TECHNICAL

REQUIREMENTS

FOR

STOREY SHELTERS

2006

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CHAPTER 1

INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1 GENERAL

A storey shelter (SS) is designed and constructed for the protection of people against weapon effects during a war emergency. People should not stay inside there for protection during other peacetime emergency situations such as a fire in a building. The SS is located at a common property area of a storey and serves the residents of the dwelling units of that storey.

1.2 PEACETIME USE

During peacetime, the SS may be used as a common facility for the residents of the storey or building. The other statutory requirements governing the design and use of the SS space shall also be complied with.

1.3 ABBREVIATIONS

Clause	Description	Abbreviation
1.1	Storey Shelter	SS
2.1	Non-Shelter	NS
2.2	Gross Floor Area	GFA
2.3.1	External Building Line	EBL
2.5.2	Finished Floor Level	FFL
2.5.4	Staircase Storey Shelter	S/C SS

1.4 DEFINITIONS

Clause	Definition	Term
2.1	The space in the SS tower that is not intended for use as a shelter.	Non-Shelter
2.1.1	Building exit staircase used as SS	Staircase SS
2.1.2	Height of SS measured from its FFL to the soffit of the SS ceiling slab.	SS Clear Height
2.1.2	Height of NS measured from its FFL to the soffit of the NS ceiling slab.	NS Clear Height
2.2	Relevant Authority means the Commissioner of Singapore Civil Defence Force and includes officers authorised by him generally or specifically to exercise the powers, functions and duties conferred by the Civil Defence Shelter Act.	Relevant Authority
2.3.1	The edge line of the ceiling slab above the SS wall under consideration.	External Building Line
2.3.1	Distance from external face of a SS wall to the nearest EBL.	Setback Distance

CHAPTER 2

ARCHITECTURAL REQUIREMENTS

CHAPTER 2: ARCHITECTURAL REQUIREMENTS

2.1 SS OR NS FORM

2.1.1 Plan

The configuration of a SS or NS on plan shall be rectangular or square. For case of staircase SS, recesses are allowed.

2.1.2 Dimensions

The maximum internal length of any floor and roof slab of a SS shall be 8000 mm. The minimum internal width of a SS shall be 1200 mm. The ratio of the internal length to the internal width shall not exceed 3:1. The minimum and maximum SS clear height shall be 2400 mm and 3900 mm respectively (See FIGURE 2.1.2). The maximum NS clear height shall be 3900 mm.

2.2 SIZE OF SS - AREA AND VOLUME

The minimum internal floor area and minimum internal volume of a SS shall be in accordance with TABLE 2.2.

The maximum internal floor area of a SS shall be 32 m^2.

2.3 LOCATION OF SS

2.3.1 SS Position

A SS has to be positioned such that the setback distance of each SS wall shall be as large as is practical, and shall not be less than the minimum specified setback distance.

A pair of adjacent SS can share an internal common wall (See FIGURE 2.3.1(a)).

Each of the dwelling units served by the SS shall have at least one exit door at the same storey as the SS. The travel distance between the SS door and the exit door (at the same storey as the SS) of any dwelling unit served by the SS shall not exceed 40 metres (FIGURE. 2.3.1(b)).

2.3.2 SS Tower

In a building of more than one-storey, the SS (or NS, where applicable) on every storey shall be located one on top of the other to form a vertical tower with its walls structurally continuous to the foundation (See FIGURE 2.3.2).

2.3.3 Setback Distances of SS Walls (Without Reinforced Concrete Down-hang Beams along EBL)

(a) The SS walls shall be located at minimum setback distances from the EBL (See FIGURE 2.3.3(a), FIGURE 2.3.3(b) and FIGURE 2.3.3(c)). The setback distances of the SS shall comply with TABLE 2.3.3.

(b) Where the storey height of a SS on the first storey is greater than the storey heights of other SS above it, the minimum setback distances of the SS on the first storey may be the same as the setback distances of the SS above it.

(c) For SS walls (where the SS door is not located), trellis constructed of RC or steel hollow section may be used to make up for the shortfall in setback distance However, a minimum 1200 mm RC ceiling slab from the SS wall shall be provided (see FIGURE 2.3.3(d)). A perpendicular or parallel trellis arrangement, or a combination of both, with respect to the SS wall concerned, shall comply with the geometrical configuration as shown in FIGURE 2.3.3(e) and FIGURE 2.3.3(f).

2.3.4 Setback Distances of SS Walls (With Reinforced Concrete Down-hang Beams along EBL)

(a) Where down-hang beams are provided along EBL in front of SS walls, the minimum setback distance of these SS walls can be reduced based on the effective storey height and in accordance with TABLE 2.3.4(a). The effective storey height is determined by the storey height less the depth 'd' of the down-hang beam (See FIGURE 2.3.4(a)). If a down-hang beam is also provided along EBL in front of the SS wall with SS door, the setback distance of this wall shall be in accordance with TABLE 2.3.4(b). Otherwise, it shall be in accordance with TABLE 2.3.3.

(b) The setback distances of the SS on the first storey (where its storey height is greater than the storey height of the SS directly above it) may be the same as the setback distances of the SS directly above it provided a down-hang beam of dimensions not less than those provided at the 2nd storey ceiling slab is provided at the 1st storey ceiling slab.

(c) For SS walls (where the SS door is not located), RC ledge or trellis constructed of RC or steel hollow section may be used to make up for the shortfall in setback distance However, a minimum 1200 mm RC ceiling slab from the SS wall shall be provided (see FIGURE 2.3.4(b)). A perpendicular or parallel trellis arrangement, or a combination of both, with respect to the SS wall concerned, shall comply with the geometrical configuration as shown in FIGURE 2.3.3(e) and 2.3.3(f).

(d) Clause 2.3.4 shall apply only if the width of the reinforced concrete down-hang beam is at least 125 mm.

2.4 THICKNESS OF SS WALL

The thickness of SS wall varies according to SS clear height and the setback distance. The thickness shall comply with the following requirements:

(a) The minimum SS wall thickness shall be in accordance with TABLE 2.4.

(b) Wall thickness of any SS or NS within the SS tower shall not be less than the wall thickness of the SS or NS above it.

(c) The minimum thickness of an internal SS wall, which is common to two adjacent SS shall be 200mm.

2.5 SS DOOR

2.5.1 Opening Dimensions

The opening dimensions of SS door shall be:

(a) 850/900(W) x 2055(H) mm

(b) 900(W) x 1900(H) mm

(c) 1000(W) x 2055(H) mm

2.5.2 Location

The SS door shall be located on a SS wall with the minimum setback distance of 3000 mm:

The vertical edge of the SS door frame shall have a minimum 150 mm nib for cast in-situ construction (See FIGURE 2.5.2(a)), and 300 mm nib for pre-cast door frame panel Type 1 (See FIGURE 3.5.4(j)).

The FFL of the floor slab outside the SS shall be done such that the SS door can be opened adequately for the peacetime use of the SS (See FIGURE 2.5.2(b)).

A full-height shielding reinforced concrete wall, with a minimum thickness of 200 mm, has to be provided in front of the SS door at the shelter entrance on each storey. The shielding wall has to be positioned such that it is not more than 3000 mm from the SS door (see FIGURE 2.5.2 (c)).

2.5.3 Strengthened Ceiling Slab Outside SS Door

The minimum thickness of the reinforced concrete ceiling slab immediately outside the SS door shall be 150 mm and structurally connected to SS tower. The dimensions of this strengthened portion shall be as shown in FIGURE. 2.5.3.

2.5.4 Protection of Accessibility to the SS Door – Not Applicable for S/C SS

For SS located at a storey where only one staircase (or scissor-staircase arrangement) serves that storey, the accessway from the staircase to the SS shall have a minimum width of 2000 mm and its floor and ceiling shall be at least 150 mm reinforced concrete elements and shall be cast-in-situ with the SS.

2.6 RESCUE HATCH – Not Applicable for S/C SS

2.6.1 General

A rescue hatch shall be provided on the floor and ceiling on every SS in a SS tower, except that the bottom-most SS shall not have a hatch in its floor and the top-most SS shall not have a hatch in its ceiling. The hatch shall be made of airtight sealed galvanised steel construction *and be fire rated*.

2.6.2 Position

The rescue hatches in an SS shall be positioned adjacent to the SS walls with minimum dimensions as shown in FIGURE 2.6.2(a). The vertical centreline of the hatch in the ceiling shall be offset from the centreline of the hatch in the floor of the same SS by at least 1400 mm (FIGURE 2.6.2 (b)).

2.6.3 Dimensions

The net clear opening of the rescue hatch shall be 700 mm x 700 mm. The dimensions of the rescue hatch are as shown in FIGURE 2.6.3.

2.6.4 Access

The access to the rescue hatch shall be by a ladder made of either stainless steel or aluminium and shock-mounted to 12.5g in all directions to the SS wall with details and dimensions as shown in FIGURE 2.6.4.

2.7 FIXTURES IN SS

2.7.1 General

The following fixtures (See FIGURE 2.7.1) shall be provided inside each SS to provide adequate communication and some basic facilities:

(a) power points;

(b) telephone point;

(c) lighting point;

(d) TV/radio point

The telephone point at each storey shall have its own independent line.

The fixtures shall be designed and installed in accordance with the relevant Codes of Practice and statutory requirements for peacetime usage.

Other fixtures, such as cabinets and shelves, which are required for peacetime use, are allowed provided they are installed in accordance with Chapter 7.

2.7.2 Power Points

Three power points shall be provided inside each SS. One shall be in the vicinity of the TV/radio outlet. In the case of staircase SS, every main and intermediate landing shall have at least a power point.

2.7.3 Lighting Point

Luminaries shall be mounted only on the soffit of SS ceiling with screws, using non-metallic inserts. Wall mounted luminaries are not permitted.

2.7.4 Cable Entries and Openings

All cable entries shall be fully sealed for air-tightness as required under Clause 3.6.

2.8 NS IN SS TOWER

2.8.1 Aggregate Wall Height of NS

Several NS can be stacked one on top of the other within an SS tower, without the need for NS floor slab to be connected to external floor slab, provided that the aggregate wall height of the NS does not exceed 12 m (See FIGURE 2.8.1).

Aggregate wall height of NS refers to the sum of the height(s) of NS between two levels of the SS tower where the full external perimeters of the SS tower at those levels are structurally connected by floor slabs to the structural frame of the building. Tie beams of equivalent stiffness as the external slabs could be used to brace the SS tower.

The minimum thickness of all the intermediate slabs between each NS shall be 200 mm. Where an NS is located above an SS, the minimum thickness of that intermediate slab between the NS and SS shall be 300 mm (See FIGURE 2.8.1).

2.8.2 NS Walls/Columns

The relevant architectural technical requirements of the NS Walls/Columns as stipulated in Chapter 3 Clause 3.3.2 shall be complied with.

2.9 FINISHES IN SS

Finishes within a SS shall comply with the following:

(a) The walls and the ceiling slab shall be cast with a smooth concrete finish.

(b) The walls and ceiling slab may be finished with a skim coat of not thicker than 2 mm.

(c) No plastering or tiling shall be permitted on the walls and ceiling slab.

(d) Floor tiles or floor finishes, which are laid on wet cement mortar, are permitted.

(e) Skirting tiles laid on wet cement mortar are permitted up to a maximum 100 mm high above the FFL.

2.10 EXIT STAIRCASE

Where there is only one exit staircase or exit scissors-staircase serving the dwelling units, the minimum waist of exit staircase and the thickness of the intermediate landing slab shall be 150 mm. The staircase shall be constructed of reinforced concrete. In addition, the staircase shall meet the structural requirements as specified under Chapter 3 Clause 3.4.2 (g).

2.11 DESIGN REQUIREMENTS OF STAIRCASE STOREY SHELTER

2.11.1 General

Two typical layouts can be adopted for a staircase storey shelter (S/C SS) with respect to the arrangement of the blast hatch protecting the peacetime mechanical ventilation shaft opening into the staircase SS. The two layouts are as follows:

a Horizontal blast hatch arrangement (see FIGURE 2.11.1(a-1) to (a-6));

b Vertical blast hatch swinging into mechanical ventilation shaft (see FIGURE 2.11.1(b-1) to (b-6)); and

Note: In Figures a & b, the mechanical ventilation shaft walls at each storey are deemed as the SS walls i.e. bounds of protection of the SS.

The staircase SS has to be a totally enclosed space with reinforced concrete walls, floors, roof, risers, treads and landings. As no other openings (except the two ventilation sleeves per storey closed during peacetime) are permitted, the staircase SS has to be mechanically ventilated for peacetime purpose. For this peacetime ventilation purpose, openings for entry of ventilating air via mechanical ventilation (MV) riser are permitted.

2.11.2 SS Door at Shelter Entrance

At every storey, one SS door with removable door kerb, is to be provided at the shelter entrance (see FIGURES 2.11.1(a-1) & 2.11.1(b-1)). As the swing of this SS door is against the direction of exit travel, it shall not double up as the peacetime fire-rated door. Hence, a separate peacetime fire-rated door swinging in the direction of exit travel is required. In the case of a staircase shaft giving access to the roof level, a SS door, swinging outwards and left permanently open during peacetime, has to be provided at the door opening of the staircase shaft at roof level. If the SS door is exposed to weathering, it has to be suitably protected.

2.11.3 Internal SS Wall and SS Door

Inside the staircase SS, there has to be a reinforced concrete internal wall of minimum 200 mm thickness running the full height of the staircase shaft. At every storey, one SS door swinging in the direction of exit travel, with removable door kerb, is to be provided either at the staircase entrance landing or at the intermediate landing (illustrated in FIGURES 2.11.1(a-1) & 2.11.1(b-1)). The SS door net opening dimensions shall be:

a Door width – 1000 mm (Note: The minimum clear opening of the door way shall be 970 mm measured between the face of the door and the face of the door stop with the door open at 90°).

b Door height – 2055 mm.

This SS door is to be kept open permanently during peacetime. The RC wall and this SS door serve to compartmentalise the staircase shaft into a series of SS, one for every storey. This series of SS is similar to the normal SS (located in a common area of each storey, stacked one on top of another to form a SS tower).

2.11.4 Staircase SS Area and Volume

The aggregate planar area of the staircase entrance landing, intermediate landing and the staircase treads (excluding the over-lapping tread at each riser and area taken up by the internal SS door) of each storey is taken as the internal floor area of the staircase SS. The product of the internal floor area of the staircase SS and its internal height (measured from the finished floor level to the soffit of the ceiling slab) is taken as the internal volume of the staircase SS.

2.11.5 Thickness of SS/NS Elements

The minimum thickness of staircase waist and landing slab shall be 200 mm for SS and NS. Where there are Non-Shelters (NS) interspersed within the staircase SS tower, the provision of SS doors at the intermediate landings, as well as blast hatches shall be as shown in FIGURE 2.11.5.

2.11.6 Blast Hatch at MV Duct Opening

As the staircase SS is to be mechanically ventilated during peacetime, there would be MV duct openings in the landing slab (see FIGURE 2.11.1(a-1)) or staircase SS wall (see FIGURES 2.11.1(b-1)). These MV duct openings have to be designed such that they can be closed and made airtight by BCA-approved blast hatches when the staircase shaft is converted for use as SS. The height of the blast hatch opening shall be between 600-700mm, whereas its width shall be between 500-700mm. In the case of vertical blast hatch, the bottom edge of the opening in the SS wall shall be between 900 mm to 1100 mm above the finished floor level of the landing slab (see FIGURES 2.11.1(b-2)). There shall be reinforced concrete or steel nib provided around the MV shaft for inspection and maintenance of the blast hatch for layouts shown in FIGURES 2.11.1(a-1) to 2.11.1(a-6) and 2.11.1(b-1) to 2.11.1(b-6). The details of the MV shaft above roof level as shown in FIGURES 2.11.1(a-3) or 2.11.1(a-4) and 2.11.1(b-3) or 2.11.1(b-4) (whichever is applicable) have to be complied with.

TABLE 2.2: MINIMUM INTERNAL SS FLOOR AREA AND VOLUME

Gross Floor Area (GFA) * of Dwelling Unit	Nominal Occupancy of Dwelling Unit (No. of persons)
GFA $\leq 45m^2$	2
$75m^2 \geq$ GFA $> 45m^2$	3
$140m^2 \geq$ GFA $> 75m^2$	4
GFA $> 140m^2$	5

* The GFA of the dwelling unit excludes the area of balconies that are open on at least two sides to make the balconies conducive for sky-rise gardening in accordance with URA guidelines.

Area of Storey Shelter = TNO x $0.6m^2$

Volume of Storey Shelter = TNO x $1.8m^3$

TNO = Total Nominal Occupancy of units served by Storey Shelter

TABLE 2.3.3: MINIMUM SETBACK DISTANCES OF SS WALLS WITHOUT REINFORCED COMCRETE DOWN-HANG BEAM ALONG EBL

Storey Height (SH) (mm) Column (1)	Setback Distance of SS Wall with SS Door (mm) Column (2)	Setback Distance of SS Walls without SS door (mm) Column (3)
$2500 \leq SH \leq 2800$	3000	2200
$2800 < SH \leq 3100$	3200	2400
$3100 < SH \leq 3500$	3400	2600
$3500 < SH \leq 4000$	3600	2800
$4000 < SH \leq 4500$	3850	3050
$4500 < SH \leq 5000$	4100	3300
$5000 < SH \leq 5500$	4300	3500
$5500 < SH \leq 6000$	4550	3750
$6000 < SH \leq 6500$	4800	4000
$6500 < SH \leq 7000$	5000	4200
$7000 < SH \leq 7500$	5250	4450
$7500 < SH \leq 8000$	5500	4700

TABLE 2.3.4(a): MINIMUM SETBACK DISTANCES OF SS WALLS WITH REINFORCED CONCRETE DOWN-HANG BEAM ALONG EBL

Effective Storey Height (Ht) (mm) Column (1)	Setback Distance of SS Walls (mm) Column (2)
$Ht \leq 2200$	2100
$2200 < Ht \leq 2800$	2200
$2800 < Ht \leq 3100$	2400
$3100 < Ht \leq 3500$	2600
$3500 < Ht \leq 4000$	2800
$4000 < Ht \leq 4500$	3050
$4500 < Ht \leq 5000$	3300
$5000 < Ht \leq 5500$	3500
$5500 < Ht \leq 6000$	3750
$6000 < Ht \leq 6500$	4000
$6500 < Ht \leq 7000$	4200
$7000 < Ht \leq 7500$	4450
$7500 < Ht \leq 8000$	4700

TABLE 2.3.4(b): MINIMUM SETBACK DISTANCES OF SS WALL WITH SS DOOR AND REINFORCED CONCRETE DOWN-HANG BEAM ALONG EBL

Effective Storey Height (Ht) (mm) Column (1)	Setback Distance of SS Wall With SS Door (mm) Column (2)
Ht ≤ 2800	3000
2800 < Ht ≤ 3100	3200
3100 < Ht ≤ 3500	3400
3500 < Ht ≤ 4000	3600
4000 < Ht ≤ 4500	3850
4500 < Ht ≤ 5000	4100
5000 < Ht ≤ 5500	4300
5500 < Ht ≤ 6000	4550
6000 < Ht ≤ 6500	4800
6500 < Ht ≤ 7000	5000
7000 < Ht ≤ 7500	5250
7500 < Ht ≤ 8000	5500

TABLE 2.4: SS CLEAR HEIGHT AND MINIMUM SS WALL THICKNESS

SS Clear Height (Ht) (mm)	Setback Distance of SS Wall (mm)	SS Wall Thickness (mm)
$2400 \leq Ht \leq 3400$	< 6000	300
	≥ 6000	250
$3400 < Ht \leq 3900$	< 6000	325
	≥ 6000	275

