International Journal of Engineering Research & Management Technology ISSN: 2348-4039

March- 2015 Volume 2, Issue-2

Email: editor@ijermt.org www.ijermt.org

Design and Cost Estimation of a Proposed Building

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ABSTRACT

Our Project is design and estimation of proposed building. So in this project we have considered limit state method of design because limit state method is based on flexure, compression, shear, torsion and all these factors depend on the imaginary behavior of structure at the time of collapse. Limit state method is also based on probabilistic approach while in working state method it is based on actual behavior of structure at service time. In LSM we take more factor of safety with compare to wsm. For estimation purpose we have used centre line method for calculation because this method is suitable for walls of similar cross sections. Here the total centre line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with main wall, the centre line length gets reduced by half of breadth for each junction. Such junction or joints are studied carefully while calculating total centre line length. The estimates prepared by this method are most accurate and quick.

INTRODUCTION

As a part of civil engineering, we all are aware of the importance and role of structural design in construction of any type of structure. For a structure to be resistive and durable against all the type of forces acting on it by the nature, it is very important to design all the members of that structure i.e. beams, columns, slabs, walls, footings, so that it can bear both live load and dead load. This is not only where the work of an engineer stops. He also has to keep in mind that whatever he is constructing is economical. For all engineering work, it is required to know beforehand the probable cost of construction known as the estimated cost. If the estimated cost is greater than the money available, then attempts are made to reduce the cost by reducing the work or by reducing the specifications. From this the importance of estimate for the engineers may be understood. In preparing an estimate, the quantities of different items of work are calculated by simple measurement method and from these quantities, the cost is calculated. The calculations mainly consists of, length x breadth x height or length x breadth or length x height. In preparing an estimate, one has to go into details of each item, big or small; nothing can be left or missed. Coming onto designing, the method used today is Limit State Method of Design. The inadequacies of the elastic and ultimate load methods of design paved the way for the limit state method of design with a semi-probabilistic approach. Limit state design is a method of designing structures based on a statistical concept of safety and the associated statistical probability of failure. Structures designed should satisfy the dual criterion of Safety and Serviceability. Safety may be defined as an acceptable degree of security against complete collapse or failure, which in concrete structures can occur by various modes such as compression, tension, shear, flexure, torsion, fatigue or their combinations. Serviceability requirement means that the member or structure should not in its intended lifetime deteriorate to such an extent it fails to fulfill its function for which it is designed. In concrete structures, this state may be reached due to excessive deflection, cracking, vibration, corrosion of reinforcement, etc. Limit state design philosophy uses the concept of probability and is based on the application of the method of statistics.

DESCRIPTION OF PLAN

For proposed plan we have 4 rooms, 1 bathroom, 1 verandah with dimensions of:

PLAN = (11.05 × 5.46)m
TOTAL AREA = 60.33m^2
AE ROOM = (2.7 × 5.0)m
JE ROOM = (2.4 × 5.0)m
SDC ROOM = (2.4 × 5.0)m
LABOUR STORE ROOM = (2.4 × 5.0)m
BATHROOM = (1.2 × 1.5)m

VERANDAH = (5.46 × 1.73)m
There are 5 doors are available in the proposed plan having dimensions:
AE ROOM door = (1.1 × 2.1)m
JE ,SDC , LABOUR STORE ROOM door = (0.9 × 2.1)m
BATHROOM door = (0.8× 2.1)m
6 windows of size : (1.0 × 1.05)m
1 ventilator: (0.60 × 0.75)m
Thickness of wall = 230mm
Height of building = 3m

Limit state of method of design
There are two main limit states

- Limit state of collapse
- Limit state of serviceability

Limit states are the acceptable limits for the safety and serviceability requirements of the structure before failure occurs. The design of structures by this method will thus ensure that they will not reach limit states and will not become unfit for the use for which they are intended. It is worth mentioning that structures will not just fail or collapse by violating (exceeding) the limit states. Failure, therefore, implies that clearly defined limit states of structural usefulness has been exceeded.
Limit state of collapse was found / detailed in several countries in continent fifty years ago. In 1960 Soviet Code recognized three limit states: (i) deformation, (ii) cracking and (iii) collapse.
There are two main limit states

1. Limit state of collapse
2. Limit state of serviceability

i) Limit state of collapse deals with the strength and stability of structures subjected to the maximum design loads out of the possible combinations of several types of loads. Therefore, this limit state ensures that neither any part nor the whole structure should collapse or become unstable under any combination of expected overloads.
(ii) Limit state of serviceability deals with deflection and cracking of structures under service loads, durability under working environment during their anticipated exposure conditions during service, stability of structures as a whole, fire resistance etc.

