

## CHAPTER-8

### STRUCTURAL DESIGN OF GODOWN AND FACILITIES

#### DESIGN CONSIDERATIONS

The structure provides both space and protection to the foodgrains stored. It has to be functionally sound as well as physically strong so that it can perform well. It should also be integrated with the other facilities so that a co-ordinated flow of men and materials can take place. In the proposed CSP Centres, the foodgrain godown is the major structure and needs prime consideration. Its functional requirements, as mentioned earlier, are as follows:

- (i) It should provide protection from entry of direct water from roof, walls or floor.
- (ii) It should be able to seal the entry of moisture during rainy season.
- (iii) It should provide protection from direct heat or development of excessive heat.

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- (iv) It should provide aeration of stocks.
- (v) It should provide protection from insects, rodents and birds and hinder their growth inside or around the structure.
- (vi) It should allow easy loading and unloading of the structure.
- (vii) It should permit sealing of the structure to allow fumigation of the stocks.
- (viii) It should provide safety and security against risks of fire, theft, burglary etc.

The structural requirements of the godown are as follows:

- (i) The roofs, walls, columns, foundations and other components of the structure should be able to withstand loads due to their own weight, wind pressure, seismic vibrations, snow etc.
- (ii) They should be properly protected from the effects of moisture, temperature, smoke and other weathering conditions by suitable surface coating.
- (iii) They should be easy to clean, repair and maintain as and when needed.
- (iv) The floors should be able to withstand the weight of the material stored on them and should not develop cracks or cavities under the normal circumstances.

Besides, some other pertinent requirements of the structure are as follows:

- (i) It should permit use of local materials and skills for its construction.
- (ii) The design of structure should be in accordance with the local architect and methods of construction.

(iii) It should be cost-effective both for construction as well as maintenance. The design of the various structural components like roof, walls, columns, foundation, floor etc. for godown as well as other facilities is a standard practice with civil engineers. The conventions and methods of design are fairly well standardised and are being used since long for construction of various buildings. The improvements in design with respect to arrangement of space, use of special type of materials and methods of construction have been continuously attempted and incorporated by engineers practicing design of such structures. So, it has been considered worthwhile and

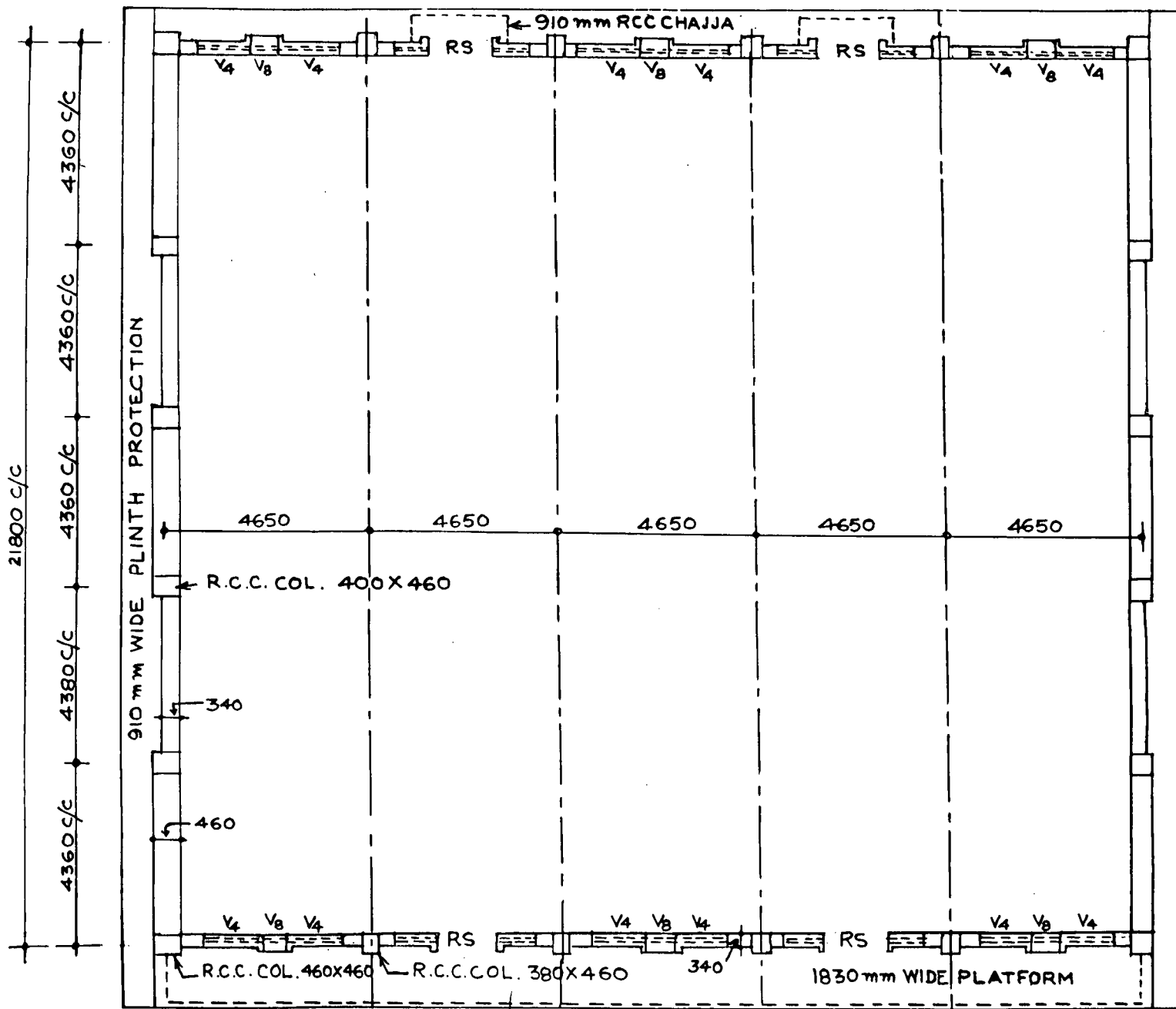
sufficient to bank upon their experience rather than attempt a complete structural design which may only serve a limited purpose for meeting objectives of present case study.

