures which have a low degree of kinematical indeterminacy. For instance the frame shown in fig. 2.a The frame (a) is nine times statically

indeterminate. On other hand only two unknown rotations, θb and θc i.e.cinematically indeterminate to additional gradation- if the slope deflection is rummage-sale. The edge (b) is once unstipulated.

B. Sign Conventions

Cooperative revolution& Fixed and instants are measured optimistic once happening in a right-handed route





$$\theta_{A1} = \frac{2}{3}\frac{M_A L}{2EI} = \frac{M_A L}{3EI}$$

$$\theta_{BI} = \frac{1}{3} = \frac{M_A L}{2\ EI} = \frac{-M_A L}{6\ EI}$$

hence $\theta_{B1} = \frac{1}{2}\theta_{A1}$

$$\theta_{A2} = \frac{1}{3}\frac{M_B L}{2\ EI} = \frac{-M_B L}{6\ EI}$$

$$\theta_{B2} = \frac{2}{3}\frac{M_B L}{2\ EI} = \frac{M_B L}{3\ EI}$$

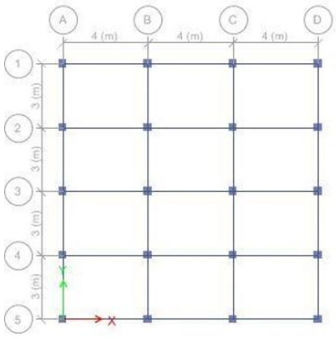
$$\theta_{B1} + \theta_{B2} = 0$$

Hence: MA = 2MB and$\theta A = \theta A1 - \theta A2$

$$= \frac{M_A L}{3EL} - \frac{M_A L}{12EL}$$

$$\theta_A = \frac{3M_A L}{12EI}$$

$MA = \frac{4EI}{L}.\theta A$
$MB = \frac{2EI}{L}.\theta A$



Relation between Δ & M

Relation between Δ & M

$$R = \frac{\Delta}{L}$$

by moment area method or by conjugate beammethod.

$$\Delta = \Sigma_{M\ at\ B}$$

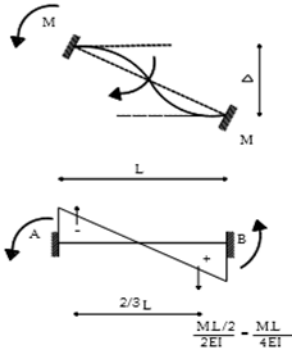
$$= \frac{M L}{4EI}\left(\frac{2L}{3}\right)$$

$$= \frac{M L^2}{6EI}$$

$$M = \frac{6EI}{L^2}\Delta$$

$$= \frac{6EI}{L}.R$$

R (+ ve) when the rotation of member AB with clock



IV. EXAMINATION& STRUCTURAL MODELLING

A. Overview:- It is identical imperative to develop a computational model on which linear / non-linear, static/ dynamic checkup is achieved. The main portion of these interval offerings an immediate of various limitations important the computational models, the basic assumptions and the geometry of the designated Structure considered for this study. Accurate modeling of the nonlinear properties of various structural elements is very important in nonlinear examination. In the present study, frame elements were modeled with inelastic flexural hinges using point plastic model. A detailed description on the nonlinear modeling of RC frames is presented. Infill walls are modeled as equivalent diagonal strut elements. The last part of the chapter deals with the computational model of the equivalent strut counting modeling nonlinearity.

B. Structure Description

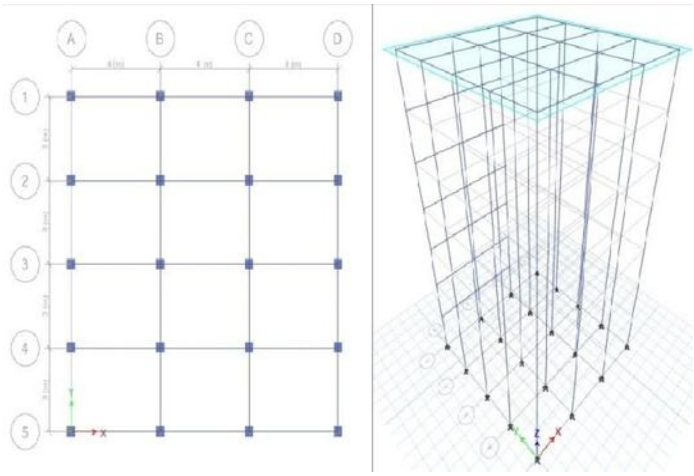
A framed Procedure located at Hyderabad India (Seismic Zone -II) is selected for the present-day study. The Structure is objectively symmetric in plan and in elevation.

