

CODE OF PRACTICE FOR CONSTRUCTION OF FOODGRAINS STORAGE STRUCTURES

1. SCOPE

1.1 This standard covers the basic constructional requirements for non perishable agricultural commodities storage structures, chiefly intended for trade and government purposes.

1.1.1 This code does not apply to storage of perishables or those commodities which require cold storage.

2. TERMINOLOGY

2.0 For the purpose of this standard the definitions given in IS 6151 and the following definition shall apply.

2.1 Foodgrains – All cereals, pulses, millets and milled products like semolina, flour and atta.

3. LOCATION

3.1 The structure shall be located on a raised well-drained site not liable to flooding or inundations and it shall be away from a place likely to be affected by seepage water.

3.2 In selecting the location, maximum attention should be paid to the hygienic and sanitary conditions of the area and the following minimum distances shall be maintained. The construction in residential areas shall be avoided, as far as possible:

- a) Bone crushing mills, garbage dumping grounds, slaughter houses, tanneries and hide curing centres, sewage treatment plants, or such other places, the vicinity of which is deleterious to the safe storage of non-perishable agricultural commodities- 500 mtrs.
- b) Kilns, Dairies (processing units) and poultry runs-300 mtrs.
- c) Factories and other sources of fire and environmental hazard such as workshops, hay stacks, timber stores, petrol pumps, CNG stations and LPG bottling plants -150 mtrs.

3.3 The structure should be free from passing over of any tension electric line and in the event of such lines passing over, then the relevant Electrical Code provisions should be taken into account while planning the storage structure. The structure should be free from gas / oil pipe lines.

3.4 There shall be no tree, the roots of which affect the foundation, near the structure. The structure shall always be kept clear of branches of trees, poles, etc. by at least 3 m by which rats and squirrels would otherwise find access into it. Necessary precautions for preventing attacks by termites shall be taken.

3.5 The structure may preferably be situated near a transport head or a main road. If the structure is located in the interior, an approach road shall be provided.

3.6 At the site of the structure, there shall be sufficient parking and manoeuvring space for vehicles. If the structure is situated at a ferry head, railway station, airport, etc., sufficient berthing, loading and unloading facilities shall be made available.

4. ANCILLARY STRUCTURES AND OTHER AMENITIES

4.1 It is desirable to have ancillary structures attached to godowns having capacity of 5000 tonnes and above. The other details of the ancillary structures for small and big godowns are given in Annex A.

5. CAPACITIES AND DIMENSIONS

5.1 The recommended capacities and dimensions of storage structures are given in Table 1. The capacities have been estimated on the basis of 16-bags high stacks. The stacking arrangement shall be as shown in Fig. 1

TABLE 1 CAPACITIES AND DIMENSIONS OF BAGGED STORAGE STRUCTURES

TYPE OF GODOWN (1)	APPROXIMATE BAGS (2)	CAPACITY (3)	INTERNAL DIMENSIONS	
			Length (4)	Breadth (5)
			m	m
Small	1 120	100	12	7.5
	2 700	250	20	9
	5 400	500	34	12
	10 500	1 000	35.5	18
	28 510	2 500	97.19	14.48
Large	57 020	5 000	129.74*	21.34 125.01 +

NOTE 1 - The size of the large capacity godown has been arrived at keeping the normal maximum size of each stack to 9.15 x 6.10 m that may be adopted for stack fumigation.

NOTE 2 - The above dimensions may be suitably adopted depending upon the availability of land.

NOTE 3 - For storage capacity 2 500 tonnes and above, godowns may be divided in suitable compartments depending upon the availability of land.

* For four compartment design.

+ For three compartment design.

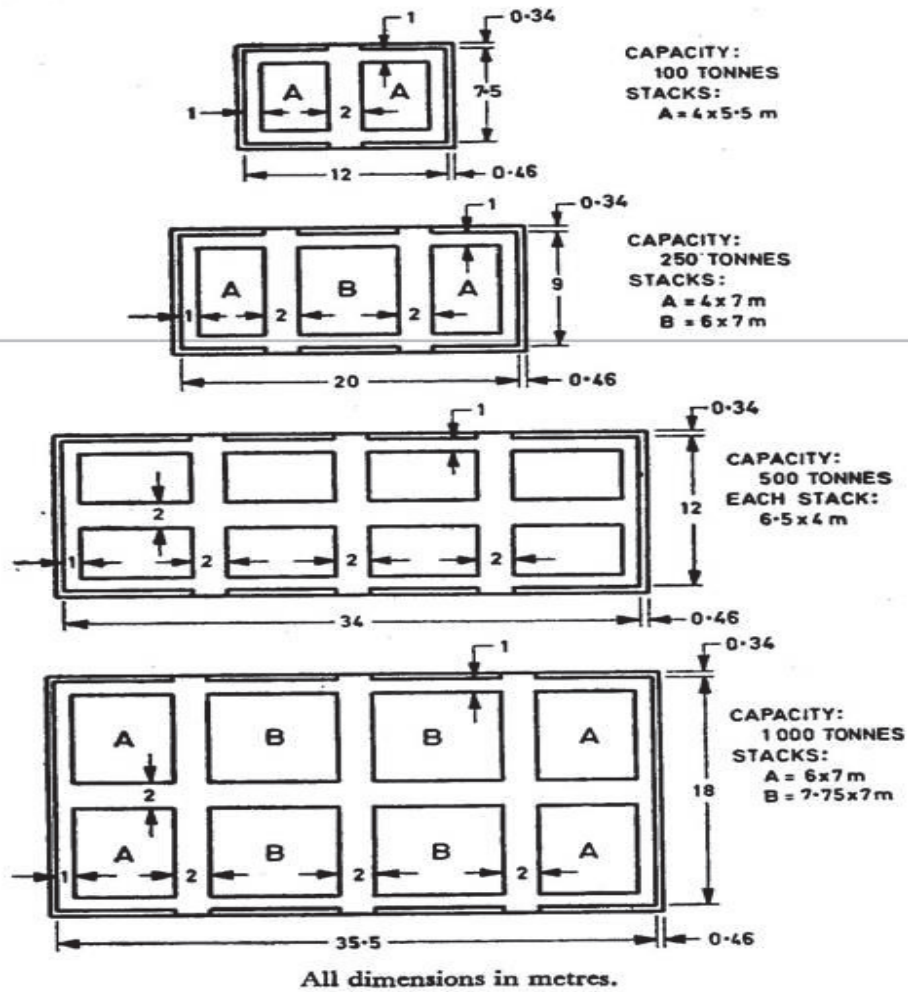


FIG. 1 STACKING ARRANGEMENT (Contd)

