

**DRAFT TECHNICAL DOCUMENT ON THE CODE OF PRACTICE FOR
CONSTRUCTION OF FOODGRAINS STORAGE STRUCTURES**

Last date for comments : 05 January 2009

1. SCOPE

1.1 This standard covers the basic constructional requirements for foodgrain 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 Food grain – 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) | Kilns, bone crushing mills, garbage dumping grounds, slaughter houses, tanneries and hide curing centres or such other places, the vicinity of which is deleterious to the safe storage of foodgrains | 500 m |
| b) | Dairies and poultry runs | 500 m |
| c) | Factories and other sources of fire such as workshops, hay stacks, timber stores and petrol pumps. | 150 m |

3.3 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.

3.4 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.

3.5 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 5 000 tonnes and above. The other details of the ancillary structures for small and big godowns are given in Appendix A.

5. CAPACITIES AND DIMENSIONS

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

TABLE 1 CAPACITIES AND DIMENSIONS OF BAGGED STORAGE STRUCTURES

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

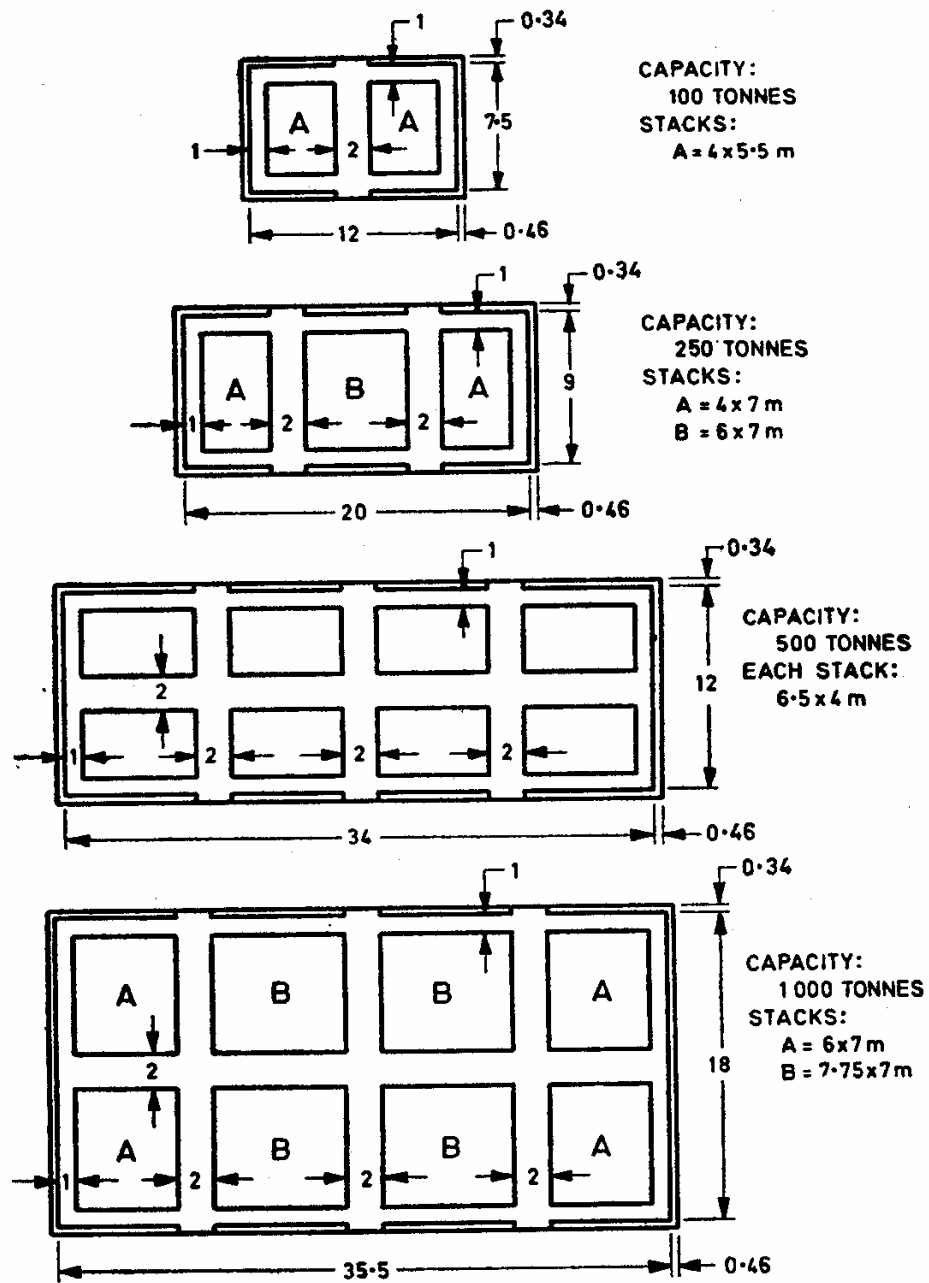
NOTE 1 - The size of the large capacity godown has been arrived at keeping the normal maximum size of each stack to 9.15 x 6.10 m that adopted for stack fumigation.

