International Journal of Research in Engineering, Science and Management
Volume-2, Issue-5, May-2019
www.ijresm.com | ISSN (Online): 2581-5792

Design of Warehouses

Vishal Dhawale[1], Shubham Jadhav[2], Krushna Gore[3], Ganesh Dhobi[4], Manoj Wagh[5]
[1,2,3,4]*Student, Dept. of Civil Engineering, Dr. Vithalrao VikhePatil College of Engineering, Ahmednagar, India*
[5]*Associate Professor, Dept. of Civil Engg., Dr. Vithalrao VikhePatil College of Engineering, Ahmednagar, India*

***Abstract*: In the 20th century, warehouses become one of the most important and critical parts in the supply chain system due to the fact that it consumes a considerable part of logistics cost and quality. India is agrarian country, in the country production of the various crops is in large quantity. As there is various types of crops production are taken, these crops are stored in various types of warehouses as per the requirement of the crops. In India, 50% of storage capacity warehouses are required. The farmer produces a large amount of yield production, but storage facilities are inadequate. Hence 30% losses of total yield production occur. It affects the living standard of the farmer and the growth of the country. This paper elaborate study between available constructed warehouses and modified warehouse. Design proposal studied and prepared. From the present study, the proposal is made which is economical and the design of an economic one is selected.**

***Keywords*: warehouse; stack; truss, beam, column; foundation.**

1. Introduction

The research paper illustrates the basic information about the warehouse and its basic need for the agricultural industry. The warehouse provides a facility for agricultural crop and agricultural products at the village and the district. The primary aim of a warehouse is to assist the storage and movement of goods from suppliers to the customer. Customer's demand can be fulfilled timely and cost-effective manner if a sufficient quantity of good quality warehouses is available. In order to achieve it efficiently, we may have to hold stock, but this is not the main role of Indian warehouses. The basic aim is to minimize the total cost of operation, and storage while providing the desired level of service.

Indian economy is based on agriculture; In India agriculture is the main source of livelihood for around 61% population of India [1, 3, 7, 9, 13]. So agriculture and agricultural growth occupy a higher degree of importance in the development of the country. In India, 50% of storage capacity warehouses are required. The farmer produces a large amount of yield production, but storage facilities are inadequate. Hence 30% of losses of total yield production occur. District Ahmednagar and its adjoining area are well known for its agricultural products such as Bajra, Wheat, Cotton, Food grain, etc. After getting an idea about the need of warehousing, Let us identify the different types of warehouses. In order to meet their requirement, various types of warehouses are available such as Private, Public, Government, Bonded, Co-operative, etc.

2. Objectives

- The main objective of the study is the current status of Indian warehouses.
- Recognize the need for warehousing.
- Designing and developing economical warehouse.
- Increasing the life of storage products.
- Obtaining profit or revenue from the warehouse.

3. Technical details and methods technical detail

The warehouse is constructed on 3678.43 m^2; in spite built-up area of the warehouse is 1646.34 m^2. Entire structure predominantly consists of 20 numbers of Stacks each having dimensioned 6.09 m ×9.14 m. It consists of One Office with tool Room and the Guard Room as per the standard dimension. The total capacity of Warehouse is 3000 MT. The warehouse is divided into two sections (150 MT of each stack) for proper ventilation and circulation of air. Front facing opening (shutter) with a dimension of 2.44×3.05m is provided to loading and unloading the goods at the corner of each stack. The cantilever slab of 1.52m is provided throughout the shutter to protect from sunlight and rainwater. The isolated foundation is provided below each column and step footing is provided below each stack. Depth of footing is 1.5 m below the G.L. and base slab is provided 1m above G.L. The height of the column is 5.48 m above G.L., each having dimensions 0.3 m ×0.3 m. The spacing of the column is 6 m c/c from the longer side and 5.94 m c/c from the shorter side. Plinth beam is provided parallel to the base slab, 1m above the G.L. The other 2 beams are provided at the height of 2.74 m and 5.48 m above G.L. respectively. The dimension of the beam is 0.3×0.3 m. The thickness of the wall is 0.3 m. Space is provided in front of stacks of 9.14 m, with front space of 6.09 m. The thickness of the base slab is 0.3m. The span of truss is 30 m with 5 m height. Minimum 1 m of space is provided from the bottom of the truss. Asbestos sheets are provided for warehouse having thickness 6.00 mm, Overall size 1.05 m, land width - 1.01 m, Cover efficiency - 91%

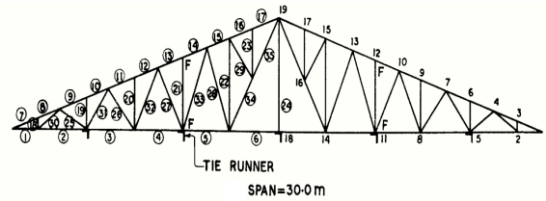
A. Methods

- *Data Collection:* To finalize the capacity of warehouse data of agriculture production has been procured from Rahuri Krishi Vidyapeeth. (M. P. K.V.) Rahuri, District Ahmednagar, Maharashtra, India. Data related to the topography of the area has been collected from the survey of numerous warehouses.