The design of foodgrain storage godowns is being practiced in India for long. Various agencies like Food Corporation of India, Central Warehousing Corporation, State Warehousing Corporations, Marketing Federations, Civil Supplies Corporations, Public Works Departments and many other agencies have considerable experience in design and construction of foodgrain storage godown. Based upon the research, development of new materials and experience with several structures, the designs have been suitably modified and appropriated to suit the conditions as well as bring about economy. Food Corporation of India and Central Warehousing Corporations are the two agencies who have constructed the largest number of godowns in various regions of the country. It was therefore considered necessary as well as sufficient to adopt the structural design of godowns prepared by these agencies. Design features of a 2500 MT capacity godown based upon the designs prepared by these two agencies are given the following paragraphs (See figs 8.1 to 8.9)

## DESIGN OF STRUCTURAL COMPONENTS OF STORAGE GODOWN

### Design of Roof

The roof consists of AC Sheets supported on tubular trusses. The span of the truss is 21.8 m and bay spacing 4.185 m. The tie level of the roof has been kept at 5.48 m from the floor level. Tubular trusses have been



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**FIG-8.1 PLAN OF STORAGE GODOWN (CAPACITY 2500MT)**

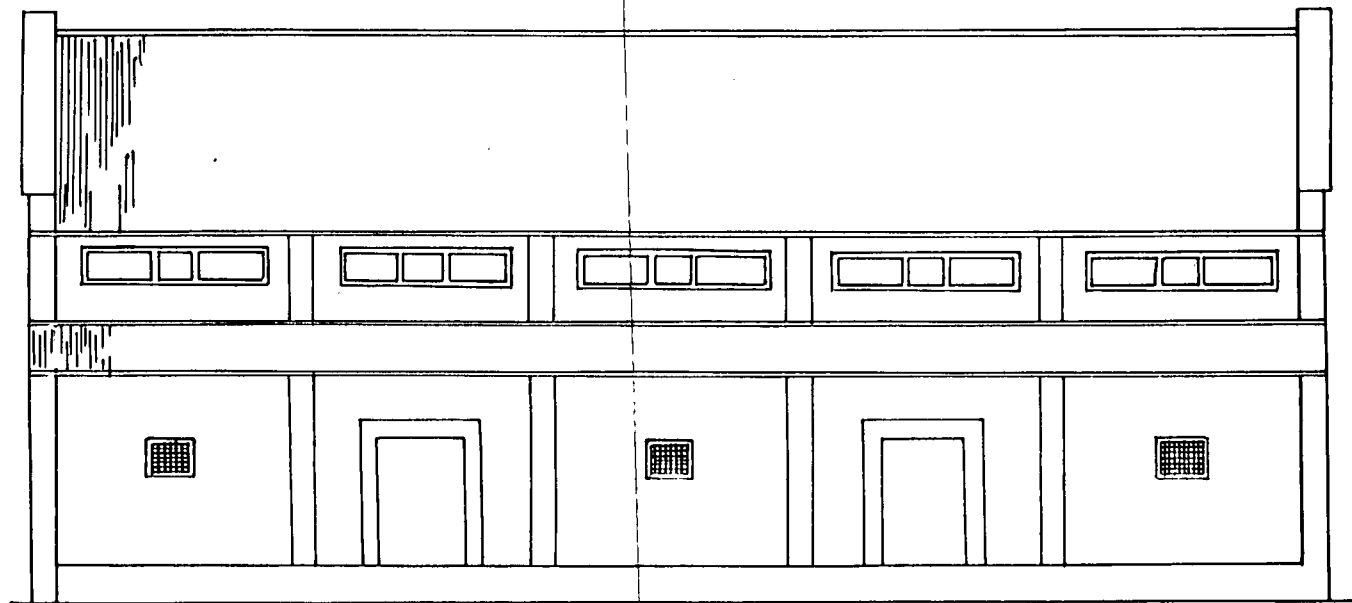


FIG-8-2 FRONT ELEVATION OF STORAGE GODOWN(CAPACITY 2500 MT)