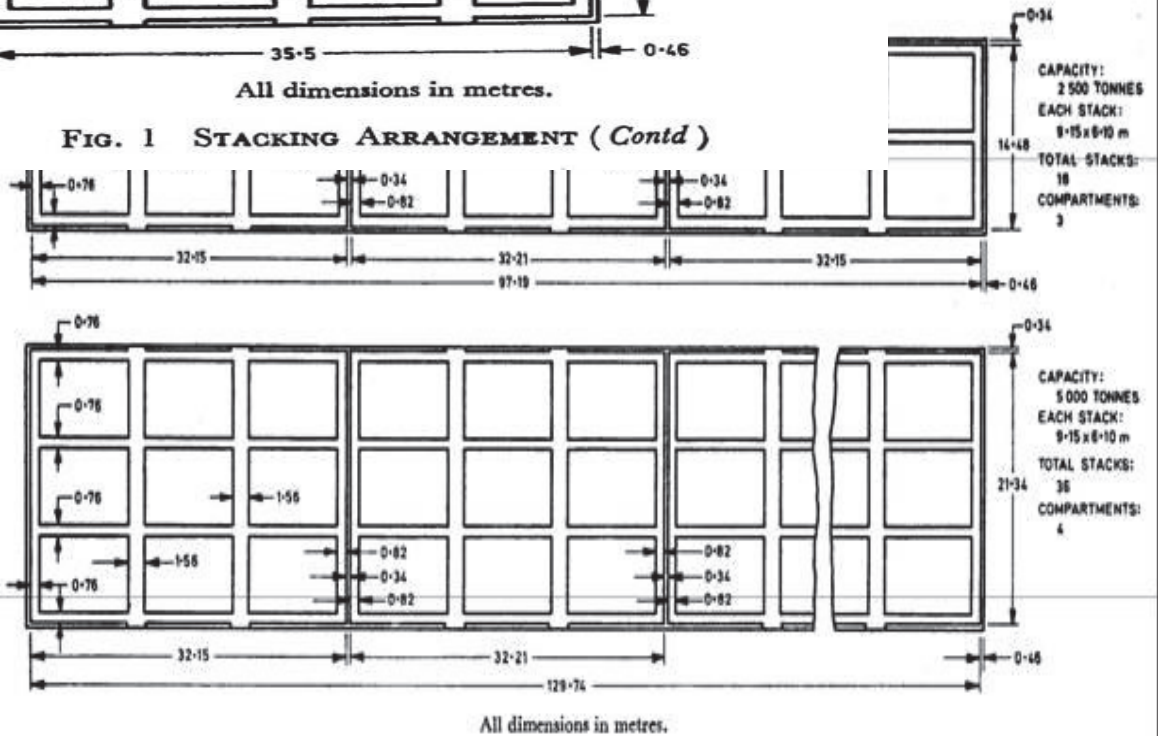


FIG. 1 STACKING ARRANGEMENT

5.2

The non-perishable a

gricultural commodity storage structure shall be of single span according to the availability of land. In larger storage structures, suitable compartments may be provided according to the local requirement. General plans for typical bagged food grain structures for capacity 2500 tonnes and 5000 tonnes including the recommended arrangement for partition walls and stacking of bags are given in Fig. 2.

6. FOUNDATION

- 6.1 Suitable foundation depending upon the site conditions may be provided. The type of foundations will depend upon the property of the subsoil and the same may be provided according to relevant Indian Standard Codes.
- 6.2 The foundation shall, in no case, be less than one metre deep unless hard rock is met with at a depth less than one metre, subject to a minimum depth of footing not less than 75 cm. The foundation shall not be less than 120 cm deep under the cement concrete columns.
- 6.3 Wherever rock is met within the foundation depth, it shall be properly dressed, levelled and, if necessary, cut in horizontal steps so as to receive the footings of the foundation.
- 6.4 The foundation, in general, shall consist of the bed of cement concrete not leaner than the mix of 1: 5: 10 (1 cement : 5 coarse sand : 10 stone aggregate of 40 mm nominal size) for the walls and under the footing of the columns. The reinforced cement concrete columns shall be of mix not leaner than 1: 1.5 : 3 (1 cement : 1.5 coarse sand : 3 stone aggregate

20 mm nominal size) for the nominal mix concrete and M 20 for the controlled concrete as per the requirement of design. The coarse of the lean concrete under the footings of the walls and RCC columns shall not less than be 15 cm. and 7.5 cm. respectively or otherwise as per the recommendation in the structural designs.