- *Design of warehouse:* To investigate data related to warehouses such as capacity (dimension of a warehouse) required for an operation is determined by maximum quantity in tonnage and volume of supplies stored and then govt. schemes, case study, ISO standards, the problem in reality facing, the material used, various design methods. From the available data, the production of food grain is 3000 metric tons. By using density volume of wheat is calculated and from that, no. of bags is calculated. Further than using above data size of clearly indicate that there is an acute shortage of organized and good quality warehousing and storage infrastructure in the country, for both, agricultural and non-agricultural commodities.
- For design production from data then the volume is calculated, Area is decided that is the dimension.

4. Design of truss (A-Type Truss)

A. Design of truss has been carried out as per the Is 875-1987 part I, II, III. [2,5,12]



- Load Calculation
- Dead load, Live load, Wind load
- Load Combination
- 1.5(D.L. + L.L.)
- 1.5(D.L. + W.L.)
- 1.2(D.L. +L.L. +W.L.)

- Design of Slab: [4,10,11]
- Design of one-way slab and Two-way slab.
- As the ratio of length & width of all slabs is less than 2, two-way slabs have been considered to design.
- Use Steel Fe415 and Concrete Grade M20.
- For Max. depth:

Xu max= 0.48d

Mu lim= 0.138 fck bd^2

- For the area of steel :

$$Mu = \frac{0.87\ fyAstd\ (1 - Astbd}{fyfck)}$$

- Spacing of bars $= \frac{\text{area of one bar x 1000}}{\text{Ast}}$

Maximum spacing for main reinforcement <3d or 300mm (whichever is less)

Check for shear

Shear force due to load $Vu = \frac{Wd \times L}{2}$

Nominal shear stress $\tau v = \frac{Vu}{bd}$

Percentage of tensile steel $Pt = \frac{Ast \times 100}{bd}$ %

Shear strength of concrete (table 19 page 73 IS 456: 2000) If $\tau v < \tau c$ than no shear reinforcement is required

B. Design of Beam: [4,10,11]

- Use M20 and Fe 415 Steel
- The total load on beam (W) = Weight of wall + Self-weight of the beam
- Design load for consideration (Factored load) = 1.5 × W
- The effective length of span = c/c distance of column
- Factored moment

(Mu) = (Wu x L.eff.)/8

- Maximum shear

$(Vu) = \frac{Wu \times L.eff}{2}$

- Check for singly or doubly reinforced beam
- Calculation of reinforcement
- Check for shear

C. Design of column: [4,10,11]

- Design of short column and long column.
- If the ratio of effective length to its least lateral dimension <12 then it is short column and if least lateral dimension >12 then long columns.
- Use M20 and Fe 415
- Load on each Colum due to truss
- Factored Load
- Height of Column above G.L.
- Leff. (Effective length), It is designed as an axially loaded short column.
- Percentage Reinforced Pu = 0.40 fck Ac + 0.67 fyAsc.
- Provision of lateral ties

Diameter not less than ø/4

Pitch: Not more than

Least lateral dimension = 300 mm or 16 × ømm

D. Design of footing:

Design of isolated footing.

- Use M20 and Fe 415
- Calculation of Self Weight of Footing
- Calculation of the area of footing=

Total Load/Soil Bearing Capacity

Determination of the size of footing

Calculation of Soil Reaction for Factored Load

Vu= Soil pressure from shaded area = qu × B [{(B-b)/2} - d]

Assume 0.2% steel for M-20 concrete

Minimum depth required

$\tau cbd = Vu$

Check for Bending:

Mu lim. = 0.138 × fck bd^2

Mu =qu $(B - b)^2/8 \times B$

Mu < Mu lim.
Check for two way shear
Perimeter of critical section = 4 × (b + d)
Calculation of Area of critical section

$$\text{Two-way shear stress} = \frac{\text{Upward pressure}}{\text{Area of critical section}}$$

Max. Shear stress permitted = 0.25√fck

$$Mu = 0.87 \times fy \times Ast \times d \left[\frac{1 - Ast \times fy}{bd \times fck}\right]$$

Calculation of Ast and spacing.