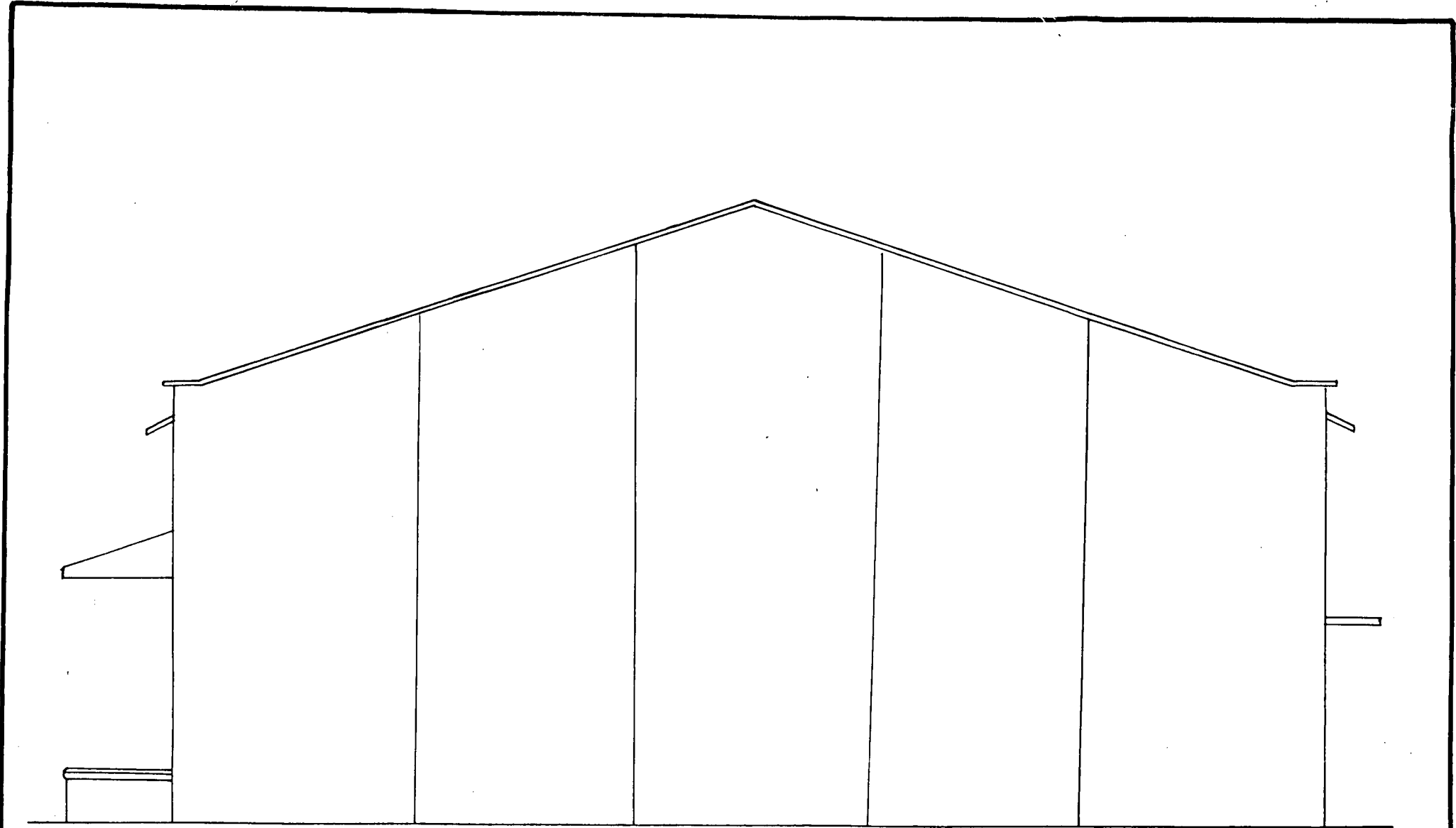
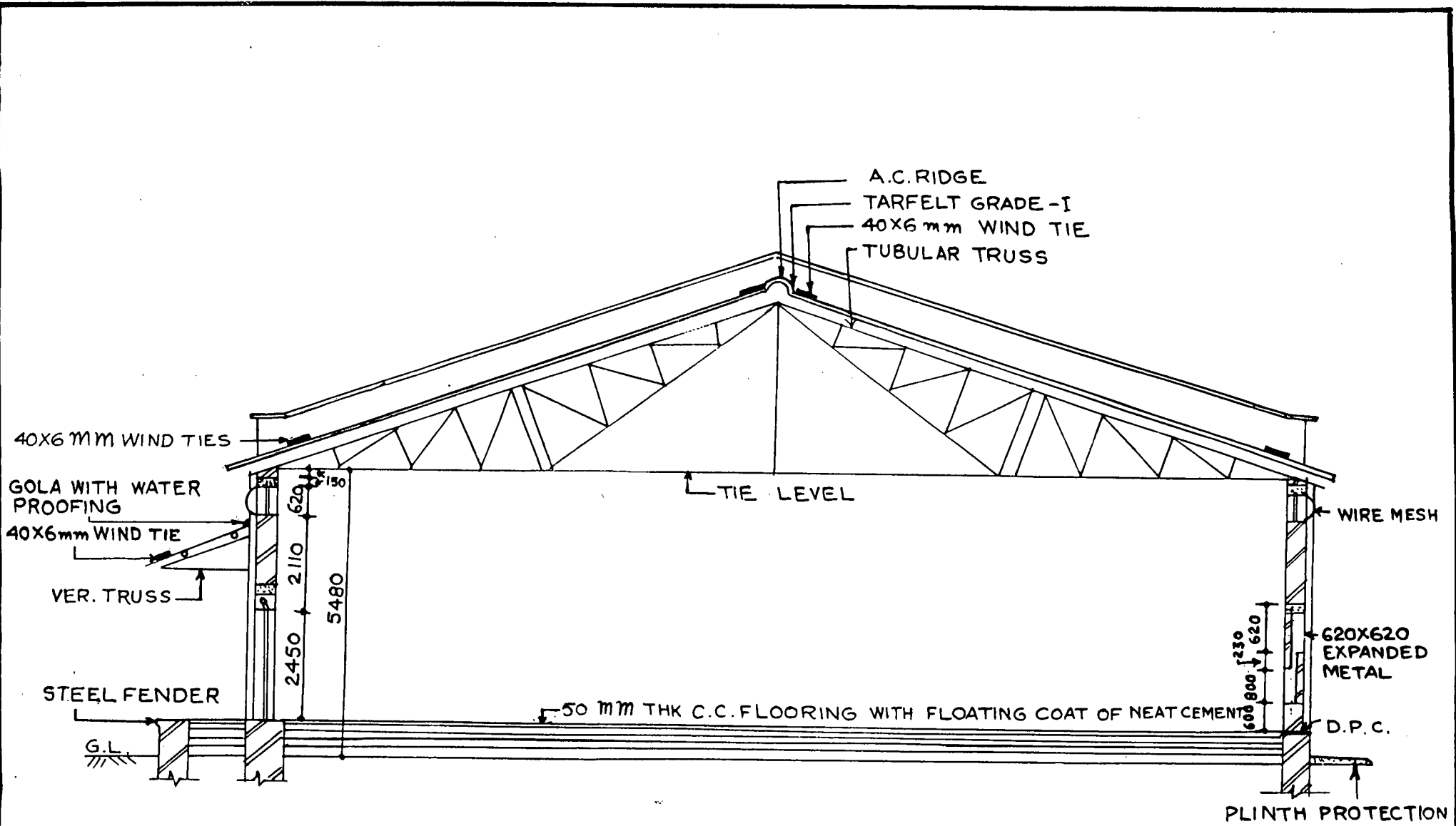


FIG-8.3 SIDE ELEVATION OF STORAGE GODOWN



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FIG-8.4 SECTIONAL ELEVATION OF GODOWN TRUSS

adopted since they are more economical than the angle-iron or channel section trusses. AC sheets are preferred over galvanised iron sheets since they are bad conductor of heat and therefore help in protecting the stocks from extreme heat during summer. The joints of sheets are kept overlapped in such a way that water does not enter through these joints. At the points where sheets are fastened to the purlins with iron hooks, tarfelt washers are used to seal off the joints against water. The trusses are supported on RCC columns, fastened with the help of bolts embedded in concrete columns.

The godown is provided with platform/verandah 1.83 m wide on one side of the godown to facilitate receipt and despatch of the stocks. The verandah is also provided with AC sheets supported on tubular truss. The verandah trusses also have the same spacing as the roof trusses and are placed at a height of 3.48 m. They are fastened to the columns with the help of horizontal bolts with welded MS plate embedded in reinforced concrete.

#### Design of columns

The vertical columns are meant to take the load of the roof and truss. These are RCC columns of the size 460 x 380 mm, built in 1:2:4 concrete. The vertical reinforcement consists of 6 bars of 16 mm dia and horizontal reinforcement with 6 mm dia bars with 220 mm c/c.

The gable walls are supported with the help of RCC Columns 460x460 mm at the ends. The intermediate columns have the size of 460 x 400 mm. These columns are relatively less reinforced due to little vertical load on them. The columns are supported on RCC base.