- No. of Floors of Structure – G+6
- Slab Thickness – 150 m
- Each Floor Height – 3.0 m
- Total Height of the Structure – 18 m
- External Wall Thick – 230 mm
- Internal Thickness – 120 mm
- For Live Load – 3.5 kN/m
- Column Sizes – 400 x 400 mm
- Beam Sizes – 300 x 450 mm

The cross sections of the structural members (columns 300 mm×600 mm and beams 300 x 450 mm) are equal in all frames and all stories. Storey masses to 295 and 237 tons in the bottom stories and at the roof level, correspondingly. The design base shear was equal to 0.15 times the total weight.

RC MEMBERS Sizes:

- Column Sizes – 400 x 400 mm
- Beam Sizes – 300 x 450 mm



Plan View of G+ 6 Structures

For Calculation of Dead Load:

Self- weight- 1 kn/Sq.m Floor load -2 kN/Sq.m

External wall Thickness – 230mm

For Density of Brick Wall = 20 kN/ m^2

= 20 x 0.23 x 3

= -13.8 kN/m^3

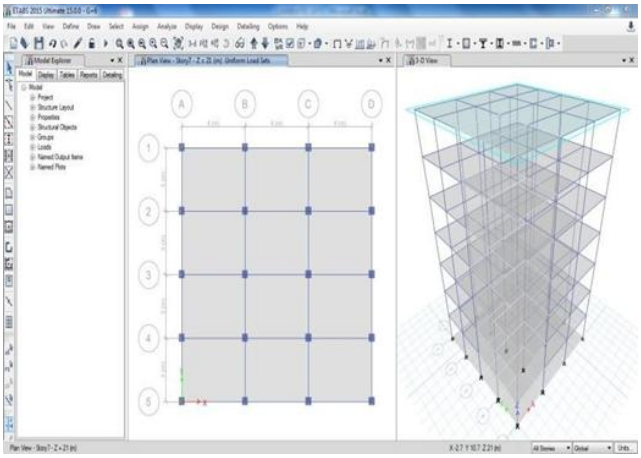
Internal wall Thickness – 120mm

For Density of Brick Wall = 20 kN/ m^2

= 20 x 0.12 x 3

= -7.2 kN/m^3

For Considering of Floor Load -1.8 kN/m^2 Live Load –3 kN/ m



3D Modeling of ETABS 2015

Dead Load (IS875-PART-1): A Structure has to perform many functions satisfactorily. Amongst these functions are the utility of the Structure for the intended use and occupancy. Structural safety, fire safety; and compliance-with hygienic. Sanitation, ventilation and daylight standards. The design of the Structure is dependent upon the minimum requirements prescribed for each of the above functions. The minimum requirements pertaining to the structural safety of Structures are being covered in this code by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, snow loads and other external loads, the structure would be required to bear. Strict conformity to loading standards recommended in this code, it is hoped. Will not only ensure the structural safety of the Structures which

are being designed and constructed in the country and thereby reduce the hazards to life and property caused by unsafe structures, but also eliminate the wastage caused by assuming unnecessarily heavy loadings. This Indian standard code of practice was first published in 1957 for the guidance of civil engineers, designers and architects associated with planning and design of Structures. It included the provisions for the basic design loads (dead loads, live loads, wind loads and seismic loads) to be assumed in the design of Structures. In its first revision in 1964, the wind pressure provisions were modified on the basis of studies of wind phenomenon and its effect on structures, undertaken by the special committee in consultation with the Indian Meteorological Department. In addition to this, new clauses on wind loads for butterfly type structures were included; wind pressure coefficients for sheeted roofs both curved and sloping, were modified; seismic load provisions were deleted (Separate code having 3 been prepared) and metric system of weights and measurements was adopted.