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.

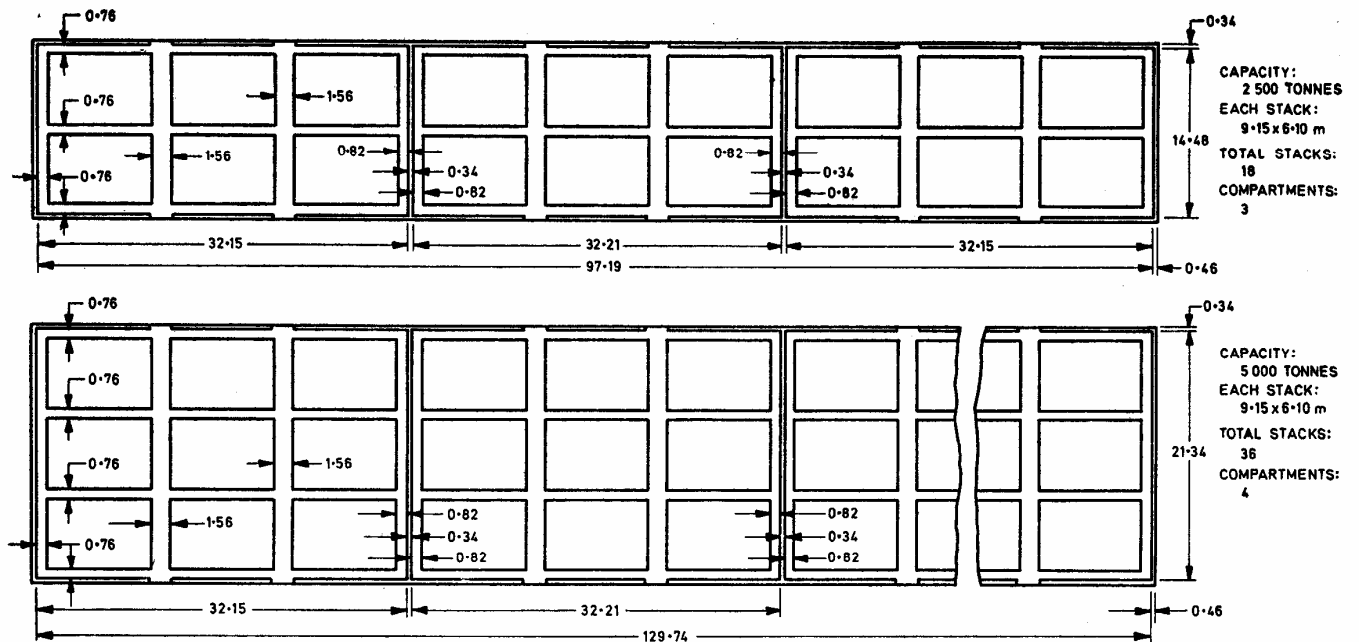
* For four compartment design.

+ For three compartment design.



All dimensions in metres.

FIG. 1 STACKING ARRANGEMENT (Contd)



All dimensions in metres.

FIG. 1 STACKING ARRANGEMENT

5.2 The food grain 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 2 500 tonnes and 5 000 tonnes including the recommended arrangement for partition walls and stacking of bags are given in Fig. 2.

NOTE – According to recent experience, two-span structure requires a central valley-gutter which was a weak point being a source of leakage and required constant attention and also added to maintenance cost.

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.

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.

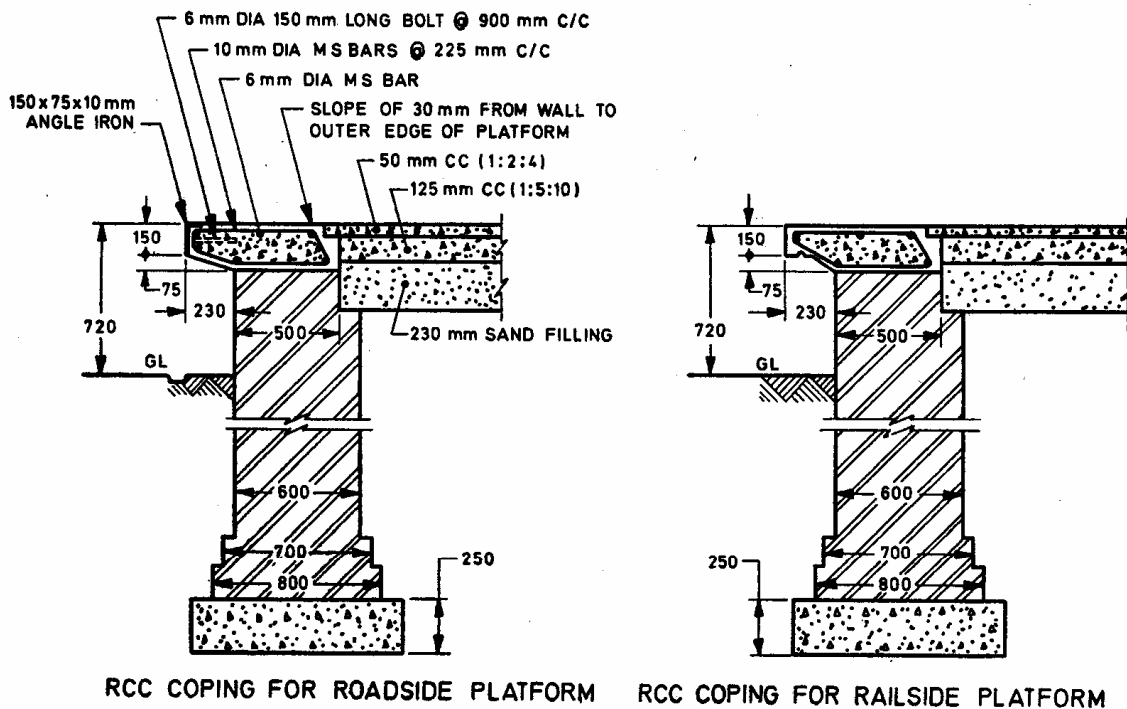
6.4 The foundation, in general, shall consist of lean cement concrete (1 : 5 : 10) for the walls and reinforced cement concrete (1 : 2 : 4) footings for reinforced cement concrete columns