### Design of Walls

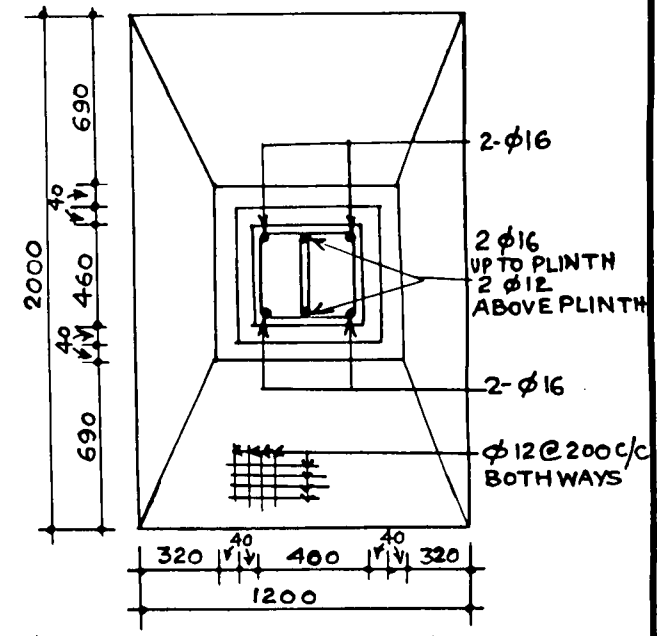
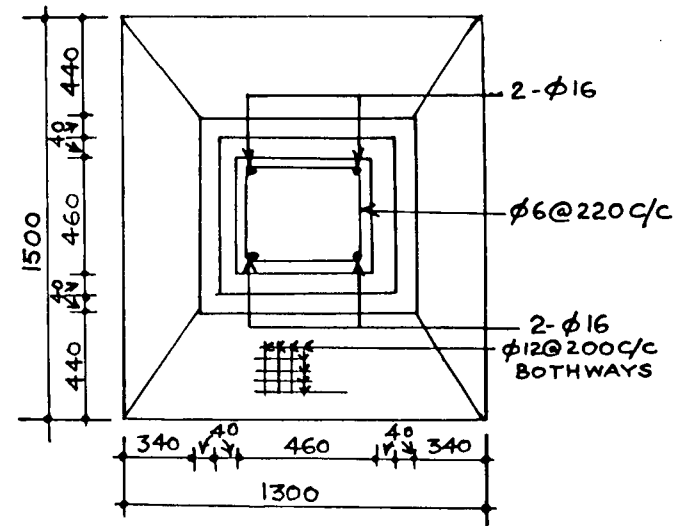
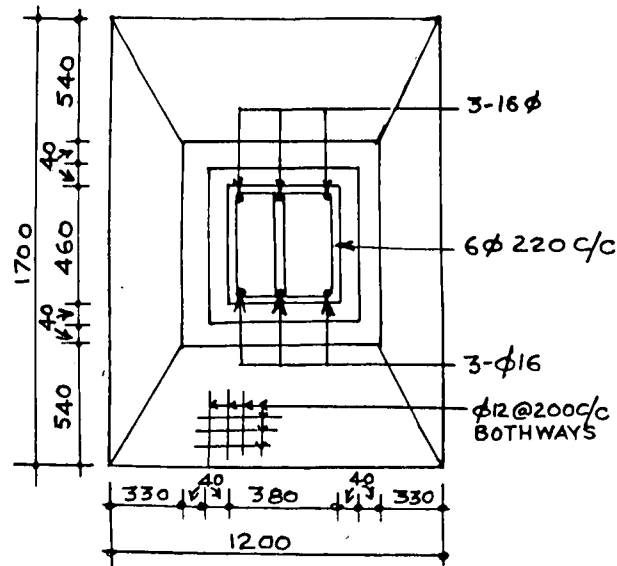
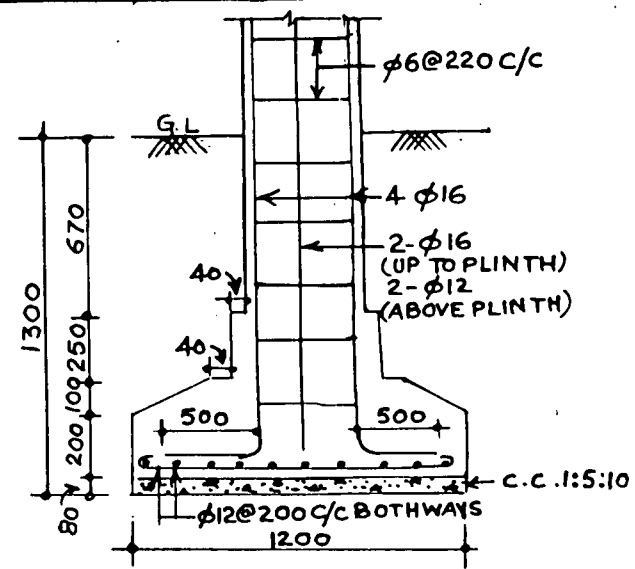
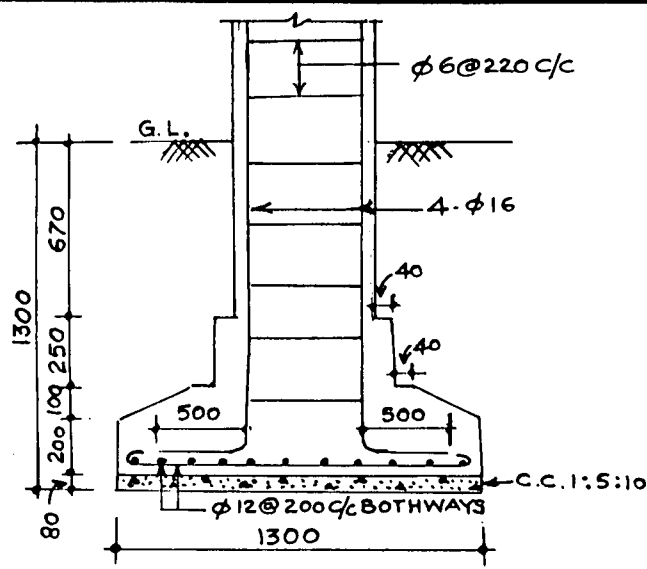
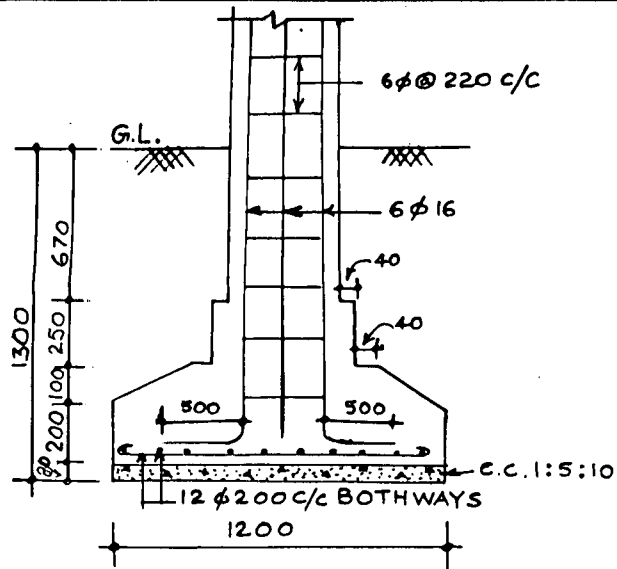
The walls of the godowns are generally made of bricks. The thickness of the gable walls is kept as 460 mm whereas that of front and rear walls is kept as 340 mm. Brick work is done in Cement mortar(1:6) and plastered with the same on both inside and outside to give it smooth finish as well as make it damp proof. RCC bandis provided at the height of 5180 mm above plinth.