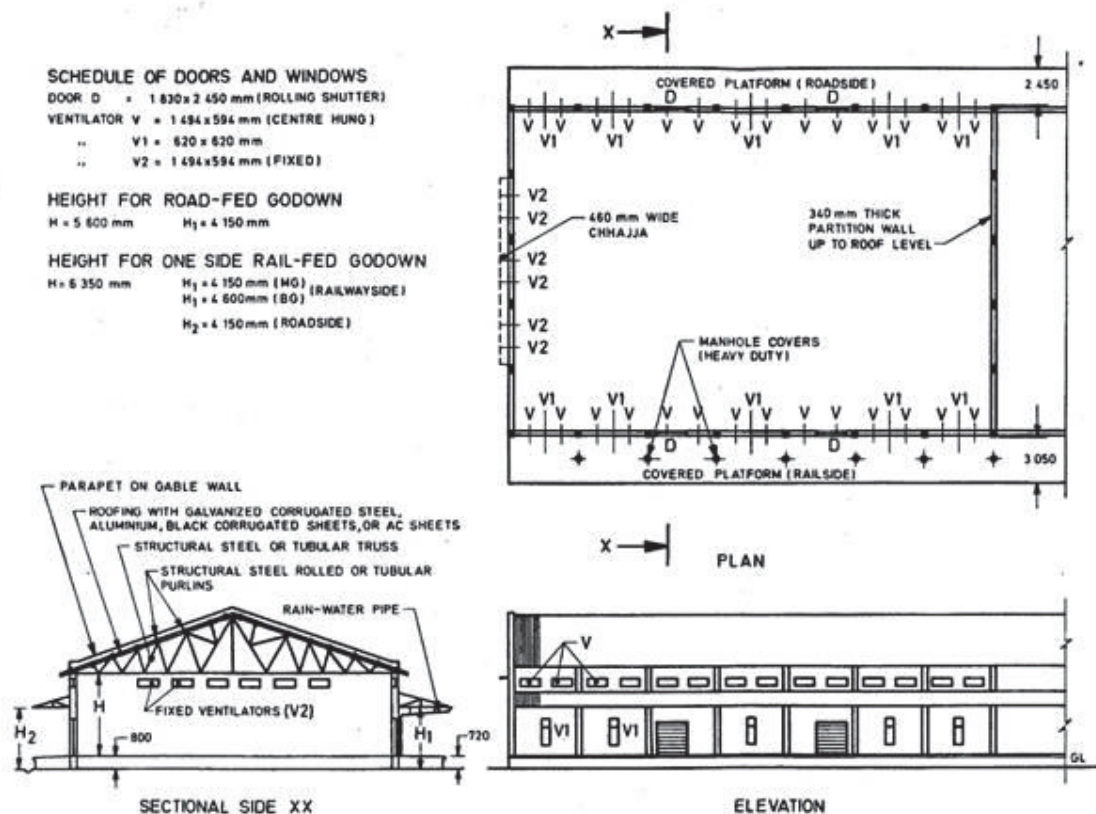


FIG. 2 TYPICAL BAGGED FOOD GRAIN STORAGE STRUCTURE FOR 5 000 TONNES CAPACITY WITH RAILSIDE PLATFORM ON ONE SIDE AND ROADSIDE PLATFORM ON THE OTHER SIDE

- 6.5 The foundation shall be carried to hard soil and to a depth at which cracks in the soil do not exist and where the bearing capacity is adequate to withstand the intensity of foundation pressure. The bearing capacity of the soil shall be properly investigated.
- 6.6 The foundation on both the sides shall be refilled with selected earth suitable for filling and free from salt, organic or other foreign matter or with sand except the seashore sand or moorum which shall be compacted and made flush with the ground level.
- 6.7 To meet the menace of white ants and rodents suitable pesticidal treatment shall be done in the foundations and under floors.

7. PLINTH

- 7.1 The plinth shall generally be kept 80 cm above the finished ground level and in exceptional cases, depending upon the topography of the land, the plinth height can be extended upto 90 cm, for the road-fed structures whereas for the rail-fed structures, the plinth height shall be 106 cm above the top of corresponding broad gauge track. The minimum width of platform for the road-fed structures shall be 183 cm and 244 cm for

rail-fed structures. To prevent rain water from getting inside the godowns through the doors, the platform shall be provided with a slope of at least 1 in 40 from the wall to its outer edge. In case of the road-fed structures, the platform plinth level of the structure should be fixed taking the highest floor level into account. The general arrangement of platform plinth with coping details and other particulars is shown in Fig. 3.

- 7.1.1 Where platforms are provided, they shall be preferably covered.

- 7.2 **Filling of plinth and Foundation** – The plinth shall be filled with selected earth depending upon the availability, excluding black cotton soils and other unsuitable soils, in layers not exceeding 200 mm with each layer being watered, well rammed and consolidated. When filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and consolidated in order to avoid any settlement at a later stage. The finished level of filling shall be kept in slope intended to be given on the floor. These layers shall be taken up to the formation level for the earth filling.

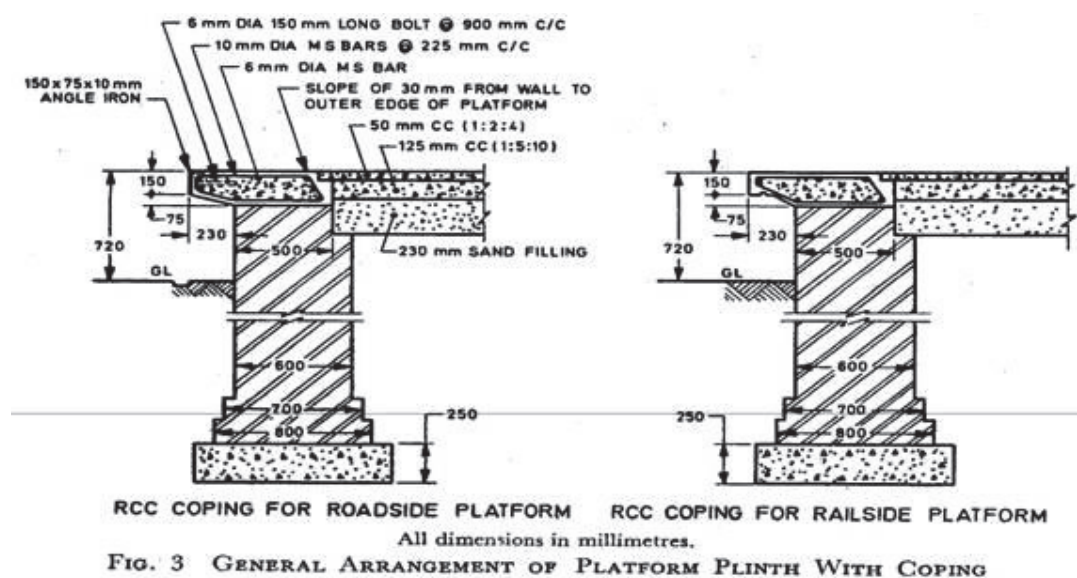
- 7.3 The plinth shall be constructed of either stone or brick masonry in cement mortar 1:6 (1 cement : 6 coarse sand) including gable walls. It shall be provided with damp proof course of well graded concrete with waterproofing compound (see IS 2645) to a minimum thickness of 40 mm on brick masonry and 50 mm on stone masonry.

