International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June 2018 www.irjet.net p-ISSN: 2395-0072

ANALYSIS AND EVALUATION OF A COMMERCIAL & RESIDENTIAL BUILDING (G+5) BY USING STAAD.PRO

Dheekshith K[1], Suraj[2], Vijayakumar G Shet[3], Preejesh P P[4], Yarhok Myrphet[5]

[1]Assistant Professor Department of Civil Engineering, Srinivas School of Engineering, Mangaluru
[2,3,4,5] B.E. Students, Department of Civil Engineering, Srinivas School of Engineering, Mangaluru

---

ABSTRACT- It's very important for a structural engineer in the growing market of competent, save time to complete. This is an attempt done to analyze and design an office and house building by using Staad.Pro software package.

Analysis and devise of balanced commercial buildings, any commissions look at and see that the structure safe against all possible loading conditions.

The analysis was performed by means of Staad.Pro software packages. The Limit state method design in accordance with the determination of the SI was accepted: 456-2000 at a sufficient to make certain protection and utility of the designed construction. With its new features, Staad.Pro surpasses its predecessors and compotators with a capacity for the exchange of data with software such as AutoCAD.

1. INTRODUCTION

History of the building is characterized by several trends. One is to increase the resistance of the material used. Building construction is an olden day human practice. It started with the functional need for a controlled environment to resist the effects of climate. Building shelters were one means by which human (people) were able to adapt themselves to a wide variety of climates. Today, the construction of the building is a basic need, due to the scarcity of the country. A lot of time, there will be possibility of human error in the classic method of manual design of the building. Therefore, it is necessary to use certain software on the computer that delivers more accurate results and reduce the time. STAAD.Pro is the structural software today is accepted by the structural engineer that solves a typical static analysis of the wind, seismic analysis with various combinations of load to confirm various codes is 456:2000, IS 1893:2002, 875:1987 etc. There is strong demand for the construction of high-rise buildings due to the increasing urbanization, availability of less planar lands and population growth. Family residential buildings are called houses. Residential buildings in addition to housing are called (to distinguish it from house building) a duplex apartment. A condominium is an apartment that inhabitants admit rather than the charter. Homes can also in pairs (paired), terraces created, where all but two of the houses on the other and on the other were built.

Residential buildings have different names like cottage (cottage) or timeshare; according to their use, if they are only seasonal are called as a cabin or a large House; Value for example, a cottage or mansion; Mode of the building as a House of logs or mobile home; above the ground stilt or tree house, even if the residents need special care such as an orphanage in the nursing home or prison; or in the case of the group such as barracks or dorms.

2 SLAB LOAD ON BEAM

Beams are secondary carriers to support the slab load. Support beams can carry loads conveyed by slabs in the form of triangular or trapezoidal. To simplify structural analysis of beam loads, triangular and trapezoidal plate on the equivalent uniformly distributed loads are considered. Two factors are there in the code to change these corresponding to uniformly distributed loads run time bending and shear forces accepted.

These fees are triangular, trapezoidal model. These loads are appropriately uniform distributed entitled to convert as per the code. But the concentrated loads are not taken in to account while deciding the loads on the beam.

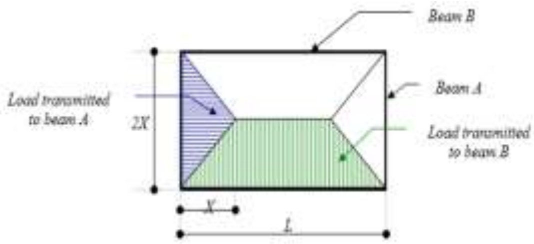

Fig. 2.1 Beam load calculation

For two way slab load on beam can be calculated as

Load on beam X-direction = (area of trapezoid * slab load)/L

Load on beam y direction = (area of triangle * slab load)/L

Where, Slab load = (density * thickness of slab) + LL + FF

For one way slab load on beam can be calculated as

Load on beam = (area of rectangular slab * slab load) / L

Where, Slab load = (density * thickness of slab) + LL + FF

3. WORKING WITH STAAD PRO

3.1 SORT OF LOADS

They are broadly sorted as ortho loads, plane loads and longitudinal loads. The ortho loads mainly comprises of intrinsic weight, extrinsic weight and resultant weight.

3.1.1 Intrinsic Weight (DL)

Intrinsic weights are abiding or stationary burden which are delivered to the constructed building passim its intended existence. Intrinsic weight or load is primarily because of own heaviness of formative members, steadfast segment of bulkhead or walls, permanent fastened accessories and weights of distinct substances.