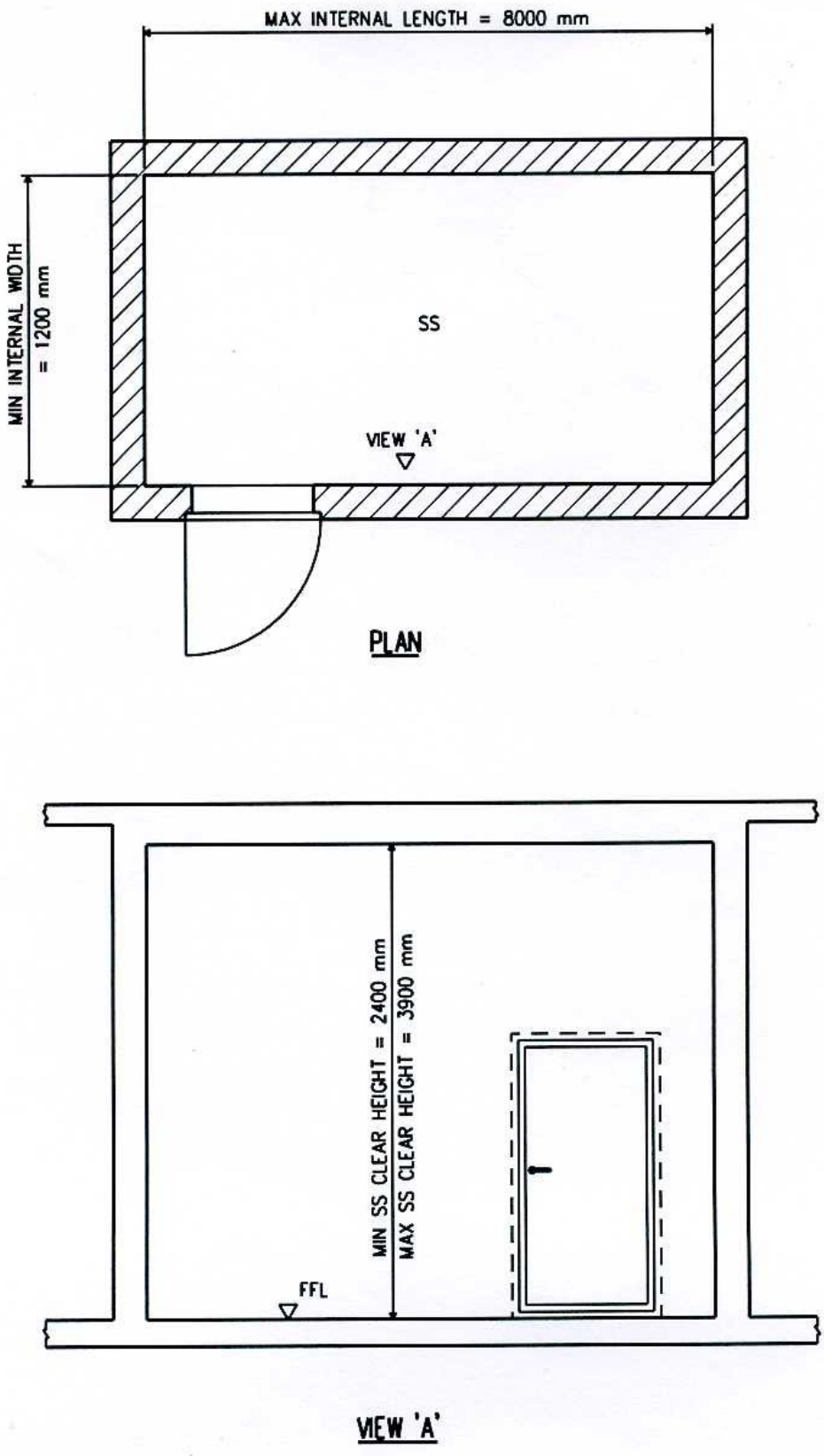


FIGURE 2.1.2 TYPICAL LAYOUT OF SS

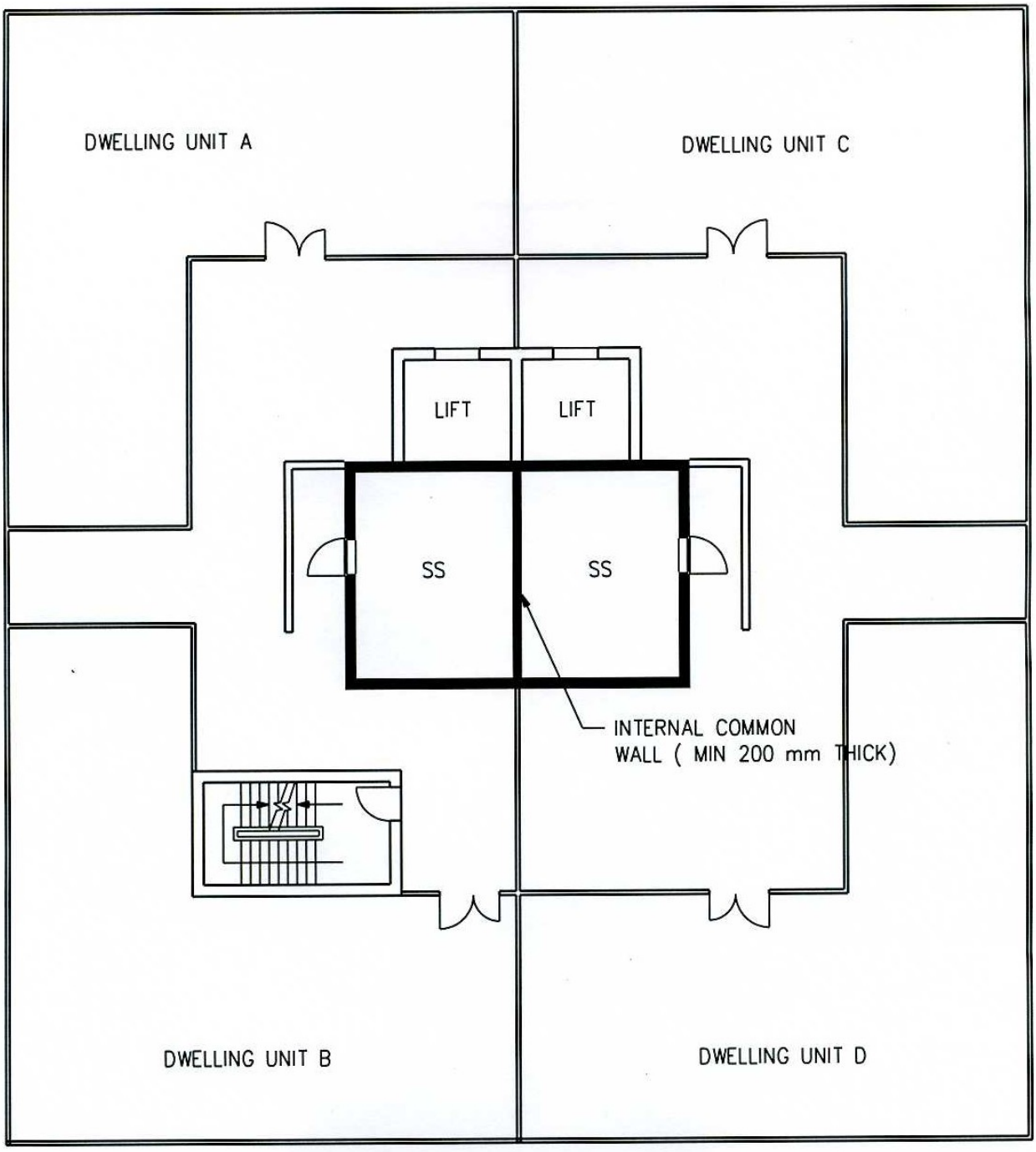


FIGURE 2.3.1(a) INTERNAL COMMON WALL BETWEEN TWO SS IN NON-LANDED DWELLING UNITS

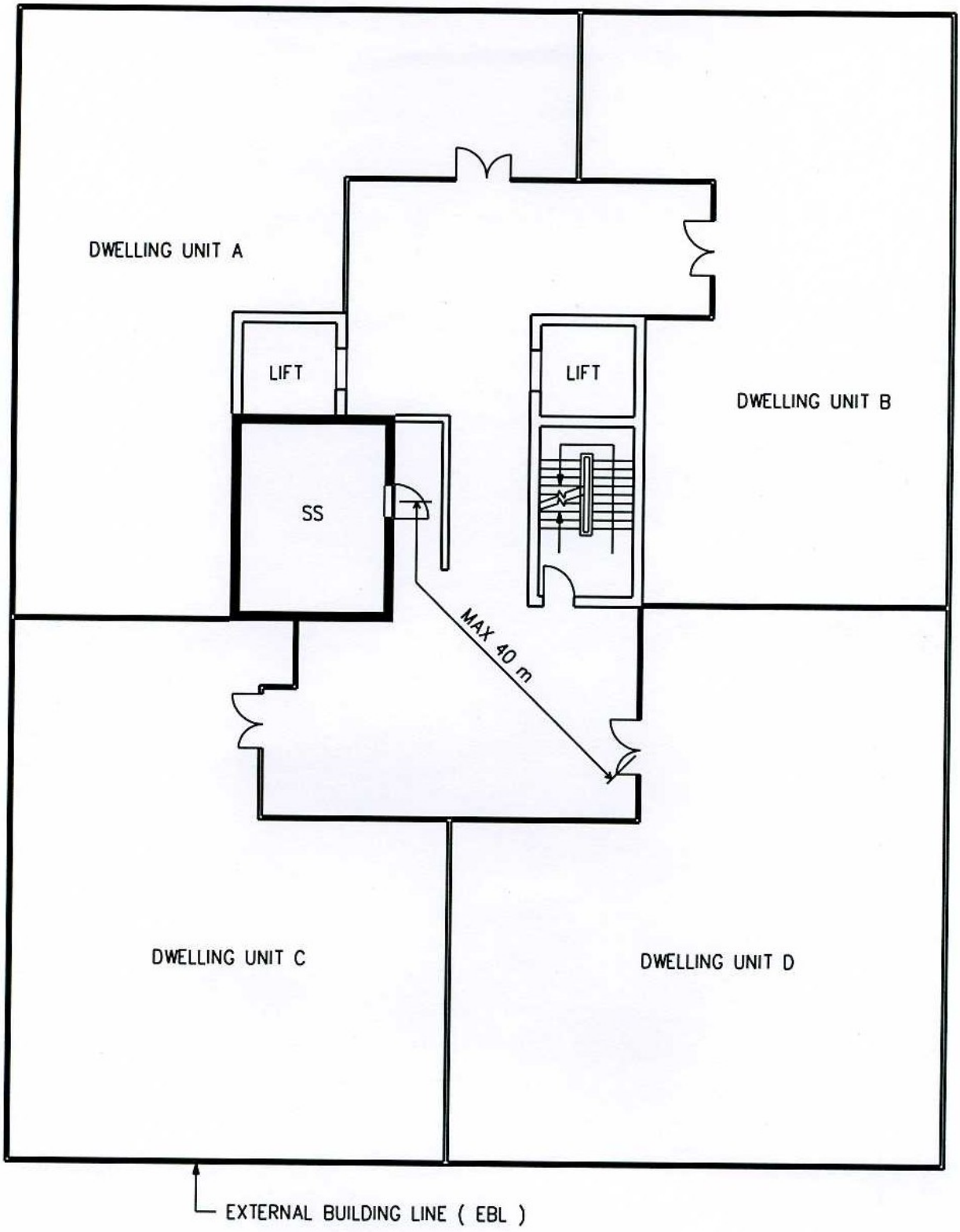
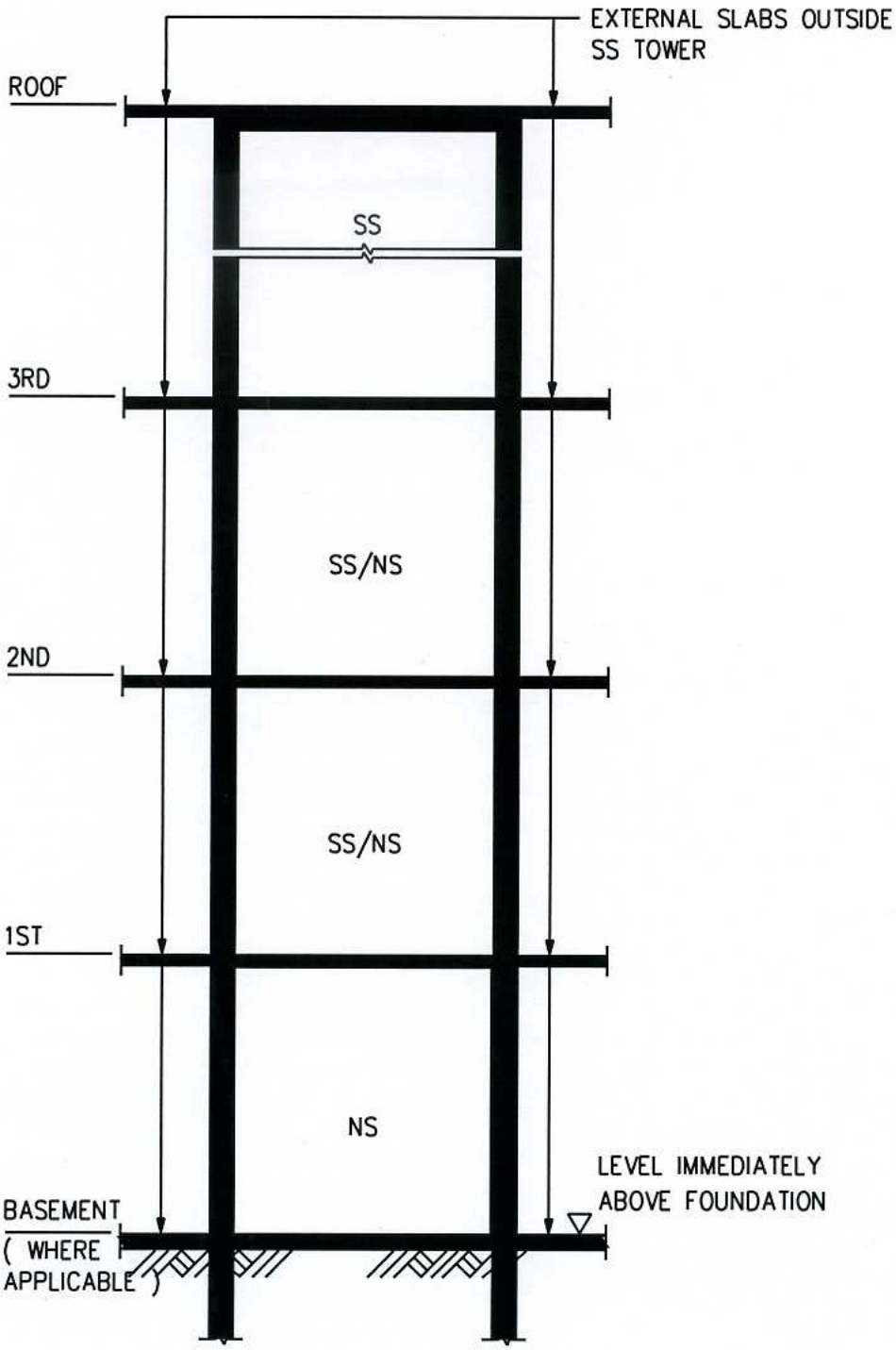


FIGURE 2.3.1(b) SS POSITION



NOTES

1. SS TOWER WITH SS AND NS WHERE APPLICABLE.

FIGURE 2.3.2 SCHEMATIC SECTION OF SS TOWER

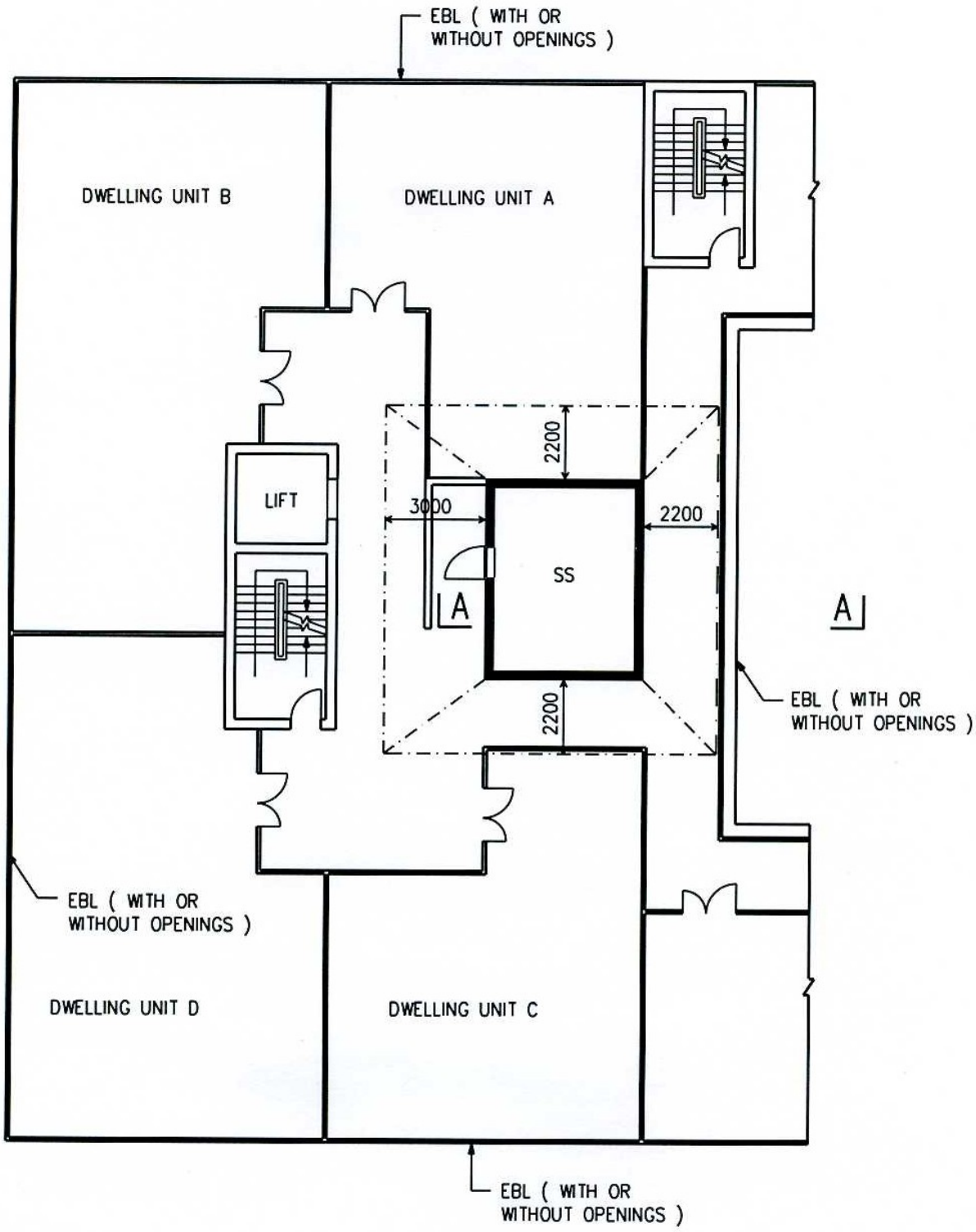


FIGURE 2.3.3(a) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS (WITHOUT DOWN-HANG BEAM) FOR STOREY HEIGHT ≤ 2800 mm

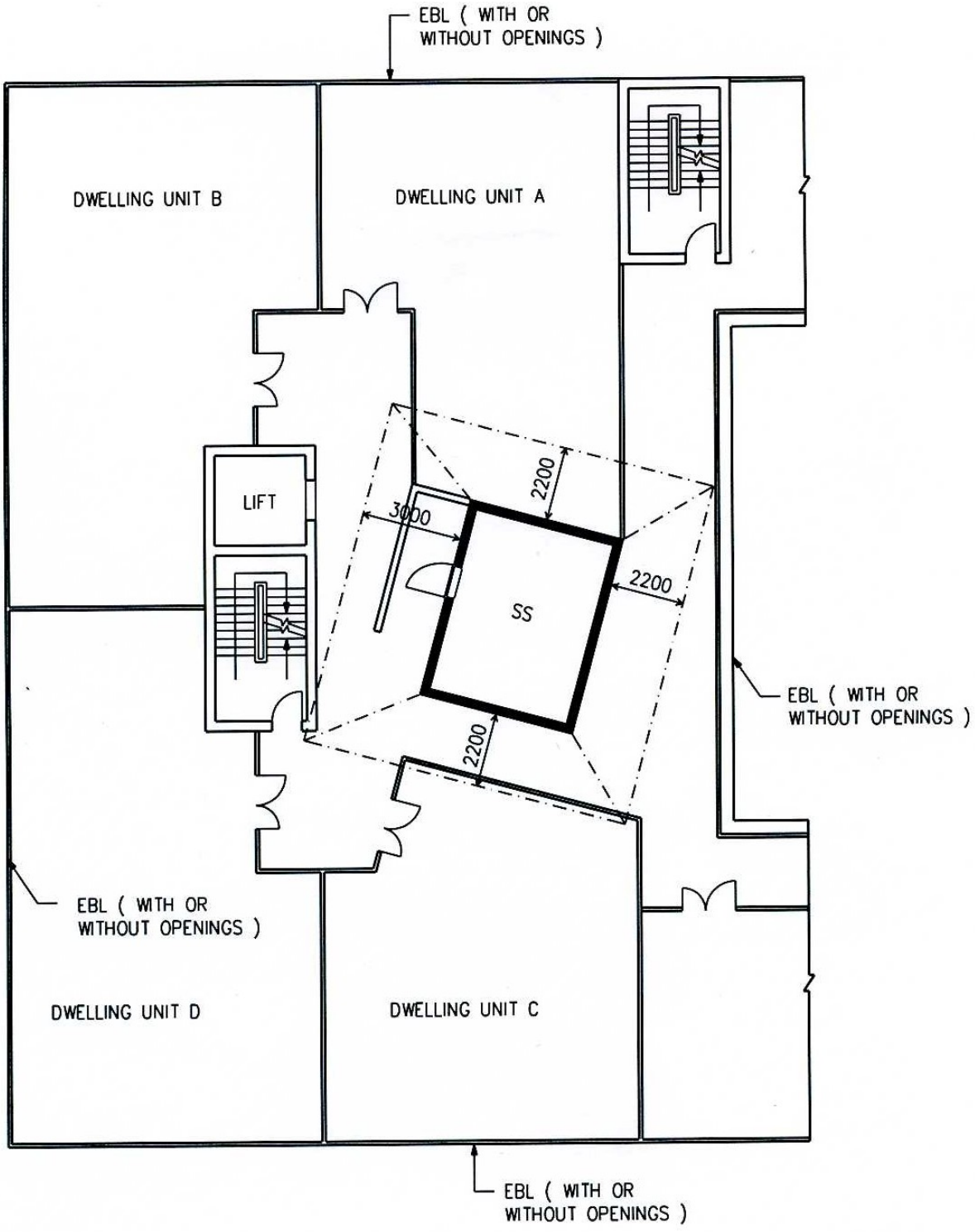


FIGURE 2.3.3(b) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS (WITHOUT DOWN-HANG BEAM) FOR STOREY HEIGHT ≤ 2800 mm

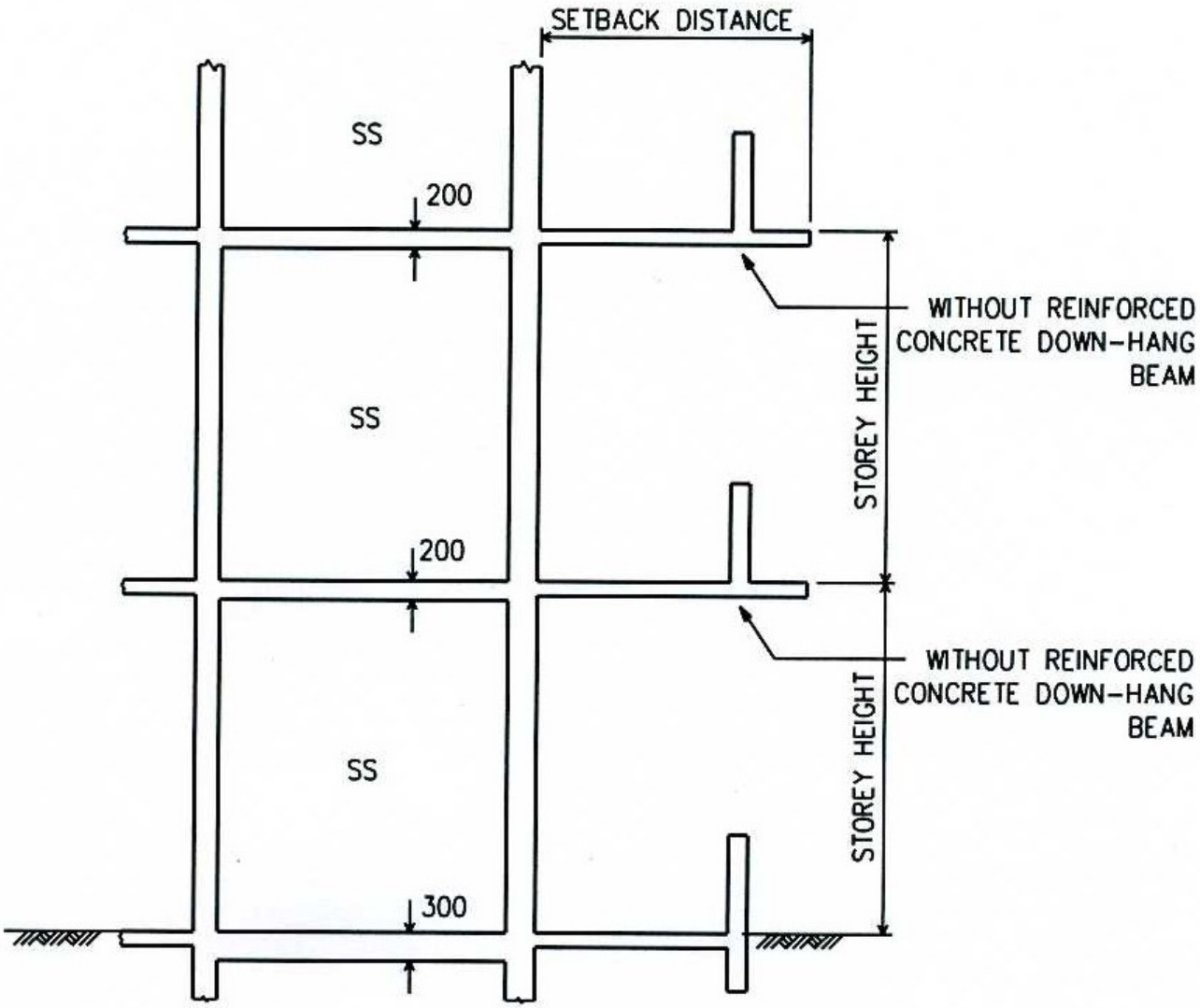


FIGURE 2.3.3(c) SETBACK DISTANCE OF SS WALLS (WITHOUT DOWN-HANG BEAM)