7.3 The plinth shall be constructed of either stone or brick masonry in lime mortar (1:2) or cement mortar (1:6). Gable walls shall be in cement mortar (1:4). It shall be provided with damp proof course of well graded concrete with waterproofing compound (see IS : 2645-1964) 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.

7.4 Plinth Protection – The godowns 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 $0.06 \text{ m}^3 / 10 \text{ m}^2$ 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.



All dimensions in millimetres.

FIG. 3 GENERAL ARRANGEMENT OF PLATFORM PLINTH WITH COPING

8. FLOOR

8.1 The flooring in the godown 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 godown (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 concreted (1 : 5 : 10) 75 mm thick,
- d) A layer of bitumen maxphalt80/100 or equivalent spread uniformly at the rate of 1.7 kg/m², and
- e) A further layer of cement concrete (1 : 5 : 10) 75 mm thick over the waterproofing layer of bitumen.
- f) 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.

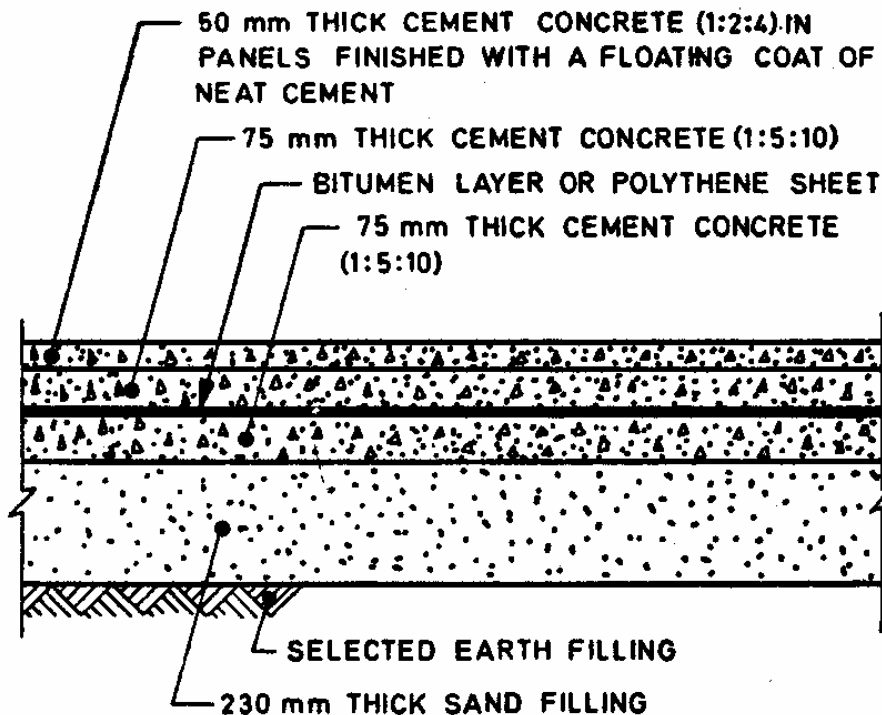


FIG. 4 DETAILS OF FLOORING (MAIN GODOWN)

