Lesson-39 Design of Warehouses (Shed) and Control of Environment

Very large volume sheds have also been constructed by Central Warehousing Corporation for storing grains and other products. Sheds are usually made of steel or corrugated sheet construction with flat concrete or bitumen floors. In our India, food grain are stored in conventional godowns designed for bagged storage.

39.1 Design of Warehouses (Shed)

The following important points to be considered during design of godowns.

- The godowns side walls are of brick or stone masonry and sloped roofing in asbestos or Corrugated Galvanized Iron (CGI) sheets over steel trusses.
- Generally a godown has a capacity of 5000 tonnes and consists of 3 compartments, each having a span of not less than 21·7 m with a clear height of 5·4 m.
- Air circulation is maintained through steel ventilators and air inlets of rolled steel sections.
- Requirement of steel and cement is about 50 and 300 MT respectively.
- Bagged food grains are arranged in stacks with a base of 6 m x 9 m with a stack height varying from 4 to 5 m, leaving 27 per cent free space of the floor area for alleyways generally.
- It should be leave a free space of 2 m between the stacks and 0.8 to 1.0 m between wall to stack for easily moving of person for observation.
- There should be 2.4 x 2.4 m size two large doors of opposite direction and top ventilators are used.
- Each door is provided with a light overhanging hood of 3.6 m long and 2.4 m wide.
- A ground ventilator having an opening of 30 x 30 cm is provided below each corresponding top ventilator. The top of ventilator is kept at height of 60 cm above the floor level. It is also provided with iron rods, wire netting and shutter.
- The thickness of wall is kept minimum of 37.5 cm and maximum of 45 cm.
- The height of wall on which trusses are placed is generally kept about 5.5 m.
- The roof is either gabled or flat. The gable roof is covered with corrugated metal sheet with maximum precautions taken to make it leak proof. However, flat roof is more durable as it is made of either reinforced brick or reinforced concrete of about 10 to 12.5 cm thickness.
- Wheat can be held in bags under dry climatic conditions for a period up to 2 years. (This period is shortened to 8 to 12 months in humid conditions).
- Wheat can be kept in bulk any where up to 5 years.

39.1.1 A Problem regarding Design of Storage Structure

Design a bag storage structures for storing 250 tonnes of Paddy. Assume reasonable data where ever necessary.

Solution.

Design capacity of the storage structure = 250 T = 250,000 kg

Capacity of a bag of 100 x 60 x 30 cm = 75 kg of Paddy

Hence, number of bags required for storage of 250 T paddy i.e,250,000 kg of paddy

$= \frac{250,000}{75}$

= 3340 bags required for storage of 250 T paddy.

Bags are arranged in number of Stacks.

Let there be 10 bags in length and 10 bags in width in one stack.

So, No of bags/layer = 10 x 10 = 100

If there are 12 layers in a stack, total number of bags/stack

= 100 x 12 = 1200

Hence, the number of stacks required

$= \frac{3340}{1200}$ = 2.78 ≈ 3 Stacks required for storage of 250 T of paddy

Space required by each stack

Length of stack l = 10 x 1.0 = 10.0 m

Width of stack w = 10 x 0.6 = 6.0 m

Height of stack h = 12 x 0.3 = 3.6 m

The clear distance between the walls and the end of stack = 0.8 m

The clear distance between the stacks i.e. between two stack = 2.0 m

Hence, the length of floor L is

L = (3 x 6.0) + (2 x 2.0) + (2 x 0.8)

= 23.6 m ≈ 24.0 m

The width of floor W is

W = (10 x 1.0) + (2 x 0.8)

= 11.6 m ≈ 12.0 m

Therefore, the overall dimensions of the godown may be taken

as 24.0 m length, 12.0 m width and the height of the walls may be kept as 5.0 m above the floor level.

The floor plan of the godown is shown in following Figure

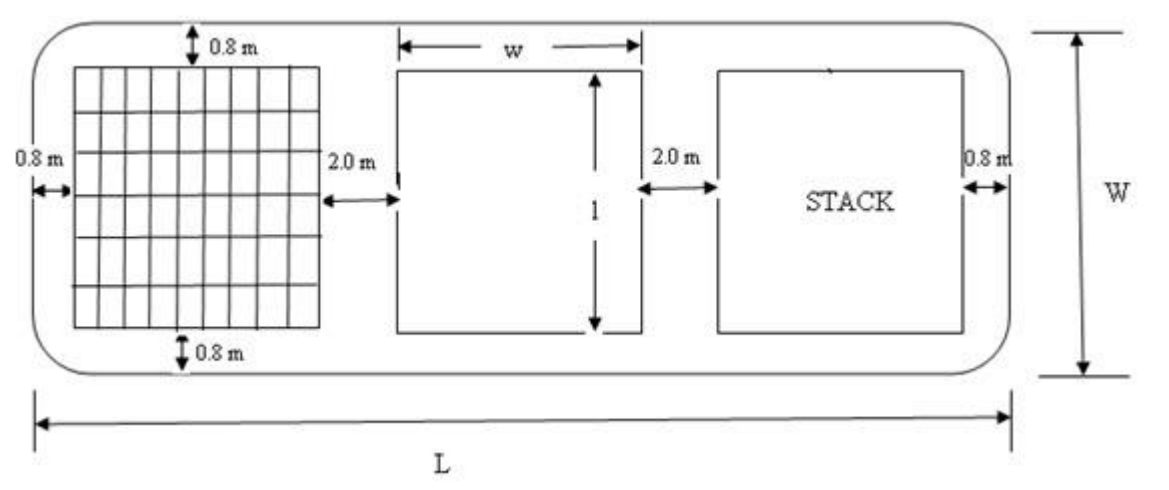

Fig. 39.1 Floor plan of the godown

39.2 Control of Environment

The control of environment involves maintain of atmospheric gases present in a storage structures. There are modified and controlled atmosphere storage techniques are available. In controlled atmosphere we will lower down the Oxygen level (2-5%) and increase the level of carbon dioxide. Due to this respiration rate of the grains is reduced. Increase in the level of carbon dioxide results that it kills insects.

Controlled Atmosphere Storage (CAS) relies on the continuous measurement of the composition of the storage atmosphere and injection of the appropriate gases into it, if and when needed. Hence the system requires sophisticated instruments to monitor the gas levels. The CAS systems are equipped with refrigeration units, N2 generators and O_2 and ethylene evacuators. The N_2 generator extracts gaseous N_2 from atmosphere and pumps it into the storage chamber. A pressure relief valve, so as to maintain the pressure within the container, lets out part of the air. This procedure is repeated till the O_2 content within the container is lowered to the desired level. Respiration of the commodity also helps to reduce the O_2 level. Periodic injection of air or N2may be necessary depending on the O_2 level in the chamber. The CO_2 level is continuously monitored and when it exceeds the desired level, part of the storage gas in the hold is passed through hydrated lime scrubbers, which removes CO_2. The storage air is also passed through an ethylene absorber, which removes the ethylene. Humidity within the storage chamber is also monitored and maintained. CAS does not prevent deterioration but lengthens the storage life from a few days to as much as several months in fruits, depending upon the produce involved. Three techniques are generally

recognized for providing CA conditions in a storage room; conventional, liquid N_2 and N_2 generator systems. Conventional CA depends on the respiration of the commodity to generate CO_2. The CO_2 concentration is controlled by the use of wet scrubbers, hydrated lime or by an inert adsorbent. This storage requires that the room be essentially gas tight because leakage can cause the concentration of O_2 to increase beyond allowable limits.