### Design of Column footings and wall foundations

The design of various column footings and wall foundations is given in figures 8.5 and 8.6. The safe bearing capacity of 11 MT/Sq m has been assumed for designing these structural components. The foundation is usually laid over firm soil. A layer of lean cement concrete 1:5:10 is first laid before starting the foundation/column footings. The depth of the column footings is kept as 1300 mm and that of the wall foundations as 1200 mm. The size of footing and reinforcement varies with the column type.

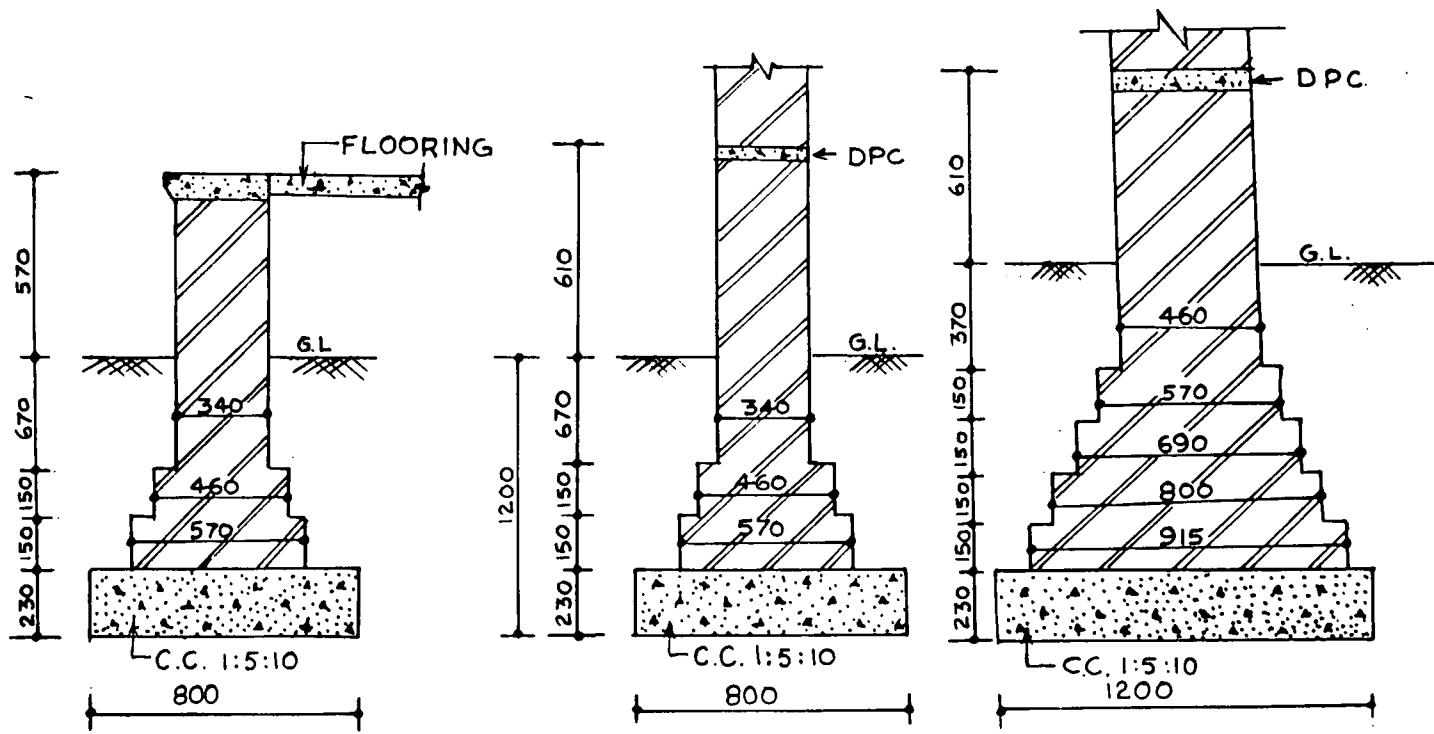
The RCC work for column is done with the cement concrete mix of 1:2:4. The foundation work is done in bricks joined together with the cement mortar mix of 1:6. DPC is laid over the brick foundation wall at a height of 610 mm. The thickness of damp-proof course is 40 mm and it is coated with <sup>a</sup>layer of residual petroleum bitumen @ 1.7 Kg/Sq m.

The exposed surfaces of the foundation walls are plastered with cement mortar of ratio 1:3 and thickness not exceeding 6 mm. The excavated earth is filled in trenches around footings and foundations. Each layer of earth after filling is rammed and watered to consolidate the filled up earth.



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FIG-8.5 DETAILS OF COLUMNS AND COLUMN FOOTINGS



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FIG-8-6 DETAIL OF WALL FOUNDATION

### Design of Floor

The floor is laid over well rammed earth filled in' layers and each layer consolidated by ramming and watering. A layer of sand filling (150 mm thick) is given over the rammed earth. This is followed by 150 mm layer of stone aggregates of size 63 to 100 mm consolidated in two layers. Another layer of 75 mm thickness of stone aggregates of 50 mm nominal size is laid over the coarse aggregate layer and consolidated. Then a polythene layer is given to prevent seepage of water through the floor. Over the polythene layer, 50 mm thick layer of cement concrete mix of ratio 1:2:4 is laid. The surface of the floor is finished with a floating coat of neat cement in the form of cement slurry. The section of a typical godown floor is given in fig. 8.7.