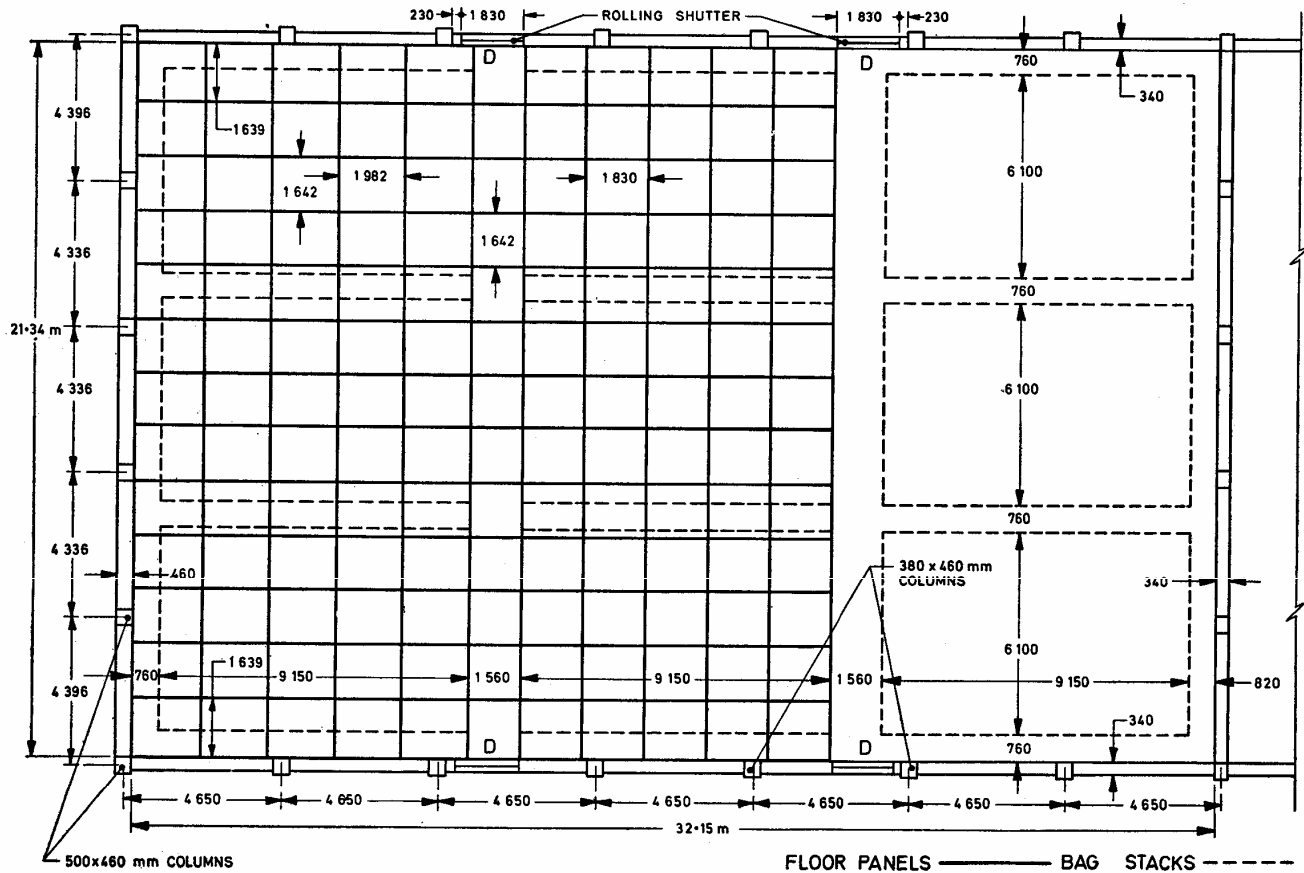


FIG. 5 TYPICAL ARRANGEMENT OF FLOOR PANELS

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 godown.

9.1.1 The longitudinal walls shall be of brick or stone masonry in cement mortar 1 : 6 and shall be at least 5 600 mm high for road-fed and 6350 mm for rail-fed godowns from the floor level. They shall be at least 340 mm in thickness with pilasters provided at truss supports. For span of 10 m and above, RCC columns may be provided under the trusses instead of pilasters. A spacing of 4650 mm from centre to centre of such RCC columns is recommended. For gable walls and partition walls also, pilasters or RCC columns shall be provided at intervals, as required. The gable wall shall be preferably of brick or stone masonry in cement mortar (1:4) up to at least 3 m in height, and at least 460 mm in thickness. The walls shall be flush with the outer surface of the plinth in case the platform is provided, and shall be plastered with cement mortar (1:6). They shall be rendered smooth both on the outer and inner surface. There shall be no offsets or projections in the wall. The inside edges of the walls where they meet the floor, all corners shall be rounded off to a radius of at least 50 mm. In seismic area, continuous RCC

bands (1 : 2: 4) and corners shall be rounded off suitably plastering at lintel and tie level of minimum 150 mm thickness for full width of wall shall be provided.

In seismic areas, 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 alleyway. 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 tow steel ventilators of opening not less than 1 494 × 594 mm shall be provided in each bay between RCC columns spaced at 4 500 mm from centre to centre. The ventilators shall be fixed 150 mm below the top edge of the wall measured from inside the godown. 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. In between the above ventilators, air inlets of steel ventilator 620 × 620 mm glazed openable outside double-hung in each bay shall also be provided at 600 mm from the floor level of the godown except those which have a rolling shutter opening. These shall be protected by expanded metal from outside (*see* Fig. 7). When closed, the shutter shall fit tight in frame. On gable walls, suitable number of steel ventilators glazed fixed with fixed wire-mesh shall be provided. 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)].