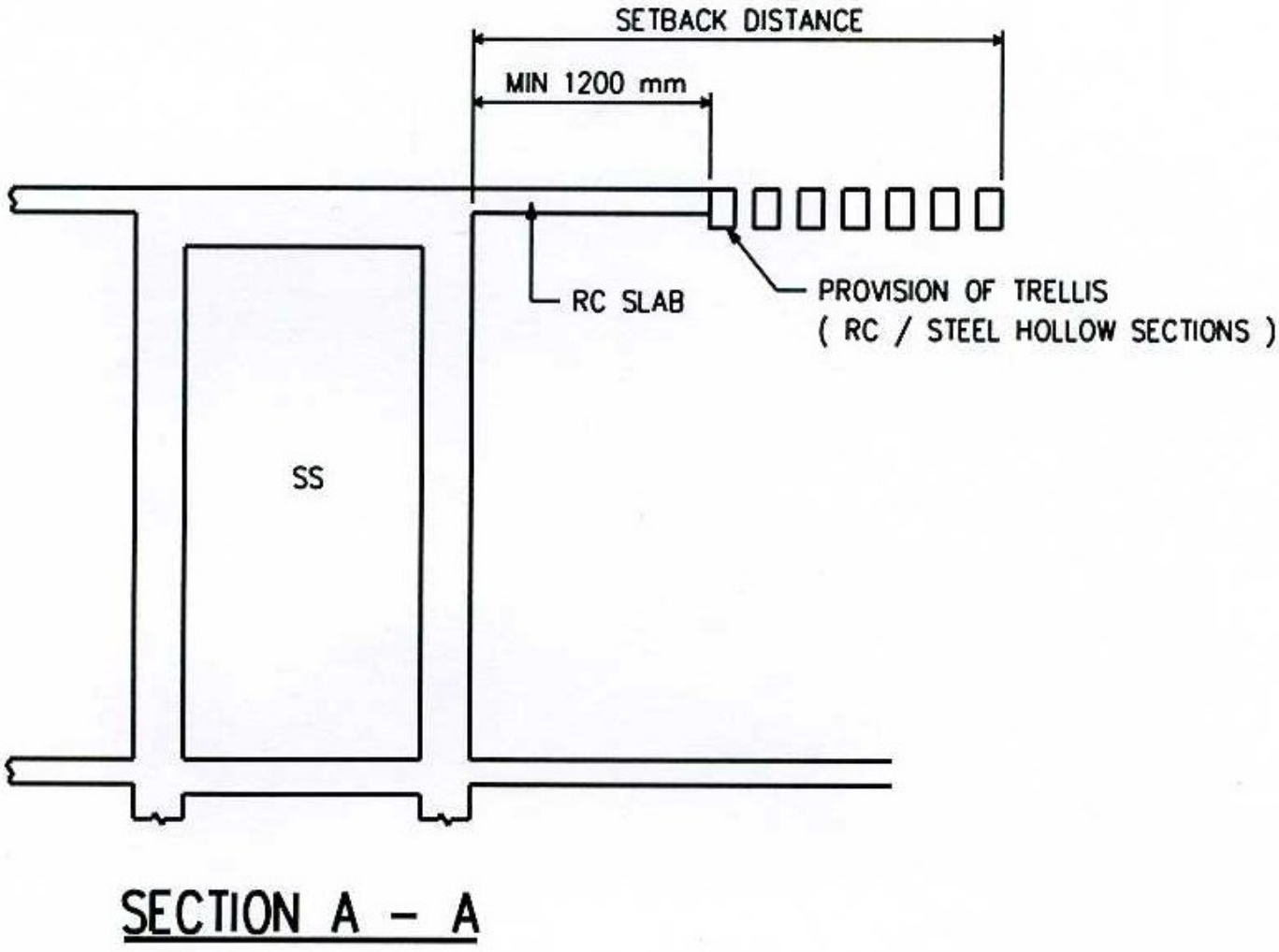


FIGURE 2.3.3(d) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTIONS) TO MAKE UP FOR SHORTFALL IN SETBACK DISTANCE

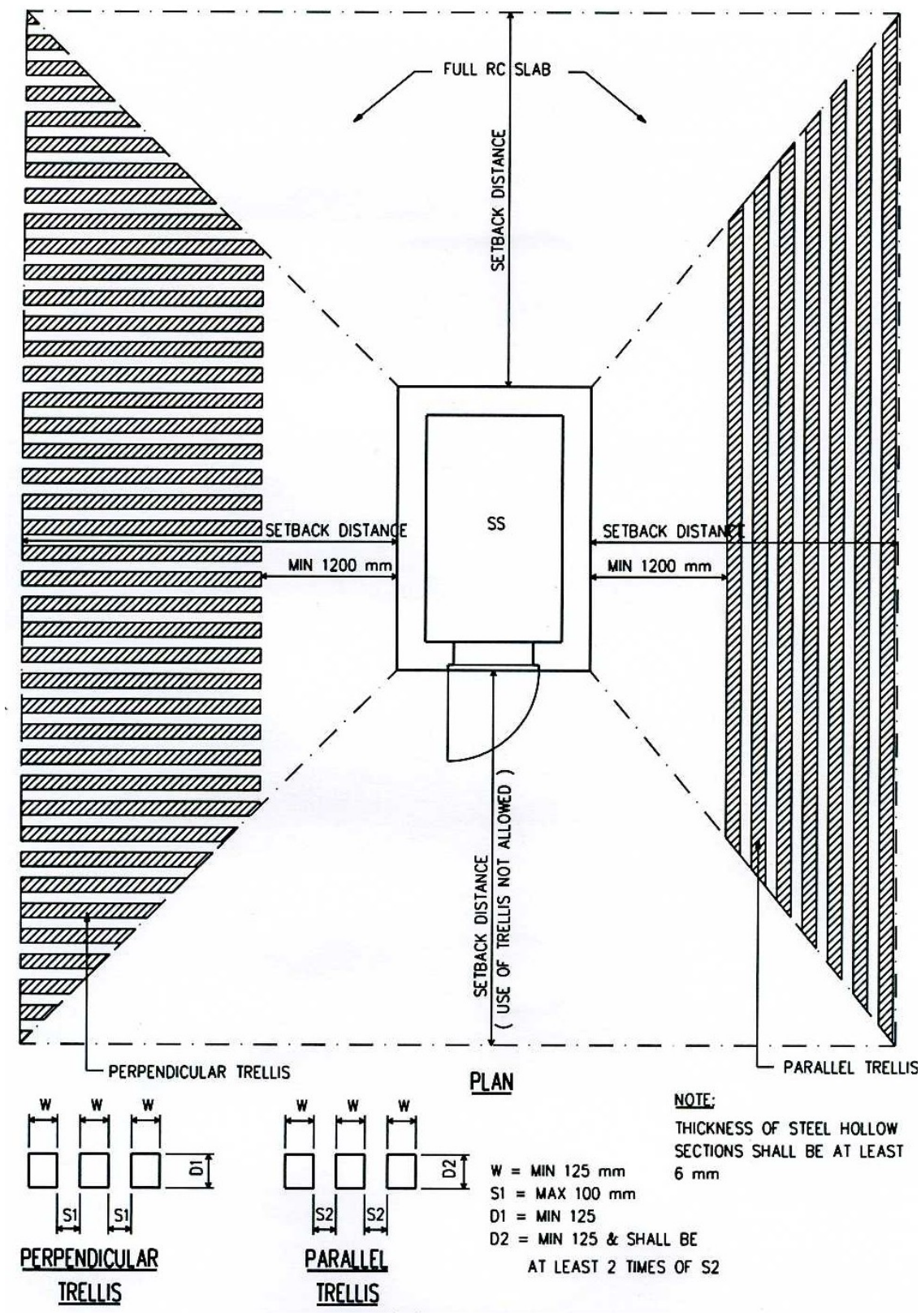


FIGURE 2.3.3(e) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTIONS) TO MAKE UP FOR SHPRTFALL IN SETBACK DISTANCE

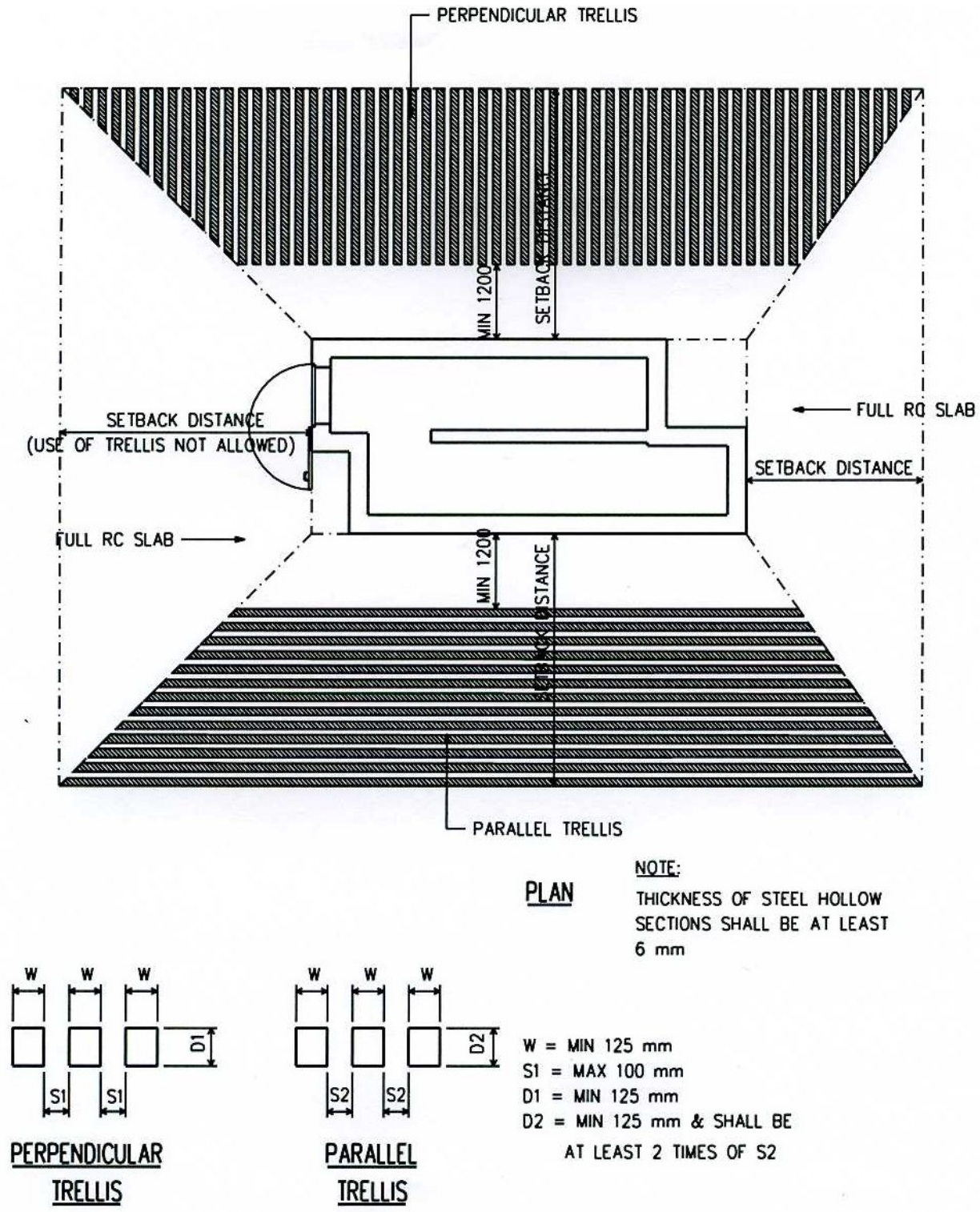


FIGURE 2.3.3(f) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTIONS) TO MAKE UP FOR SHPRTFALL IN SETBACK DISTANCE

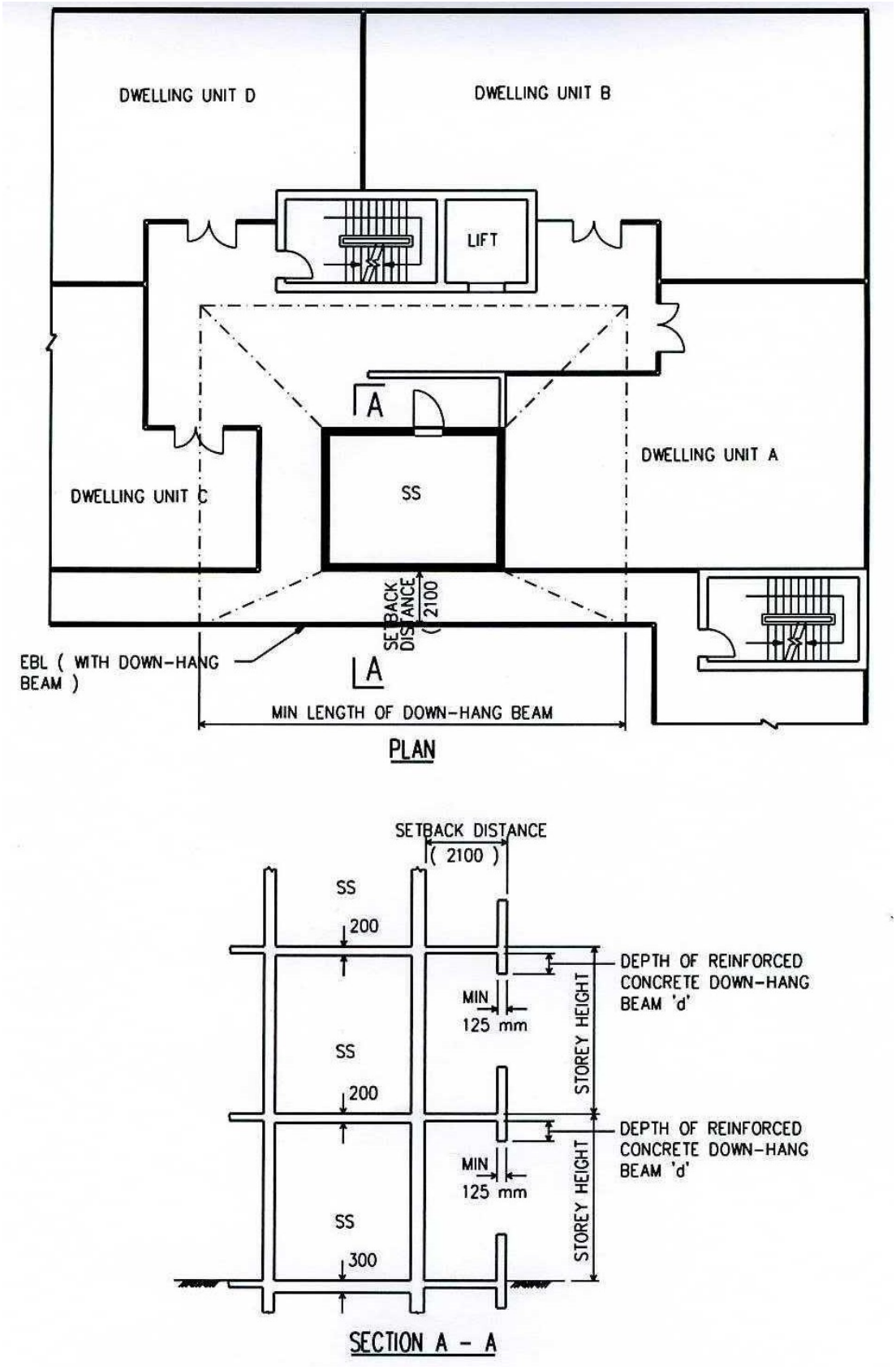


FIGURE 2.3.4(a) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS (WITH DOWN-HANG BEAM) FOR EFFECTIVE STOREY HEIGHT ≤ 2200 mm

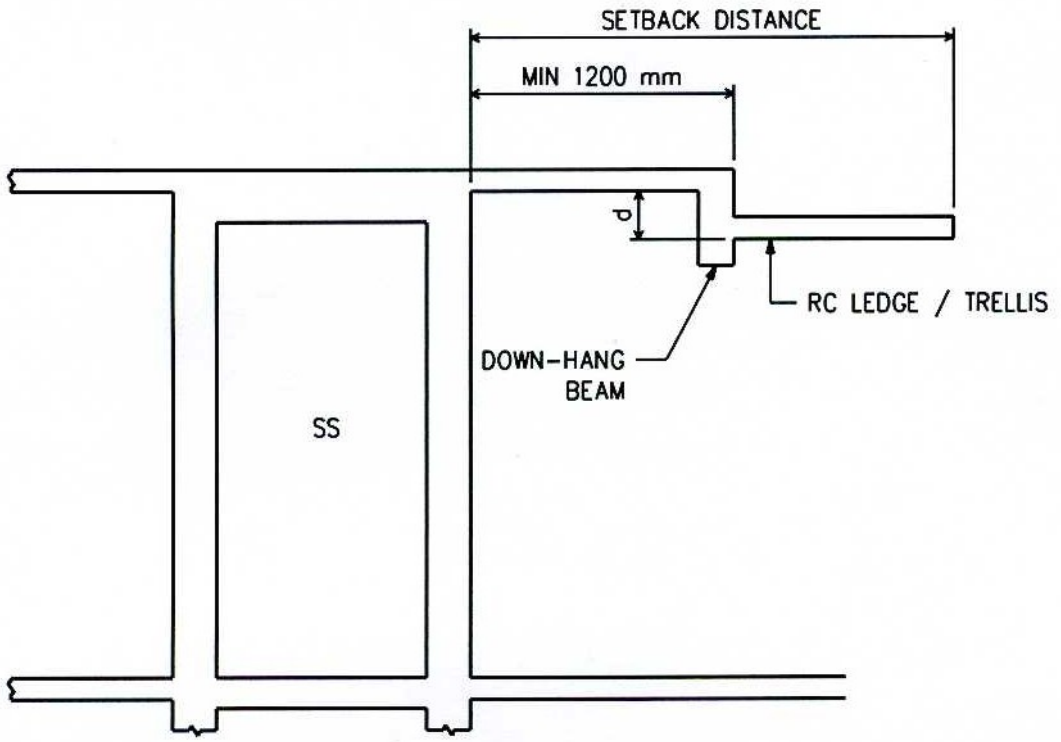


FIGURE 2.3.4(b) DOWN-HANG BEAM NOT LOCATED AT EXTERNAL BUILDING LINE

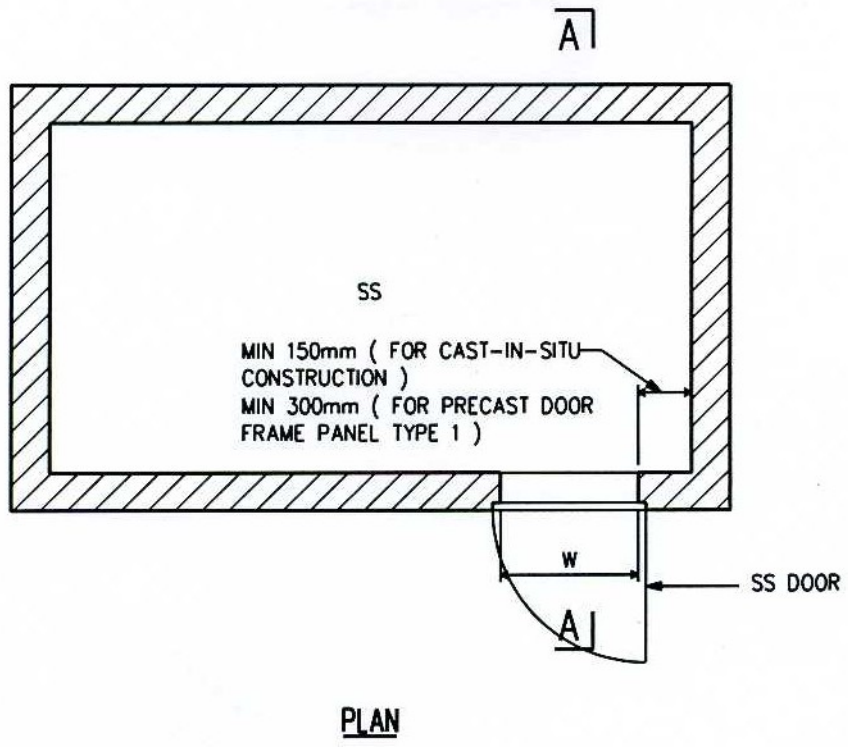


FIGURE 2.5.2(a) CONCRETE WALL SEGMENT AT SS DOOR

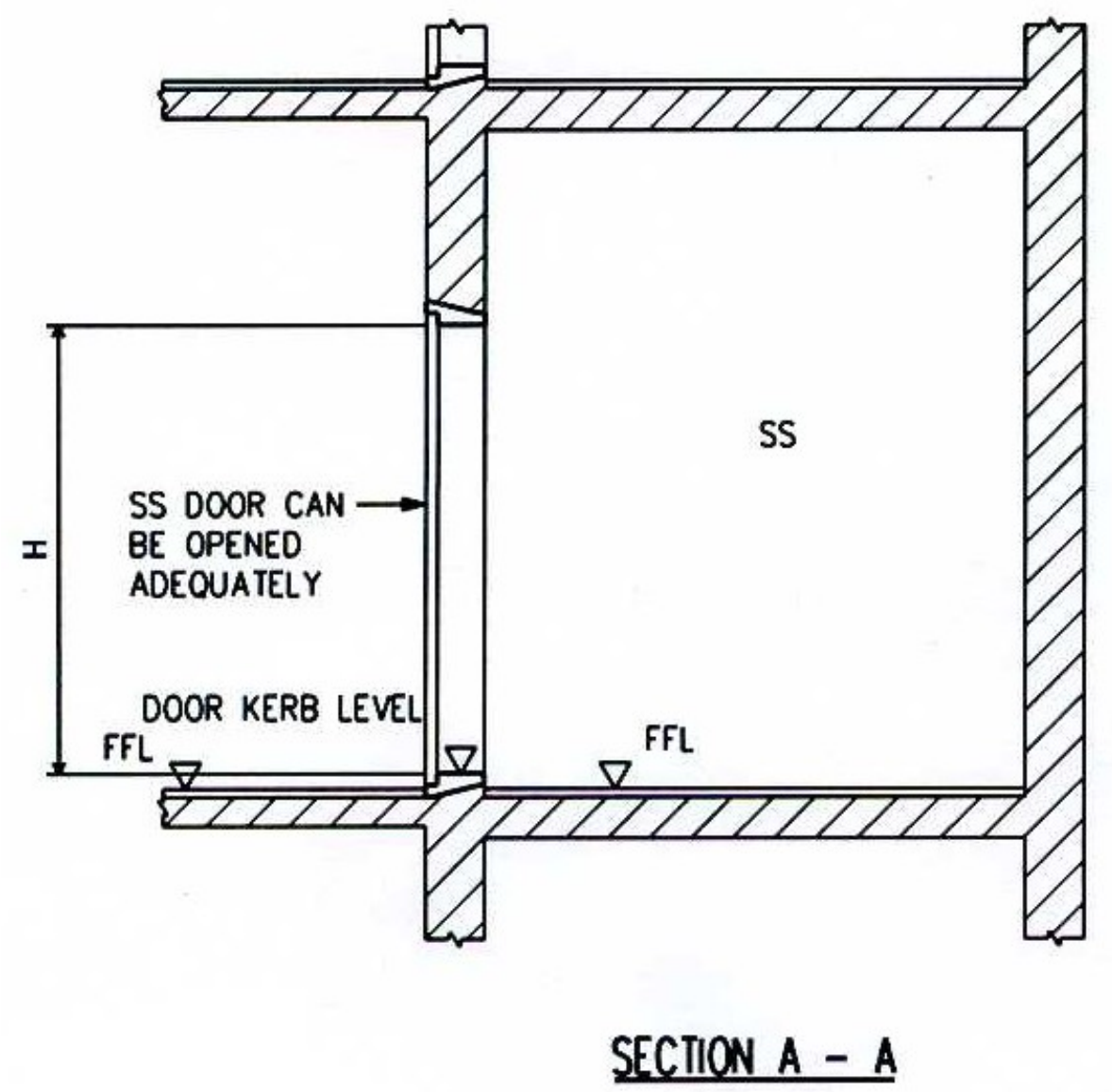
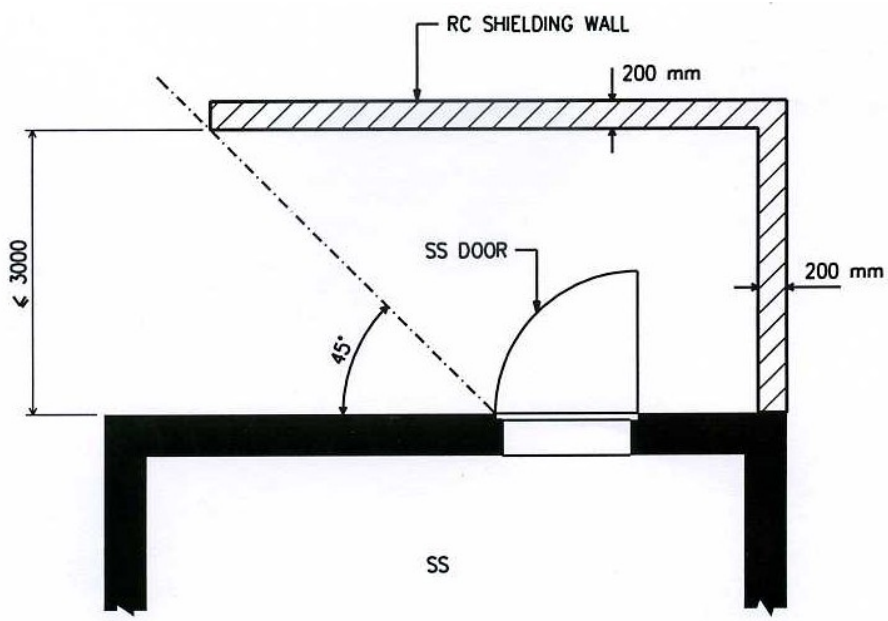
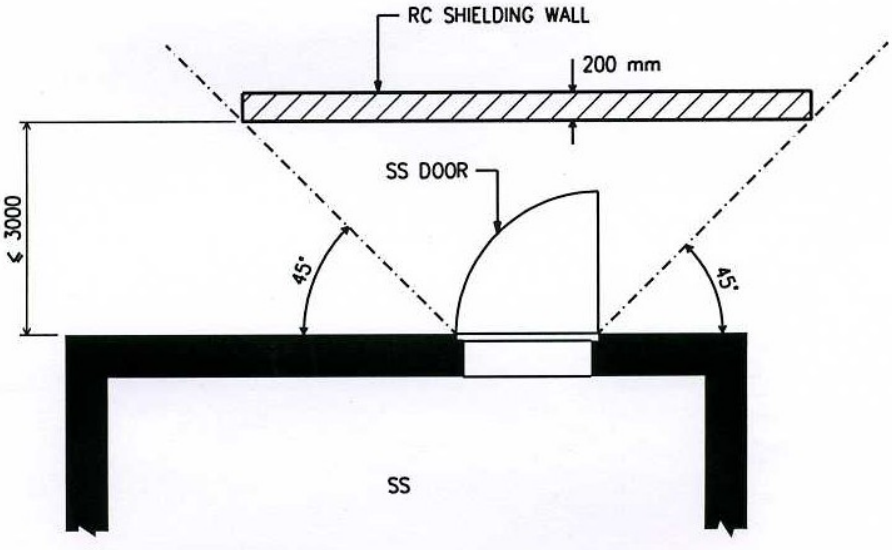


FIGURE 2.5.2(b) SS DOOR KERB



PLAN
ALTERNATIVE 'A'



PLAN
ALTERNATIVE 'B'