E. Design of Stack for Wheat Production [4, 6, 11]

Total weight on soil = Total weight on foundation + 10% of total weight of foundation

$$\text{Width of foundation} = \frac{\text{Total weight}}{\text{s.b.c}}$$

$$\text{Depth of foundation} = \frac{w}{a \times \rho} \times \frac{[1-\sin\emptyset]2}{[(1+\sin\emptyset)]\,2}$$

Depth of concrete slab: $D = \alpha \times \sqrt{3q/M}$
wheat production = 3000 MT = 3000000 kg
Density of wheat grain = 790 kg/m^3
Area of one bag = (0.6x 0.9) m^2 = 0.54 m^2
Thickness of one bag = 0.2 m

$$\text{Volume of wheat grain} = \frac{\text{mass of wheat grain}}{density\ of\ wheat} = \frac{3000\text{MT}}{790} = 3797.46\ \text{m}^3$$

Volume of one bag = l x b x h= 06 x 0.9x0.2
= 0.108 m^3

$$\text{No. of. bag} = \frac{\text{volume of wheat grain}}{volume\ of\ one\ bag} = \frac{3797.46}{0.108} = 35161.74 = 35200 \text{ bags}$$

Size of stack = 6.09 m x 9.14 m = 55.66 m^2

5. Result

- The design of R.C.C. structured is done by Limit State Theory.
- All the slabs are designed as two way Slabs, by the method provided by IS 456: 2000.
- It is evident that load in a slab below office is so less, that slab was safe in all aspects with the minimum reinforcement as per IS 456: 2000.
- The Reinforcement is 1.61 % in the slab below Stacks.
- Beams are designed individually as fixed beams with doubly and singly reinforced of 300 mm × 300 mm.
- Columns are designed as Axially Loaded Short Column of dimension 300 mm × 300 mm.

The isolated footing was provided of a maximum size of 2.2 m × 2.2 m and safe bearing capacity of the soil is 150 KN/m^2.

6. Conclusion

- The life span of stored goods enhanced by design of modified warehouse.
- Farmer can be benefited and life style can be changed. Also problem of Farmer suicides can be overcome.
- By storing the goods in ware house quality of foods can be preserved.
- Future need can be fulfilled at the time of famine or any other natural or manmade disaster.
- Maximum space and storage can have utilized with minimum investment.

Acknowledgment

We are honored to express my deep sense of gratitude towards our guide Dr. Manoj Wagh for his creative suggestions, helpful discussion, unfailing advice, and constant encouragement during the project work. We consider ourselves privileged to have worked under him, as we always share his vast Experience so generously and patiently in spite in his busy schedule. We sincerely appreciate the interactive help received from him by the way of advice and suggestions. At the outset, we take this opportunity to express our sincere gratitude to Dr. Uday Naik, Principal, Dr. Vithalrao Vikhe Patil College of Engineering, Vilad ghat Ahmednagar, for giving us an opportunity to pursue our studies for the present work. We have been always graced by our parents, their support and blessings have driven our performance and success. We are grateful to our family their kind support and motivation have helped us to complete this work successfully.

Nomenclature

qu = factored load
Mu= factored moment
Fck= characteristics of strength of concrete
b= width of column
d= depth of section
B= width of footing
Fy=characteristics of strength of steel
τc = shear stress in concrete
τv= nominal shear stress
a= angle of repose
ρ =density of soil
s.b. c. = safe bearing capacity
$\emptyset$ = angle of reposse
M= modulus of rupture

References

[1] Bramhankar E.B. (1968) Problems of warehousing agricultural products with special reference to the warehousing corporation in India, Pune University, Ph.D. Thesis.
[2] B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, "Design of Steel Structure," Laxmi Publishing Company.
[3] FAO Agricultural services bulletin no. 109 (1994), "Grain storage technique, evolution and trend in developing countries."
[4] IS 456:2000 Indian Standard Code of practice for Plain & Reinforced Concrete.
[5] IS 875:1987 Code of practice for Design of Load for Building & Structure (Part 1 – Dead Load, Part 2 – Imposed Load and Part 3 – Wind Load)

[6] IS 4082:1996 Stacking and Storage of Construction Materials and Components at Site.
[7] Mamta Barnwal (2006) Warehousing Infrastructure: Empowering the Agricultural Sector, The ICFAI University press (2006).
[8] Nveen Prakash (2008) Negotiable Warehouse Receipts: Concept & Implementation warehousing. The Warehousing (Development & Regulation) Act 2007: Issues & Challenges, FICCI New Delhi.
[9] Pattanaik B.B. (2008) The warehousing (development and regulation) Act: Impact on agribusiness, FICCI New Delhi.
[10] S.S. Bhavikatti, "R.C.C. Theory & Design," New Age International Publishers.
[11] SP 16. Indian Standard Codes of Design Aids for Reinforced Concrete.
[12] SP 38. Handbook of Typified Designs for Structures with Steel Roof Truss.
[13] Saxena J.P. (2003) warehouse management and inventory control.