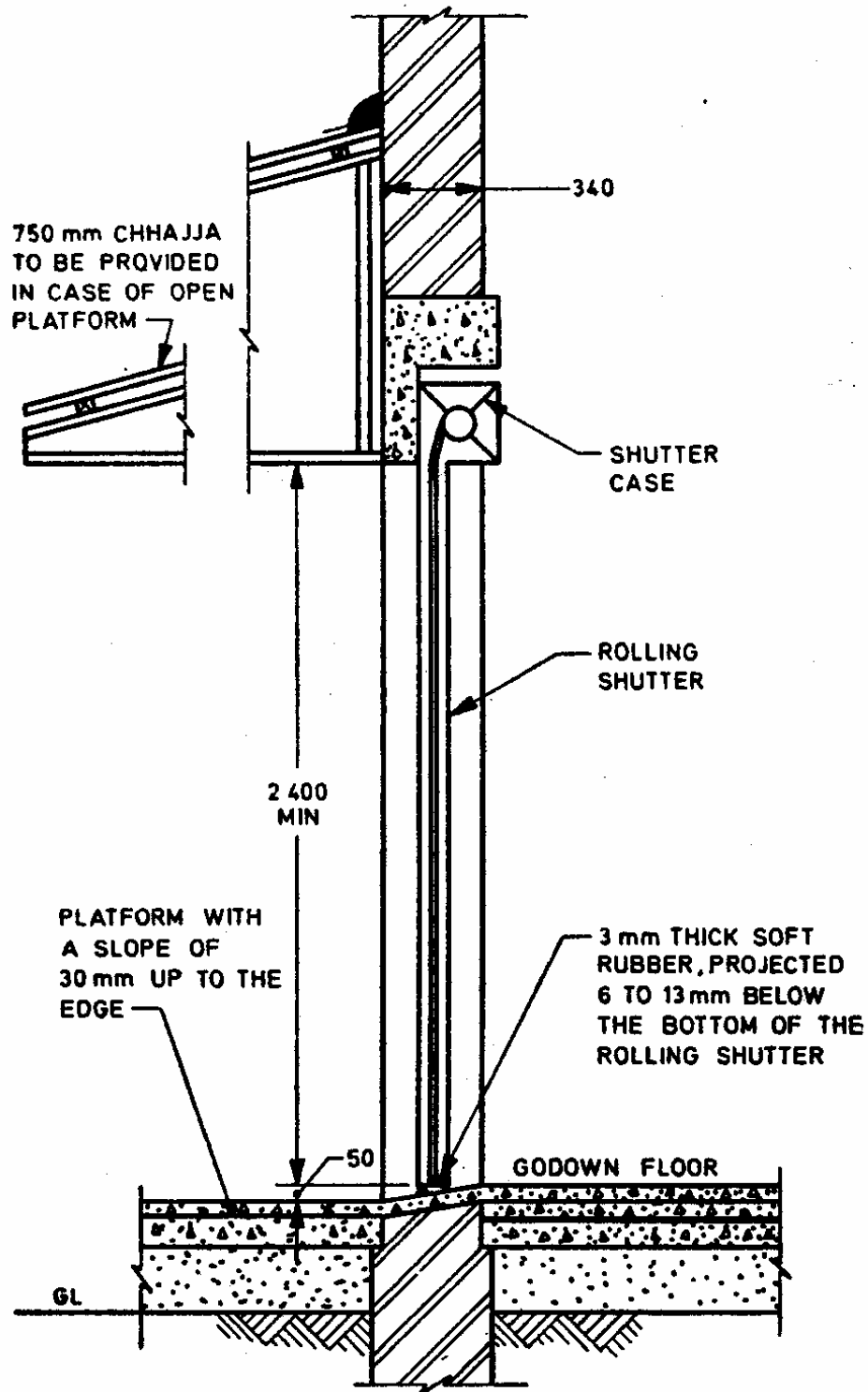
11. ROOF

11.1 The roof shall be of single span structural steel or tubular trusses of RCC flat types. These trusses shall be fixed on the RCC columns, pilasters or RS joists at a height 5 600 mm for the road-fed and 6 350 mm for the rail-fed godown from the floor level to the tie level at the column ends (*see* Fig.8)

11.1.1 RCC shell-type roof is well suited for grain storage structures. Wherever such type of roof is used, expertise in structural, centering and shuttering design as well as expertise in execution shall be obtained (see IS : 2204)

11.2 The roof of the platforms shall be of a cantilever structural steel or tubular trusses fixed on to RCC columns. The platform cantilever trusses shall be fixed at a height of 3 350 mm for rail-fed godown and for those served by metre-gauge railway and 4 350 mm for rail-fed godown with broad-gauge line. The height shall be measured from the floor level of the godown to the

bottom tie of the truss. The width of platform for railside and roadside shall be 3 050 mm and 2 450 mm respectively.