Dead load calculations:

Dead load: IS 875 PART 1

3.1.2 Extrinsic Weight (LL)

Extrinsic weights are either mobile or in motion loads without any variation in speed or momentum in the structure. These are presumed to be generated by the deliberate use or subsistence of the building composing weights of mobile partition, human being or furnishings.

The floor plates have to be designed to convey indifferently sorted loads or intensive loads, LL give rise to greater stress in the compartment under considerations.

Live load calculations:

Live load: IS 875 PART 2

Live load on commercial building = 5 kN/m^2

Live load on residential building = 3 kN/m^2

3.2 STAAD.Pro pre attach

The creator commands with the STAAD analyzing tool through the STAAD input. That input text is a file composed of a succession of allowances which are accomplished respectively. The commands incorporate either directives or data appropriate to analysis and / or evaluation. The STAAD pre attach file can be originated through a file evaluator or the modeling techniques. In ordinary, any text evaluator may be employed to emend or to originate the STAAD pre attach file.

Fig. 3.1 STAAD.Pro Input

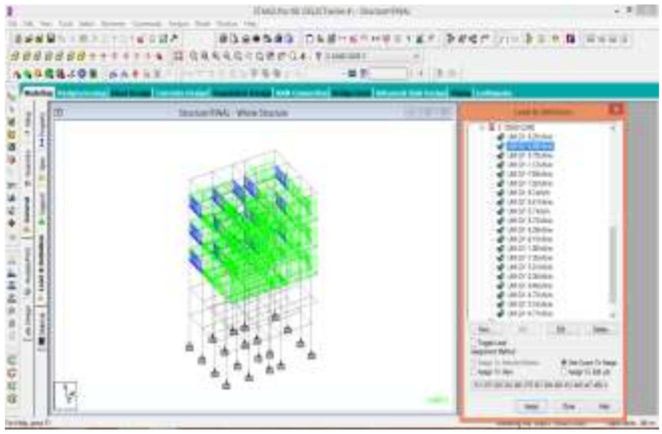

Fig. 3.2 Assigning load to the residential structure

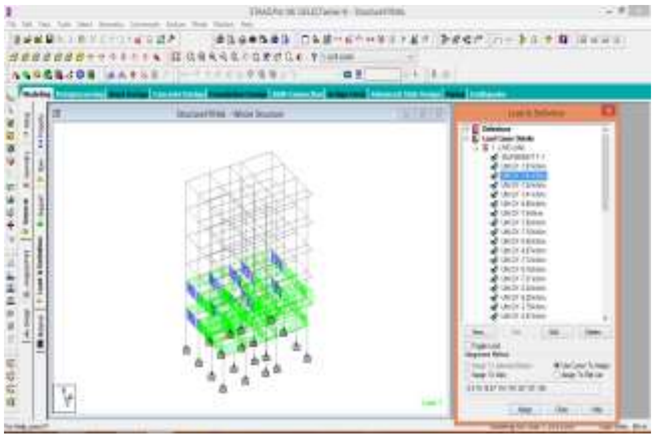

Fig. 3.3 Assigning load to the commercial structure

3.3 ORIGINATION OF THE STRUCTURE

The structure may be originated or created from the pre attach file or guiding the co-ordinates in the established input. The figure below exhibits the GUI origination method.

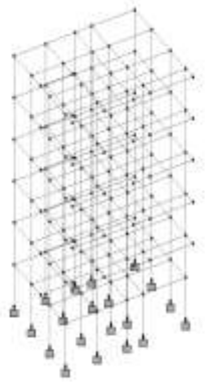

Fig. 3.4 Model developed in STAAD PRO

Fig. 3.5 3D Rendering from STAAD.Pro

3.4 ANALYSIS OF THE FRAME

A multi- storied frame consists of beams and columns whose degree of indeterminacy will be very high and known. The design of various members such as beams, columns trusses requires bending moment, shear force and direct thrust at all sections of the frame. The bending moment at all sections of beams or columns are obtained by analysis of the frames. Frames are analyzed for vertical forces and final moments are obtained by super imposing.