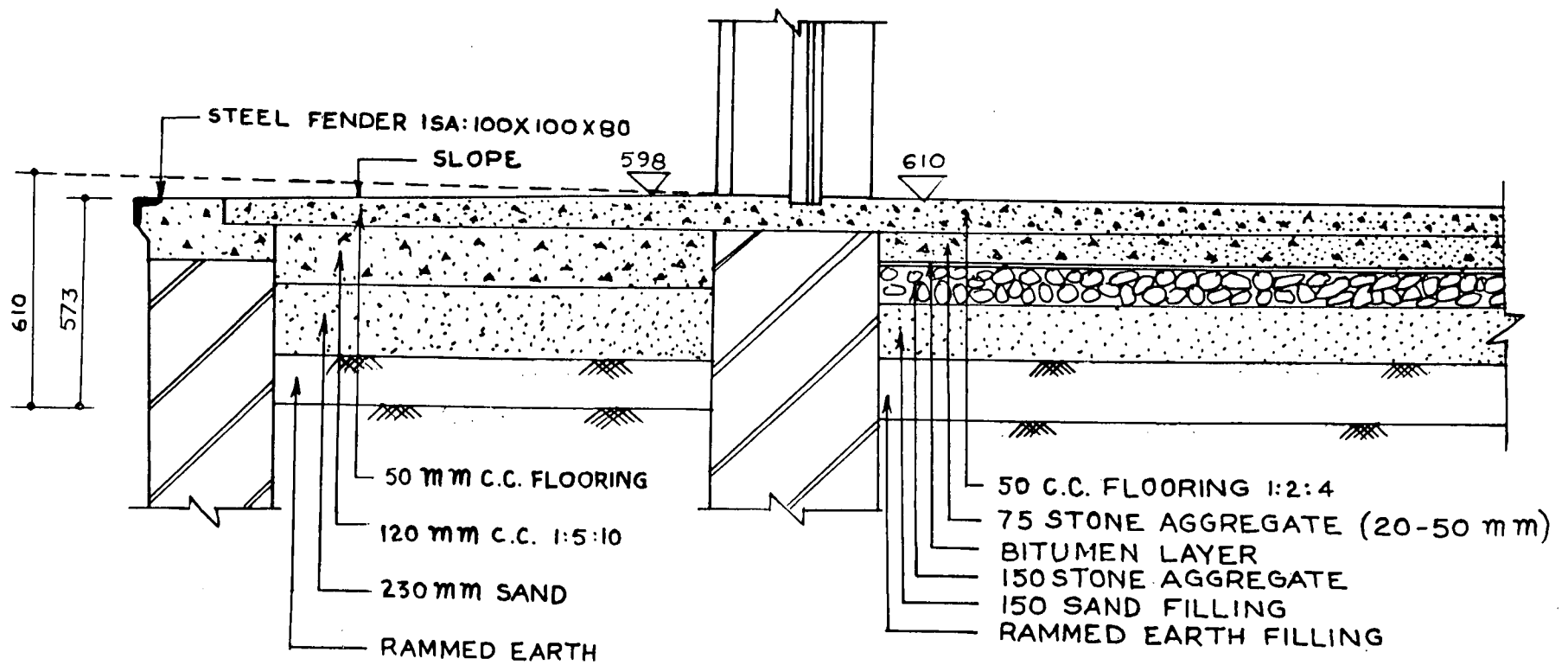
### Design of Ventilators and Doors

Two types of ventilators are used in the foodgrain storage godown-

- (i) Steel Ventilators ( $V_4$ ) glazed composite units with fixed and centre hung alongwith wire mesh fixed on end parts- size 1490x620 mm
- (ii) Steel ventilators ( $V_8$ ) glazed and double hung - size 390x800mm

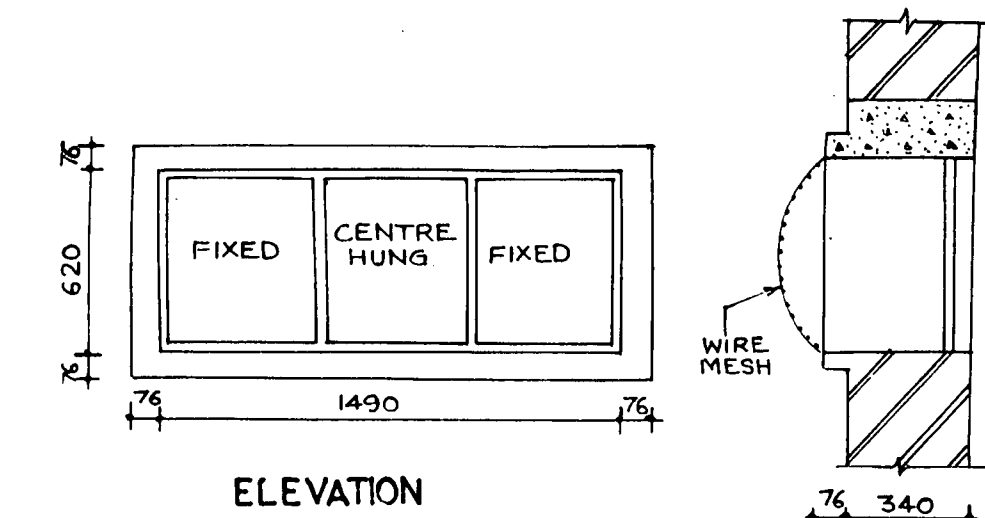
The details of the ventilators are given in figure 8.8.

For doors, rolling shutters are provided (size 1830x2450 mm). The shutters can be rolled manually or with a lever mechanism. The bottom of shutter rests into a guide sleeve so that no gap is left between the floor and shutter. These shutters are fixed on the inside of the godown wall. A standard godown shutter as well



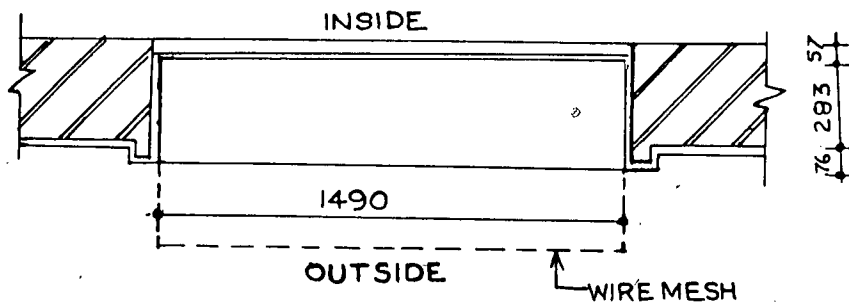
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FIG-8.7 DETAILS OF GODOWN FLOOR