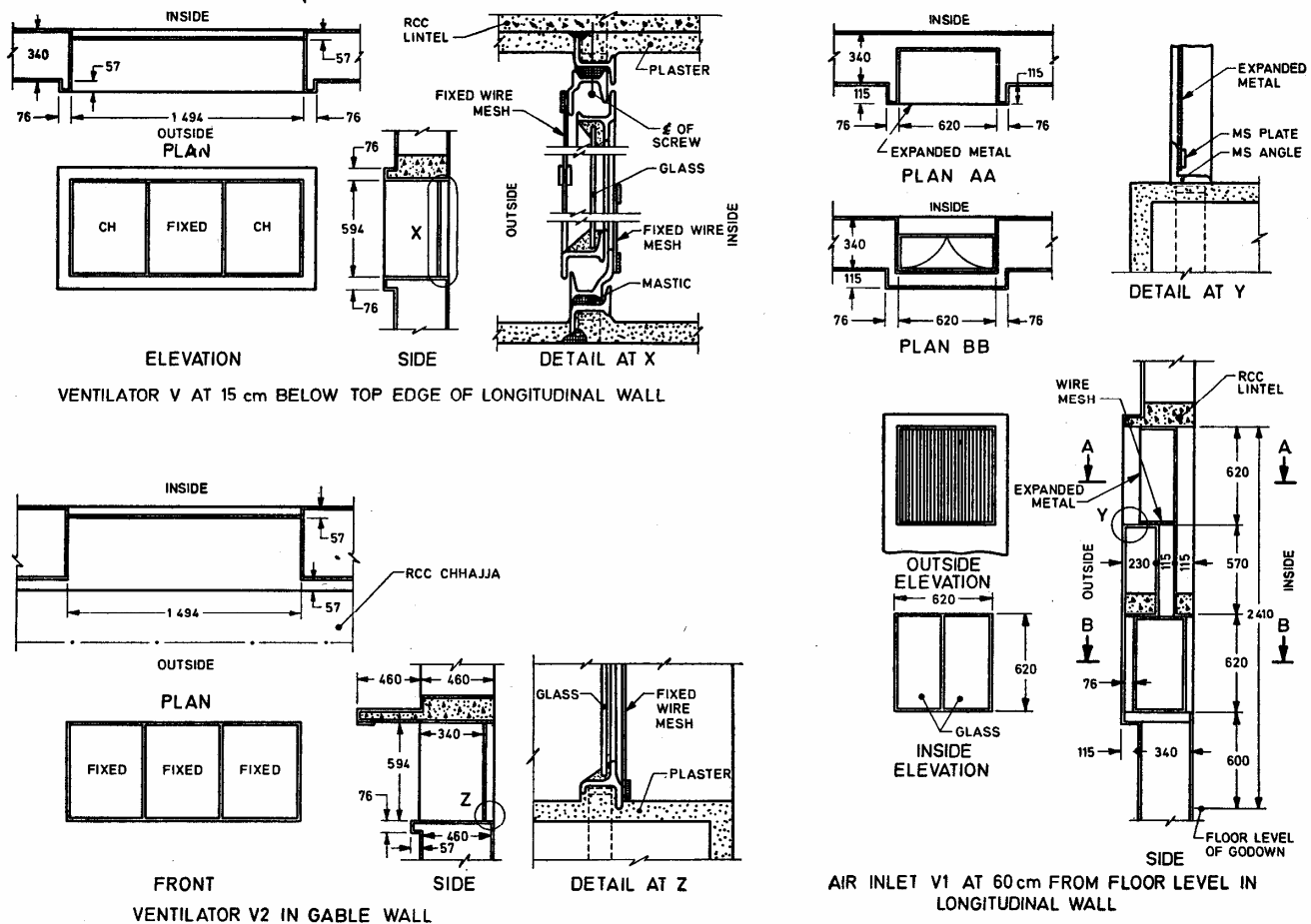


All dimensions in millimetres.

FIG. 6 DETAILS OF ROLLING SHUTTER

11.3 The trusses shall be connected by suitable sets of wind bracings at rafter level and continuous longitudinal runners or the bracings at tie level.

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)



All dimensions in millimetres.

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

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. They may be provided preferably at the partition 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.