FIGURE 2.5.2(c) SHIELDING FOR SS DOOR

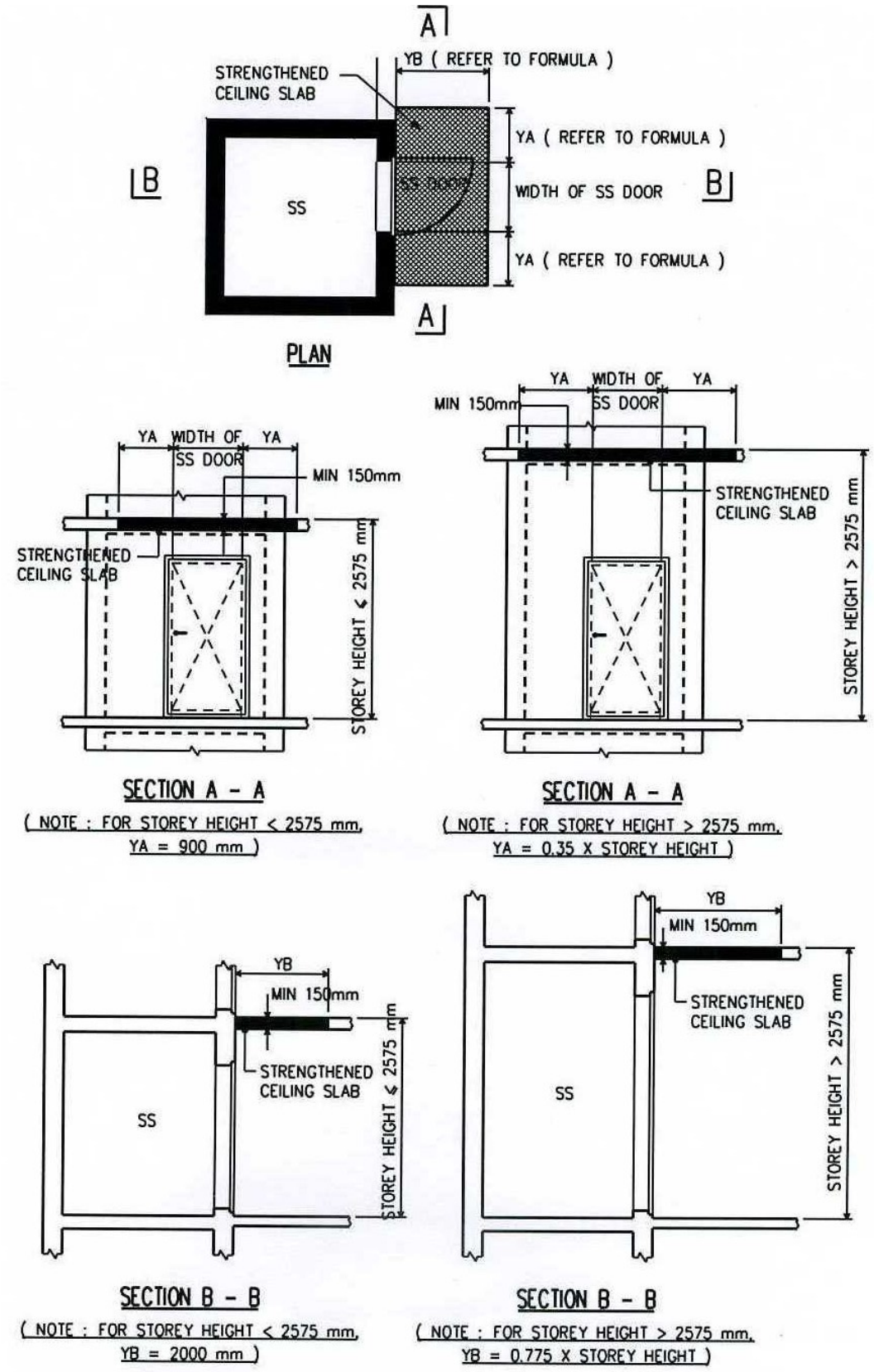


FIGURE 2.5.3 REQUIREMENTS FOR STRENGTHENED CEILING SLAB IN FRONT OF SS DOOR

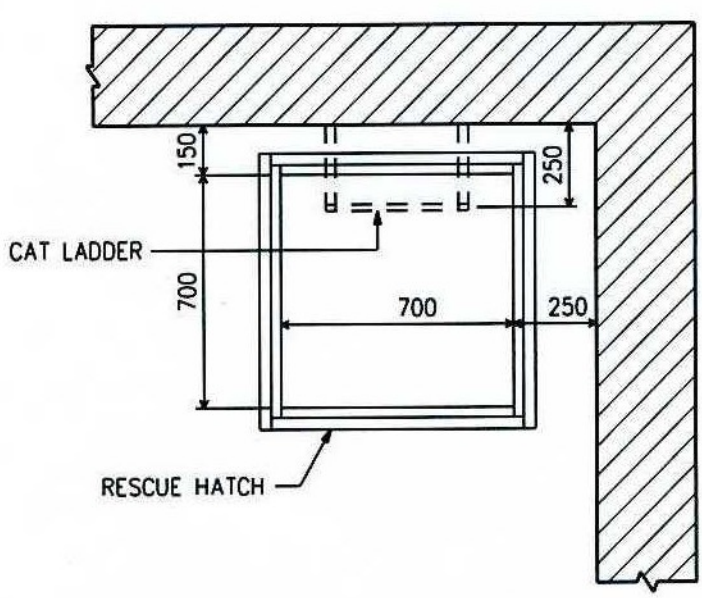


FIGURE 2.6.2(a) MINIMUM DISTANCE OF RESCUE HATCH FROM SS WALL

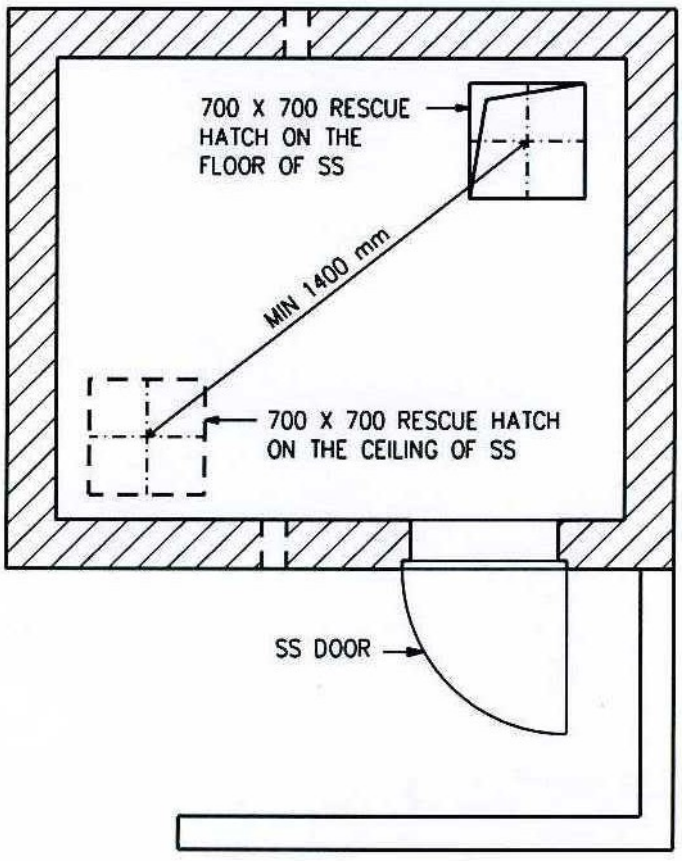


FIGURE 2.6.2(b) MINIMUM DISTANCE BETWEEN CENTRE LINES OF RESCUE HATCHES

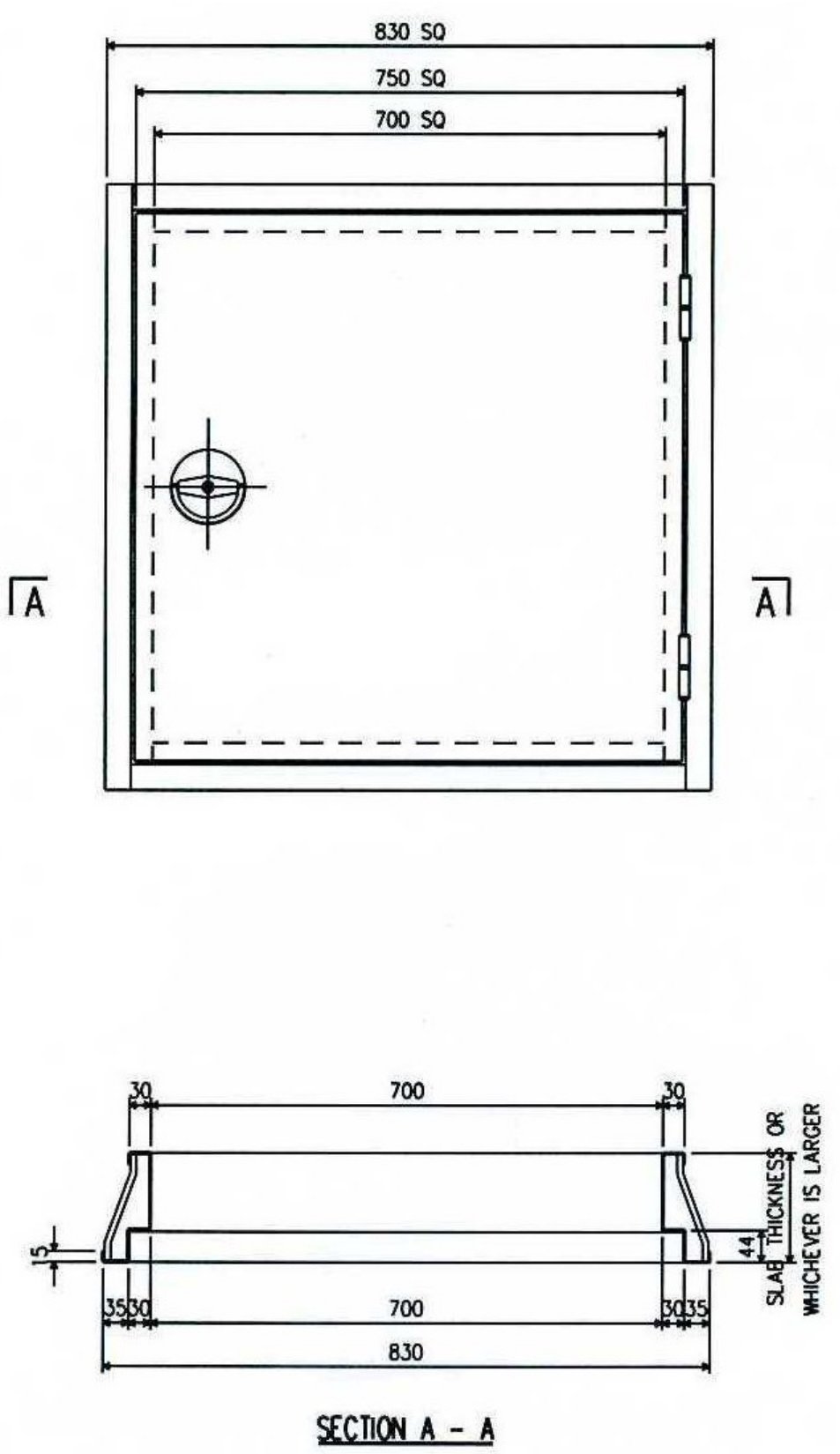


FIGURE 2.6.3 MINIMUM DIMENSIONS OF RESCUE HATCH

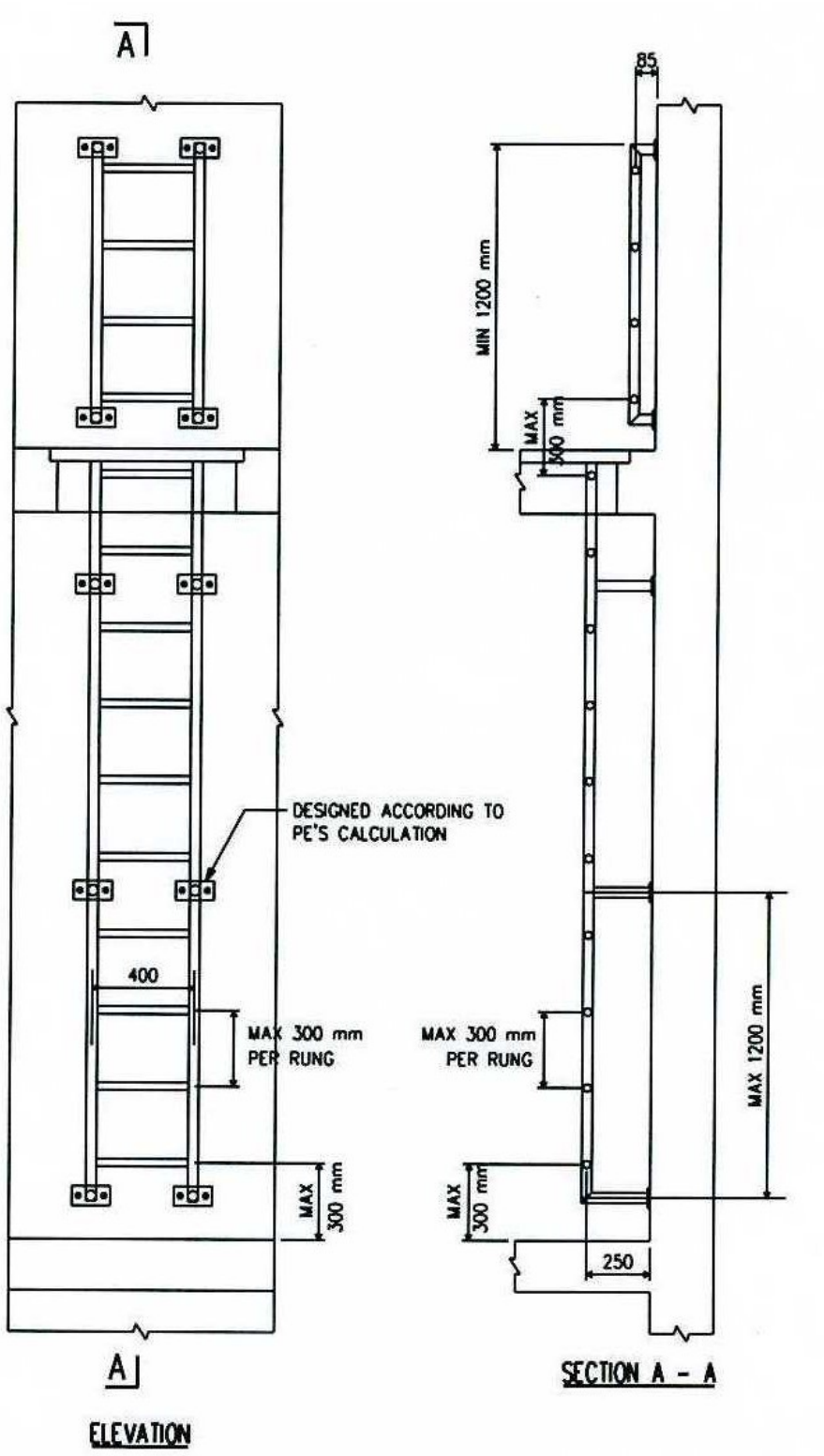


FIGURE 2.6.4 DETAILS OF CAT LADDER TO RESCUE HATCH

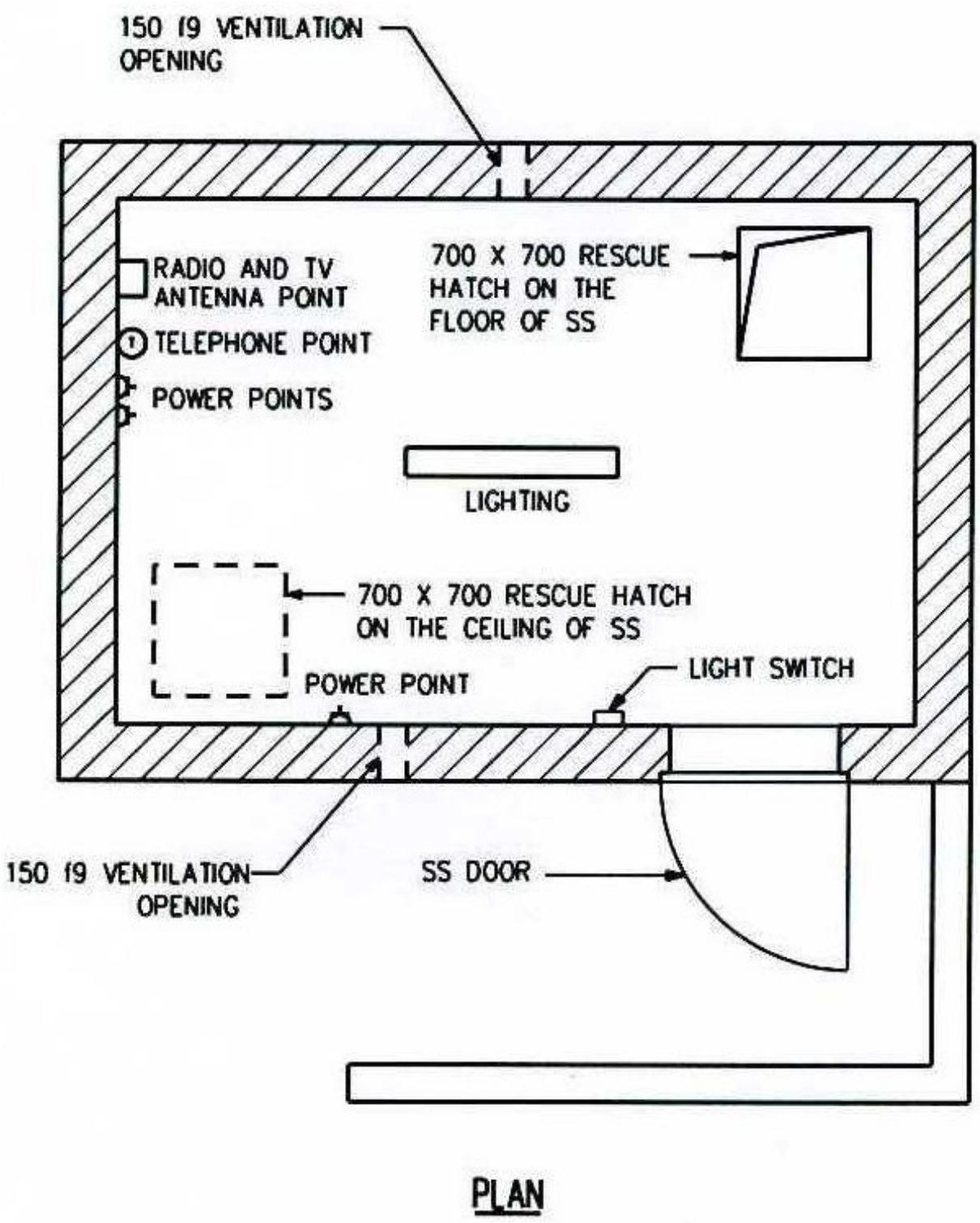


FIGURE 2.7.1 SPECIFIED SS FIXTURES AND OPENINGS

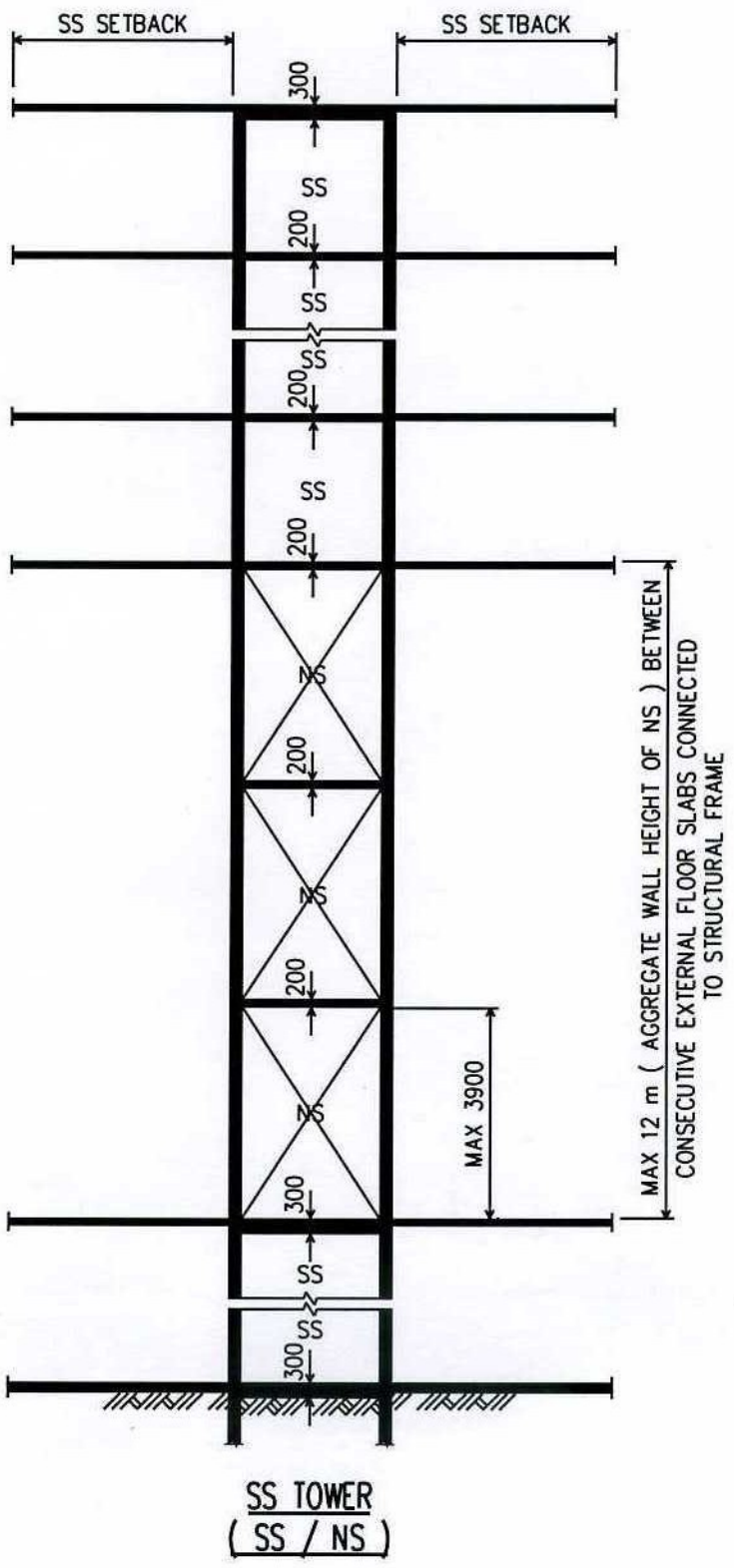
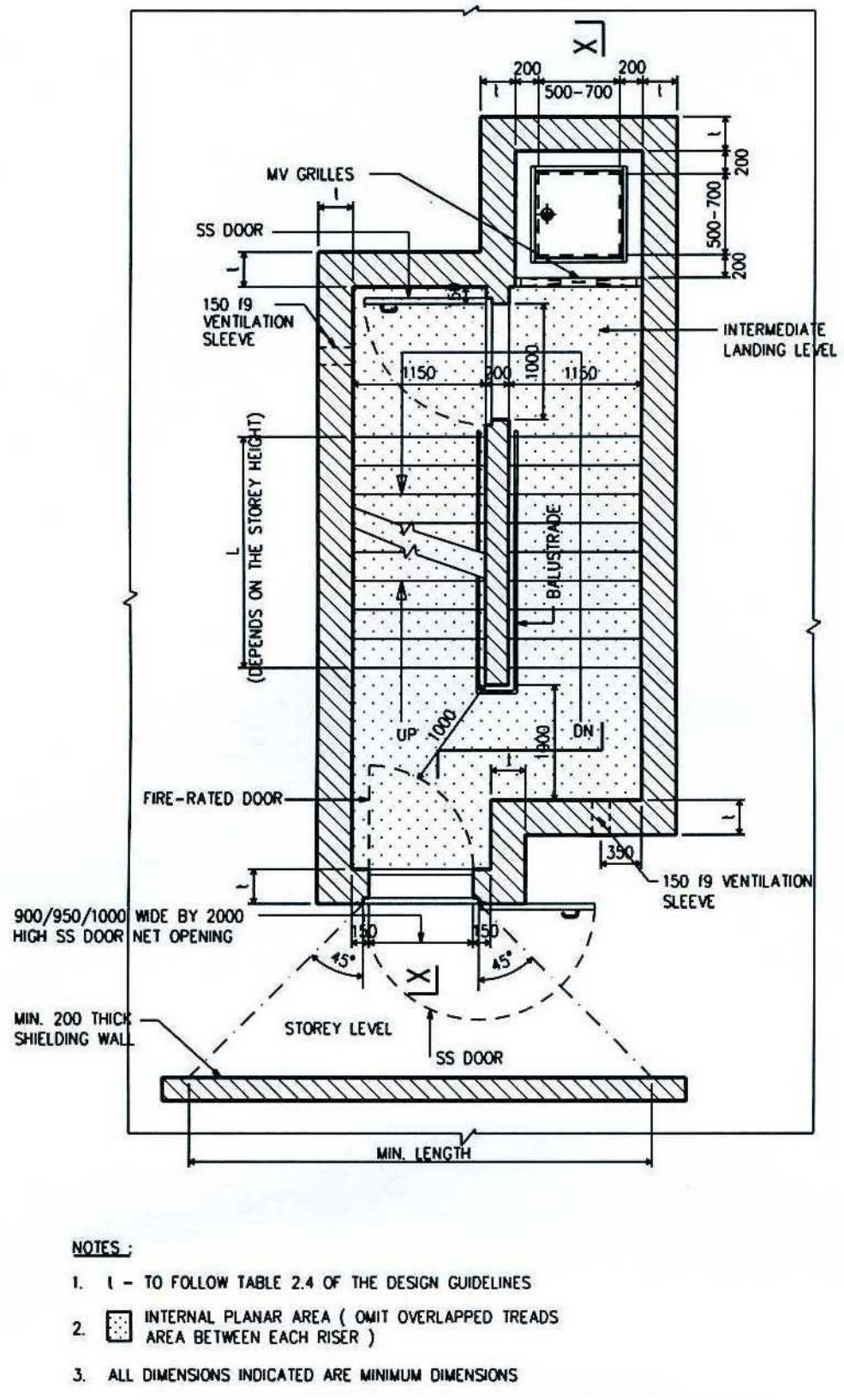


FIGURE 2.8.1 SS TOWER



NOTES :

1. t – TO FOLLOW TABLE 2.4 OF THE DESIGN GUIDELINES
2. INTERNAL PLANAR AREA (OMIT OVERLAPPED TREADS AREA BETWEEN EACH RISER)
3. ALL DIMENSIONS INDICATED ARE MINIMUM DIMENSIONS