The increased adoptions of the code, a number of comments were received on provisions on live load values adopted for different occupancies. Simultaneously, live load surveys have been carried out in America and Canada to arrive at realistic live loads based on actual determination of loading (movable and immovable) in different occupancies. Keeping this in view and other developments in the field of wind engineering; the Sectional Committee responsible for the preparation of the standard has decided to prepare the second revision in the following five parts:

Part 1 Dead loads

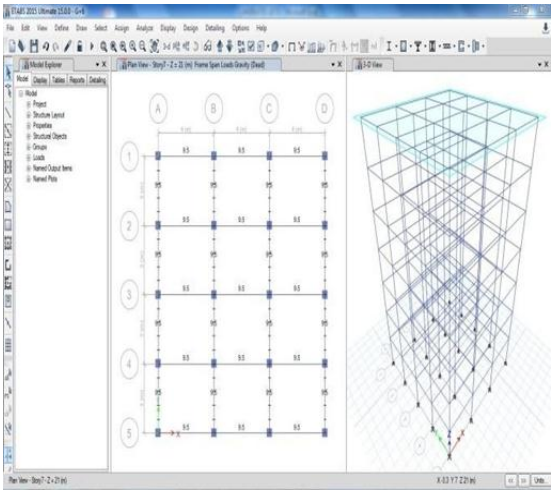
Part 2 Imposed loads

Part 3 Wind loads

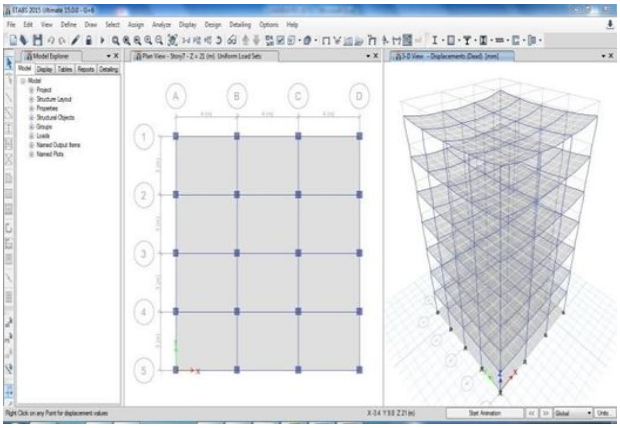
Part 4 Snow loads

Part 5 Special loads and loads combinations

Earthquake load is covered in a separate standard. Namely IS: 1893·1984· which should be considered along with the above loads. 0.4 This standard deals with dead loads to be assumed in the design of Structures and same is given in the- form of unit weight of constituents. The unit weights of other constituents that are likely to be stored in a Structure are also included for the persistence of load calculations due to stored constituents, 0.4.1 this 'standard incorporates IS: 1911t published in 1967. The unit weight of constituents incorporated in this standard are based on information available through published Indian standards and various other publications. 0.4.2 The values given in this standard have been rounded off in accordance with IS: 2-1960. "Criteria for earthquake resistant design of structures (Third revision). Schedule of unit weights of Structureconstituent's l fir SI revision). Rules for rounding off numerical values.



Dead Load on G+ 6 Structures



3D Modeling of G+ 6 RC Framed Structures.

V. CONCLUSIONS AND FUTURE SCOPE

A. Conclusions

- Usefulness of Additional frame technique was checked under wind forces.
- It was found that substitute frame method can be effectively applied for examination of frames under wind loads.
- Wind forces can be neglected while performing approximate examination by Substitute frame method if the Structure height is 14.7 m or less in

both working stress method as well as limit state method.

- In this proposition smooth borders controlled against sideway are analyzed using slope-deflection calculations. Steadiness calculations are reproduced at all rigid joint of the edge and also at the support.

- Few complications are unraveled to illustrate the procedure. The shear force and bending moment charts are pinched for the close edges.

B. Slope Deflection Examination (Sway Case)

- Design wind pressure for the region was assumed to be

  1.5 kN/m2

- Along with the vertical loads, the frame was assumed to be resisting the wind pressure for a length of 4m i.e. the spacing between the frames was assumed to be 4m.

- Rotation contribution factors were same as calculated in the vertical loading case.

- Restrained moments were calculated again.

Same steps were then followed as in case of vertical loading examination, repeating the cycles till the values of near end contributions converged.

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