NOTE – These are the usual specifications adopted for such structures. The actual specifications shall be based on proper designs and stresses developed depending upon the strength of raw material and mortar used. In seismic areas suitable precautions may be observed in the construction of building which should be according to IS 1893 and IS 4326. In case of non-availability of bricks and stone for masonry work, cement concrete hollow blocks may be used and jointing etc. may be done with cement mortar 1 : 4 (1 cement : 4 coarse sand).

- 7.4 **Plinth Protection** – The structure shall be provided with plinth protection of at least 900 mm width excluding platform portion around the structure and shall have minimum outward slope of 1 in 48 for satisfactory drainage of rain water. The plinth protection shall not be required on the side where rail side platform is provided. The

plinth protection may consist of a layer of 115 mm thick brick or stone ballast, consolidated dry to the required slope, the surface shall be grouted evenly with fine sand $0.06 \text{ m}^3 / 10 \text{ m}^3$ and slightly sprinkled with water and rammed. A topping of 50 mm thick cement concrete (1 : 3 : 6) may be laid in alternate panel slabs over a well-rammed brick or stone ballast and finished smooth at top. The finished surface may have a minimum outward slope of 1 in 48. Any other mode of the plinth protection may be adopted depending upon the site condition and economy of the materials for a particular locality. IF vehicular traffic is likely to come on the plinth protection, the same should be suitably designed as a pavement in such portions.

- 7.4.1 It may be ensured that wherever plinth protection is laid on filled up earth; such filling shall be with selected earth properly consolidated. Black cotton soil shall not be used in such filling.



8. FLOOR

- 8.1 The flooring in the storage structure should be damp proof, rigid, durable and free from any cracks or crevices.

- 8.1.1 The following types of flooring may be provided for in the structure (Fig.4):

- a) Selected earth filling well consolidated and stabilized to avoid possibility of settlement and cracks,
- b) A layer of sand filling 230 mm thick thoroughly watered and well consolidated,
- c) A layer of cement concrete (1 : 5 : 10) 150 mm thick,

NOTE 1 - In area which may have water logging, a layer of bitumen maxphalt 80/100 or equivalent spread uniformly at the rate of 1.7 kg/m^2 may be provided in between the layer of cement concrete (1 : 5 : 10) as referred to in 8.1.1 (c)

NOTE 2 - In case, polythene sheet is used in place of maxphalt, a layer of 700-gauzepolythene sheet sandwiched in between the sand layers as referred to in 8.1.1 (b) shall be laid with necessary overlap of 150 mm at joints; joints hot sealed and ends properly anchored in suitable grooves left in walls for water tightness.

- d) A top wearing coat of 50 mm thick cement concrete (1: 2: 4) finished with floating coat of neat cement shall be provided. The cement concrete flooring shall be laid in panels not exceeding 3.5 m² in area and 2.5 m and above in any direction. Such panels shall be suitably adjusted so as to avoid transfer of any uneven load at the joints under the stacking bays and alleyways. The panels shown in Fig. 5 may be suitably adopted.

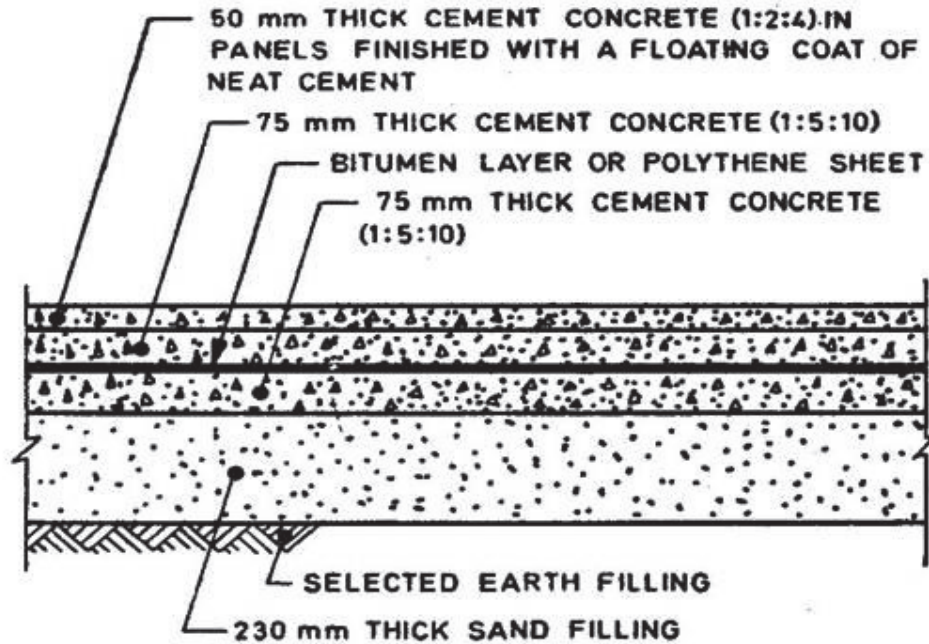
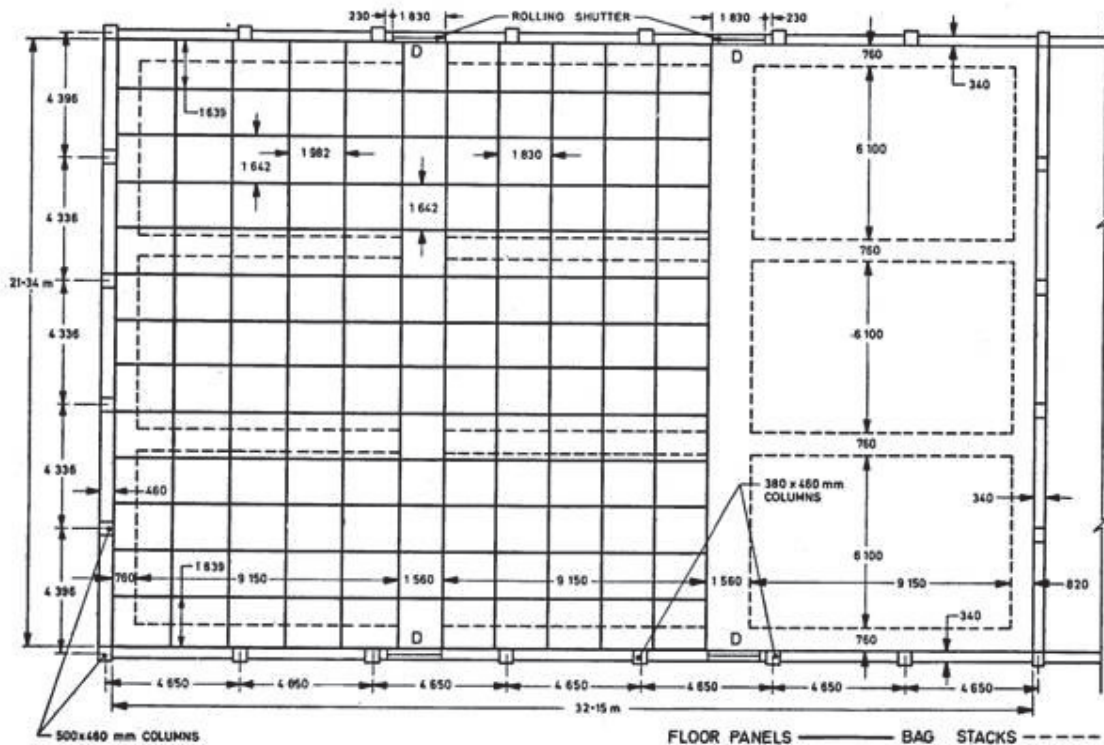