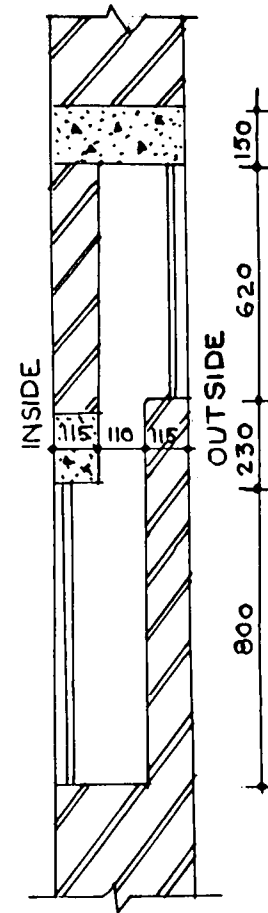
ELEVATION

SECTION

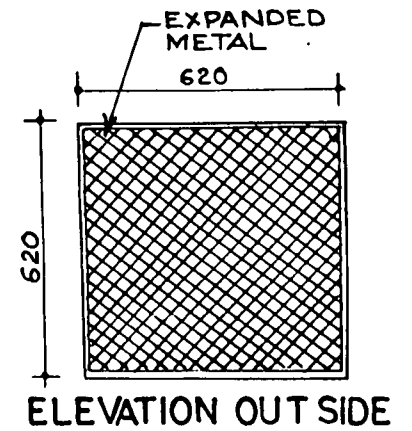


PLAN

VENTILATOR V-4 TYPE

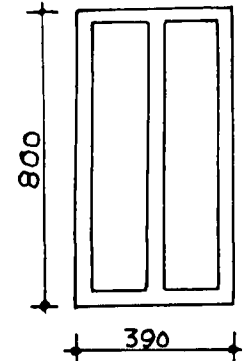


SECTION



ELEVATION IN SIDE

ELEVATION OUT SIDE



VENTILATOR V-8 TYPE

FIG-8-8 DETAILS OF VENTILATORS

#### DESIGN OF OFFICE-CUM-RESIDENCE COMPLEX

The office-cum-residence of CSP centre is proposed to cover an area of about 75 Sq.m. The ground floor will house the office, stores and laboratory and the first floor will house the residence of the manager. The floor plan of the area covered is given in Figs 8.9 and 8.10.

If found necessary the ground floor construction may be extended to house a bank, a milling units for foodgrains as well as an outlet for sale of fertilizers/seeds etc.

#### PLAN FOR OTHER FACILITIES

The other facilities that may be needed at the CSP centre are roads, drying yard and boundary wall. A layout plan of CSP centre incorporating these facilities is given in figure 8.11. However the arrangement of facilities will vary according to the size and dimensions of available land area.

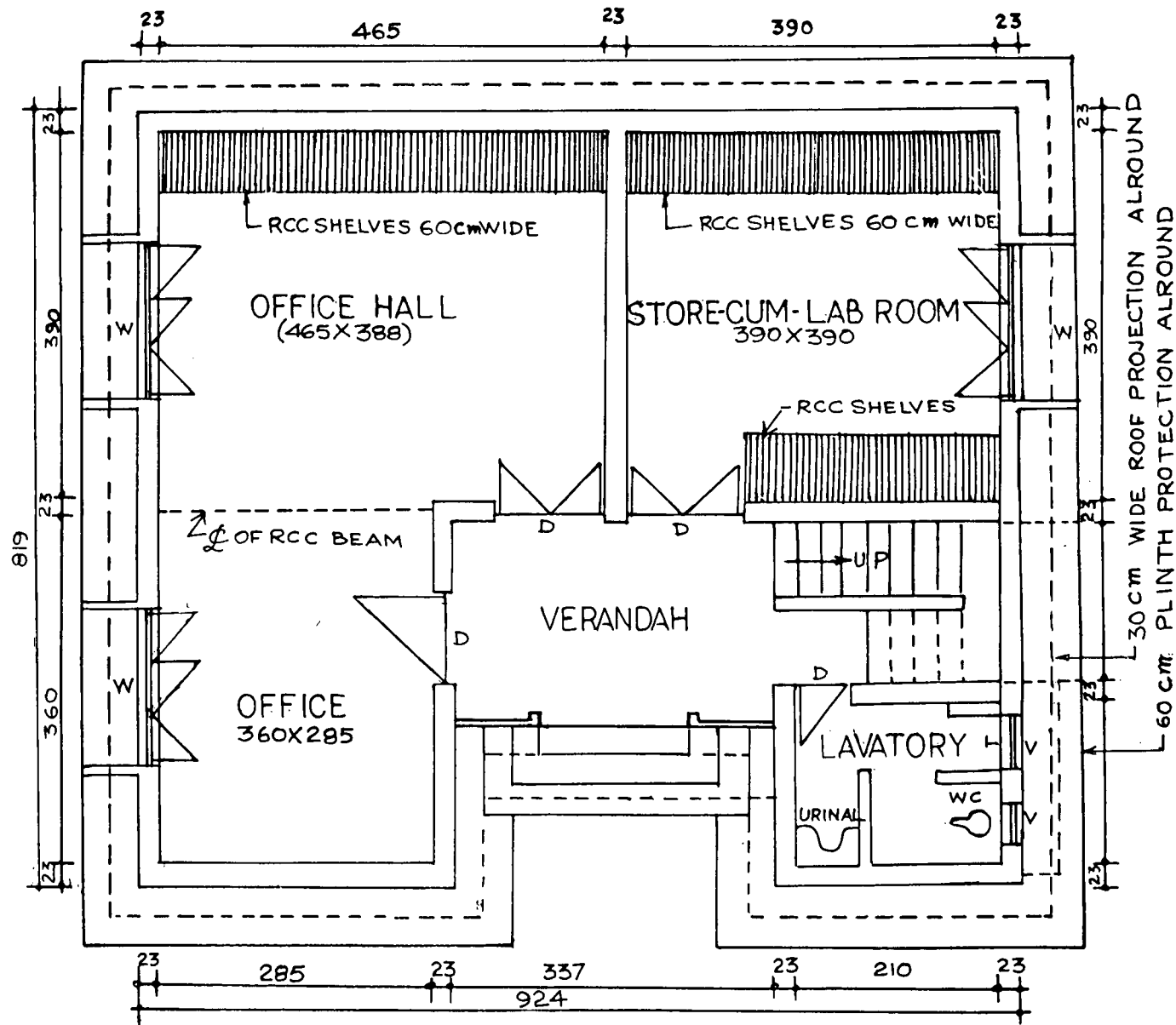
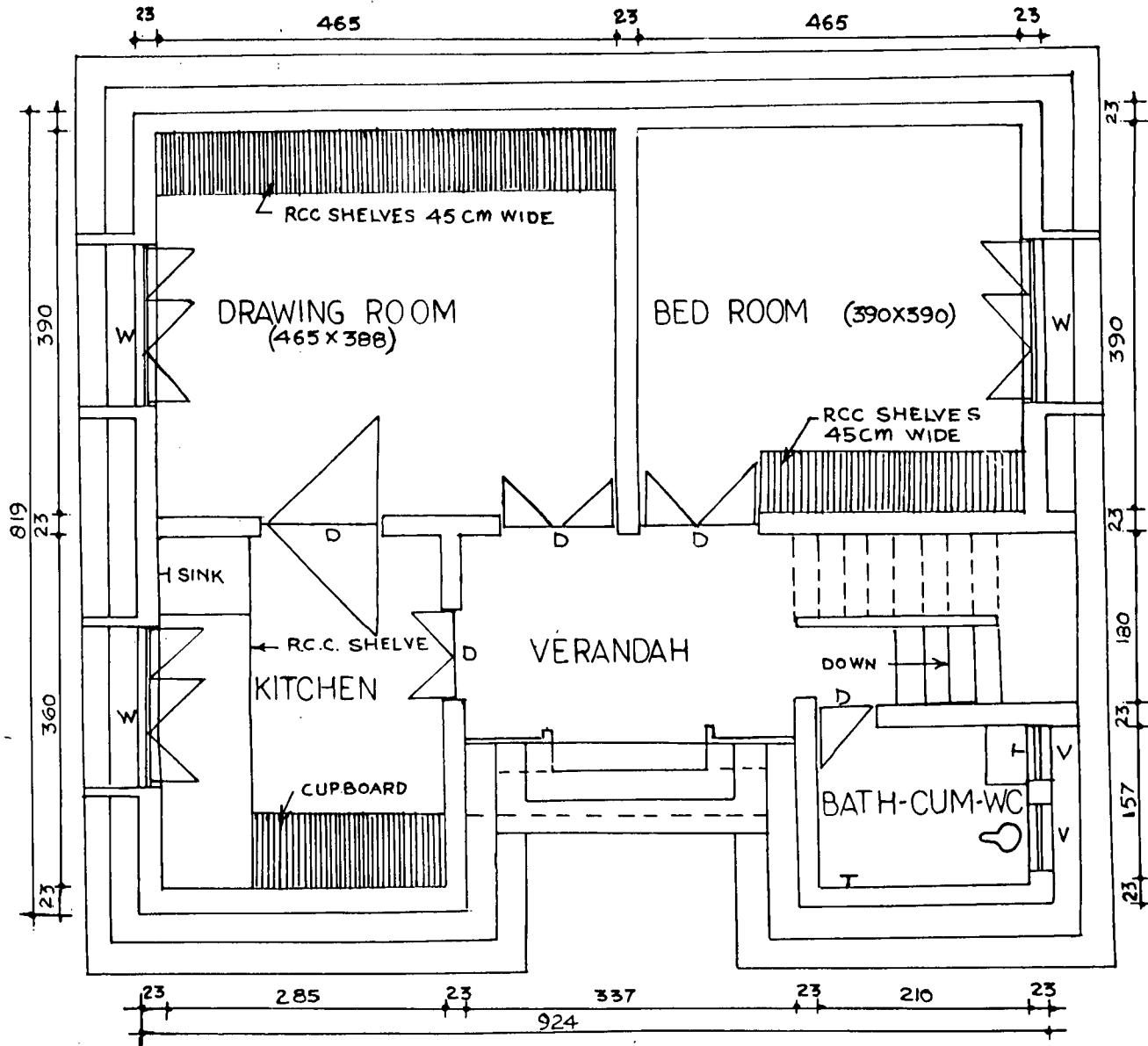