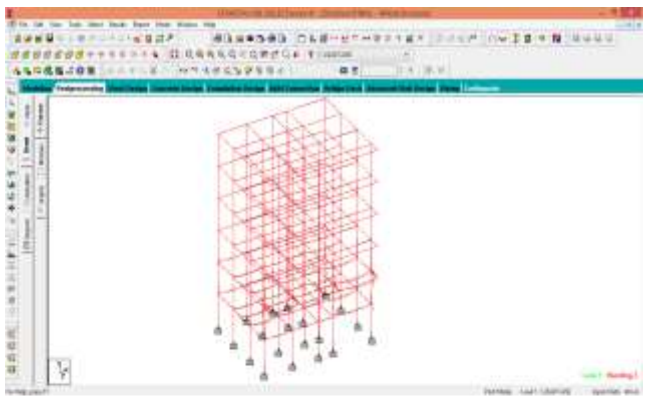

Fig.3.6 Deflection in the structure

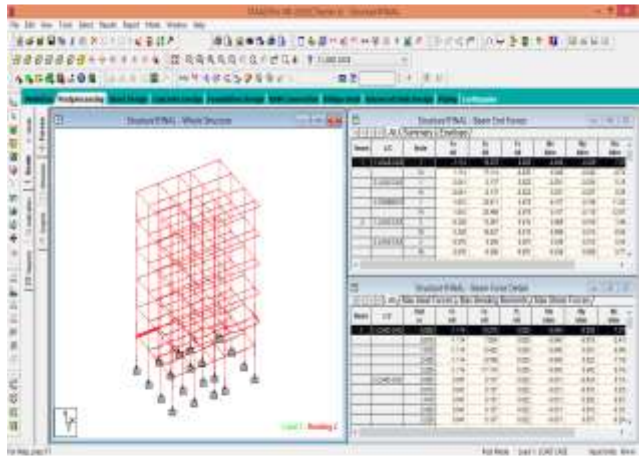

Fig. 3.7 Shear force in the structure

4 STRUCTURAL PLANNING

4.1 INTRODUCTION

After attaining the architectural manoeuvre of the building, framing task is undertaken. This includes determining the following:

(a) Positioning besides alignment of baluster

(b) Positioning the bars

(c) Traversing plates

(d) Designing stairs

(e) The selection of the right kind of jogging/ footing

The basic principle in determining the order of the members is that the loads to the foundation should be transferred along the shortest path.

4.1.1 POSITIONING AND ALIGNMENT OF COLUMNS

4.1.1.1 POSITIONING OF COLUMNS

The following are some guiding principles that will help when deciding over the column positions.

1. Column should preferably be on or close to the corners of the building and at the intersections of bar(beam)/walls.

2. As to support, usually supporting is the basic function of the columns to beams placed under the walls, their position is fixed automatically The commercial buildings will have normally rectangular shape of grid type but especially for residential buildings, the said type of pattern (shape) for columns may not be suitable or does not become possible.

3. Choose or opt the locus of the baluster or pillar to bring down the warping moments in bars when the rental placing of two pillars are in the vicinity, then one pillar instead of two a reduction beam moment should be done.

4. Under rare circumstances functional requirements cannot meet floor columns above the pillars at the Park level. Then, column on the parking deck to support the cam on the upper floors of columns is required. In such a case, the columns on the parking deck is spread or provided with a bracket to support the columns on the upper floors. However the pillar on the parking deck will undergo heavy point loads from the columns of the upper floor transfer. Avoiding larger spans of the beams is better.

5. If the Centre distance between intersections of the walls is large where there no. Cross, walls, restrictions shall be subject to the spacing between two columns spans hold up bars, because the extent of the pillars determines the length of the bar because the extent of the beam, which escalates the required depth of the bars, and its own weight in total and we invite beam augments.

6. In the case of the pillars, the augment in the throughout burden due to augment in length is inconsiderable, as extent to the column is least. Columns are, so usually always cheaper as differentiated to bars or beams on the basis of price. And hence, large spans of the bars (beams) preferably economic reasons should be avoided. In general the maximum span of beams having live loads up to 4 kN/m is limited. Avoiding the large center distance between the columns is better.

7. Greater distances of the pillars augments not only the range and cost for the bar or beams, but it increases the load on the pillars on each floor constitute problem of the squat pillars in the basement of a several-storey building. Loaded parts of the column initiative to misalignment of walls in addition to interfere with the soil surface.

PILLARS IN THE SITE BOUNDARY

The columns in property line need special treatment, because the column containing specific area further off the column requires, difficulties in the assignation of jogging, in such instance, the pillar can within a cross-wall space for placing the starting point within the site boundary along be moved. Brackets can be removed from the column in the continuation of the cross beams supporting walls along the border. Alternatively, a combined stand band support has to be provided.