For the design of proposed building we design the slab , footing ,etc .We apply the limit state method in the design of slabs
SLAB
Slabs design basically divided in to two types :-

1) One Way Slab
2) Two Way Slab.

ONE WAY SLAB

One way slab is supported on two opposite side only thus structural action is only at one direction. Total load is carried in the direction perpendicular to the supporting beam. If a slab is supported on all the four sides but the ratio of longer span (l) to shorten span (b) is greater than 2, then the slab will be considered as one way slab.

Because due to the huge difference in lengths, load is not transferred to the shorter beams. Main reinforcement is provided in only one direction for one way slabs.

Two Way Slab

Two way slabs are the slabs that are supported on four sides and the ratio of longer span (l) to shorter span (b) is less than 2. In two way slabs, load will be carried in both the directions. So, main reinforcement is provided in both directions for two way slabs. Main reinforcement is provided in both the direction for two way slabs.

1. Slab of AE ROOM is designed as two way slab
   Thickness of slab = 125mm
   Main Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c
2. Slab of JE ROOM is designed as two way slab
   Thickness of slab = 125mm
   Main Reinforcement = 4 bars of 8mm Φ bar @ 300mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c
3. Slab of SDC ROOM is designed as two way slab
   Thickness of slab = 125mm
   Main Reinforcement = 4 bars of 8mm Φ bar @ 300mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c
4. Slab of LABOUR STORE ROOM is designed as two way slab
   Thickness of slab = 125mm
   Main Reinforcement = 4 bars of 8mm Φ bar @ 300mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c
5. Slab of BATHROOM is designed as two way slab
   Thickness of slab = 100mm
   Main Reinforcement = 4 bars of 8mm Φ bar @ 300mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 450mm c/c
6. Slab of VERANDAH is designed as ONE way slab
   Thickness of slab = 125mm
   Main Reinforcement = 8 bars of 10mm Φ bar @ 130mm c/c
   Distribution Reinforcement = 3 bars of 8mm Φ bar @ 330mm c/c

FOUNDATION

Different structural elements viz. beams, slabs, staircases and columns, which are placed above the ground level and are known as superstructure. The superstructure is placed on the top of the foundation structure, designated as substructure as they are placed below the ground level. The elements of the superstructure transfer the loads and moments to its adjacent element below it and finally all loads and moments come to the foundation structure, which in turn, transfers them to the underlying soil or rock. Thus, the foundation structure effectively supports the superstructure. However, all types of soil get compressed significantly and cause the structure to settle. Accordingly, the major requirements of the design of foundation structures are the two as given below:

1. Foundation structures should be able to sustain the applied loads, moments, forces and induced reactions without exceeding the safe bearing capacity of the soil.

2. The settlement of the structure should be as uniform as possible and it should be within the tolerable limits. It is well known from the structural analysis that differential settlement of supports causes additional moments in statically indeterminate structures. Therefore, avoiding the differential settlement is considered as more important than maintaining uniform overall settlement of the structure.

Types of Foundation Structures

Foundations are mainly of two types:

(i) shallow

(ii) Deep foundations.

In this we design step masonry footing which have dimensions as:

Depth of PCC = 100mm
Depth of 3rd footing = 300mm
Depth of 2nd footing = 300mm
Depth of 1st footing = 300mm
Depth of plinth below GL =500 mm
Width of PCC = 890mm
Width of 3rd footing = 680mm
Width of 2nd footing = 570mm
Width of 1st footing = 460mm
Width of plinth below GL = 350mm

ESTIMATION AND COSTING

An estimate can be defined as the procedure or method of working out the probable cost of a work. An estimate is prepared by working out the quantities and then calculating the cost suitable rates. Before the construction work of any structure is started, calculation, of quantities of various items of work and its probable cost is done. This is known as estimating. Before starting any civil engineering works or project it is necessary to know its approximate cost by calculating quantity of various items and multiplying it by unit rates of materials. As far as quantity calculation part of estimating is concerned is done by studying and analysis of drawing and specification. Estimate of a work is governed by quantity and quality aspect. Quantity is related with drawings and quality is related with specification for materials and workmanship. Costing is defined as the determination of actual cost of the before the execution of it. To know the cost of work detail estimate is prepared and measurement sheet and the probable cost of various items entered in the abstract form.

Valuation is defined as the procedure of finding out the value or fair price of a property, such as building, land, a factory, any machine, etc. By valuation present value of property is determined which may depend upon the life of property, maintenance, location, legal control.

Purpose of Estimating and Costing:

Before taking up any project for execution the owner should know the total cost of the work, so that financial arrangements can be made well in advance.