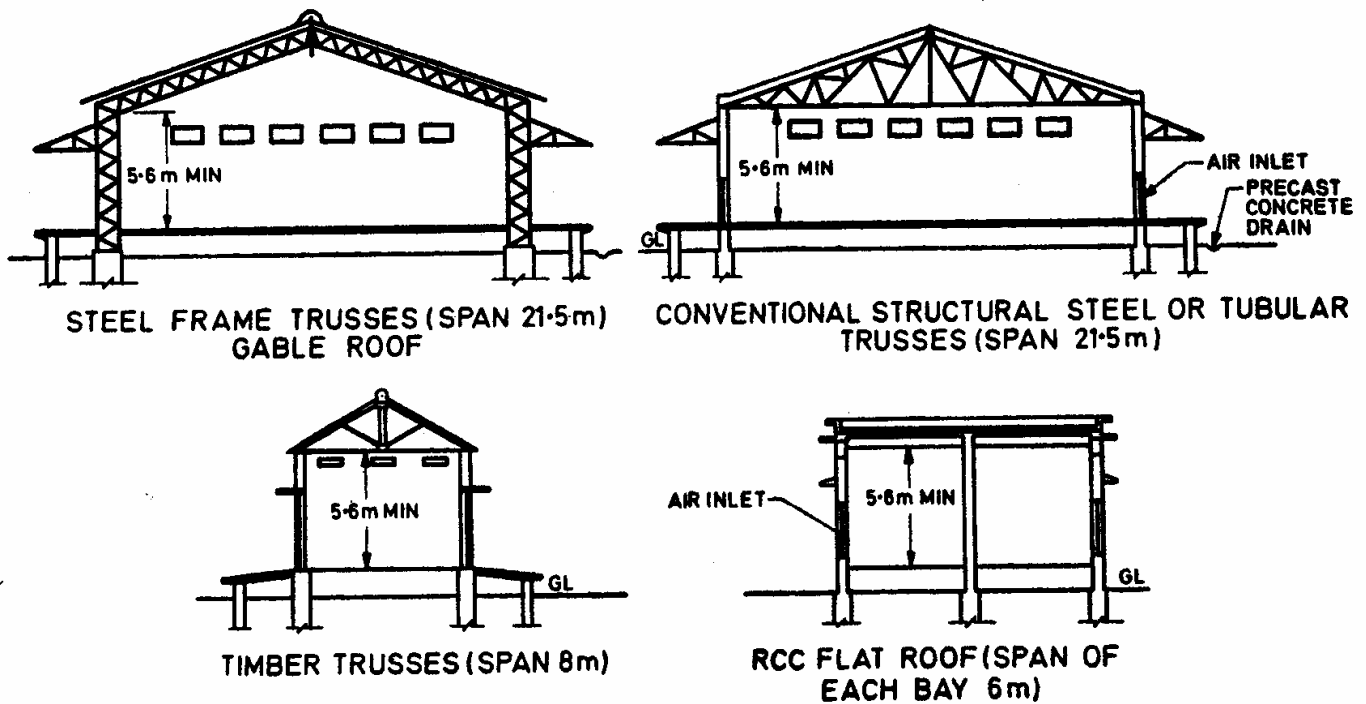


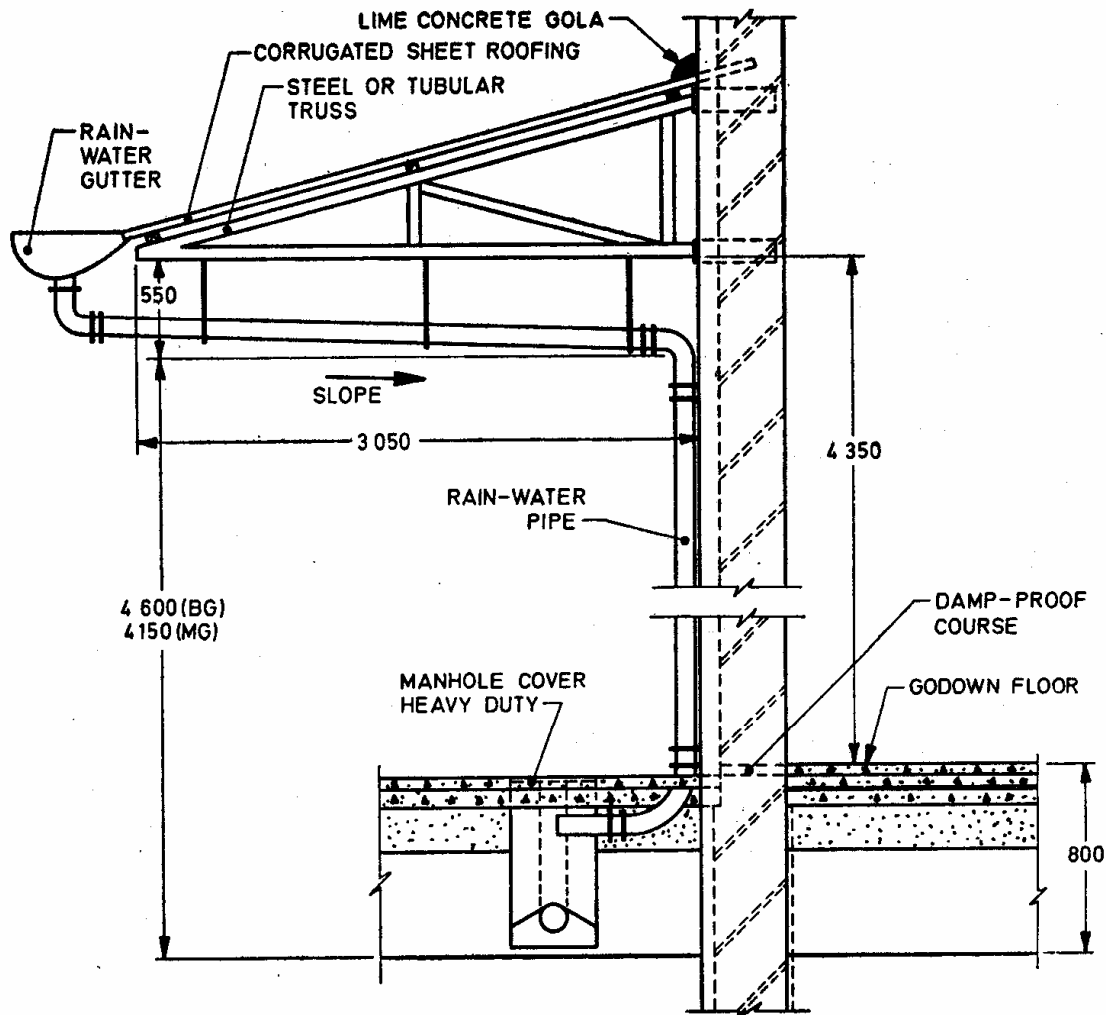
FIG. 8 DIFFERENT TYPES OF ROOFS FOR GODOWNS