4.1.1.2 DIRECTION OF COLUMNS

1. Requirements for the physical appearance and use projections of the pillars exteriorly the wall in the room should be repudiated, because they give not only inferior appearance, but hamper the use of space, and problems associated with the placement of furniture to flush with the wall.

2. Often to avoid the offset provide depth of the pillar in the broadside of the wall. The problem of the projection of the column commonly develops in the interior walls, because they are usually thinner sections. To get more spacing 150mm thick walls can also be provided. This need was also a problem for the exterior walls, to prevent the width of the wall, at least 230 mm that the column to be thin.

3. Use L-shaped columns in the corners or t-shaped corners at the intersection of the dividing walls across. Alternatively, the column gap must be brought down so that the burden on the pillar on every floor is low and the need for a bulk part of the column is not created.

4. Align the pillar so that the depth of the pillar is included in the prime plane of warping. The principles governing orientation or aligning of columns given below can be easily understood.

5. If a column is fixed on the joists at square corner, it is subject to moments in incorporated load. In this case must be set the column that the depth of the pillar is at right angles to the main center line of bending obtaining the greatest moment of inertia and thus a greater ability to resist and that even L/D ratio decreases, increased the load conveying efficiency of the pillar.

6. Depth of the bend in the plan not only on the carrying capacity of time to raise, but also increases its rigidity, allowing more time for the column at the junction of the beam is transmitted to column.

Nonetheless, if the variation is not important in the warping moment in two right angle directions, that the depth of the pillar strongly enough in relation to the great moment. Avoid the offsets in the rooms.

4.1.2 POSITIONING OF THE BARS OR BEAMS

Here are some of the guiding principles for the positioning of the bars.

1. Bar or beams, must normally offered under the walls to withstand future loads directly onto plates or slabs.

2. Beams or bars are predominantly furnished to support plates; its spacing shall be stated based on the maximal length of plate. The maximal cubic measure of the concrete slab is required to convey the given burden. In that case; the thickness of which must be kept at least minimum of 150mm. The 3DAnalysis of a multi-floored building residential or office or public building is done by considering maximum practical thickness of 200mm.

3. Avoid the maximum distance of the carrier of the deviation and cracking of the criteria.

4. It is known that the deviation is directly with the third power of the range and vice versa with the cube depth varies so L3/D3. Therefore the larger ones can be avoided.

5. However for larger length, normally the greater L/D ratio is handled to limit the depth from deliberations of headroom,

physical and psychological aftermath. Therefore, spans of beams which need greater than one meter depth beam should be avoided.

4.1.3 SPANNING OF PLATES OR SLABS

• If the rectangular plate or column with the four edges supported, it acts as a disposable plate (LY/lx) if > 2 and two - way (L_Y/L_X) < 2 plates. But not only the aspect ratio (LY/lx), but it also depends on the two - way action of the top ratio of reinforcement in both directions.

• A plate with (L_Y/L_X) > 2 serves as a one-way, because in this case a possibility action prevails. In one-way streets plate hand steel is along the short period of time only and load onto two opposing parentheses only. The steel along the long range only act as a distributor of steel and does not serve to transfer the load target to distribute the load.

• A two - way plate with aspect ratio (L_Y/L_X) < 2 General economic one-way slab in comparison, because steel long both spans acts have hand steel and transfer the burden on all its corner brackets.

• Two - way operation is favorable for immense-span and primarily for loads vast than 3 kN/m^2. For least and light loads, steel reinforcement needed for two - way plate 3D analysis and design of a multi building differs not noticeably when liken to steel for one way plate due to the requirement of the minimal steel quantity.

4.1.4 LAYOUT OF THE STAIRS

The building code (IRC, R311. 7 stairs) layout is strictly via stairs and includes the minimum tread depth (10-inch), the maximum height of the step (7 3/4 inches in the IRC, but that can vary depending on the State), the maximum deviation (typically 3/16 inch) between the riser heights has stairs and much longer. Impact occupant protection responsible for probably more than any other design element carpenters has stairs.

If stairs are rotated 90 °, with a landing is desirable and safer than winding three steps (winders). Landing is treated as a normal step with a larger running surface. Landing of older down to the floor below can be supported, and it should be at least as wide and as long as the width of the stairs. If the stairs should be turned "U" pattern, the landing must be at least twice to accommodate the width of the staircase to the second group of Stringer, run down. Those cheeks are bound in the framework of landing in the same way, as if they came from the normal ground. The same rise and tread width all the way down is necessary.