From estimate the quantities of various materials required may be worked and necessary arrangements for the same can be made. The estimate also gives rough idea of the time required for completion of work.

The number and kind of workers of different categories required to complete the work in the specified time can be found out. An estimate is immensely useful in planning and execution of any work.

1. To know the approximate cost of work.
2. To know the approximate quantity of various materials and labors required.
3. for technical sanction of the project.
4. for inviting tenders and to arrange contract.
5. To have an idea about the time of completion of project.

Method used for estimation work of this proposed building is centre line method. This method is suitable for walls of similar cross sections. Here the total centre line length is multiplied by breadth and depth of respective item to get the total quantity at a time. When cross walls or partitions or verandah walls join with main wall, the centre line length gets reduced by half of breadth for each junction. Such junction or joints are studied carefully while calculating total centre line length. The estimates prepared by this method are most accurate and quick. This method only requires one time calculation of boundary and then all other work can simply be calculated by keeping this parameter measurement unit as constant which in term is time reducing and calculation reducing method. Main items of work are given below in case of buildings, roads, etc.

1. Earthwork: Earthwork in excavation and in filling should be taken out separately under different types. Foundation trenches are usually dug to the exact width of foundation with vertical sides. Quantity of earthwork is calculated by taking dimensions length, width and height. Earthwork is measured in cubic meter.
Earth work quantity here in this project was estimated about 71.235cum @ Rs. 157.5/cum. Cost of excavation was calculated to be Rs. 11219.5 only.
Quantity of refilling of excavated earth was estimated to be 38.41cum @Rs. 112.4/cum. Cost of refilling is calculated to be Rs. 4317.28 only.

2. Bed concrete in foundation: It is calculated by taking length, breadth and thickness of concrete bed; measured in cubic meter.
PCC under 1st footing was estimated to be 4.274cum @ Rs. 4004/cum. Cost of PCC was hence calculated to be Rs. 11113 only.

3. D.P. C. (Damp proof course): It is a course provided at the plinth level under the wall for the full width of plinth wall. It is not provided at the sill of door and verandah openings for which deduction is made which calculating length of D.P.C. it is measured in square meter and expressed with specified thickness. In general 2.5 cm thick cement concrete (1:1:3) with water proofing materials is used as O.P.C.
DPC work estimated in this project was 16.62m^2 @ Rs. 257.8/m^2. Cost of DPC calculated was Rs. 4,284.40 only.

4. Masonry: Masonry for foundation and plinth is taken under one item and masonry for super structure is taken under separate item. It is computed in cubic meter by taking length, breadth and height. In case of wall footing, masonry for steps is calculated separately and added together. In buildings having more one floor, the masonry for superstructure for each floor is computed separately. Deductions for openings like doors, windows, cupboards, etc. is done.
Deduction for lintels for openings is also done by taking length, breadth and height. Different types of masonry are taken under separate items. Thin partition walls of thickness less than 10cm, honeycomb brickwork is taken under separate item in square meter and no deduction for holes is done.
Brick work in 1st footing was estimated as 9.83 cum.
Brick work in 2nd footing was estimated as 8.12 cum.
Brick work in 3rd footing was estimated as 6.56 cum
Brick work in plinth was estimated as 8.31 cum.
Total brick work up to plinth level was estimated as 40.30 cum @ Rs. 4,677.25/cum. Cost of masonry up to plinth level was calculated as Rs. 1,88,493.175 only.
Masonry work in super structure i.e. walls is estimated as 28.52cum @ Rs. 5426.15/cum. Cost of masonry work calculated for super structure was Rs. 1,54,753.15 only.

5. Lintel: Lintel is casted in R.C.C. and quantity is calculated in cubic meter. Length of lintel is equal to size of opening plus of 150 mm each on both sides.
Lintel total quantity was estimated as 0.47 cum.

6. R.C.C.: R.C.C. Work is calculated for beams, lintels, columns, footing, slabs etc. It is calculated cubic meter, by taking length, breadth and thickness. No deduction for steel is done while calculating the quantity of concrete, which includes centering, shuttering and fixing of reinforcement in position. Reinforcement (quantity of steel) is taken under separate item, including bending and measured in kg, quintals, or in metric tone. If detail drawings are not available 0.8 to 3% of concrete may be taken by volumes as a quantity of steel which is further multiplied by density. Centering and shuttering are usually included in R.C.C. but may also be taken separately in square meter of surface in contact with concrete. In R.C.C. Work, plastering is not taken separately.
RCC work excluding reinforcement for 125 mm slab in AE room, JE room, SDC room, Labor store room and verandah was estimated as 7.185 cum.