FIGURE 2.11.1(a–1) TYPICAL PLAN OF STAIRCASE STOREY SHELTER

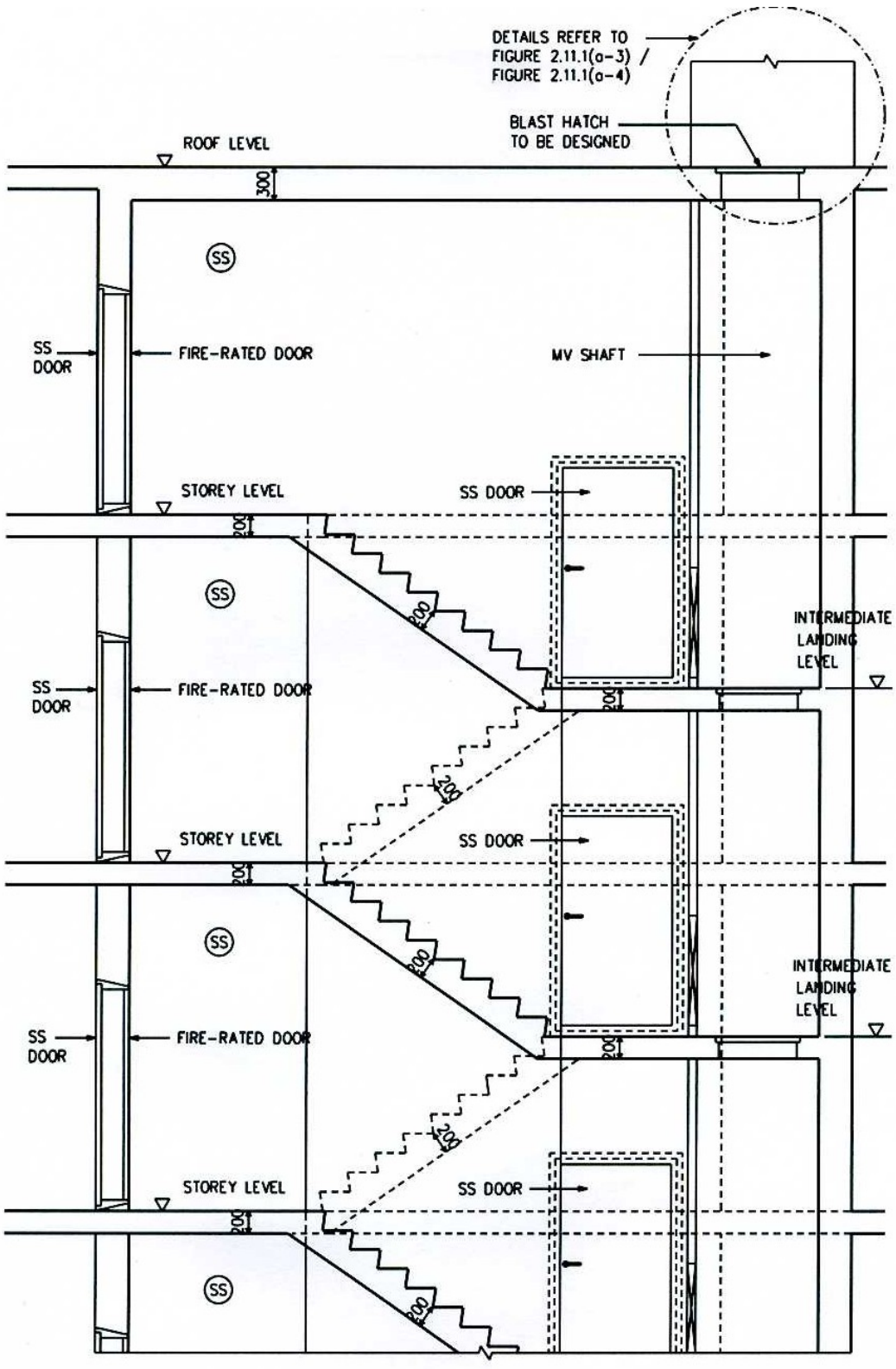


FIGURE 2.11.1(a–2) SECTION X – X OF STAIRCASE STOREY SHELTER

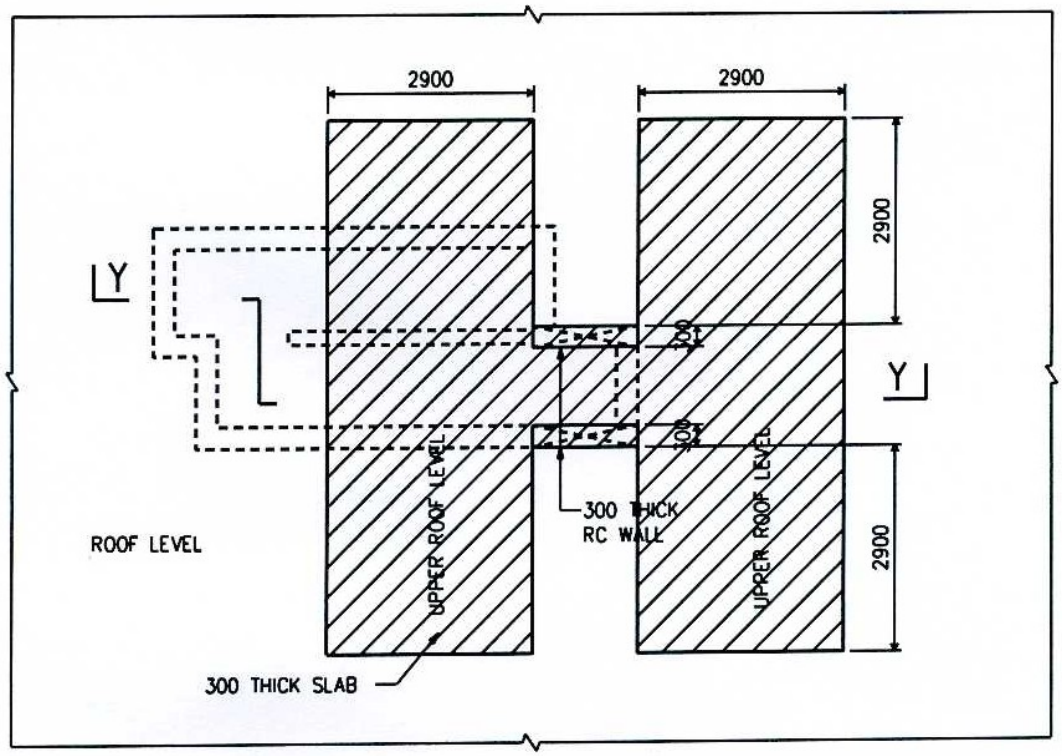


FIGURE 2.11.1(a–3) SECTION Y – Y OF STAIRCASE STOREY SHELTER

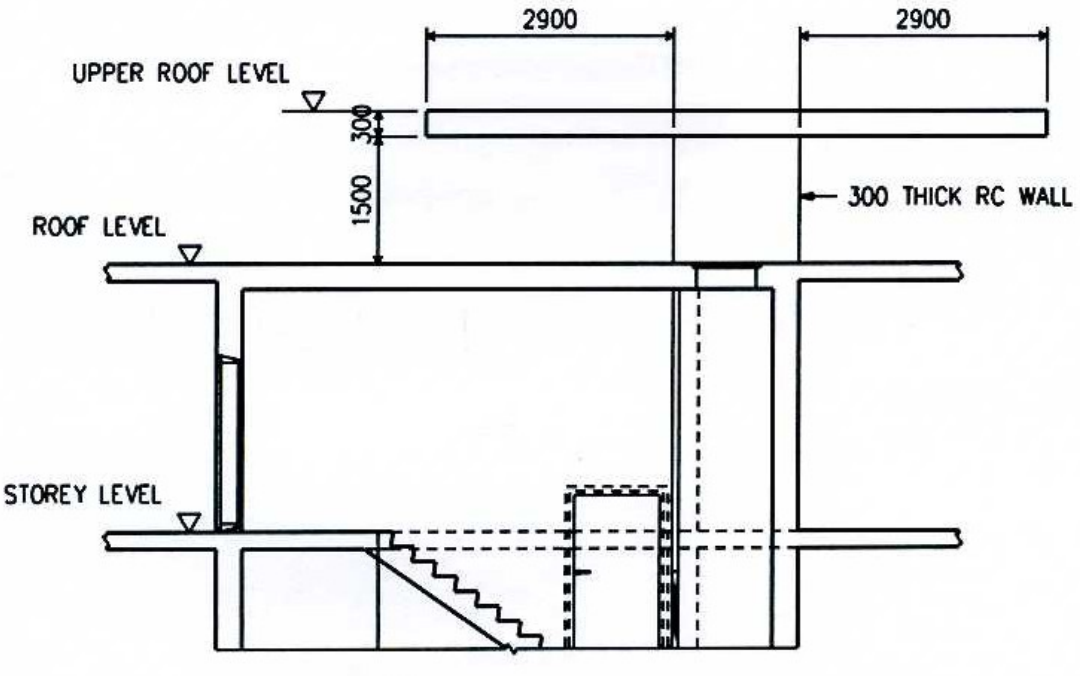


FIGURE 2.11.1(a–4) PLAN OF STAIRCASE STOREY SHELTER AT UPPER ROOF LEVEL

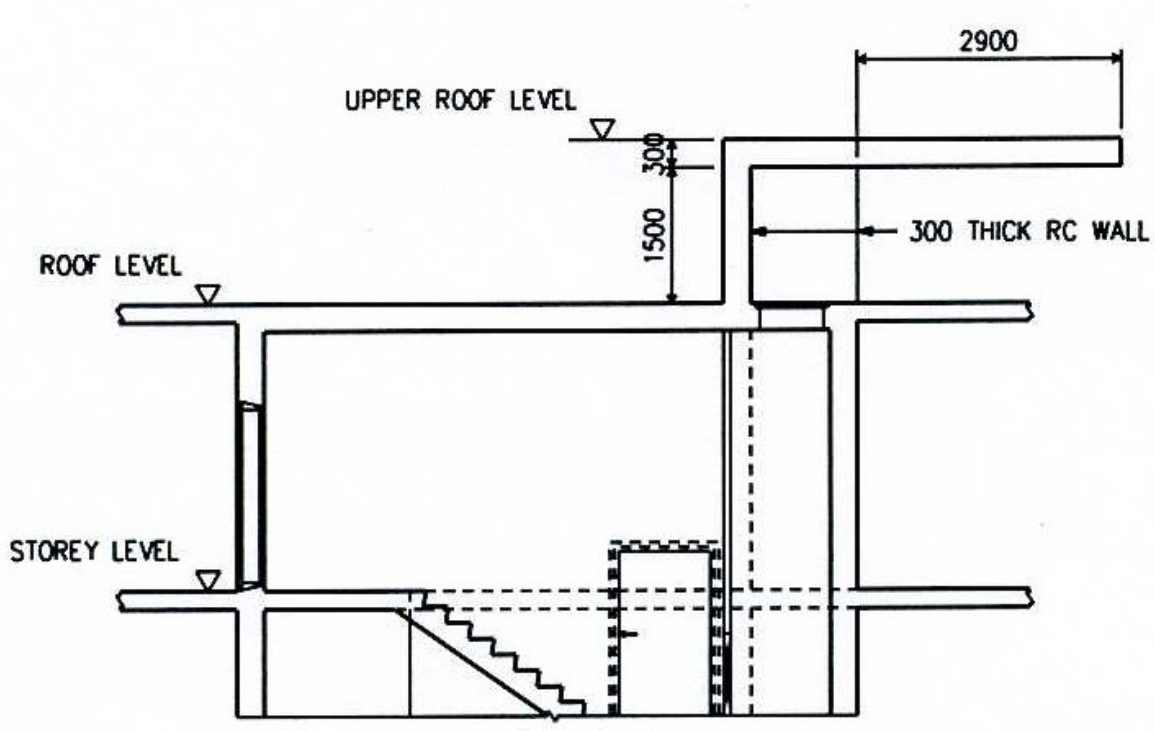


FIGURE 2.11.1(a–5) SECTION Z - Z OF STAIRCASE STOREY SHELTER

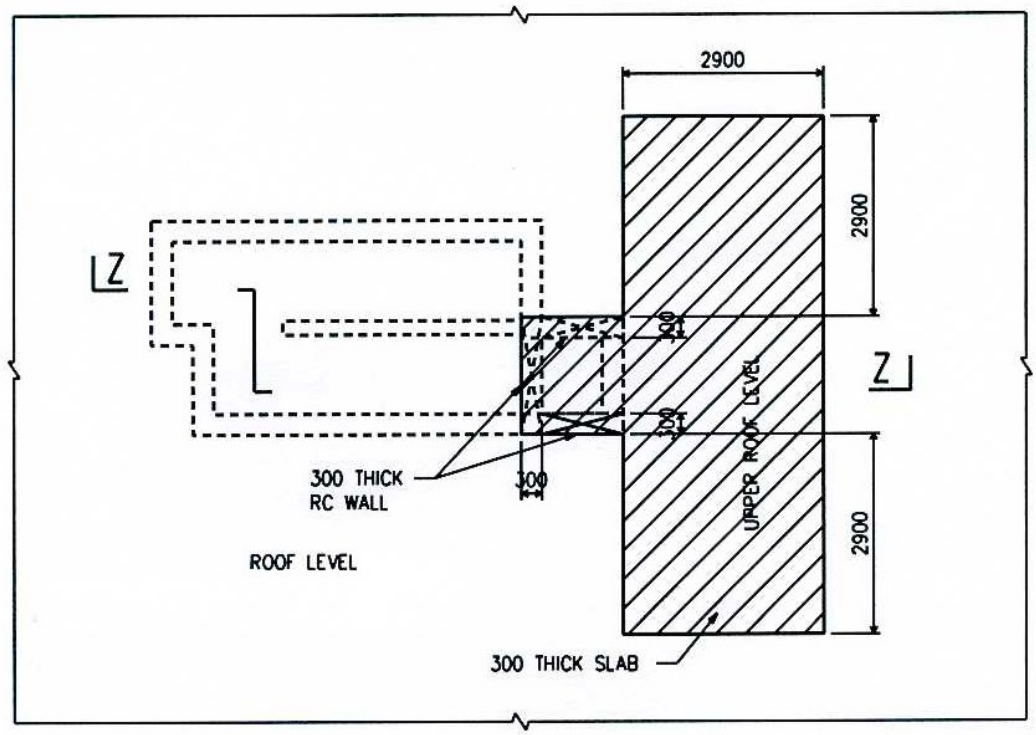


FIGURE 2.11.1(a–6) PLAN OF STAIRCASE STOREY SHELTER AT UPPER ROOF LEVEL

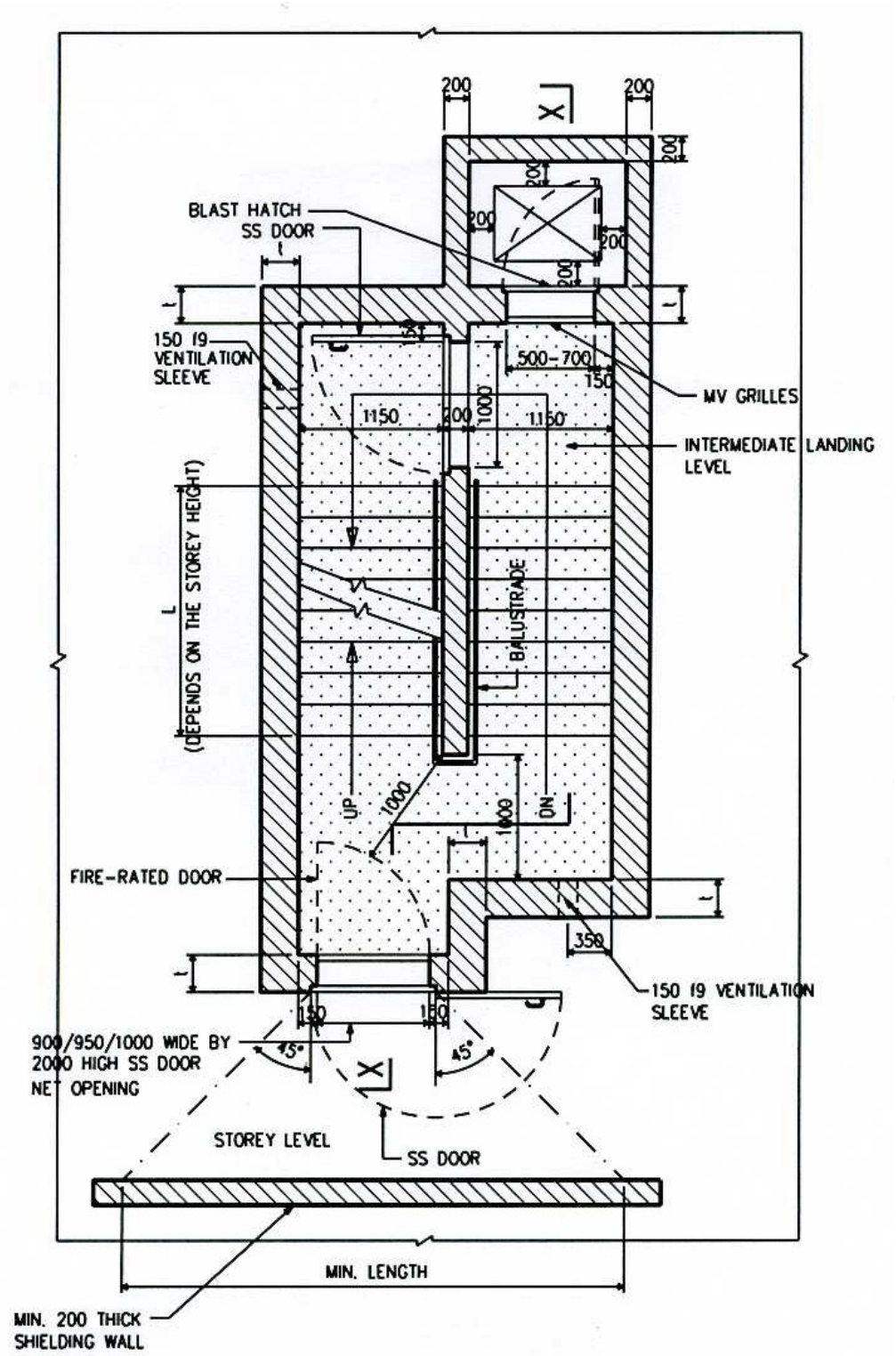


FIGURE 2.11.1(b–1) TYPICAL PLAN OF STAIRCASE STOREY SHELTER

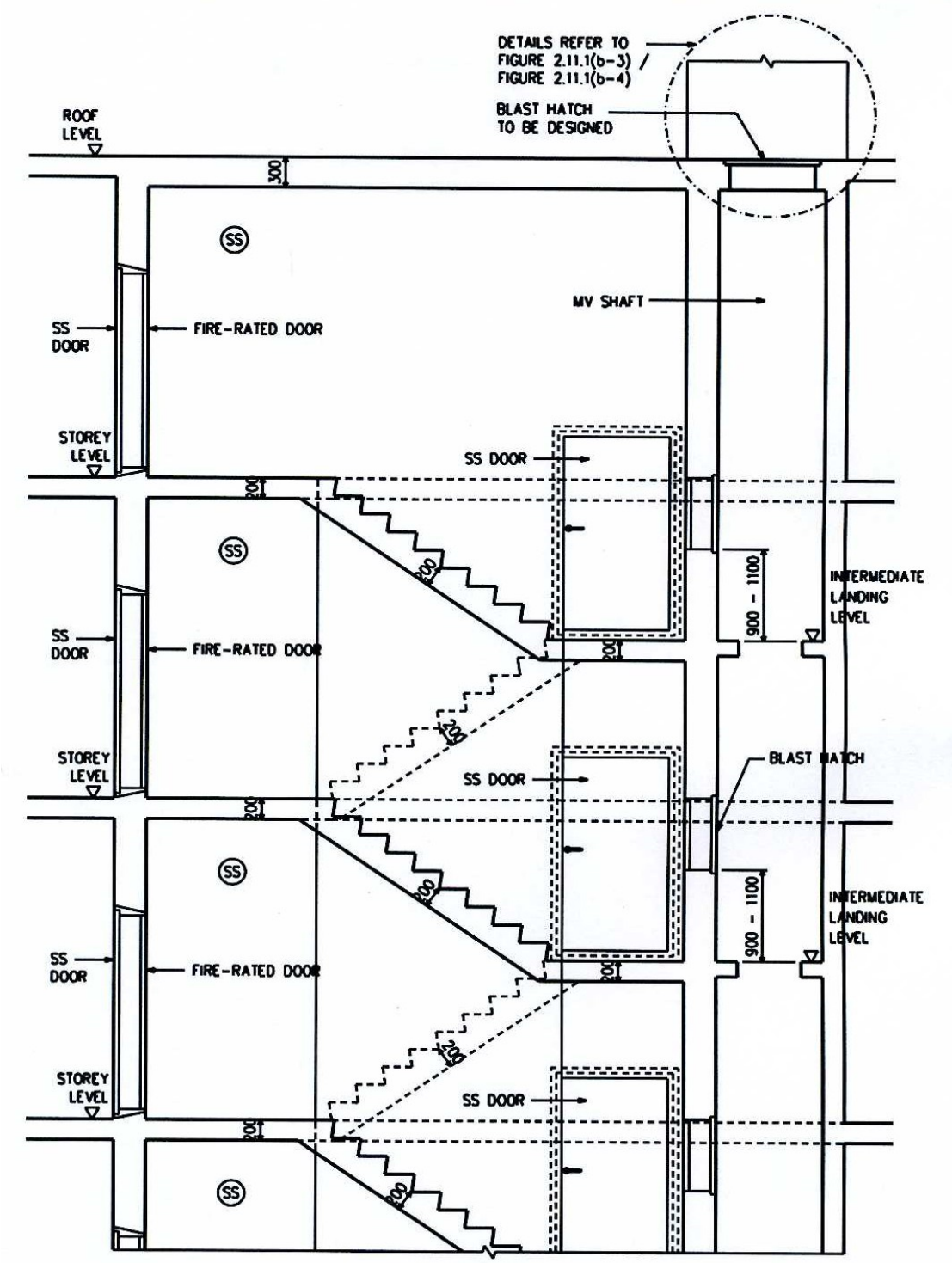


FIGURE 2.11.1(b–2) SECTION X - X OF STAIRCASE STOREY SHELTER

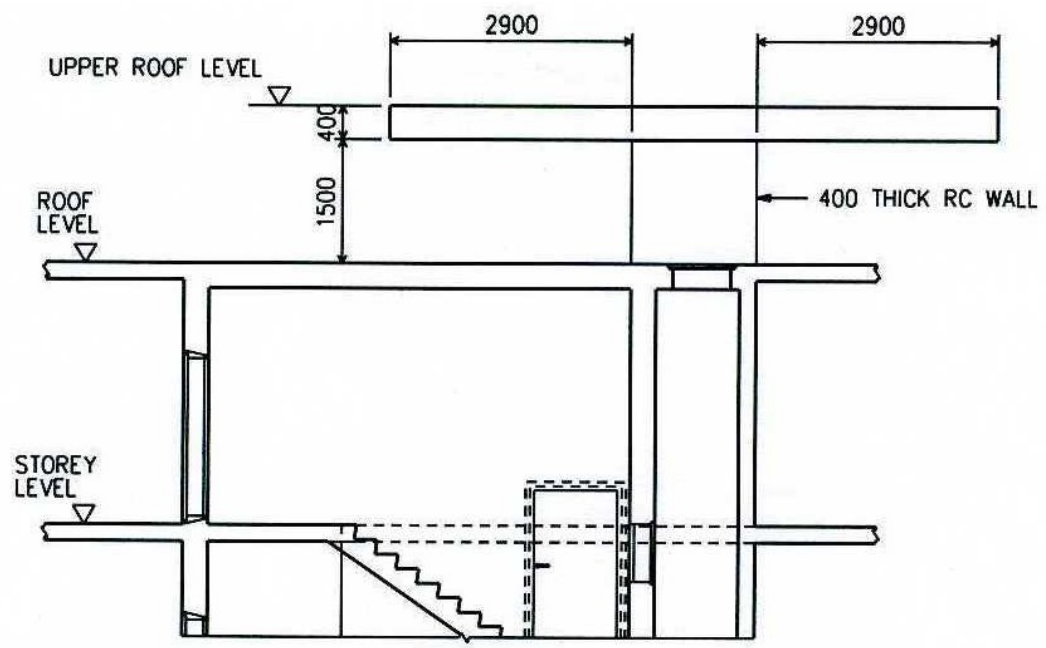


FIGURE 2.11.1(b–3) SECTION Y - Y OF STAIRCASE STOREY SHELTER

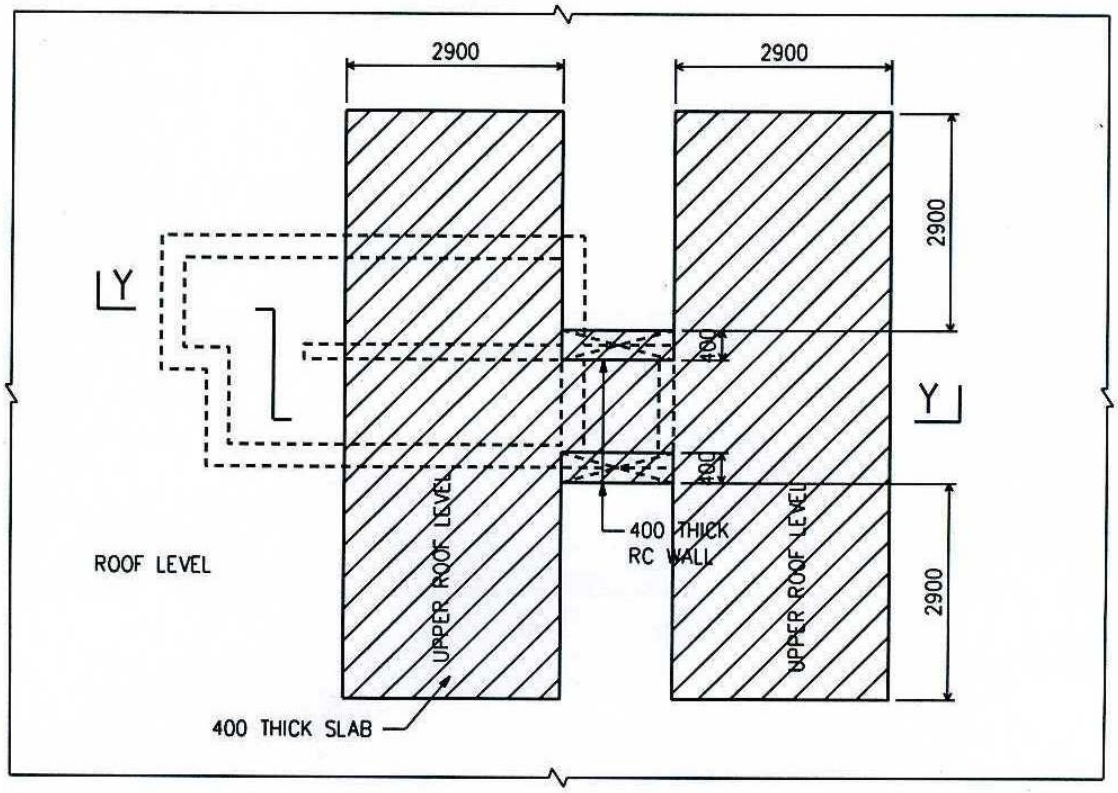


FIGURE 2.11.1(b–4) PLAN OF STAIRCASE STOREY SHELTER AT UPPER ROOF LEVEL

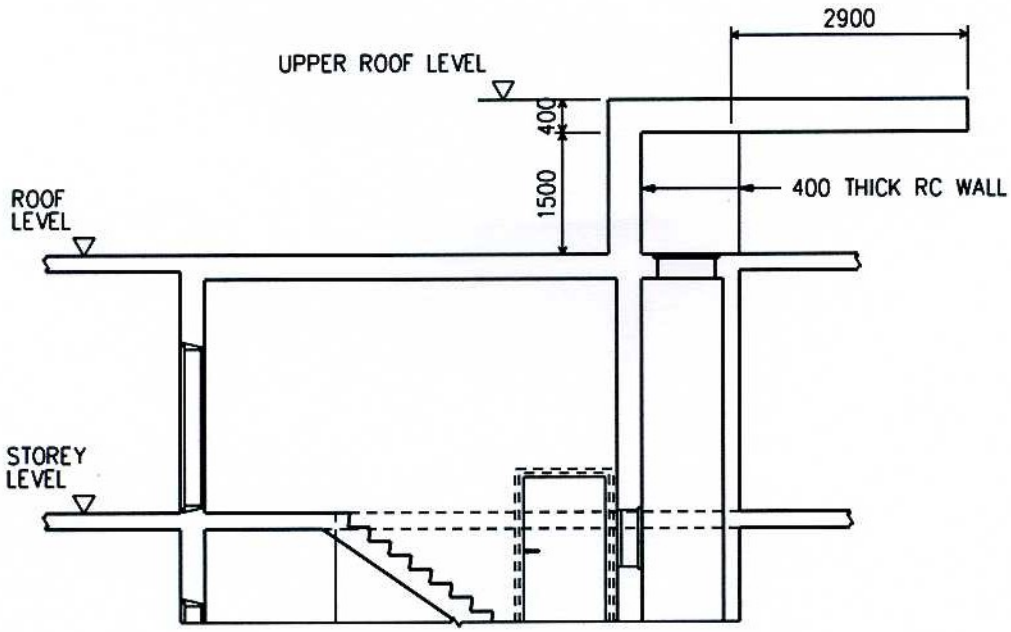


FIGURE 2.11.1(b–5) SECTION Z - Z OF STAIRCASE STOREY SHELTER

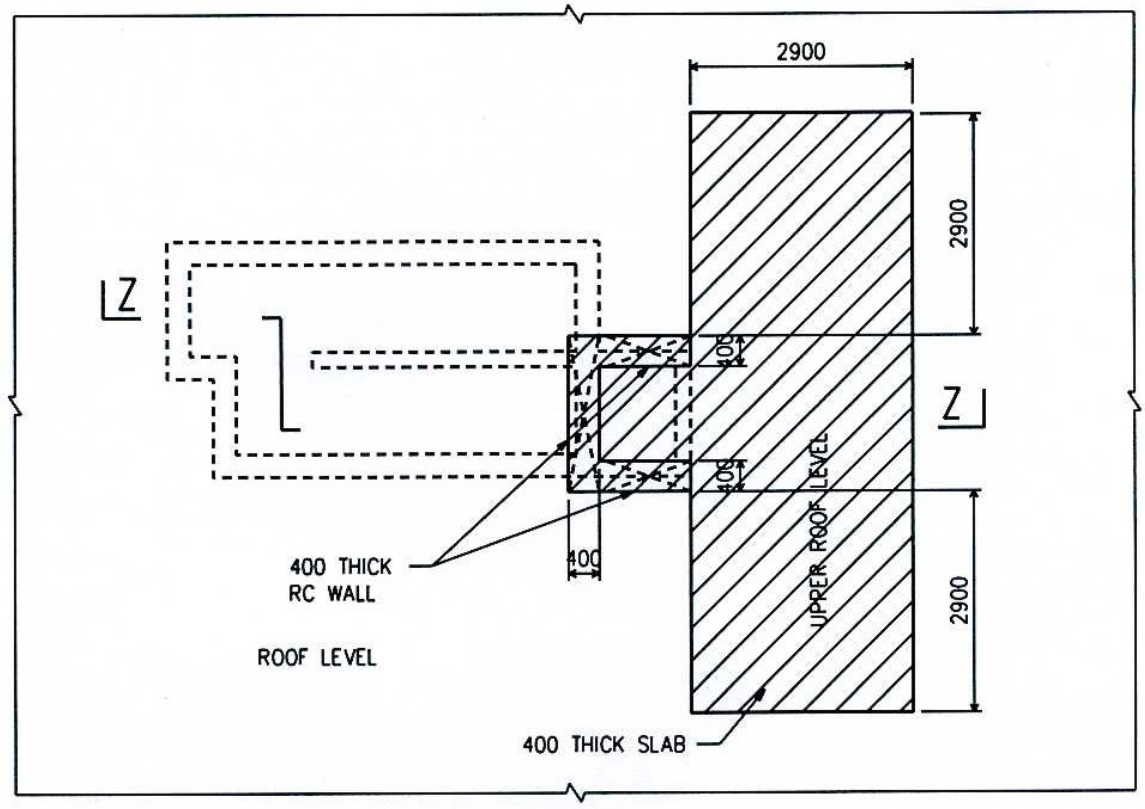


FIGURE 2.11.1(b–6) PLAN OF STAIRCASE STOREY SHELTER AT UPPER ROOF LEVEL

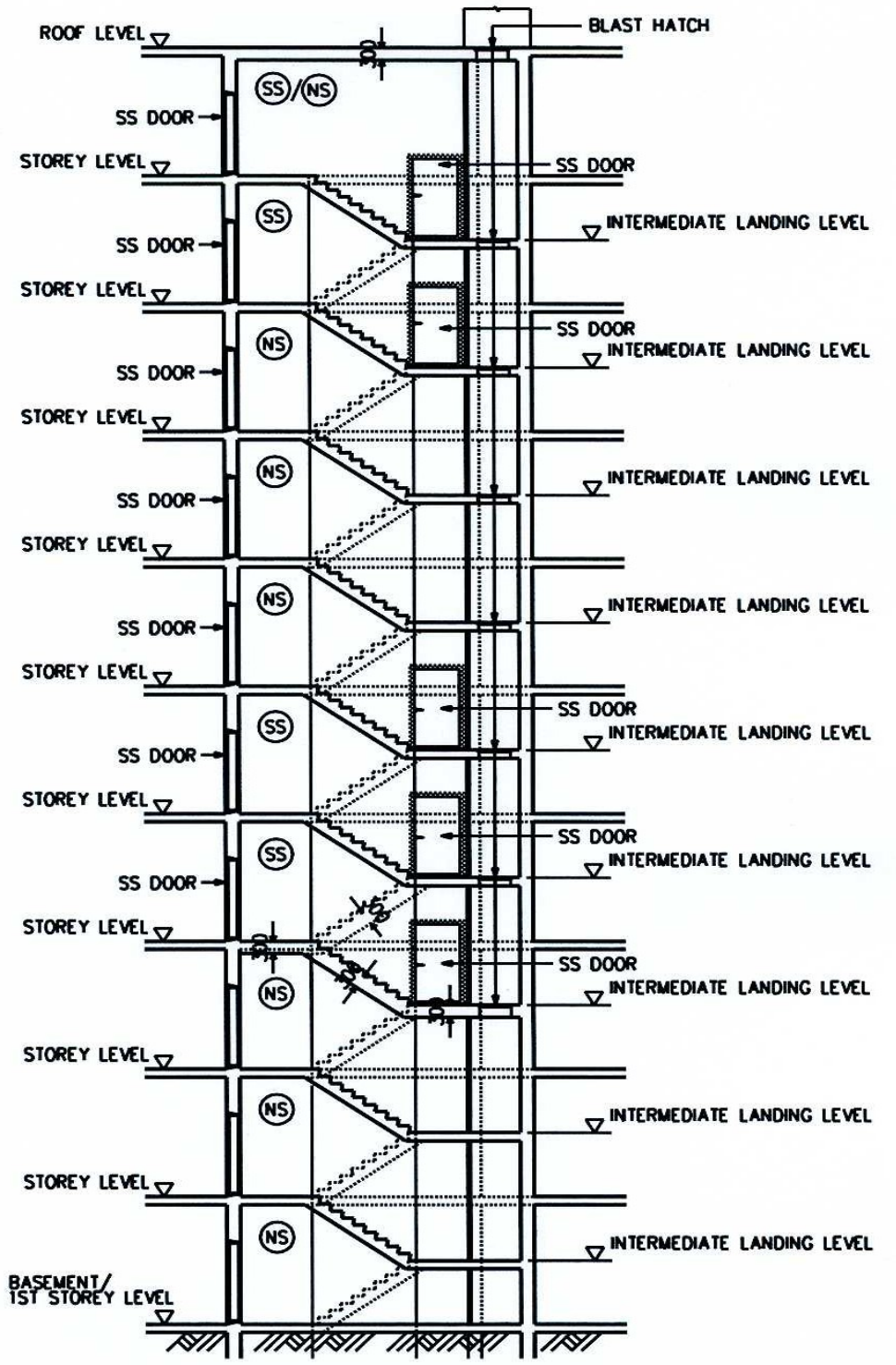


FIGURE 2.11.5 SECTION OF STAIRCASE STOREY SHELTER WITH SS / NS

CHAPTER 3

STRUCTURAL REQUIREMENTS

CHAPTER 3: STRUCTURAL REQUIREMENTS

3.1 GENERAL

The structural design of the SS tower shall take into account both the vertical and lateral loads, where applicable.

The SS tower shall be designed for maximum degrees of redundancy in the structural system against weapon effects.

3.2 MATERIALS

3.2.1 Concrete

The minimum grade of concrete for all SS elements shall be Grade 30. The use of prestressed concrete for the SS tower is not permitted.

3.2.2 Steel Reinforcement

The minimum yield stress for the main reinforcements and shear links in the structural elements forming the SS or NS shall be 460 N/mm^2 and 250 N/mm^2 respectively.

3.3 ANALYSIS

3.3.1 General

In a building of more than one-storey, the SS (or NS, where applicable) on every storey shall be located one on top of the other to form a vertical tower with its walls structurally continuous to the foundation.

3.3.2 NS Walls / Columns

3.3.2.1 Shielded NS Wall(s) and/or NS Columns

No additional design checks on SS tower is required if its supporting NS elements, either wall(s), column(s) or any of its combination, are shielded. These structural elements are deemed adequately shielded if RC slab or other equivalent structural forms provided above them and is extended beyond their edges by a minimum length of 0.5H, where H is the aggregate wall height of NS (See FIGURE 3.3.2.1).

3.3.2.2 Unshielded NS Wall(s) and/or NS Columns

The following requirements are to be complied with:

3.3.2.2.1 Unshielded NS Wall(s)

The minimum thickness of each NS wall shall be 300 mm. The HS tower shall be designed against the most severe effects as the result of the removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter on the NS wall at its most critical location (See FIGURE 3.3.2.2.1).

3.3.2.2.2 Unshielded NS Column(s)

The minimum size (either its diameter or the shorter dimension) of each NS column shall be 500 mm. The SS tower shall be designed against the most severe effects as the result of the removal of any one NS column (See FIGURE 3.3.2.2.2).

3.3.2.2.3 Combination of Unshielded NS Wall(s) and NS Column(s)

The minimum thickness of each NS wall and minimum size (either its diameter or the shorter dimension) of each NS column shall be 300 mm and 500 mm respectively. The SS tower shall be designed against the most severe effects as the result of the following (See FIGURE 3.3.2.2.3):

(a) Removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter at its most critical location; or

(b) Removal of any one NS column.

The above Item (a) and (b) are not to be considered simultaneously.

The following are the criteria to be used when performing 3.3.2.2.1, 3.3.2.2.2 or 3.3.2.2.3:

(a) The design loads shall be based on the load combination and values of partial safety factors for loads (γ_f) in accordance with TABLE 3.3.2.2.3.

(b) The design strength for a given material is derived from the characteristic strength divided by the partial safety factor for strength of material (γ_m), which shall be 1.3 for concrete and 1.0 for reinforcement.

3.3.3 Exit Staircase – Not Applicable for S/C SS

Where there is only one exit staircase or exit scissors-staircase serving non-landed dwelling units, the minimum waist and the thickness of the landing slab of the staircase shall be 150 mm. The staircase shall be constructed of reinforced concrete. Where a pre-cast concrete exit staircase is used, the support connections shall be designed for a load equal to 1.25 times its characteristic dead weight, which are acting in 2 lateral directions.

3.4 MEMBER DIMENSIONS AND REINFORCEMENT AMOUNTS

3.4.1 Member Dimensions

The minimum dimensions of members forming part of the SS tower shall be as follows:

(a) SS wall - refer to Clause 2.4.

(b) Internal common wall between two adjacent SS - 200 mm.

(c) Intermediate SS/NS slabs and staircase SS/NS waists - 200 mm.

(d) Ceiling slab of top-most SS - 300 mm.

(e) Floor slab of bottom-most SS - 300 mm.

(f) Floor slab of NS located above SS and ceiling slab of NS located immediately below SS - 300 mm.

(g) Wall thickness of any SS or NS within the SS tower shall not be less than the wall thickness of the SS or NS above it.

(h) Shielding wall in front of SS door - 200mm.

3.4.2 Reinforcement

All diameters of reinforcement specified hereinafter shall refer to minimum bar diameters. All spacing of reinforcement specified hereinafter shall refer to maximum spacing of reinforcement in both directions.

(a) Minimum Reinforcement in SS or NS walls – refer to TABLE 3.4.2

Internal common wall between two adjacent SS or internal wall for staircase SS:

Two layers of reinforcements (at both internal and external faces) shall be T10-100 c/c in both directions. The shear links shall be R6-600 c/c in both directions.

(c) Intermediate SS/NS slabs and slabs /waists of staircase SS/NS :

Two layers of reinforcements (top and bottom) shall be T10 -100 c/c in both directions. The shear links shall be R6-600 c/c in both directions.