4.1.5 SELECTING THE RIGHT KIND OF JOGGING OR FOOTING

Basis of the part of the structure, the stresses on the structure and the weight of the structure is transmitted securely on the floor/ground.

Review of the first in the design of the Foundation is the art of building and the number of floors, which will be built. The Foundation manages all along the load-bearing walls in all types of structures. For low height cushions with beam quality, manufactured insulating soles RCC structures that used the most common type of Foundation by RCC (reinforced concrete).

But with the increase in the number of levels or floors in the structure, the load on the foundation system increases performed and therefore the area of the foundation must be increased. After the appropriate load calculation is done, the kind of foundation system for the building (superstructure) is decided. In multi-storey buildings, the loads are concentrated, in this kind of use of the structures of the pads at the time of the request, and pile foundations are common.

5 FOOT DESIGN

5.1 INTRODUCTION

Foundations with reinforced concrete or soles transfer the loads from substructure to the soil. The characteristics of the foundation are based on the sort of the loading, the merits of the jogging and the specifications of the soil.

Design of a foot has typically the following courses of action:

1. Establish the requirements for general equality, including loading and the type of support structure.

2. Choose options for the foot and determine the necessary soil parameters. This step is often complemented by consultation with a geotechnical engineers.

3. The geometry of the foundation has been chosen so that minimum requirements are met on the basis of the soil parameters.

Here are the typical requirements:

• The determined bearing pressures should be less than the allowable bearing pressures. Bearing pressures are the pressures that are exerted on the supporting soil by the footings. Bearing pressures are measured in unit terms of force per unit area, like pounds per square foot.

• The determined settlement of the footing, due to applied loads, should be lower than the allowable settlement.

• The sole must have sufficient capacity to resist drag caused by horizontal loads.

- The base must be stable enough to withstand the loads of the reversal. Reversing the charges often arise due to horizontal loads above the base of the Foundation.
- Local conditions.
- Building code requirements.

4. Design of the sole is completed, including the selection and spacing of reinforcement after ACI 318 and all applicable building codes are considered. In this step the previously selected geometry must be revised requirements for the strength of the reinforced concrete to accommodate sections.

5.2 Allowable stress and strength design

Traditionally the geometry of a footing or a pile cap is selected considering unfactored loads. The structural design of the foundation is then completed using the strength according to ACI 318.

ACI Committee 336 is in the process of developing a methodology for completing the entire base design with the strength design method.

5.3 Structural Design

The following steps are followed generally, for the completion of the construction of foundations or pile head, based on ACI 318-05:

1 Determined jogging plan size by comparing the gross floor under pressure and the maximum pressure.

2 Apply the load factor in accordance with the ACI 318-05.

3 Determine whether jogging or pile cap than spanned one or two possibilities are taken into account.

4 Confirm the thickness of jogging by the comparison of shear capacity of the concrete section into account shear stress as per ACI 318-05.

5 Determine to strengthen the bar or beam requirements for the specific section based on the flexural strength capacity together with the following requirements in ACI 318-05.

- Specific requirements for jogging
- Temperature and shrink, the strengthening of the requirements
- Bar spacing requirements
- Requirements development and splicing
- Earthquake security regulations
- Other standards of design and construction

6. COLUMNS CONSTRUCTION

6.1 INTRODUCTION

The pillars are structural constituents to prop the development, shifting of the ortho loads of structure above the ground to headstock and lateral loads on the bridge through seismic and various service fees to resist.

6.2 COLUMN TYPES

The columns are of two measurable factors classified based on: external appearance and size:

- Segment of the columns are usually spherical, shaped like rectangle, denoting like unfilled, structured like octagonal or pertaining to hexagon.
- Pillars can be tiny or high. The pillar is tiny or great after its influential slenderness (KLu/R).

Where: K = influential length factor

No support for a compression = length

Members

R = radius of rotation

6.3DESIGN SHOP

1. The well-thought-out design of the fees is set:
2. Intrinsic load (DL)
3. Extrinsic load (LL)
4. Wind load (WL)
5. Cracking force (BR)
6. Heat effects (HE)
7. Preload, shorten effects (PSh)
8. Pretension effects (PE)

6.4. DESIGN of PILLAR

The pillars are devised for the ministration; the strength and outmost limit States. Extreme event that do will restrict state corresponds to the current earthquake assessment. Pillars should be devised as pliable members to warp in-elastically for divers vertex without vital reduction of capability or sensibility under the devise seismic condition. The States in the form of columns above are set boundaries that limit three States:

- Limit state of resistance

- Limit state of the service
- Extreme limit State

The pillars are bending, planar loads and instant load with respect to span subjected to shearing in longitudinal and transverse directions.