RCC work excluding reinforcement for 100 mm slab in bathroom was estimated to be 1.99 cum.
Total RCC work excluding reinforcement was estimated to be 9.09 cum @ Rs. 6,778.2/cum.
Cost of RCC work in superstructure excluding reinforcement and shuttering was calculated to be Rs. 61,654.50 only.

7. Flooring: For grounds floor, cement concrete and floor finishing of stone, marble or mosaic tiles taken under one item and quantity is calculated in square meter. For upper floors, bed of R.C.C. is taken cubic meter and other member is calculated in cubic meter.
Total floor area estimated were 49.10 squares metering @ Rs. 353.35 per square meter.
Cost of Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete.40 mm thick with 20 mm nominal size stone aggregate was calculated to be Rs. 17,349 only.

8. Plastering and pointing: Plastering is calculated in square meter and expressed with specified thickness. For masonry the measurements are taken for whole face of wall for both sides as solid and deduction for openings are made. External and internal plastering for building are taken out separately, under different times. Pointing of walls is calculated in square meter for whole surface and deductions are made similar to plastering.
Plastering work for outer walls of complete structure was estimated to be 80.37 square meter.
Plastering work for AE room was estimated to be 41.58 square meter.
Plastering work for JE, SDC and labor store room was estimated to be 91.58 square meter.
Plastering work for verandah was estimated to be 25.35 square meter.
Plastering work for bathroom was estimated to be 14.58 square meter.
Total plastering work after deduction due to openings from windows, ventilator and doors area of 32.78 square meters was estimated to be 220.95 square meter @ Rs.163.35.
Cost of plastering was calculated to be Rs. 36,092.18 only.

9. Doors and Windows: It consists of frame and shutter. Doors and windows framers are calculated in cubic meter. Quantity is obtained by calculating length including jamb, head and sill and multiplied by cross-section of frame. Doors and window shutters are calculated in square meter. Shutter of different types should be taken separately because the rates differ. Hold-fast are taken as a separate item.
Timber work in doors and windows in all rooms plus ventilator in bathroom was estimated to be 16.39 square meter @ Rs.2, 155.60 per square meter.
Cost of timber work calculated was Rs. 35,330 only.

10. Painting and Varnishing: Painting and varnishing of doors and windows are calculated in square meter. The area measured for this purpose is flat.
Total area of wall and roof excluding floor height to be painted was estimated to be 270.05 square meter.
2 coats of white wash on new work @ Rs. 22.05 per square meter costs Rs. 5,954.50 only.
2 coats of paint on new work @ Rs. 109.25 per square meter costs Rs. 29,502.90 only.
Paint and varnish on wood @ Rs. 31.90 per square meter costs Rs. 522.84 only.
Total coast of painting and varnish on new work of plaster and wood work was calculated to be Rs. 35,980.34 only.

11. Shuttering and Centering work: Centering and shuttering including strutting, propping etc. And removal of form for Foundations, footings, bases of columns, etc.
Estimated shuttering and centering work for foundation was 4.29 square meter @ Rs. 196.45 per square meter.
Cost calculated for shuttering and centering work for foundation was Rs. 940.9 only.
Estimated shuttering work for slabs was 60.33 square meter @ Rs. 401.65 per square meter.
Cost calculated for shuttering work of slabs was Rs. 24,231.5 only.

12. Reinforcement: Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.
Thermo-Mechanically Treated bars
Estimated amount of steel reinforcement was 177.10 kgs @ Rs. 68.1 per kg.
Cost of 8mm and 10mm bars calculated was Rs. 12960.50 only.

13. Electrification: Generally 8% of estimated cost of building works is taken for this item.

14. Sanitary and water supply works: Generally 8% of estimated cost of building works is taken for this item.
Total cost calculated was Rs. 5,94,015.67 only.
Taking 8% of electrification and 8% of sanitary work on total cost.
Net cost calculated was Rs. 6,89,100 only.

CONCLUSION

After calculating all these value we understand that limit state design method is more economical and efficient in different aspects because in WSM we don't design the structure I aspect of live load or wind load or any other type of load so LSM is more efficient than WSM. If we talk about estimation method than centre line method is more accurate than time saving than long wall short wall method so we always consider that method which is more time saving and efficient.

REFERENCE

1. IS CODE 456:2000
2. SP-16
3. IS CODE 10262-1982
4. IS CODE 1905-1987
5. www.google.com
6. Book of costing and estimation of B N DUTTA
7. Book of REINFORCEMENT CONCRETE DESIGN of N KRISHNARAJU