(d) Ceiling slab of top-most SS:

(i) External and internal slab reinforcement shall be T10-100 (both directions) and T13-100 (both directions) respectively;

(ii) The shear links shall be R6-600 c/c in both directions

(e) Floor slab of bottom-most SS or NS and floor slab of NS located above an SS:

(i) External and internal slab reinforcement shall be T10-100 (both directions)and T13-100 (both directions) respectively;

(ii) The shear links shall be R6-600 c/c in both directions

(f) Ceiling slab outside the SS tower which is immediately above SS door:

The ceiling slab shall be constructed of 150mm thick reinforced concrete, the reinforcement shall consist of two layers of reinforcement (top and bottom) at T10-200 c/c in both directions.

(g) Floor slab outside SS tower:

The reinforcements of every floor slab immediately outside SS tower walls shall be structurally connected to the SS tower.

(h) Exit Staircase:

The reinforcement of the waist and landing slab of exit staircase shall consist of two layers of reinforcement (top and bottom) at T10–200 c/c in both directions. The shear links connecting the two layers of main reinforcements shall be R6-600 c/c in both directions.

(i) SS slab which is integrated with pile-cap/footing:

For SS slab integrated with the pile-cap or footing of more than 500 mm thick, shear links is not required. The maximum spacing of main reinforcement shall be 200 mm c/c.

(j) Shielding wall in front of SS door:

Two layers reinforcement (one on each side of the wall) of T10-200 c/c in both directions.

3.5 DETAILING OF SS TOWER

3.5.1 General

The SS tower is to be detailed to allow for the installation of services and fixtures in SS and to resist spalling of the internal face of SS walls, soffit of ceiling slabs and/or finishes on SS floor slab.

3.5.2 Lap and Anchorage Length

Requirements for lap and anchorage length of reinforcement bars are as follows:

(a) For slabs and walls, full tension lap length shall be provided at all laps. The lap length shall be at least equal to the design tension length necessary to develop the full tensile capacity of the reinforcement. The lap length shall take into account the minimum cover, location and strength of the lapped reinforcement and the concrete grade.

(b) Welding of reinforcement is not permitted.

(c) Bundled bars are not permitted.

3.5.3 Concrete Cover

The concrete cover to the main reinforcement shall not exceed 40 mm.

3.5.4 Cast-In-Situ and Precast Elements

Cast-In-Situ SS elements shall comply with the dimensions and detailed requirements as shown in the following figures:

- FIGURE 3.5.4(a) - Plan of SS wall
- FIGURE 3.5.4(b) - Typical details of SS slabs/walls
- FIGURE 3.5.4(c) - Plan of two SS with an internal common wall
- FIGURE 3.5.4(d) - Typical details of two SS with an internal common wall
- FIGURE 3.5.4(e) - Details of SS wall reinforcement near SS door/hatch
- FIGURE 3.5.4(f) - Typical details of embedded conduit in SS wall
- FIGURE 3.5.4(g) - Plan of SS wall reinforcement details near SS door
- FIGURE 3.5.4(h) - Typical details of trimmer bars for ventilation sleeve
- FIGURE 3.5.4(i) Details pf SS slab reinforcement near rescue hatch

Pre-cast SS elements shall comply with the dimensions and detailed requirements as shown in the following figures:

- FIGURE 3.5.4(j) - Details of pre-cast SS door frame panel (Type 1)
- FIGURE 3.5.4(k) - Details of pre-cast SS door frame panel (Type 1)
- FIGURE 3.5.4(l) - Plan of SS walls with pre-cast SS door frame panel (Type 1)
- FIGURE 3.5.4(m) - Details of pre-cast SS door frame panel (Type 2)
- FIGURE 3.5.4(n) - Details of pre-cast SS door frame panel (Type 2)
- FIGURE 3.5.4(o) Details of pre-cast SS door frame panel (Type 2)
- FIGURE 3.5.4(p) - Plan of SS wall with pre-cast SS door frame panel (Type 2)

3.5.5 Joints

(a) Construction joints in an SS tower shall be properly executed to ensure that the strength and the integrity of the SS are not impaired. The type and location of joints shall be specified in the design after taking into account the following:

(i) A concrete kicker, if provided, shall not be more than 100 mm high.

(ii) All SS walls located within each storey shall be cast in one operation.

(b) Expansion joints or contraction joints in the SS tower are not permitted.

3.6 PENETRATION OF SERVICES

3.6.1 Electrical Services

All service cables which do not serve the SS directly shall not penetrate the walls and slabs of the SS and shall not be embedded within the SS walls and slabs. However, service cables from the socket which is mounted on the external face of SS may be embedded in the SS wall and slab.

Two embedded sockets mounted one behind the other (i.e. back to back mounting) on the internal and external faces of the SS wall are not permitted (See FIGURE 3.6.1(a)). Where sockets are to be mounted on both the internal and external faces of an SS wall, they shall be mounted at least 300 mm apart from each other, measured between their clear edges.

Risers for electrical services may be mounted on the external face of SS tower walls.

Where service cables and sockets in the SS are exposed on internal walls, non-metallic inserts are to be used for their mounting. For embedded service cables and sockets serving the SS, the details as shown in FIGURE 3.5.4(f) shall be followed. The encasement of power, TV, radio and telephone points and switches of Clause 2.6 shall be galvanised steel (See FIGURE 3.6.1(b)).

A maximum of four numbers of 25 mm diameter service conduits for electrical cables serving the SS are allowed to be embedded in the SS structural elements. Both ends of the concealed conduits shall be fully sealed with approved sealing material of up to a depth of not less than 100 mm into the conduits to ensure air-tightness of SS.

Where an SS or NS and lift core share a common wall, mounting of services on the lift core side of the SS wall shall be made of stainless steel material. For the purpose of installing M&E equipment within the lift core, all anchor bolts to be fixed onto this common wall shall be made of stainless steel and be embedded up to a maximum depth of 75 mm. They shall also be cast in place with the structural wall. The spacing of the anchor bolts, measured between their centrelines, shall not be less than 300 mm.

3.6.2 Pipe Services

Pipe services are allowed to pass through the SS walls provided that they are laid within a stainless steel conduit encased by 150 mm reinforced concrete all round (See FIGURE 3.6.2). Joints in pipes or the stainless steel conduit shall be located outside the SS.

Risers for services can be mounted on the external face of SS tower walls.

3.7 ACCESS TO RESCUE HATCH – Not Applicable For S/C SS

The ladder and its supports shall be designed to withstand a shock load of at least 12.5g in all directions.

TABLE 3.3.2.2.3: LOAD COMBINATION AND VALUES OF PARTIAL SAFETY FACTORS (γf) FOR ULTIMATE LIMIT STATE

Load Combination	Load Types					
	Dead		Imposed		Earth and Water Pressure (if applicable)	Wind (if applicable)
	Adverse	Beneficial	Adverse	Beneficial		
Dead and imposed and wind (and earth and water pressure)	1.05	1.05	1.05	1.05	1.05	1.05

TABLE 3.4.2: MINIMUM REINFORCEMENT OF SS OR NS WALLS

SS/NS Clear Height (mm)	Reinforcement at internal face of wall (both directions)	Reinforcement at external face of wall (both directions)	Shear Links (both directions)
$2400 \leq Ht \leq 3400$	T13 - 100 c/c	T10 - 100 c/c	R6 - 600 c/c
$3400 < Ht \leq 3900$	T16 -100 c/c	T13 - 100 c/c	R6 - 600 c/c

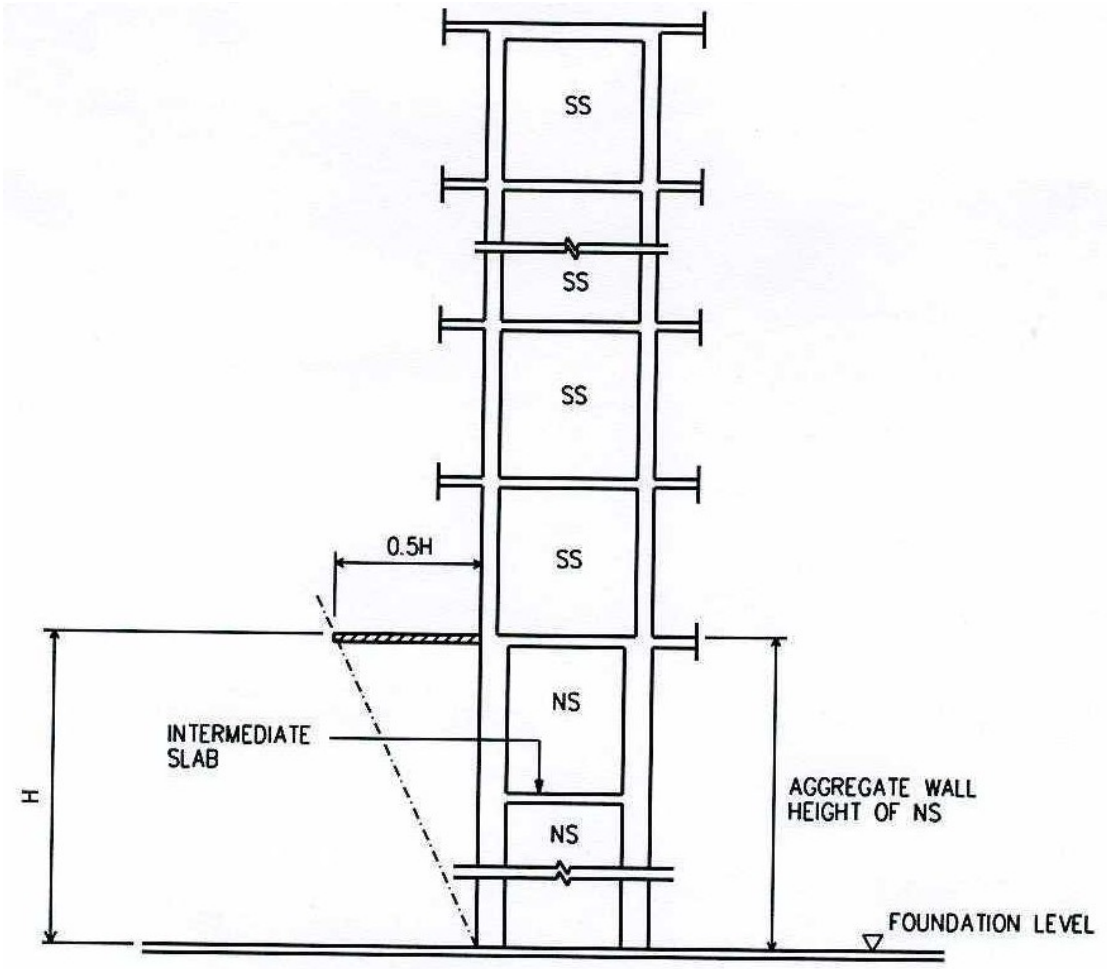


FIGURE 3.3.2.1 CROSS SECTION OF SS TOWER

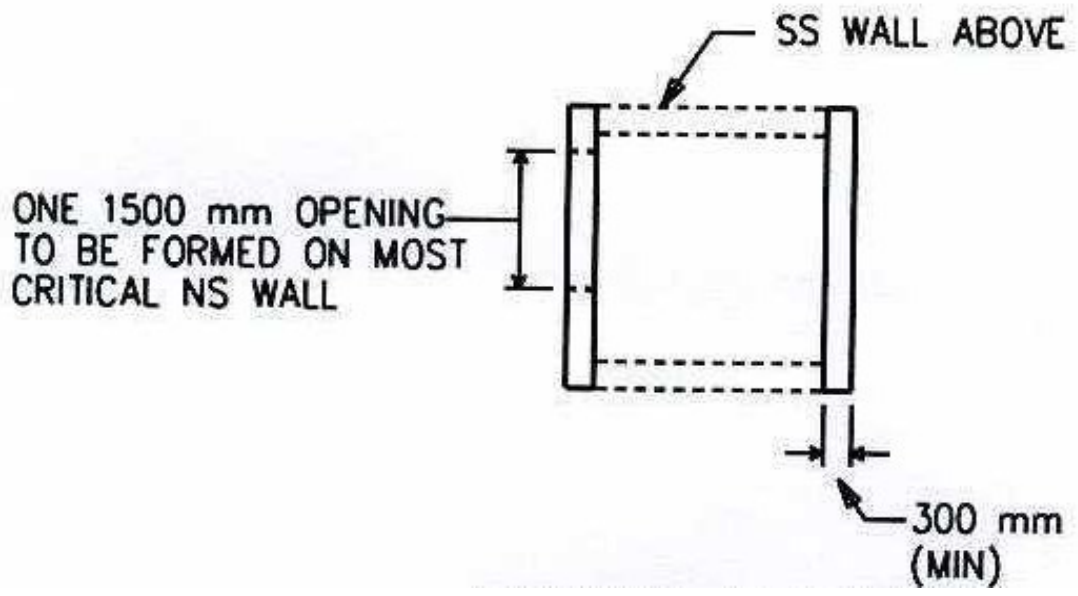


FIGURE 3.3.2.2.1 PLAN OF NS WALLS

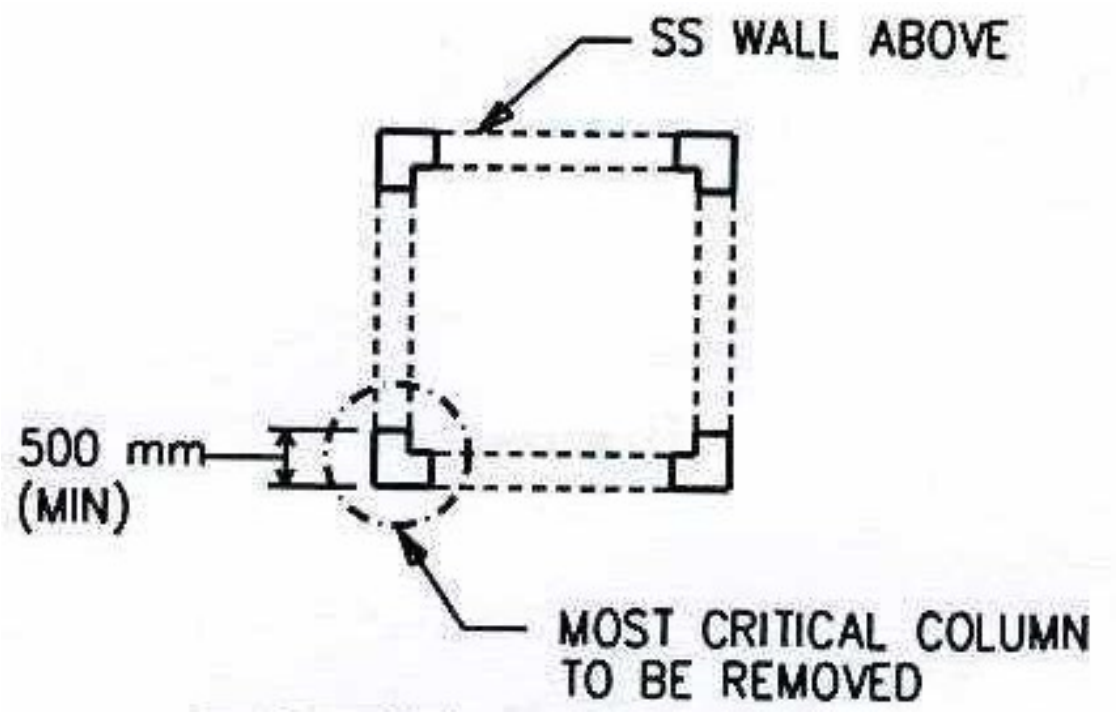


FIGURE 3.3.2.2.2 PLAN OF NS COLUMNS

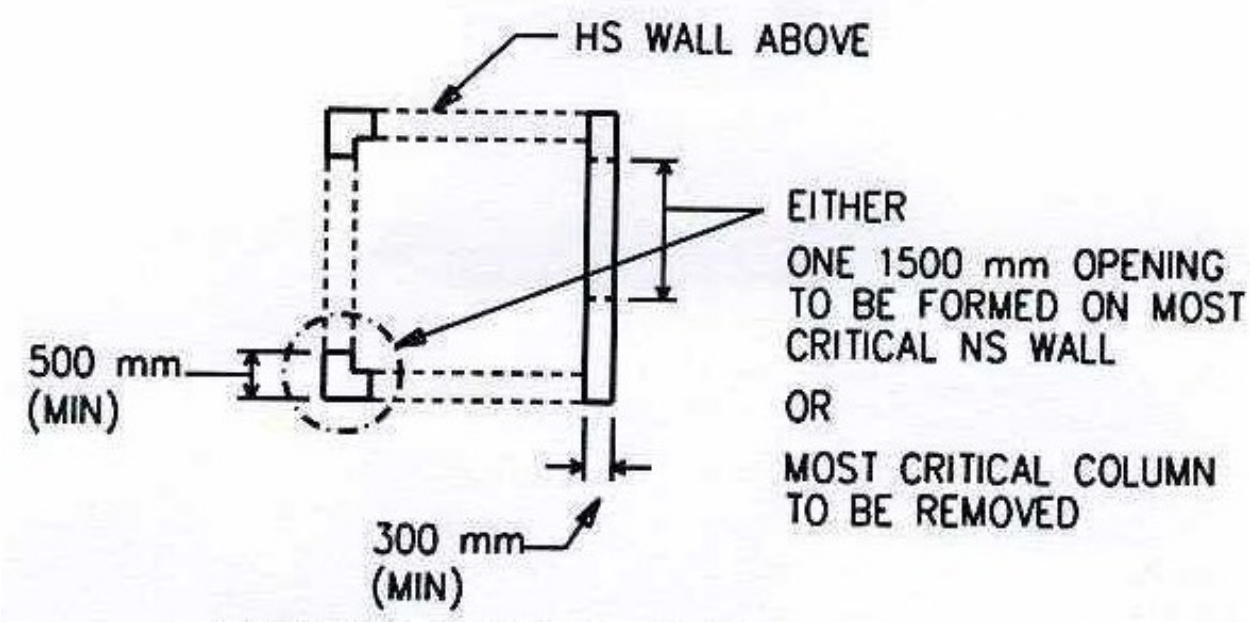
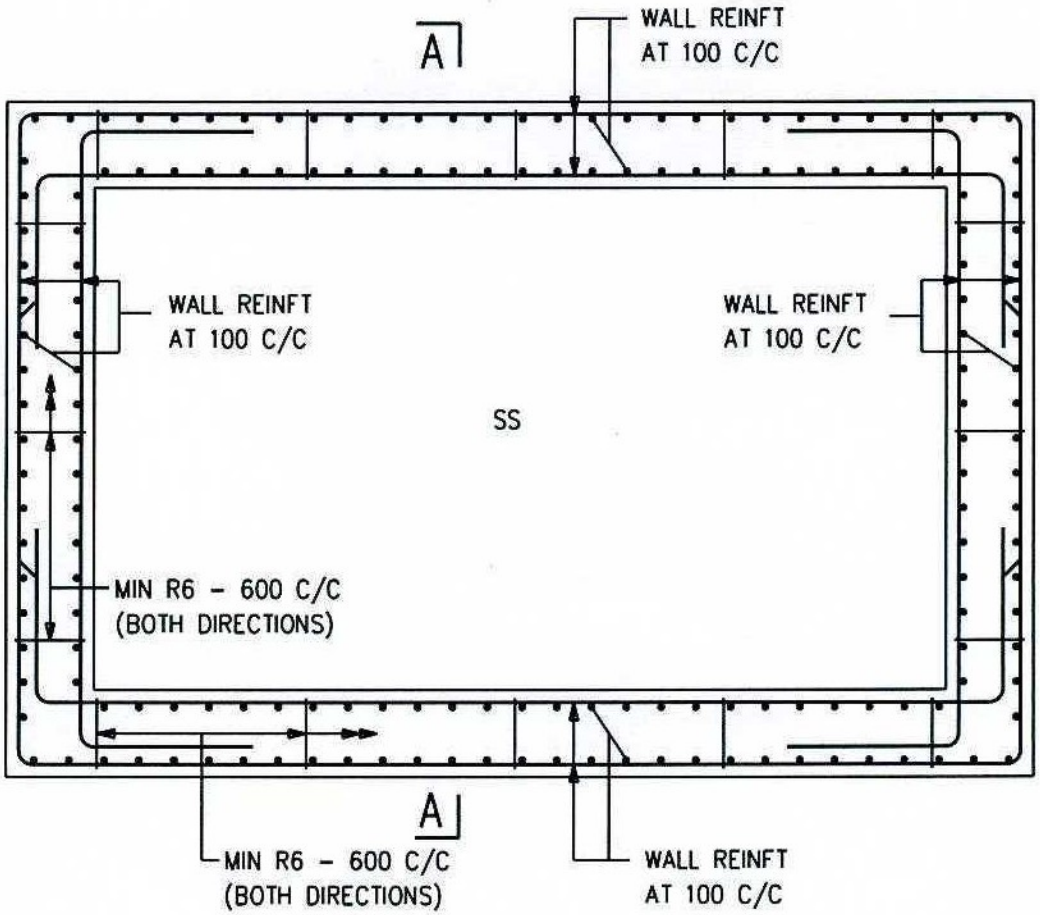
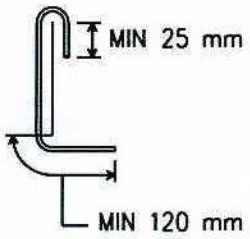


FIGURE 3.3.2.2.3 PLAN OF NS WALL & COLUMNS



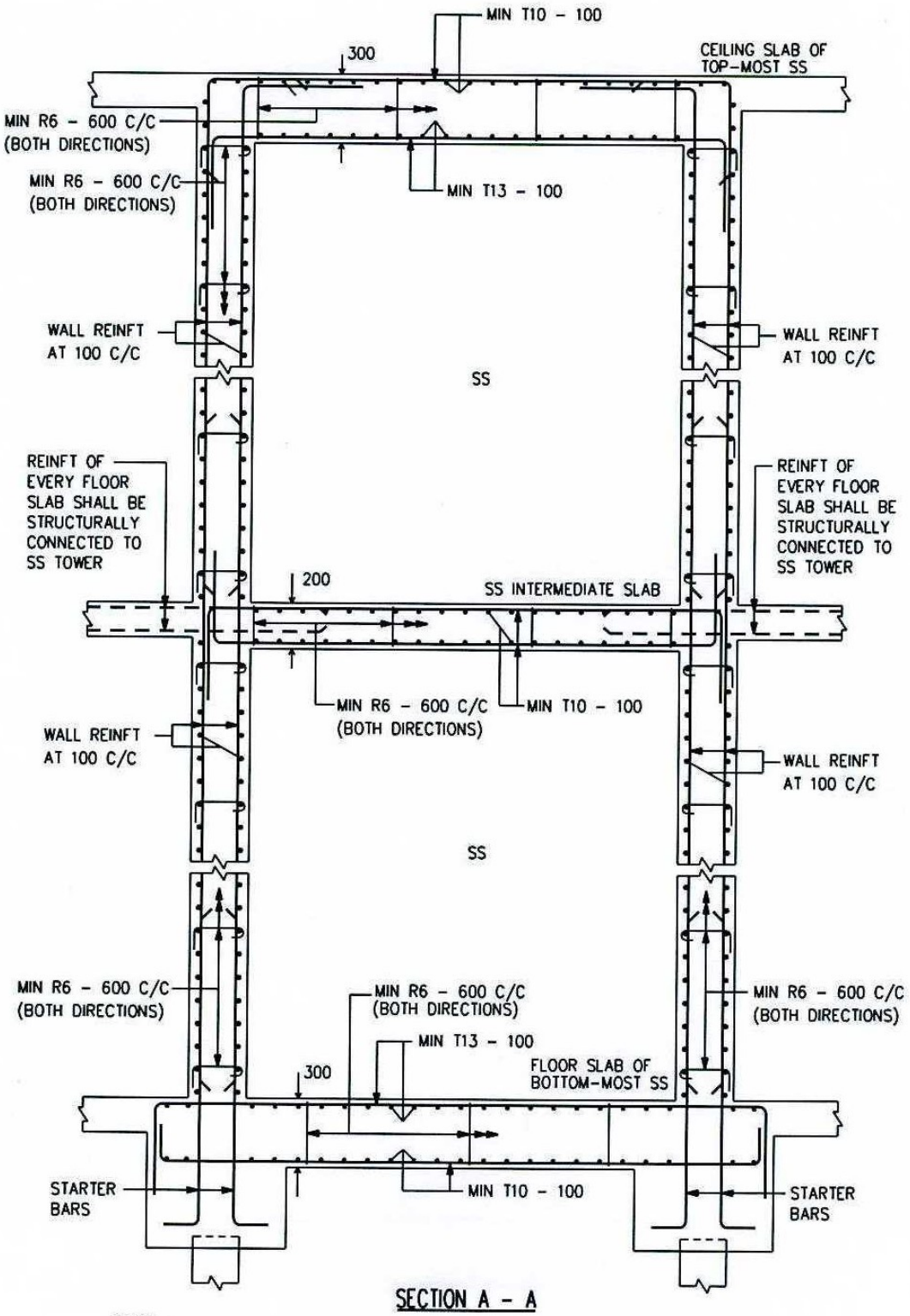


MINIMUM HOOK AND BEND ALLOWANCE
FOR SHEAR LINK

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(a) PLAN OF SS WALL

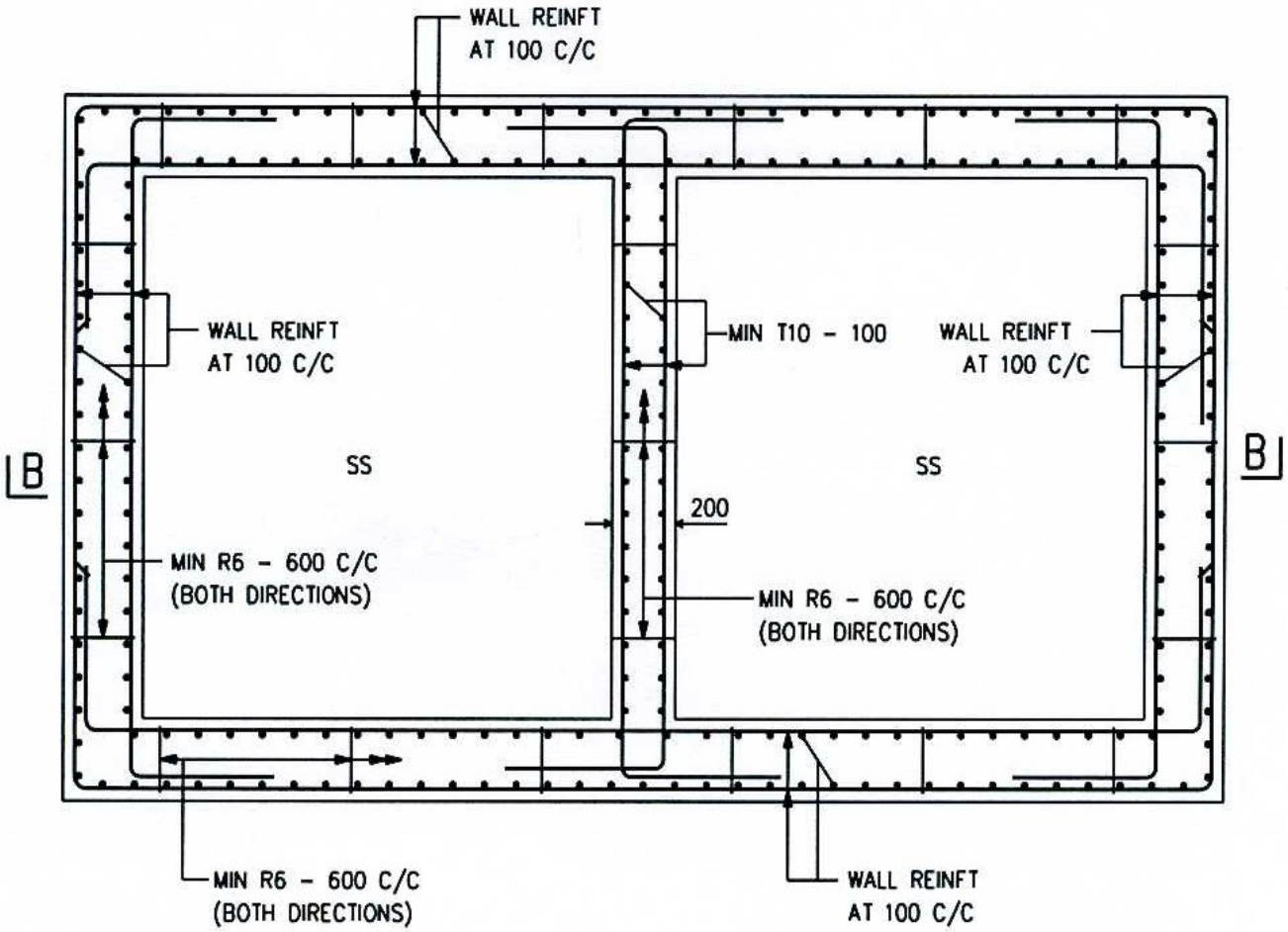


SECTION A - A

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

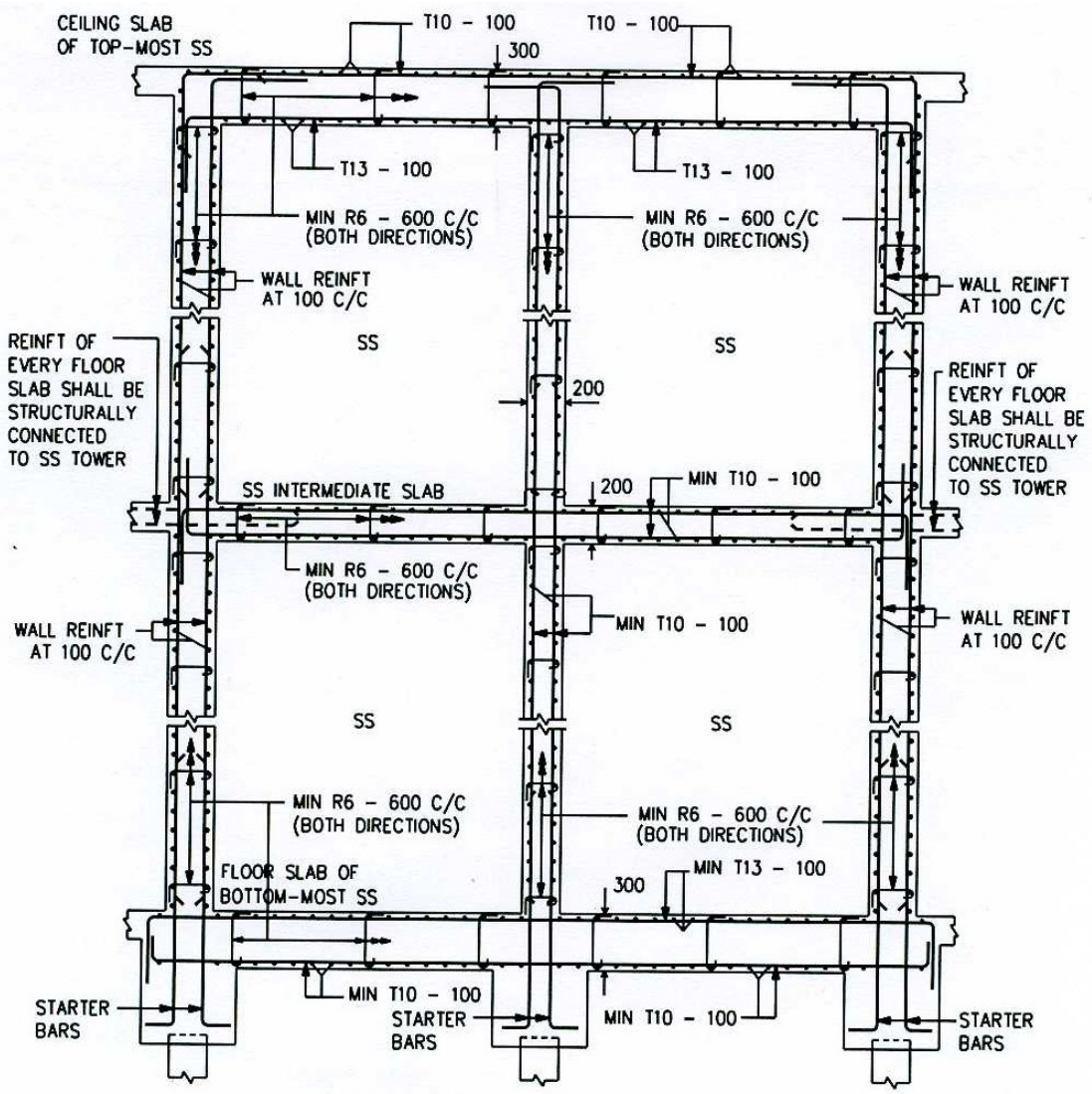
FIGURE 3.5.4(b) TYPICAL DETAILS OF SS SLABS/WALLS



NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(c) PLAN OF TWO SS WITH AN INTERNAL COMMON WALL

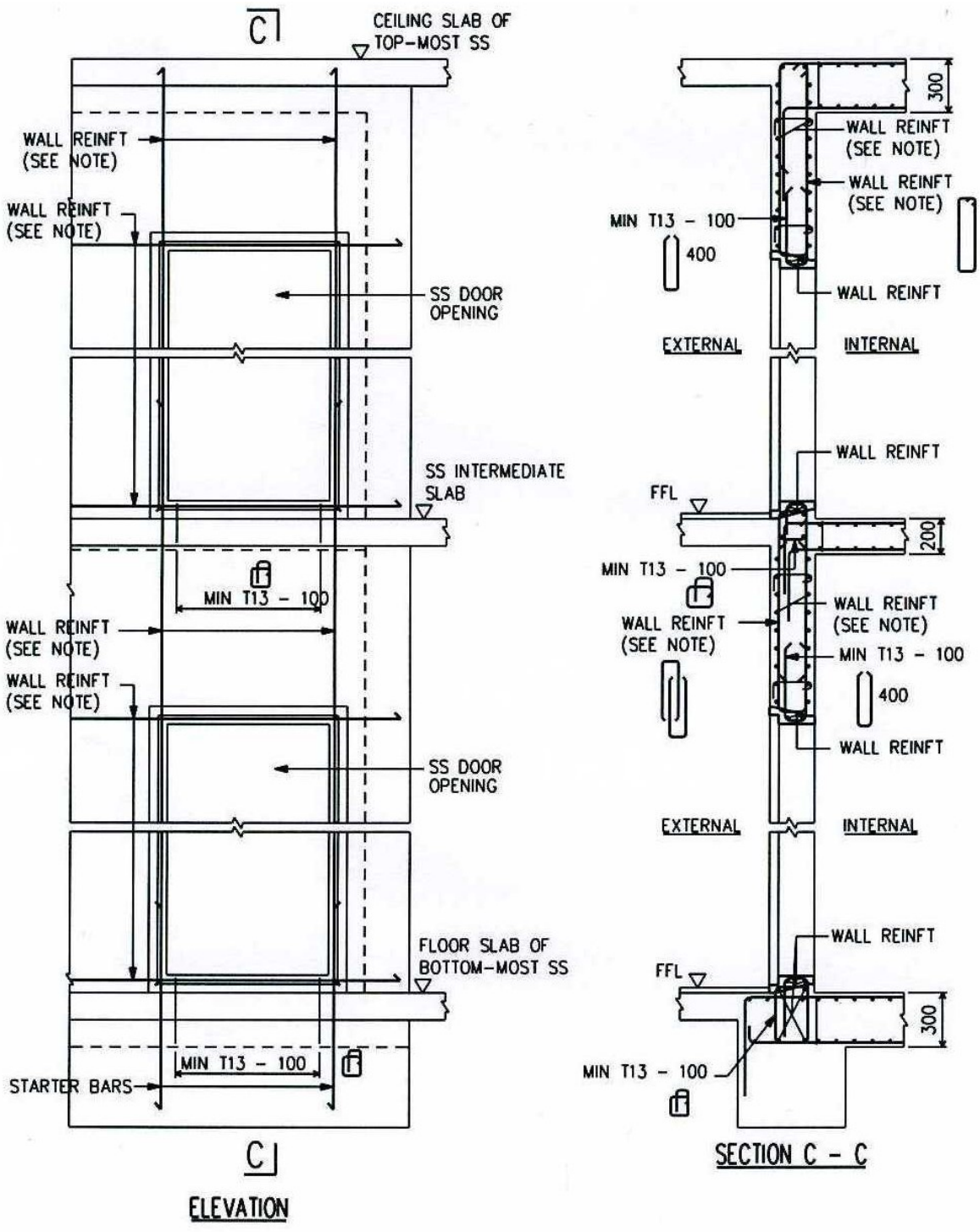


SECTION B - B

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(d) TYPICAL DETAILS OF TWO SS WITH AN INTERNAL COMMON WALL



NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(e) DETAILS OF SS WALL REINFORCEMENT NEAR SS DOOR

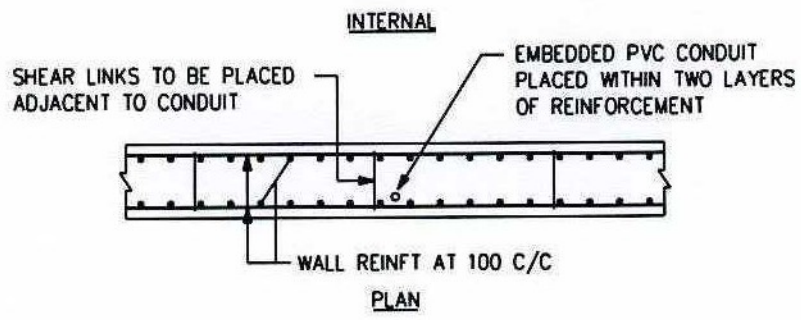


FIGURE 3.5.4(f) TYPICAL DETAILS OF EMBEDDED CONDUIT IN SS WALL

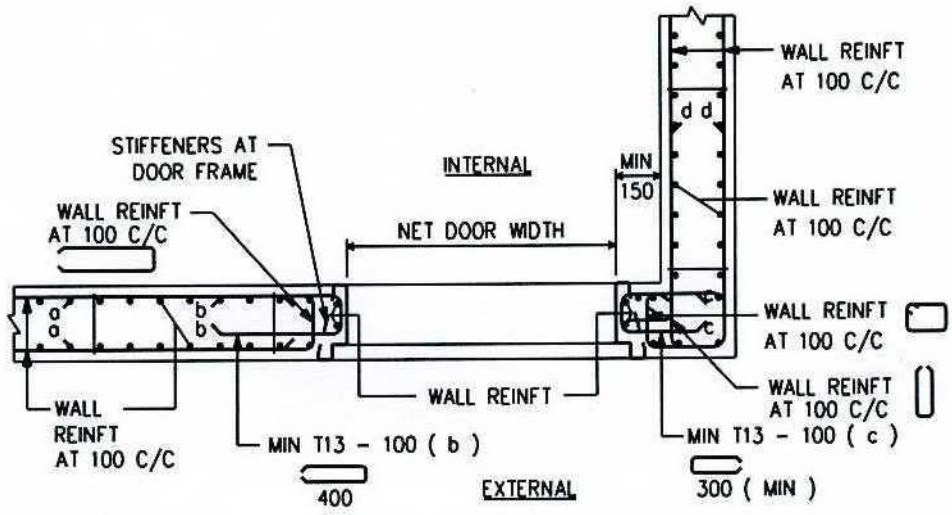


FIGURE 3.5.4(g) PLAN OF SS WALL REINFORCEMENT DETAILS NEAR SS DOOR

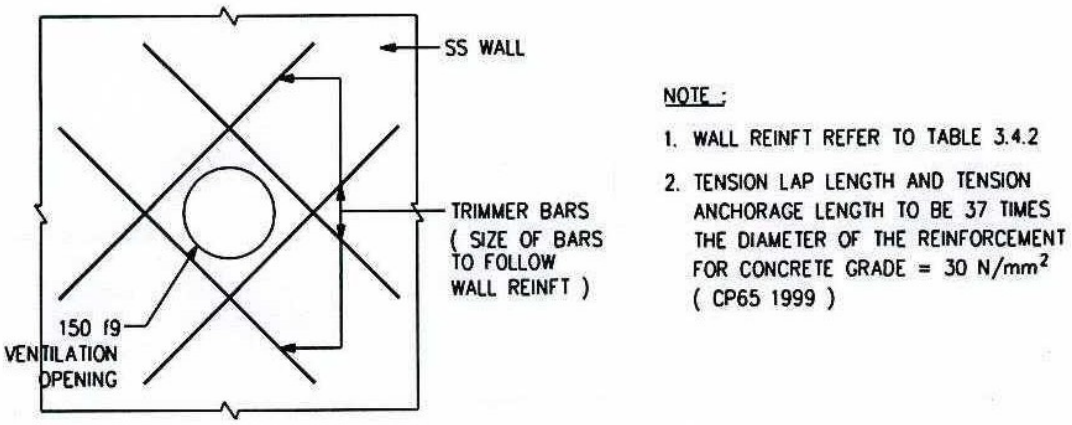
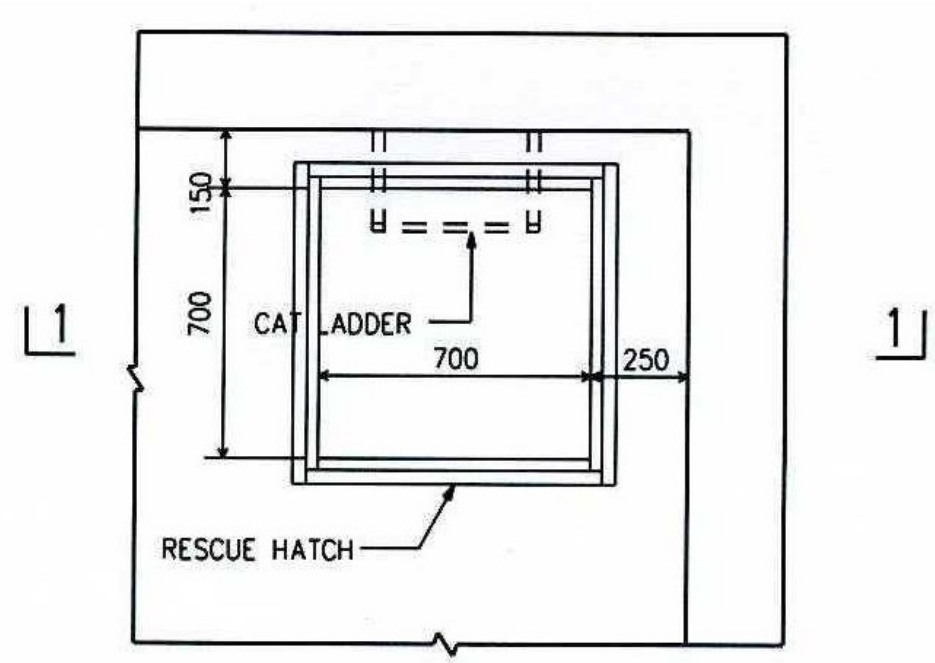
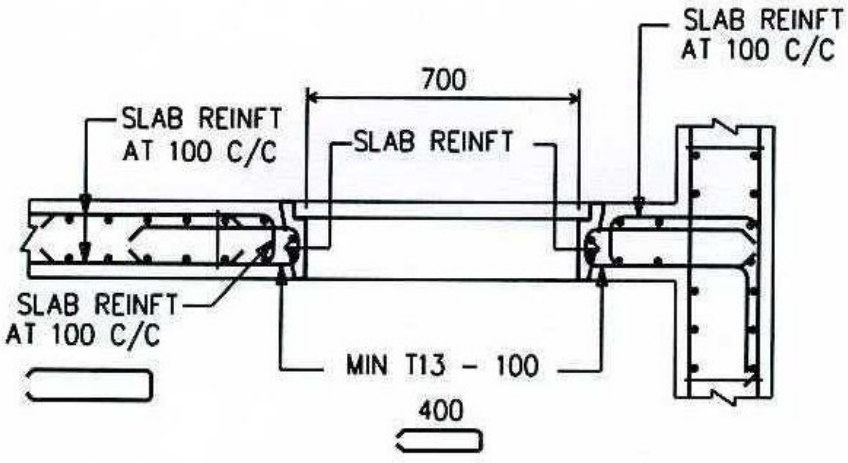


FIGURE 3.5.4(h) TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE





SECTION 1 - 1

FIGURE 3.5.4(i) DETAILS OF SS SLAB REINFORCEMENT NEAR RESCUE HATCH

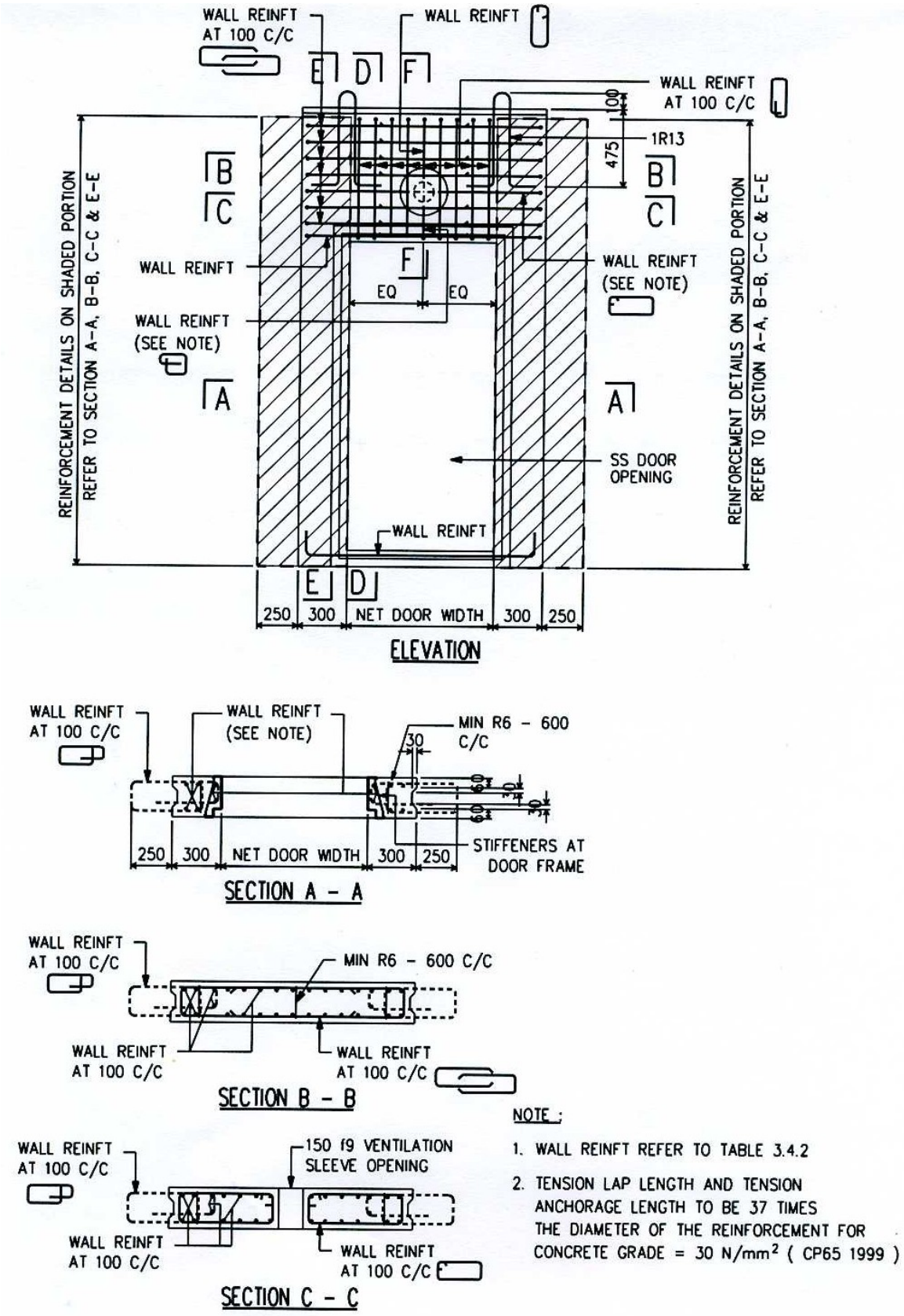


FIGURE 3.5.4(j) DETAILS OF PRECAST SS DOOR FRAME PANEL (TYPE 1)

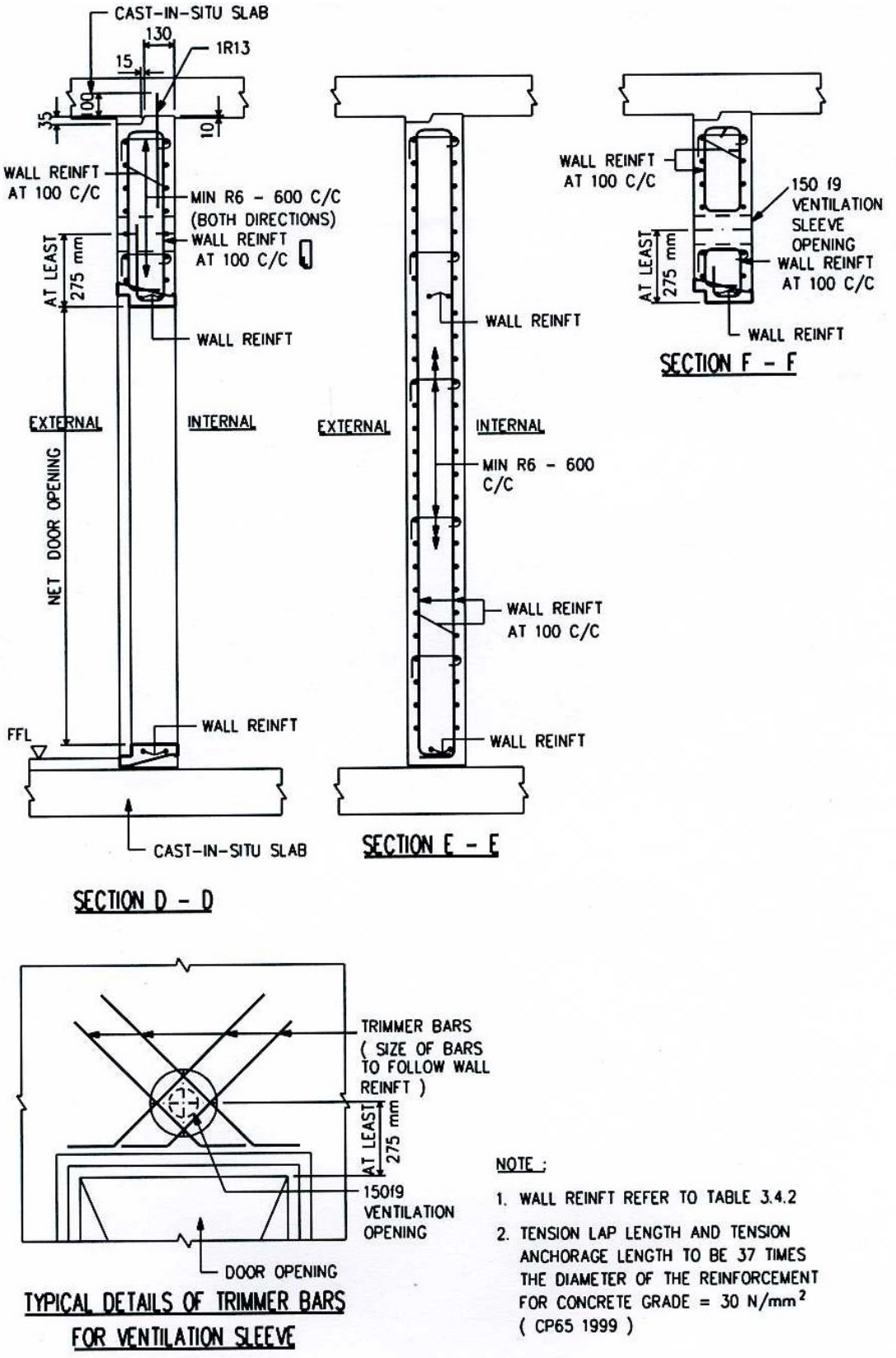
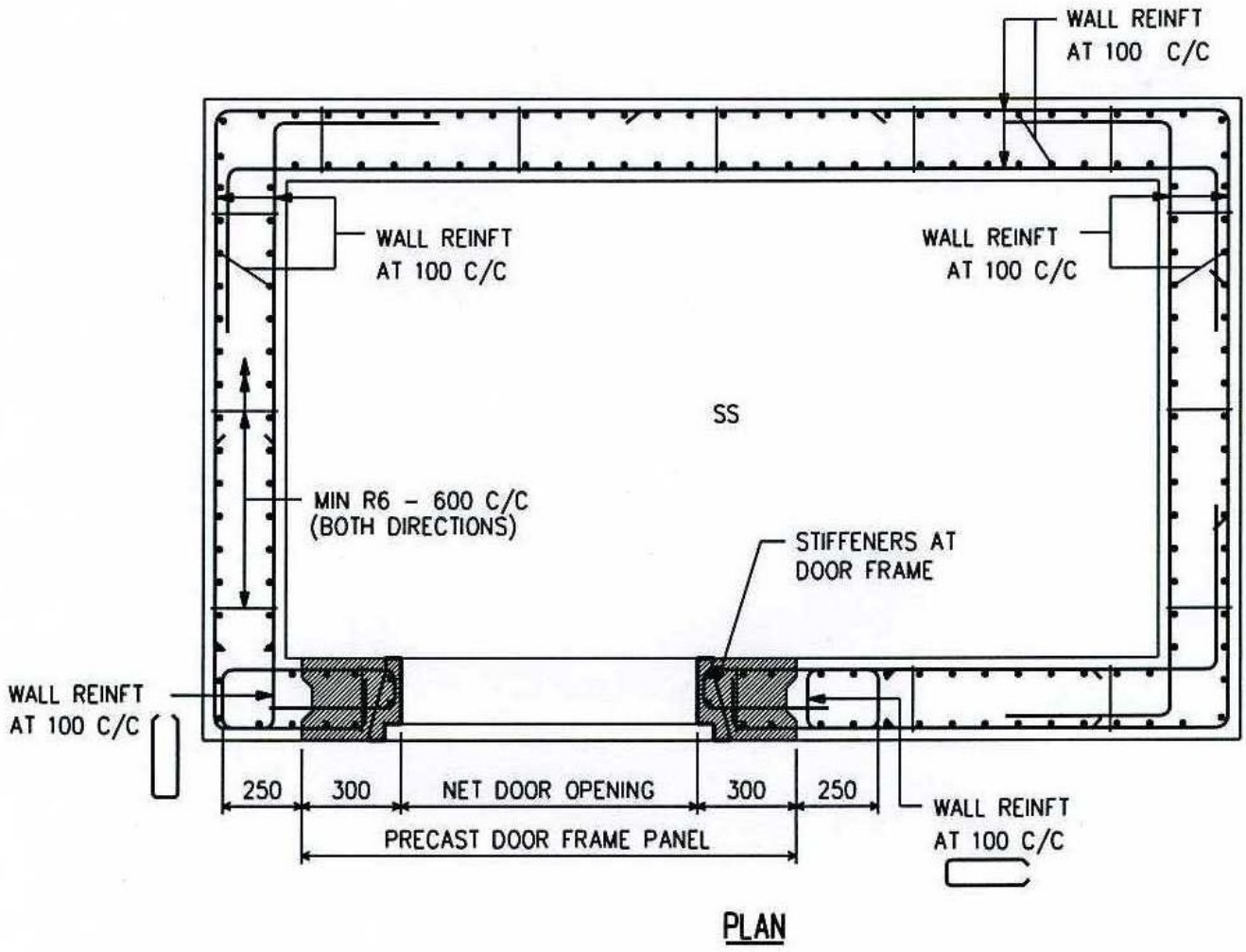


FIGURE 3.5.4(k) DETAILS OF PRECAST SS DOOR FRAME PANEL (TYPE 1)