6.4.1 limit States

As already mentioned, the columns for three Border States are designed:

- Limit state of resistance
- Limit state of the service
- Extreme limit State

6.4.2 Forces

The pillars are bending, axial loads and force with respect to distance subjected to shearing in longitudinal and transverse directions.

6.5 APPROXIMATE EVALUATIONS OF SLENDERNESS EFFECTS

The slinkiness of any compression element is depending on the ratio of KLu/r while the influential length factor, K, is to recompense for rotational and indeterminate confine conditions other than fastened ends.

Slenderness effect is disregarded if: KLu/r is less than 22.0

(Members not braced against the sides way)

KLu/r < 34-12 (M1 / M2)

(Elements braced inversely sideway)

Where:

M1 = tiny end moment

M2 = vast end moment

Lu = unsupported span of a compression element

r = radius of gyration

Note: If KLu /r are greater than 100, pillars may undergo considerable lateral inclination or deflection.

7 BEAM DESIGN

7.1 INTRODUCTION

RCC beam formative elements are devised to convey transverse external burden that cause warping moment, shearing forces, and in some occurrence twist across their span. Therefore the concrete beams are reinforced with steel rods on the tensile side in cross section when experiencing warping.

7.2 The detailing of beams is customarily related with:

(i) Size and ranging of bars,

(ii) Warping of bars,

(iii) Development span of bars,

(iv) Clear coat to the total

(v) Chair and interval or spacer bars.

Anchor of steel bars is usually supplied in the sort of curves and clasp. Bars of steel twisted or distorted steel bars do not have clasp. The rate of the bend of the anchoring bar is considered the 4 times the diameter of the rod for each 45^0 bend associated with highest of 16 times the diameter of bar. Double bars, on the other hand to increase the span of the bars. Span for the bars in various concrete mixes is shown in tables 4.2 to 4.4 of SP 34.

The value of k varies according to the type of steel used is specified below:

Table 7.1 K-value for different types of steel

SL No.	Steel grade	Minimum rate of K
1	Construction steel bars	2.0
2	Cold steel bars	4.0

7.3 The beams are sorted as:

(i) Corresponds to shape: Denoting like rectangle, Shaped like T, Shaped like L, spherical etc.

(ii) Corresponds to holdup conditions: Simply supported, zippered, constants and protrude beams

(iii) Corresponds to reinforcement: Solely reinforced and doubly reinforced

Depth of the bars is calculated on the warping capability and the criteria of the bars. Usually is the ratio between the duration of depth ratio remains as long as 10 to 15 and the depth, width of the rectangular ratio in the series of 1.5 to 2.0.

Minimal edge distance or cover in beams must be 25 mm or shall not be smaller than the greater diameter of bar for every steel reinforcement incorporating joints. formal range specified in table 16 and 16 IS456-2000 should be employed to meet sustainability principle.

Beams usually escort the following steel reinforcement specifications:

(i) Strengthening longitudinally on the face of push and pull (min. two bars with a diameter of 12 mm is indispensable to be provided in traction zone) in one or more queues are available.

(ii) Reinforcement in the sort of ortho calipers and or curved upwards the longitudinal bars are made available. (The bar to the frame of the traction folded and taken in the area of the compression of a RCC bar is generally known as stirrups.)

(iii) Strengthening the front side in the web of the beam is formed when the depth of the Web into a beam augments 750 mm

8 PANELS OR SLAB DESIGN

8.1 INTRODUCTION

A concrete panel or slab is a familiar and important formative element of modern-day buildings. Planar or horizontal panels or slabs made of reinforced concrete, usually in the range 4.0 and 20.0 inches (100 to 500 mm) thick, more frequently used, to construct floors; while the thinner plates are also used for outdoor paving and finishing. Sometimes these thin sheets of 2-inch (51 mm) are up to 6.0 inches (150 mm) thick, known as mud panels, especially when it is made beneath the plates on the ground floor or in the crawlspaces.

For more than one storey buildings, suspended slabs are commonly used.