FIG. 4 DETAILS OF FLOORING (MAIN GODOWN)



All dimensions in millimetres.

FIG. 5 TYPICAL ARRANGEMENT OF FLOOR PANELS

- 8.1.2 Alternatively the flooring and the course of the water bound macadam (WBM) underneath the cement concrete flooring (Fig. A4) should be provided as under:
- a) Selected earth in the filling well compacted and stabilized for avoiding possibility of any future settlement and cracks, etc.
 - b) 150 mm thick WBM with stone aggregate of size 63-65 mm (Grade II) with corresponding screening and binding material.
 - c) 75 mm thick WBM to be laid with 53-22.4 mm sized stone aggregate (Grade II) with corresponding screening and binding material.
 - d) 50 mm thick cement concrete flooring in the cement concrete mix of 1:2:4 finished with a floating coat of cement.
- 8.1.3 Panelling in the cement concrete flooring shall be provided with glass strip having thickness of 4 mm and depth as per the thickness of the floor.

9. WALLS

- 9.1 The design of the walls shall be in accordance with the general constructional practices (see IS 1905) and care shall be taken that the tensile stresses do not exceed the cracking limit. The following type of walls may be provided for the storage structure.
- 9.1.1 The longitudinal walls shall be of brick or stone masonry in cement mortar 1 : 6 (1 cement : 6 coarse sand) and shall be at least 5 600 mm high for road-fed as well as railfed structures from the plinth level. They shall be at least 230 mm in thickness. Whenever there is non-availability of bricks / stone for masonry work, alternatively CC hollow blocks of suitable size of mix 1 : 3 : 6 should be used. RCC columns should be provided to support the trusses connected with the beams at the top level and one more beam of RCC in the concrete mix 1 : 1.5 : 3 should be provided at the door level in the areas falling under seismic zone IV & V. The gable wall and the partition wall should be provided with the same type of masonry being provided in the longitudinal walls in the cement mortar of same ratio / mix and shall be at least 340 mm in thickness.

The walls shall be flush with the inner surface of the column and shall be plastered in cement mortar 1:6 (1cement: 6 fine sand). They shall be rendered smooth both on the outer and the inner surfaces. There shall be no offsets or projections in the wall. The inside edges of the wall where they meet the floor, all corner shall be rounded off to a radius of at least 50 mm. Spacing of the RCC columns is recommending ideally as 4650 mm from centre to centre which may also be altered as per the requirement/design/dimension of the site / plot for optimum utilization. In seismic areas, structural engineer should be consulted for giving the earthquake resistant designs of the structure and criteria for earthquake resistant designs of structures as per IS 1893 and for earthquake resistant construction as per IS 4326 shall be followed.

NOTE – Where modular bricks are used according to IS 1077, thickness of the walls may be kept as 300 mm (nominal) for the longitudinal and intermediate partition walls and 400 mm (nominal) for the gable walls.

10. DOORS AND VENTILATORS

- 10.1 A door shall be provided preferably opposite each gangway. The doors shall be of rolling shutters and fixed into suitable prepared openings. The doors shall be not less than 1830 × 2450 mm (see Fig. 6). Regular and periodical inspections and maintenance of the rolling shutters should be carried out to avoid defects and damages.
- 10.2 **Ventilators** — In longitudinal walls, one steel ventilators of opening not less than 1 494 × 594 mm shall be provided in each bay between RCC columns spaced at 4 650