12. GABLE AND PARTITION WALLS

12.1 A beam may be provided at tie level of 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 godown roof and platform roof shall be provided and suitably connected to the down-take rain water pipes (Fig.9). They shall be of cast iron or asbestos cement pipes (see IS 1626) of diameter not less than 10 cm. Their diameter shall also be adequate depending on the intensity of the rainfall of the place. The pipes shall be properly secured at the offtake 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 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.



All dimensions in millimetres.

FIG. 9 DETAILS OF EAVES GUTTER

14. FINISHING

14.1 The internal faces of the walls of godown 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 aluminum sheets shall be painted with two coats of superior quality paint suitable for GI or aluminum 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.

15. LIGHTING

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

APPENDIX A

(Clause 4.1)

ANCILLARY STRUCTURES AND OTHER AMENITIES

A-1 There may be one or more ancillary structures at each site depending upon the storage capacity and scope for future expansion. A small compact block consisting of an office room, a store room and a separate room for keeping pesticides may be provided at each site. For small capacity godowns, the following sized of rooms are suggested:

a)	Office room	4.5 × 3.5 m
b)	Store room	3.5 × 3.5 m
c)	Chowkidar-cum-switch room	4.0 × 2.25 m

A-1.1 The area of the office block would depend upon the staff pattern while that for store room would be on the basis of the storage capacity, the anticipated turnover of work, the quantity of dead stock articles, equipment and chemicals that may have to be kept at each centre. A room preferably separate with a suitable verandah may be provided for watch and ward purpose. For larger capacity of 5 000 tonnes and more, the following areas are recommended for office block:

	<i>Plinth Area</i>
a) 5 000 tonnes	100 m ²
b) Above 5 000 and up to 10 000 tonnes	180 m ²
c) Above 10 000 and up to 20 000 tonnes	278 m ²

A-2. For large-capacity godowns, the following ancillary structures may be provided for each centre in addition to the administrative block.

A-2.1 Isolation Shed – The size of the isolation shed would depend upon the storage capacity at each site. The isolation shed may preferably have RCC flat roof. It shall be partitioned into a number of compartments so as to afford keeping of infested and damaged stock separately.

The following scale is recommended:

<i>Storage Capacity</i>	<i>Capacity of Isolation Shed</i>	<i>No. of Compartments</i>
a) Up to 5 000 tonnes	100 tonnes	1
b) Above 5 000 and up to 10 000 tonnes	150 ”	2
c) Above 10 000 and up to 25 000 tonnes	250 ”	2
d) Above 25000 and up to 50 000 tonnes	500 ”	3
e) Above 50 000 and up to 75 000 tonnes	750 ”	4
f) Above 75 000 tonnes	1 percent of storage capacity	Minimum of 4 compartments

A-2.2 Lavatory Block and Sanitary Installation – For labourers and staff working in the premises of the godowns sufficient number of bathrooms, urinals, lavatories and washing places shall be provided. The following yard-stick for provision of lavatory block may be suggested:

<i>Storage Capacity</i>	<i>WC</i>	<i>Urinals</i>	<i>Washing Places</i>	<i>Drinking Places</i>
a) Up to 5 000 tonnes	1	2	1	1
b) Above 5 000 and up to 10 000 tonnes	2	3	2	2
c) Above 10 000 and up to 25 000 tonnes	3	6	4	4
d) Above 25 000 tonnes	The number may be suitably increased			

A-2.3 Water supply and the fire fighting arrangement shall be made.

A-2.4 for the staff and labourers working in the godown, facilities for drinking shall be provided at suitable locations.

A-2.5 For fire fighting purposes, a network of water supply pipe lines with fire hydrants at suitable locations may be provided to ensure supply of water at any time (*see* IS 3594 and IS 2190).

A-2.6 Canteen – It is recommended that the amenity of a canteen may be provided at each centre having a capacity of 5 000 tonnes or more. The size of canteen may be proportionately increased for godowns of higher capacities.