8.1.1 Followings are the guidelines of the design of the RCC slab and dressing:

Design of reinforced concrete slab instructions

(a) The span width of the plate:

Effective span of the plate will be less than either:

L = span + d (depth)

L = Centre to centre extent among two supports

(b) Slab or plate depth:

The depth of the plate is contingent on the warping moment criterion and deformation; the depth can be secured from

- Effective or influential depth d= Total Span /($(L/d)_{Basic}$ * modification factor)
- The effective or influential depth d of two way plate or slabs can also be deduced considering Cl.24.1, IS 456.

Table 8.1 (L/d of$_{base}$) values for various media and steel grade

Media type	Fe250 grade	Fe415 grade
Flexible	L/35	L/28
Ongoing	L/40	L/32

Otherwise, the following rules of thumb can be used:

One way slab d= (L/22) to (L/28)

Two way simply supported slab d= (L/20) to (L/30)

Two way restrained slab d= (L/30) to (L/32)

(c)Burden on plate:

The burden onto the plate consists of extrinsic weight, intrinsic weight and imposed force. The weights on plates are calculated per unit amplitude (weight/m^2).

Intrinsic load = D x Density (Where D is thickness of plate)

Extrinsic load (assuming that) = 3.5 to 5 kN/m^2 (depending on the sort of the building)

8.2 Catalog Requirements of RC Plate or slab as per IS456: 2000

a) Least Cover:

For low subjection condition - 20 mm

For an exhibition in limited condition - 30 mm

b) Minimum reinforcement:

The reinforcement in both the direction in slab must not be less than

0.15% of the overall transverse for steel Fe-250 grade
0.12% of the overall sectional unit of the steel Fe-415 grade & Fe-500 grade.

c) Distance of the bars:

Do not exceed the maximal distance of the bar

- Main – 3 times the d or 300mm (adopt smaller)
- Distribution –5 times the d or 450 mm (adopt smaller)

Where, 'd' is the effective or influential depth of plate or slab.

d) Maximum diameter of bar:

The maximal diameter of bar in slab or plate, shall not augment D/8,

Where D is the t thickness of plate or slab.

8.3DESIGN METHOD

The process of the design of the one-way plate or slab is considered as one meter-wide in the shortest direction. The different stages of the design are:

We participate in depth supported bending - and steel.

Step 1

Accepting a total thickness measured for the table, calculate the weighted loads (DL & LL) for the design. This estimate of the thickness of the plate or slab the empirical relationships between depth can be done and to extend. The minimum depth for simple construction is 100mm. A cover has to be attached according to the conditions of exposure.

Step 2

Considering the slab as beam of one meter width and using effective span, determining the maximum bending moments M for the ultimate factored load. For continuous plate or slabs, coefficient of plate below (is 456:2000 Table 7) may be used for this purpose. Otherwise any elastic analysis may be used in latter case redistribution of moment is also allowed.

Step 3

From the formula $Mu=K*f_{ck*}bd^2$ and b=1000mm, find the effective depth required as in beams. Add cover and find the total depth of slabs or plates from strength consideration. Check the depth with the width assumed in step 1 generally. The depth from step 1 will be more than the got from the strength formula.

Step 4

Check the depth used for shear. As the actual percentage of steel provided at support is not known, the check is only approximate, may not be correct.

Step 5

As the overall depth is usually greater than the minimum depth d, the tension steel required will be less than balanced amount for the section. Determine the steel quantity required by a suitable formula or use of SP 16 chart and tables for the determination of same.

9 STAIR DESIGN

9.1 INTRODUCTION

Staircase is a foremost compartment of building approaches to several floors and the roof of the building. It comprises of a stairs and plates between landings and between floors. Different types of stairs are possible through the arrangement of the stairs and landing. Staircase is an element of structural framework with a number of stairs.

Architectural considerations with aesthetic, functional and structural feasibility are important aspects to choose a certain kind of staircase for the proposed building. Other factors, affect the selection, illumination, air circulation, complacency, entry, room direction.

The different nomenclatures used in the stair are as specified beneath:

(a) Tread: The horizontal top portion of a step where foot rests is known as tread. The dimension ranges from 270 mm for residential buildings and 300 mm for public buildings and factories, where large number of people uses the staircase.

(b) Nosing: In some instance the tread is projected exterior to increase the clearance; this projection is termed as nosing.

(c) Riser: The ortho interval between two serried steps is called the raiser. In measurement it differs from 150 mm to 190 mm for public and homes buildings respectively.