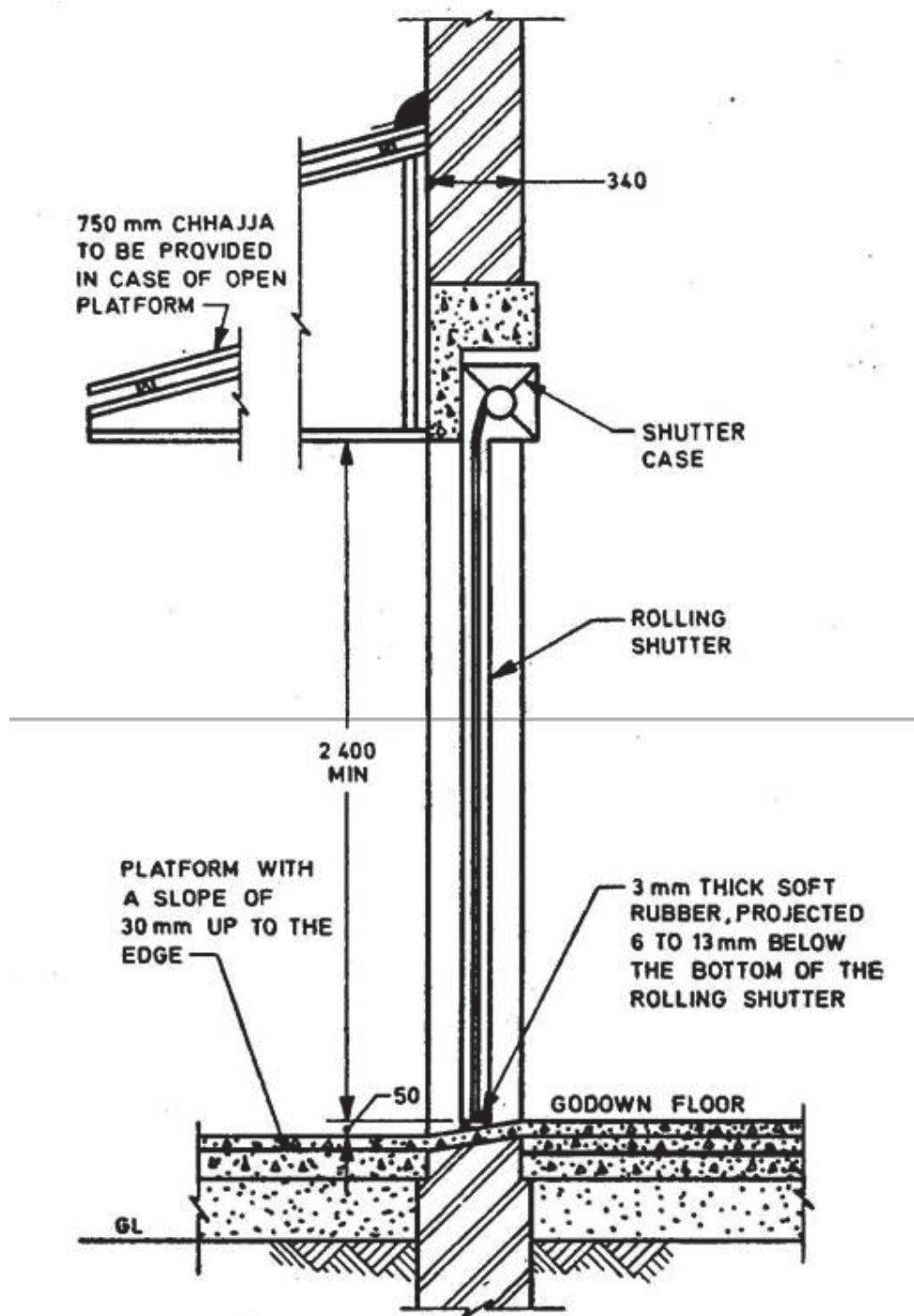
mm from centre to centre. The ventilators shall be fixed 150 mm below the top edge of the tie beam i.e. truss level of the structure. They shall be provided with glazed centre hung with fixed wire-mesh shutters (see Fig. 7). The frames of the ventilators shall be provided with suitable beading to avoid any chance of air and moisture leakage.

Air inlets of steel ventilator 620 × 620 mm in each bay shall also be provided at 600 mm above the floor level of the structure (Fig. 8) except those which have a rolling shutter opening or garage door. These shall be protected by expanded metal / hard drawn wire fabric from inside (see Fig. 8). When closed, the shutter shall fit tight in frame.

On gable walls, suitable number of steel ventilators glazed with fixed wire-mesh may be provided, if required. These ventilators shall be protected by sunshade of at least 460 mm projection. Where good local timber is available or in coastal region where steel may be subjected to salt action, timber ventilators may be provided [see IS 1003 (Part II)].

1. ROOF

- 11.1 The roof of the structure shall be of single span structural steel or tubular trusses which shall be fixed on the RCC columns of RS joists at a height of 5600 mm from the plinth level to the tie level at the column ends, both for the road-fed and rail-fed storage structures (see Fig. 9).
- 11.2 The roof of the platforms shall be of a cantilever structural steel of tubular trusses fixed on to RCC columns at a height of 4000 mm for rail-fed structures with broad gauge railway line. The height shall be measured from the floor level of the structure to the bottom tie of the truss. Outer edge of the truss should not go beyond the line of the edge / RCC coping of the platform. The width of platforms for railside and roadside shall be 2450 mm and 1830 mm respectively, which shall be measured from the face of the columns.



All dimensions in millimetres.

FIG. 6 DETAILS OF ROLLING SHUTTER

- 11.3 The trusses shall be connected by suitable sets of wind bracings and longitudinal runners etc. at the level as per the recommendations of the structural designer of the truss.
- 11.4 The design of the trusses shall be in accordance with the general constructional practices and relevant Indian Standard codes for loading standards (IS 875), tubular trusses (IS 806, IS 1161 and IS 800)