FIG-8.9 GROUND FLOOR PLAN OF OFFICE CUM RESIDENCE BLOCK.



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FIG-8-10 FIRST FLOOR PLAN OF OFFICE-CUM-RESIDENCE BLOCK

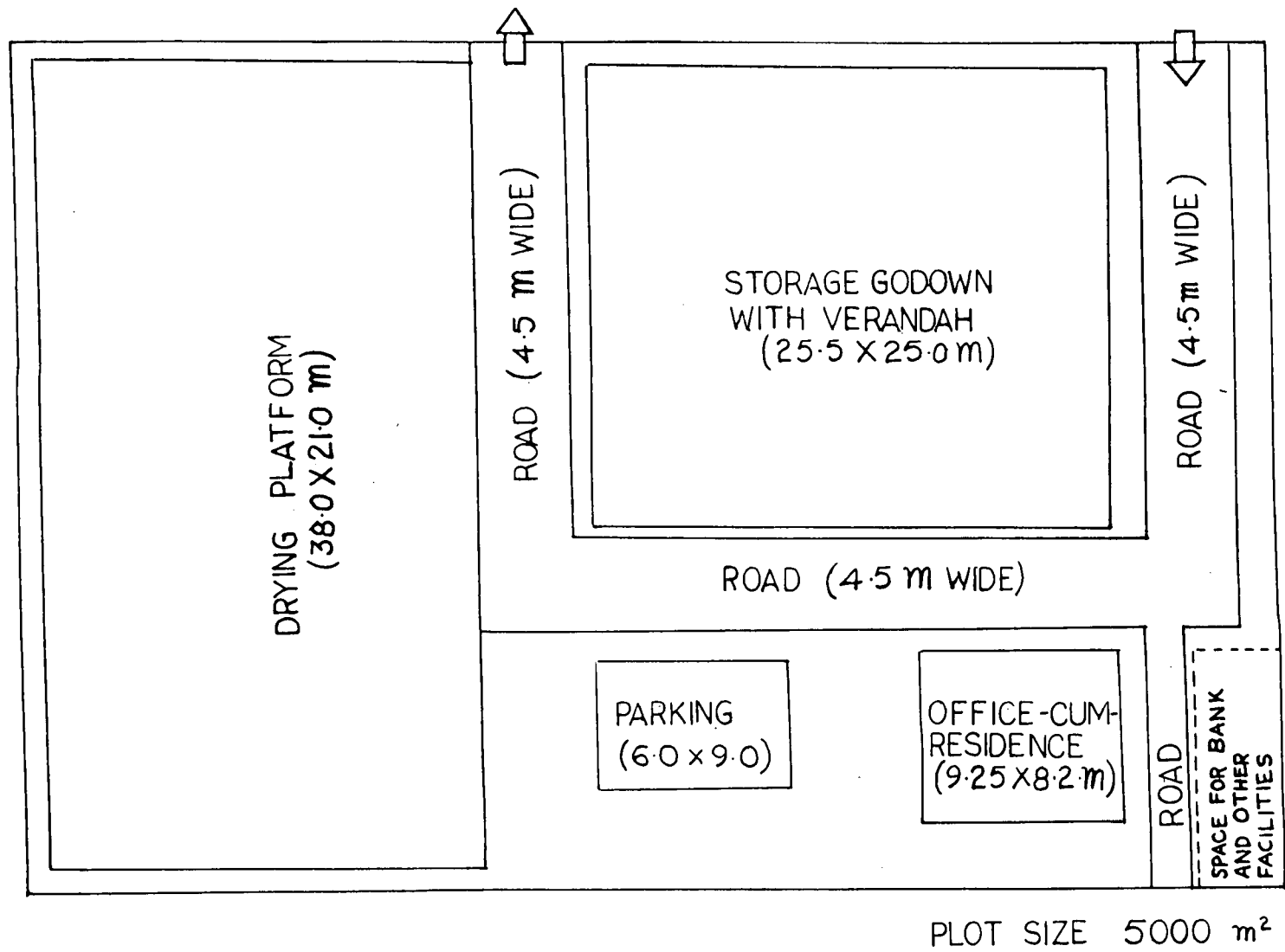


FIG-8-II LAYOUT OF GODOWN AND FACILITIES