(d) Waist: The extent or thickness of the plate size, over which the steps are assembled, is recognized as the waist.

(e) Going: Going is the planar projection among the first and the last slope of angled staircase.

9.2 General information

Here are some general guidelines when planning a staircase:

• Appropriate dimensions of the thread and the lifts or raiser for all the parallel steps should be identical in consecutive floor of a building.

• The minimum vertical height of above each phase should be 2 m.

• As a general rule, the number of slopes in a flight should be limited to twelve.

• Minimum width of stairs must be 850 mm, but it is desirable that width between 1.1 and 1.6 m. it should be the large width of the stairs in a public building, cinema etc.

9.3 construction systems

(A) Stair slab spanning longitudinally

Here, one or more supports are provided parallel to the riser for the plate in bending longitudinal direction.

In the case of two flight stair, sometimes the flight is supported between the landings which spans in transverse direction. It is worth noting that some of the above-mentioned structural systems are statically determined while others statically indeterminate, where the conditions of deformation are taken into account in the analysis. Elongated plate of the staircase is possible also with other configurations, including single flight, open-well helicoidal and free-standing staircases.

(B) Stair plate spanning in transverse direction

Here, either the waist plate or the plate components of isolated tread-slab and trade-riser units are supported on their sides or cantilevers along the width direction from a central beam. The plates will then bend in a transverse vertical plane.

9.3.1 Here are the distinct modalities:

(i) Plate holdup between two stringer bar or bulk head

(ii) Cantilever plate or slabs from a beam or wall

(iii) Double cantilever plates to a central beam

9.4 Effective length of the stairs

The provisions of section 33 456 are ready for reference below, the issue of determining the effective length of the stairs. To distinguish two cases are given to the effective scope of the beam determine stair hors Stringer.

(i) The plane interval from C to C (Center) of the bars should be reviewed as the actual distance when the plate responsible, up and down riser bars for the aligned with the risers.

Table 9.1 Influential range

SI. No.	Y	Z	Influential range in meters
1	< 1 m	< 1 m	G + Y+ Z
2	< 1 m	≥ 1 m	G + Y + 1
3	≥ 1 m	< 1 m	G + Z + 1
4	≥ 1 m	≥ 1 m	G + 1 + 1

Note: G = going

9.5 structure resolution

Most of the formative arrangements of stair traversing in longitudinal or transverse direction are traditional problems of formative resolution or evaluation, either inertly stipulated or unstipulated. Therefore, they can be transverse by the customs of transverse for a distinct arrangement. Rigorous analysis is nonetheless difficult and for some kind of commercial belt or a free-erected staircase, where the plate is folded frequently. This sort of staircase has attracted a significant charm by its corporal appearance.

CONCLUSIONS

Analysis and evaluation of the entire structure with Staad.Pro will shorten the time.

Details of the construction of all members (such as footing column, beam, plate and stairs) can be easily reached and identified.

All kinds of errors in the structural elements can be identified and are given the best section with software.

The project is improved by modern technology and the delay in starting construction work is eliminated.

An attempt was made to understand the analysis and design of commercial and residential building. A thorough knowledge of analysis and design of commercial buildings can be obtainable in the tool called STAADPro.

Among the various branches of civil engineering construction engineering counts more importance also consists mainly of a series of procedures on the ground, ground investigation includes planning, analysis, and evaluation.

Analysis and evaluation of the building are not only the most important criteria. Moreover, the construction costs have to be reduced. For this purpose, the proper method of analysis and evaluation are very important.

REFERENCES

1. D S PrakashRao, "Design Principles & Detailing of Concrete Structures"
2. S.S. Bhavikatti - "Design of the RCC structure elements." New Age International Publishers, vol. 1 2009.
3. N. Krishna Raju - "Advanced Reinforced Concrete Design", CBS Publisher and Distributor, Delhi, 3rd Edition, 2003.
4. "STAAD Pro V8i - Technical reference guide.
5. Prof. H. R. Surya Prakash, S. Krishna Murthy. "Basic Principles of Analysis and Design of an RCC Framed Structures"
6. IS 456:2000, "Plain and Reinforced Concrete", Bureau of Indian standards, New Delhi, 4th revision, 2005.
7. SP 16(Design Aids for Reinforced Concrete Structures, IS 456 1978, Bureau of Indian Standards, New Delhi 1980.)
8. IS 875 (part i & ii), Office of Indian standards. Manak Bhavan, New Delhi, second revision, 1987.