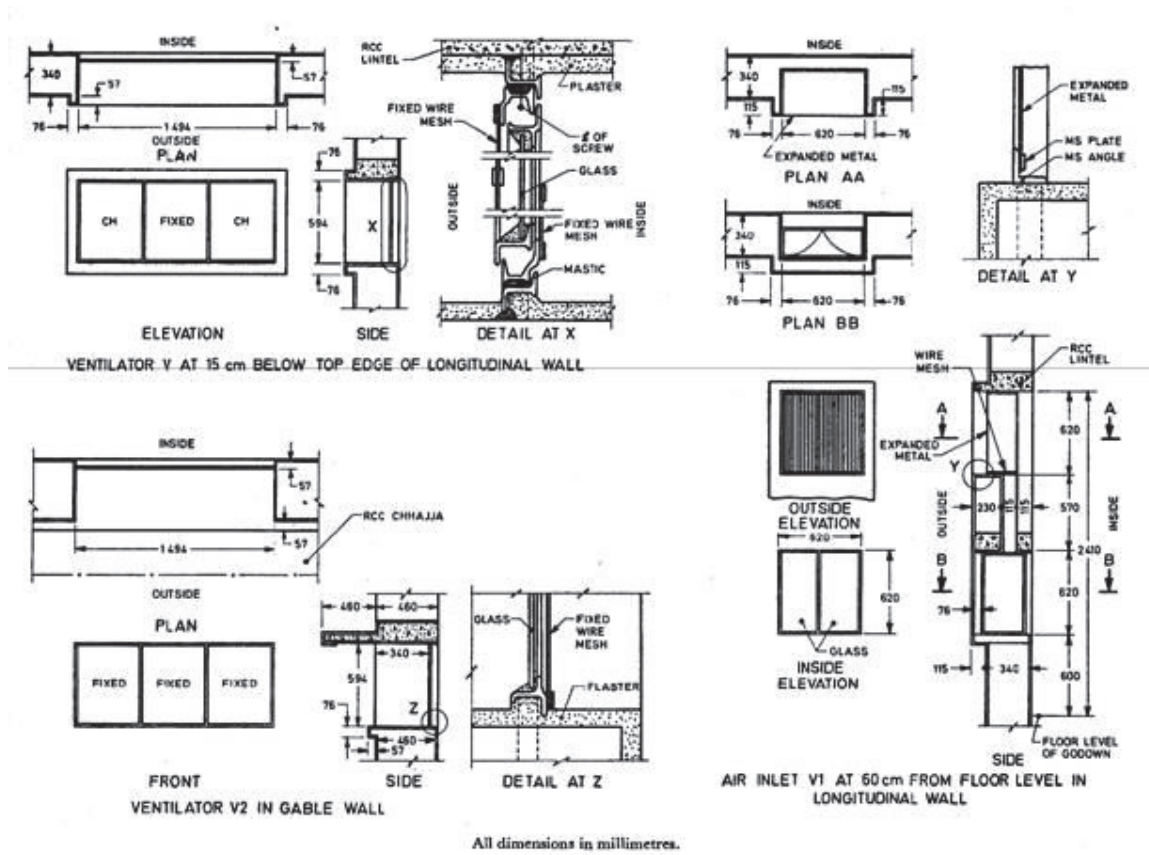


FIG. 7 VENTILATORS AND AIR INLET

- 11.5 Roofing – Materials may be corrugated asbestos sheets (see IS 459) or galvanized corrugated (see IS 277) sheets, steel sheets or corrugated aluminium sheets or black corrugated sheet, not thinner than 0.56 mm. The sheets shall project at least 46 cm from the outer face of the longitudinal walls. The sheets shall be well anchored and secured on the purlins by means of galvanized iron J or L hooks sufficiently long to have good grip over sheets and purlins and accommodate nuts and washers. In areas liable to excessive heat, use of a heat reflecting paint may be considered.
- 11.6 Purlins may be of structural steel rolled or tubular sections. The spacing of purlins shall be as given in IS 3307 (Part 1).
- 11.6.1 The design of the purlins shall be in accordance with the general constructional and Indian Standard design practices.
- 11.6.2 Suitable arrangement shall be provided for expansion of purlins and bottom runners. They may be provided preferably at the partition and gable walls.
- 11.7 The trusses need not be provided on the gable and partition walls. The purlins may, however, rest and be deeply anchored on the gable and the partition walls.
- 11.8 Wind ties of MS flat of size 40 x 6 mm may be provided in a minimum of 4 rows in the godown, structure and one row on the platform proofing.
- 11.9 Transparent / translucent sheets of about 2 percent of the total area of the roof and evenly distributed may be provided for natural light.
- 11.10 Polyester coated pre-painted sheets may also be considered in the roofing.

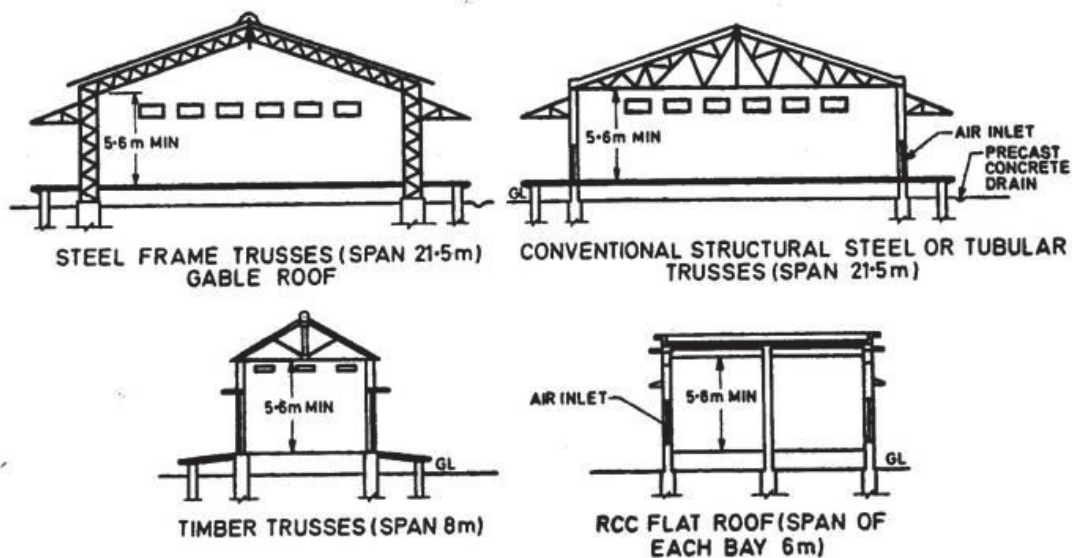


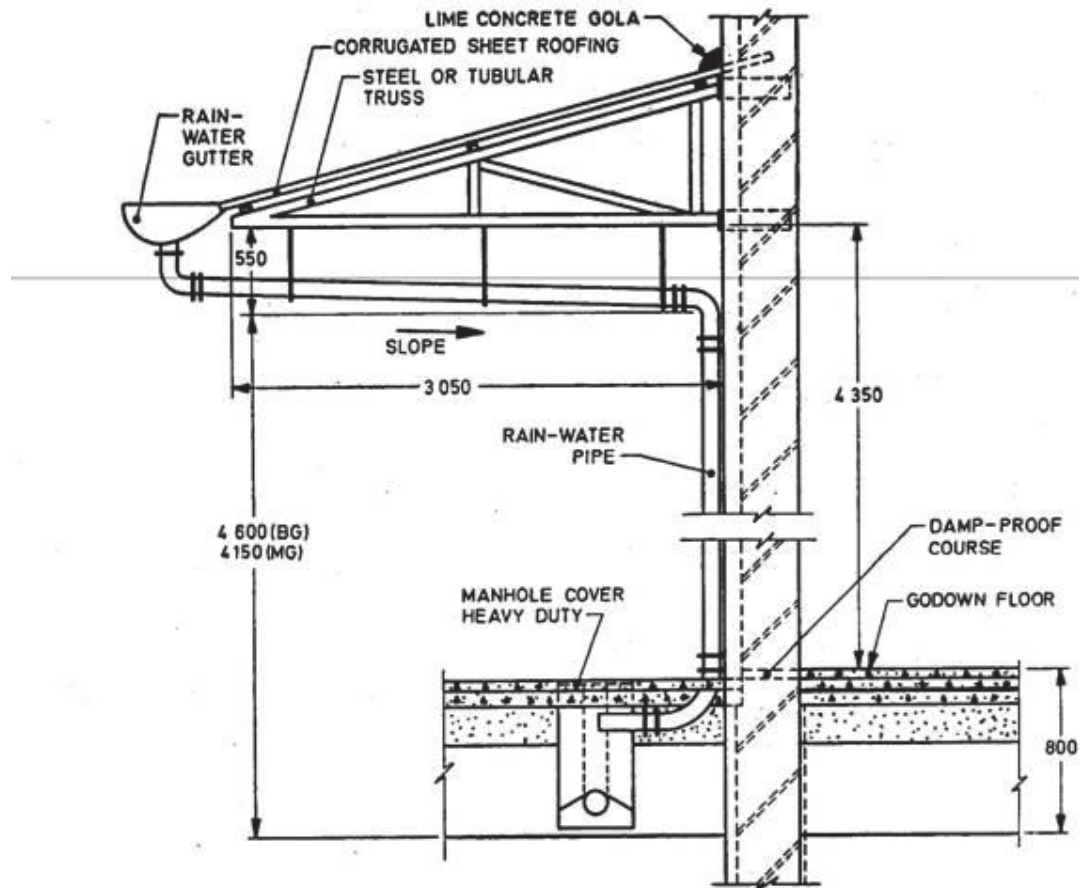
FIG. 8 DIFFERENT TYPES OF ROOFS FOR GODOWNS

12. GABLE AND PARTITION WALLS

- 12.1 A beam may be provided at tie level or truss over gable and partition walls. Where gabled roof is constructed, care should be taken that no hollow space is left between the walls and the roof covering.

13. DRAINAGE

- 13.1 **Rain Water Pipes** — On railside platform rain-water pipes shall be provided at each bay for drainage of rain water from the roof. The rain-water eaves gutter at the outer end of the platform truss of adequate section to receive the rain water both from the main structure roof and platform roof shall be provided and suitably connected to the down take rain water pipes (Fig. 10). They shall be of cast iron or asbestos cement pipes (see IS 1626), PVC or SWR pipes of diameter not less than 110 mm. Their diameter shall also be adequate depending on the intensity of the rainfall of the place. The pipes shall be properly secured at the off take and also securely fixed with clamps to the RCC columns or walls at every 1.8 metres. The rain water shall be drained off by suitable open drains fairly away from the main structure. Where railside platforms are provided, the drain pipes shall be connected to the suitable manholes provided under platform and rain water shall be drained off by asbestos cement pipes, PVC or SWR pipes of adequate diameter connecting the manholes. The manholes shall be provided with heavy-duty covers. On the road-side platforms, a strip of 90 cm brick paving may be provided along the platform walls to protect the scouring of the road surface from the rain water falling from the roof directly. A suitable saucer drain of 300 mm diameter may also be provided by the side of platform wall to drain away the rain water of the roof. Surface area drain to carry run off may also be provided for disposal of water of the complex.



All dimensions in millimetres.

FIG. 9 DETAILS OF EAVES GUTTER

14. FINISHING

14.1 The internal faces of the walls of structure shall be cement plastered and external faces up to floor level shall be smooth plastered. The internal faces may be whitewashed and external faces provided with colour wash.

14.1.1 All the steelwork and woodwork shall be provided with two coats of superior quality paint over a coat of primer.

14.1.2 The galvanized iron or aluminium sheets shall be painted with two coats of superior quality paint suitable for GI or aluminium sheets over a coat of primer suitable for such surfaces. Black corrugated sheets where used shall also be painted with suitable paints which prevent rusting and deterioration of these sheets in addition to the priming and finishing coats.

14.1.3 The paint to be used inside the godown for steelwork and steel / aluminium sheets shall resist the adverse effects of fumigants.

14.1.4 In the coastal area, choice of the paint on the steel items / structure should be according to the environmental conditions so as to combat the effect of rusting etc.

14.1.5 In the heavy Rainfall areas, external surface of walls should be finished with cement water proofing paint.

15.1 Sufficient lighting may be provided inside in the alleyways and on the outside of the structure to facilitate loading and unloading operations.