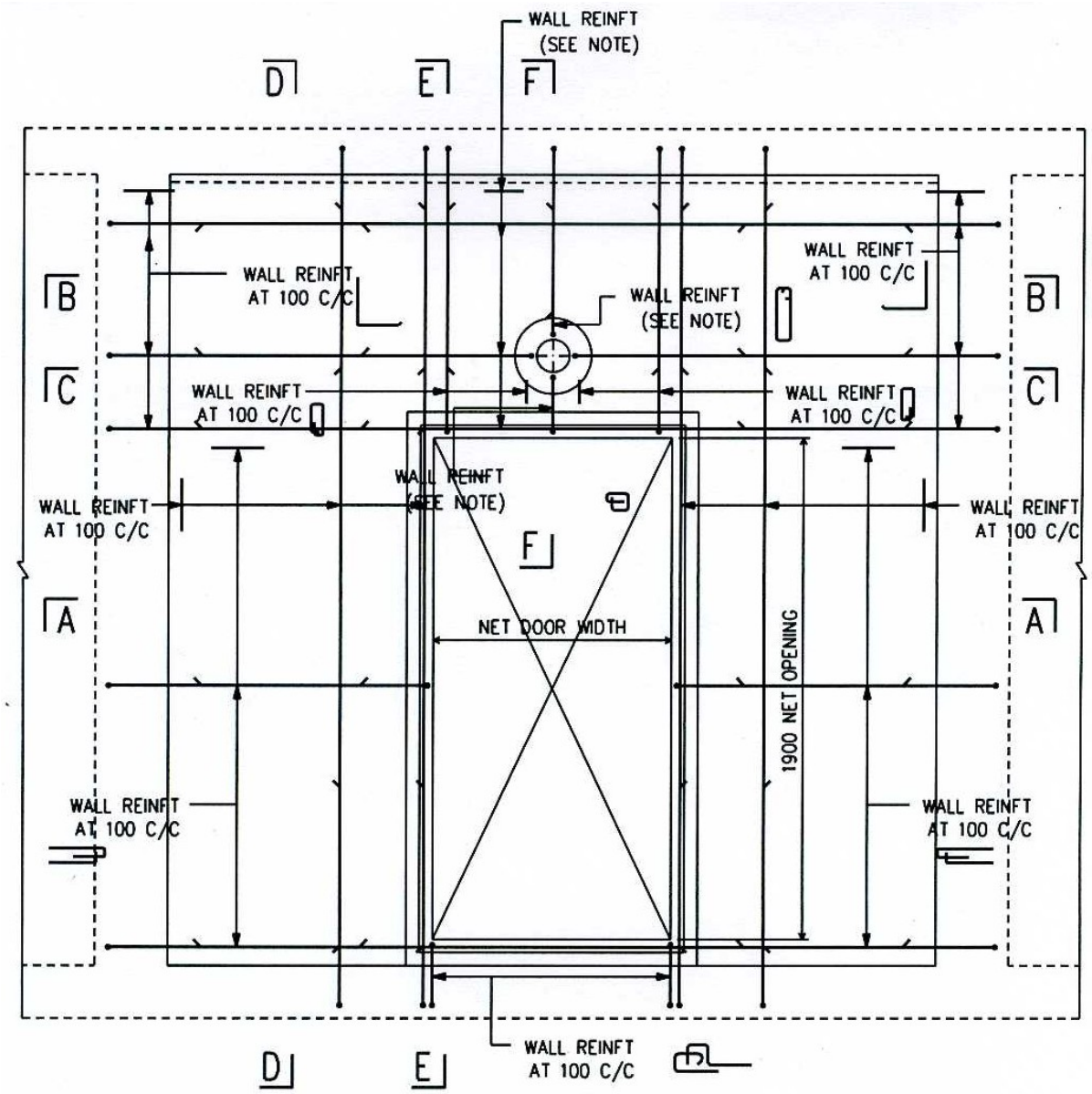


PLAN

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(l) PLAN OF SS WALLS WITH PRECAST SS DOOR FRAME PANEL (TYPE 1)



ELEVATION

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(m) DETAILS OF PRECAST SS DOOR FRAME PANEL (TYPE 2)

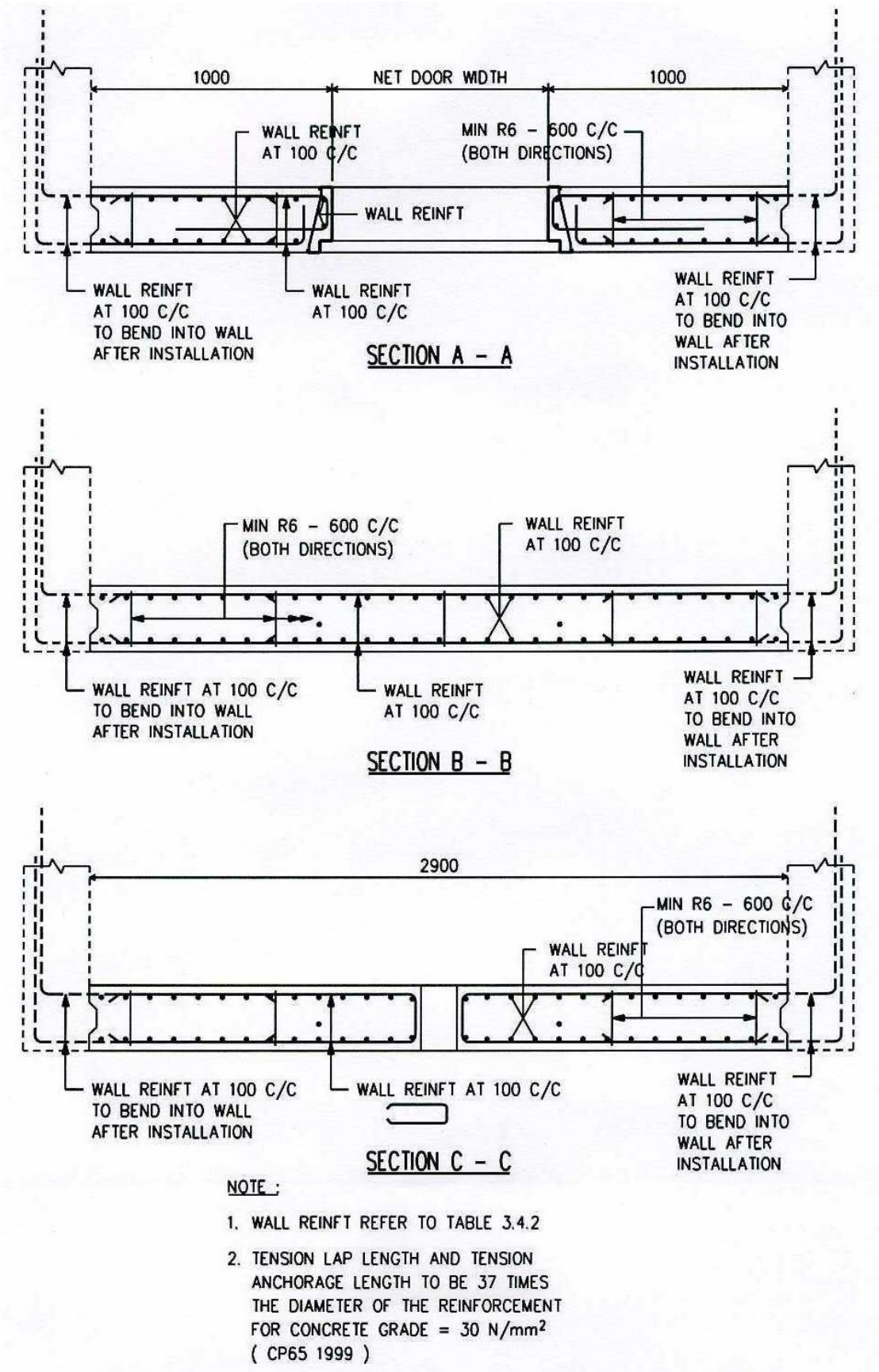


FIGURE 3.5.4(n) DETAILS OF PRECAST SS DOOR FRAME PANEL (TYPE 2)

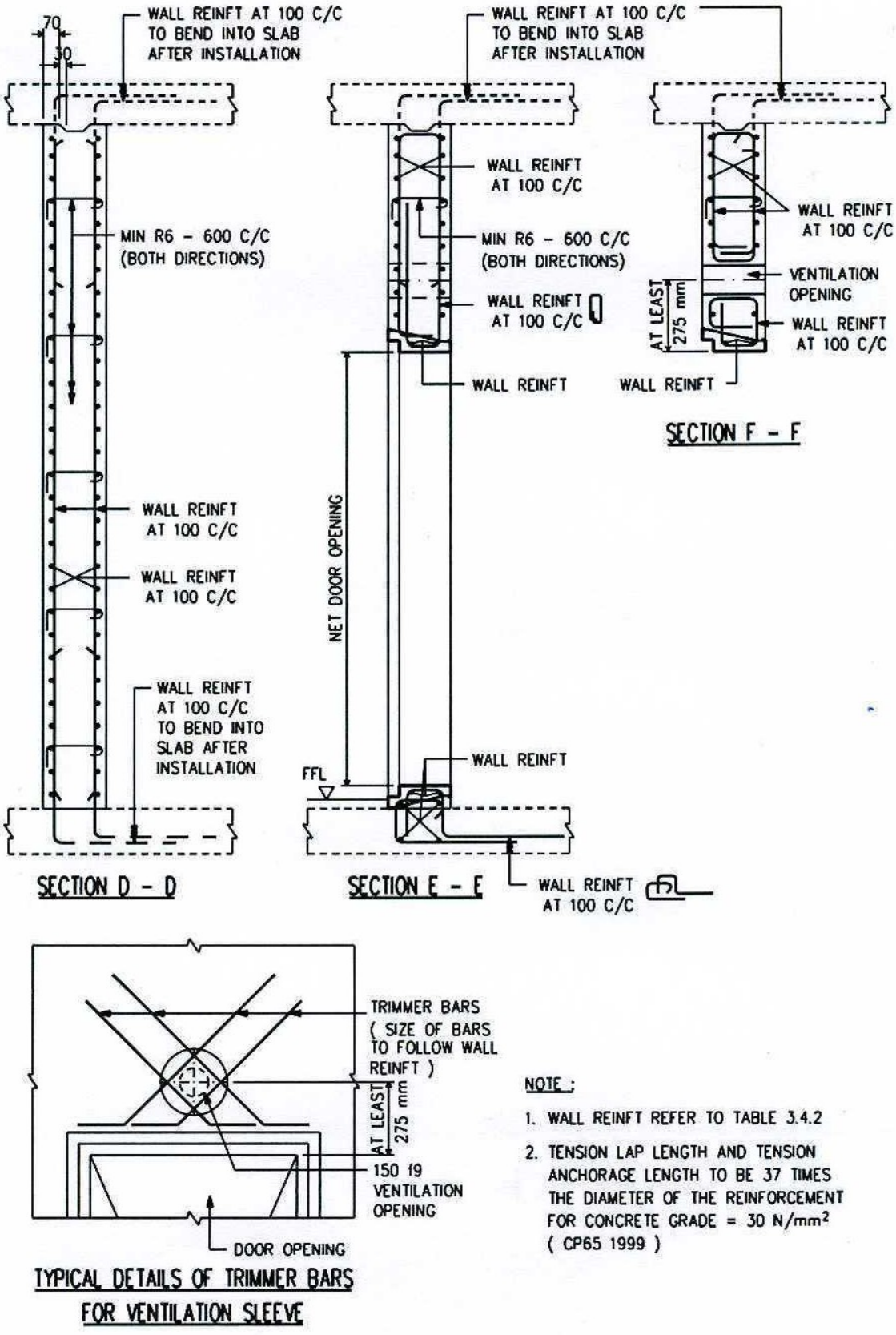
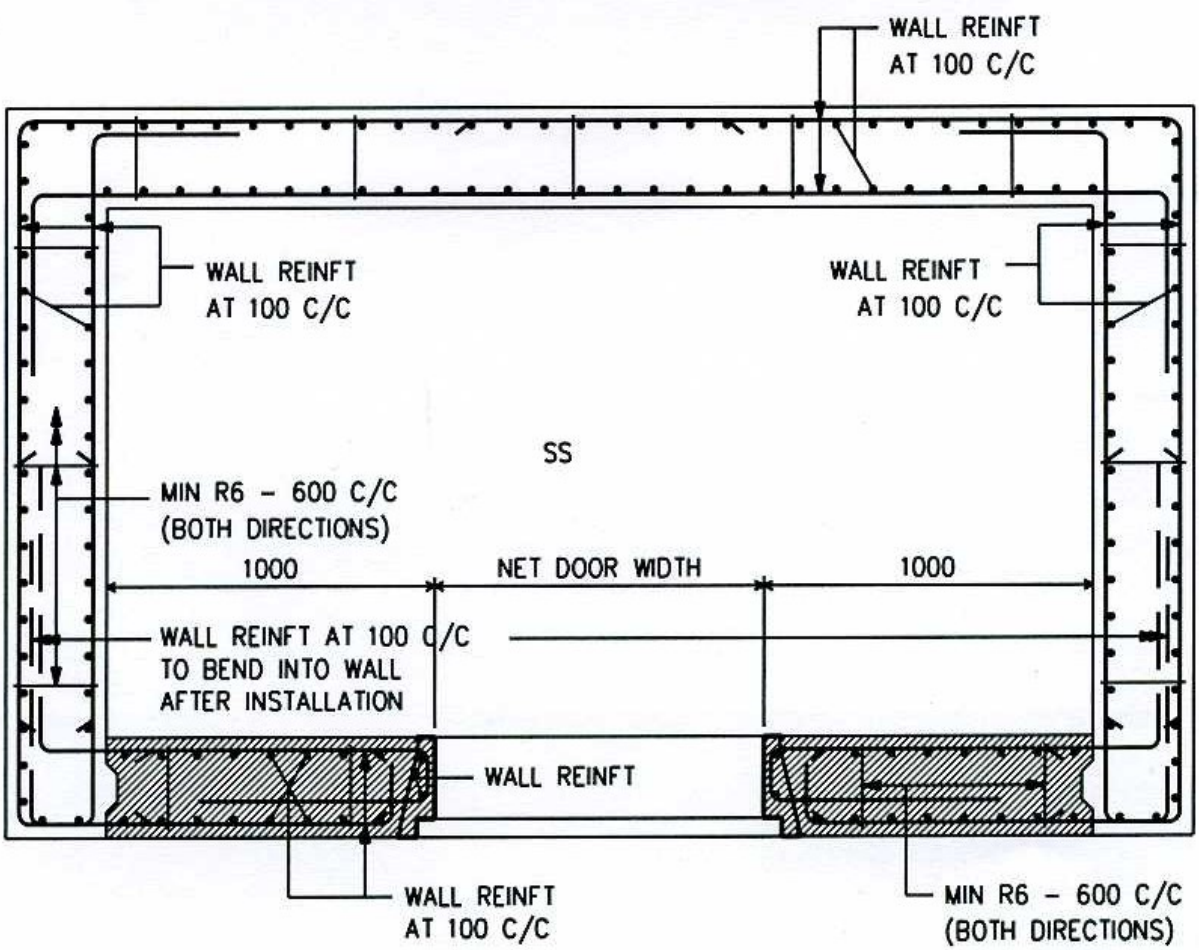


FIGURE 3.5.4(o) DETAILS OF PRECAST SS DOOR FRAME PANEL (TYPE 2)



PLAN

NOTE :

1. WALL REINFT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT FOR CONCRETE GRADE = 30 N/mm^2 (CP65 1999)

FIGURE 3.5.4(p) PLAN OF SS WALLS WITH PRECAST SS DOOR FRAME PANEL (TYPE 2)

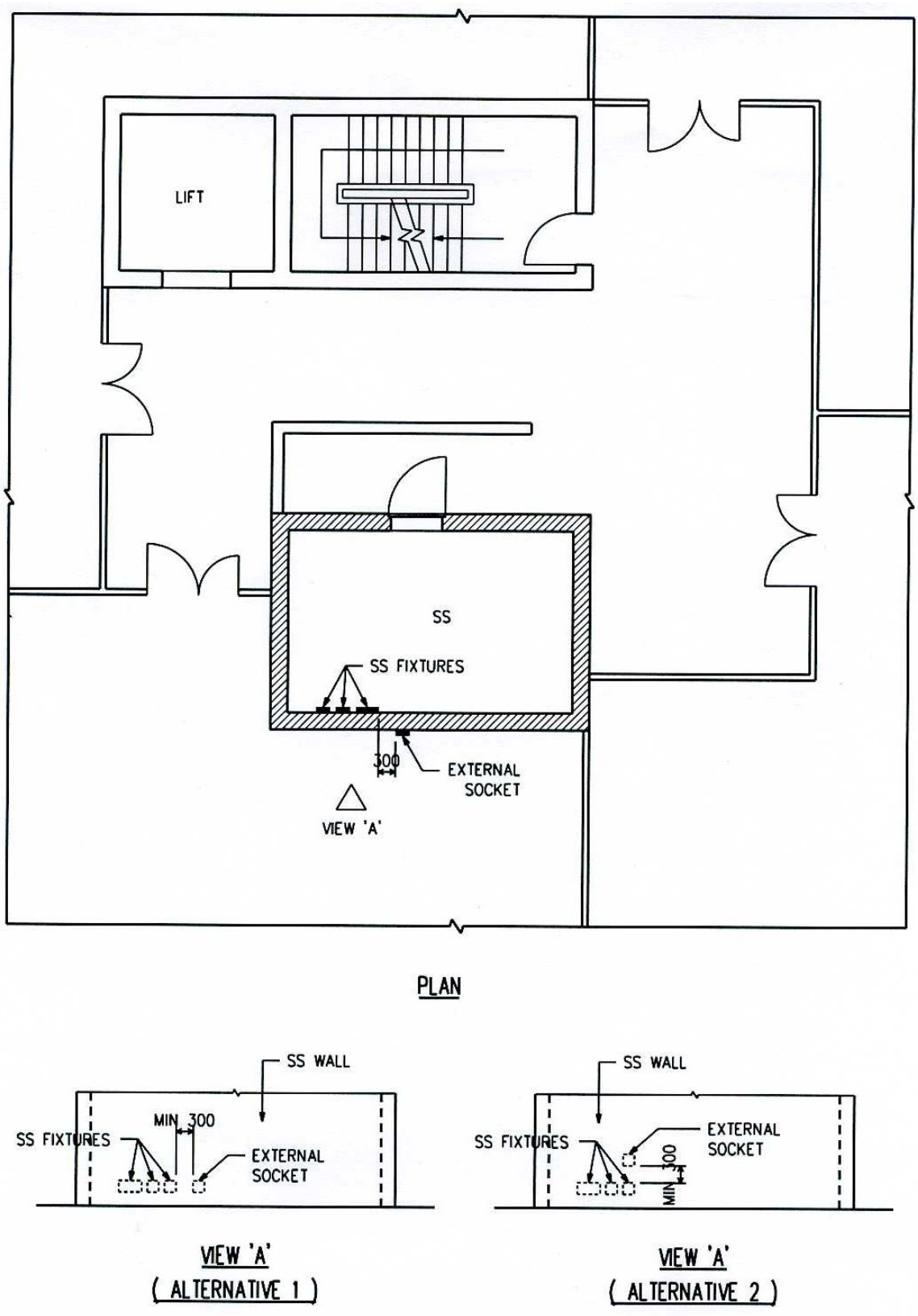


FIGURE 3.6.1(a) MOUNTING OF SERVICES ON EXTERNAL WALL OF A SS

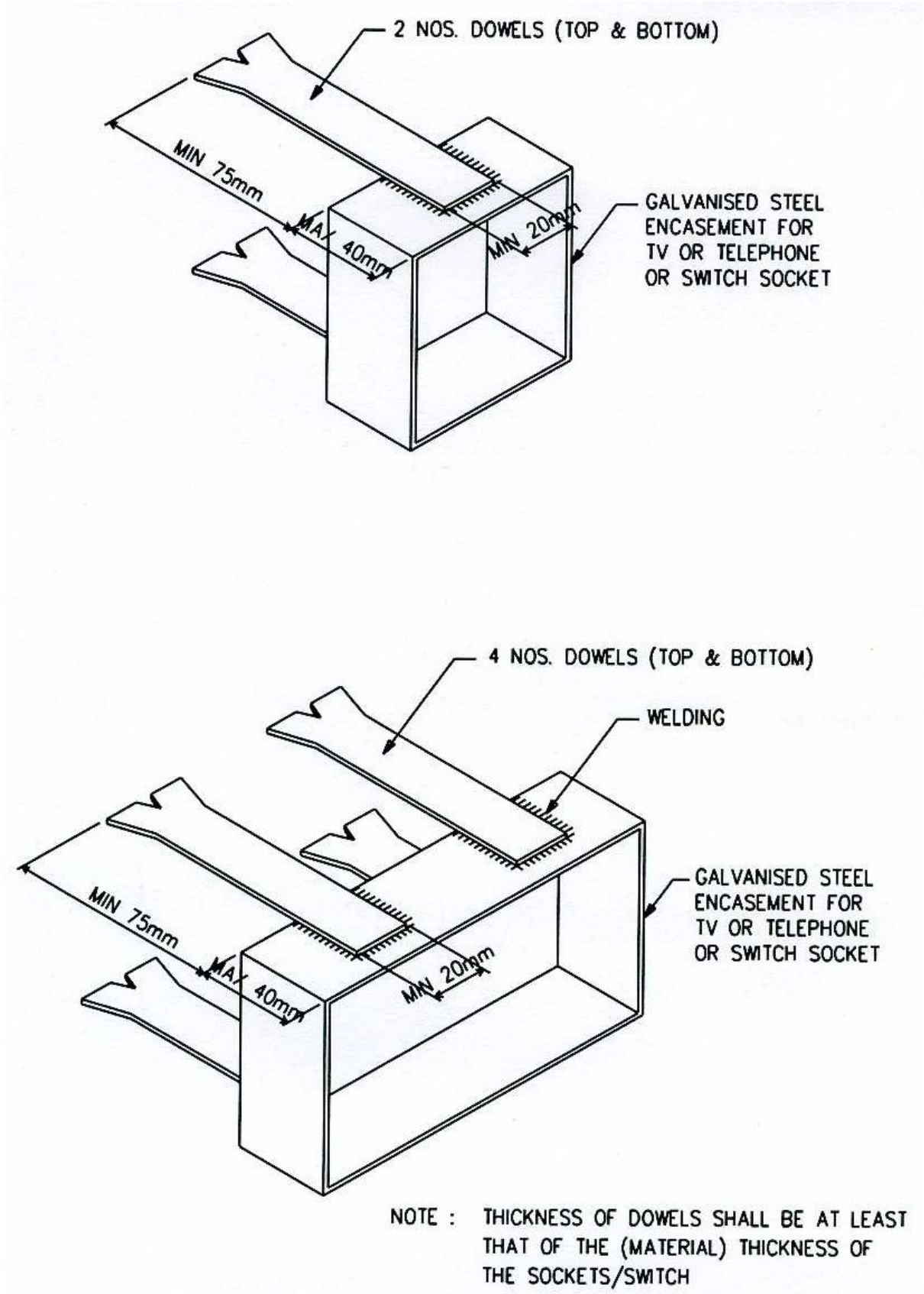
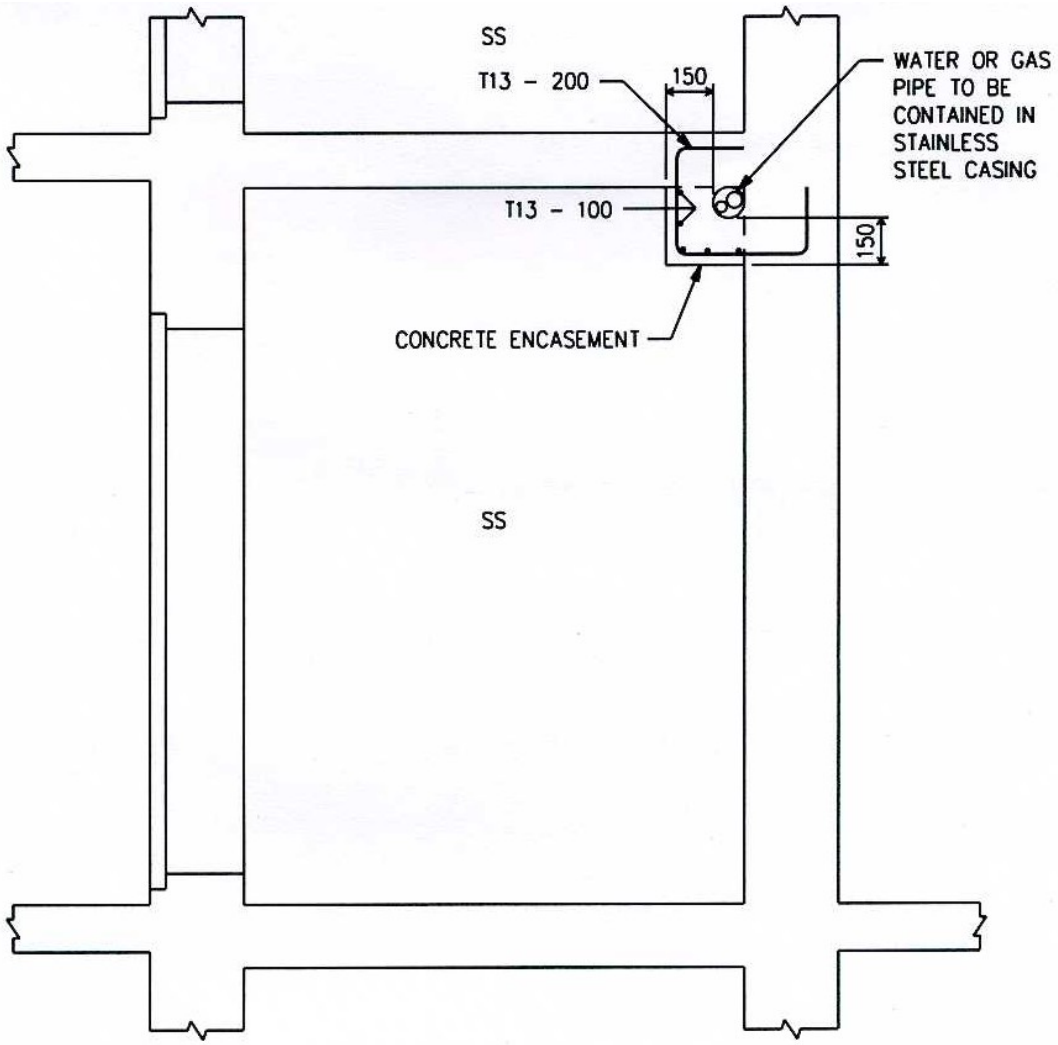
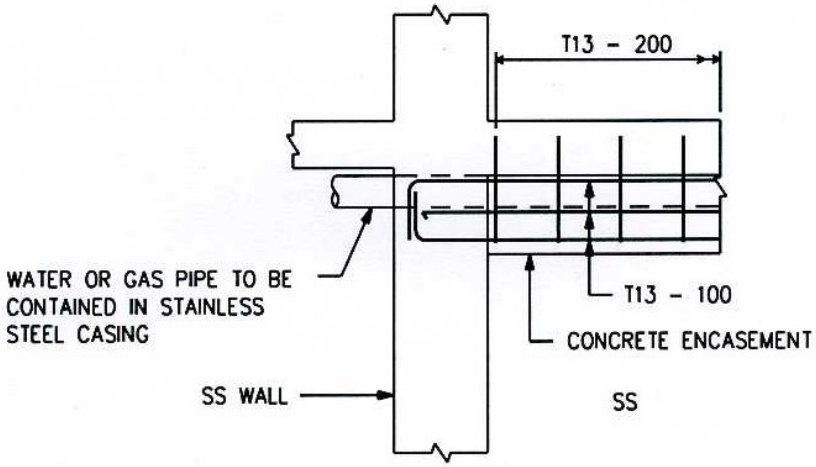


FIGURE 3.6.1(b) TYPICAL DETAILS OF EMBEDDED SOCKET/SWITCH



SECTION OF SS



END CONNECTION DETAILS

FIGURE 3.6.2 ENCASEMENT DETAILS OF WATER/GAS SERVICE PIPES PENETRATING THROUGH SS WALLS

CHAPTER 4

VENTILATION SLEEVES

CHAPTER 4: VENTILATION SLEEVES

4.1 GENERAL

Two 150 mm diameter ventilation sleeves shall be cast into the wall/s of each SS. In the case of staircase SS, no fire rating requirements need to be apply for these fragmentation plates and the two ventilation sleeves are to be provided in the SS wall at the staircase entrance landing or intermediate landing at each storey.

4.2 POSITION

The position of each ventilation sleeve shall comply with the following (See FIGURE 4.2(a), 4.2(b), and 4.2(c)):

(i) The height of each opening, measured from the centre of the opening to internal FFL of the SS shall be between 1900 mm and 2600 mm;

(ii) The ventilation sleeve shall be positioned such that there is sufficient clear space around it. The clear space around it shall be of an area of at least 700 mm diameter, measured concentrically from the centre of the opening to any structural elements within the SS;

(iii) Where the ventilation sleeve is placed above or adjacent to the SS door, the centre of the opening shall be at least 275 mm from the nearest edge of the door frame;

(iv) The shortest distance between the centres of the two ventilation sleeves shall be at least 1000 mm.

4.3 ACCESSIBILITY OF VENTILATION SLEEVES

4.3.1 Clearance in front of Fragmentation Plates

There shall be an unobstructed clear space measuring 300 mm in front of the fragmentation plates.

4.3.2 False Ceiling Below Ventilation Sleeves

Where false ceilings are provided outside the SS and below the ventilation sleeves, there shall be one access panel of a minimum size of 600 mm x 600 mm positioned directly below each ventilation sleeve.

4.4 FRAGMENTATION PLATE

Each ventilation sleeve shall have a 10mm thick stainless steel fragmentation plate mounted on the external face using 12 mm stainless steel bolts (See FIGURE 4.2(c)).

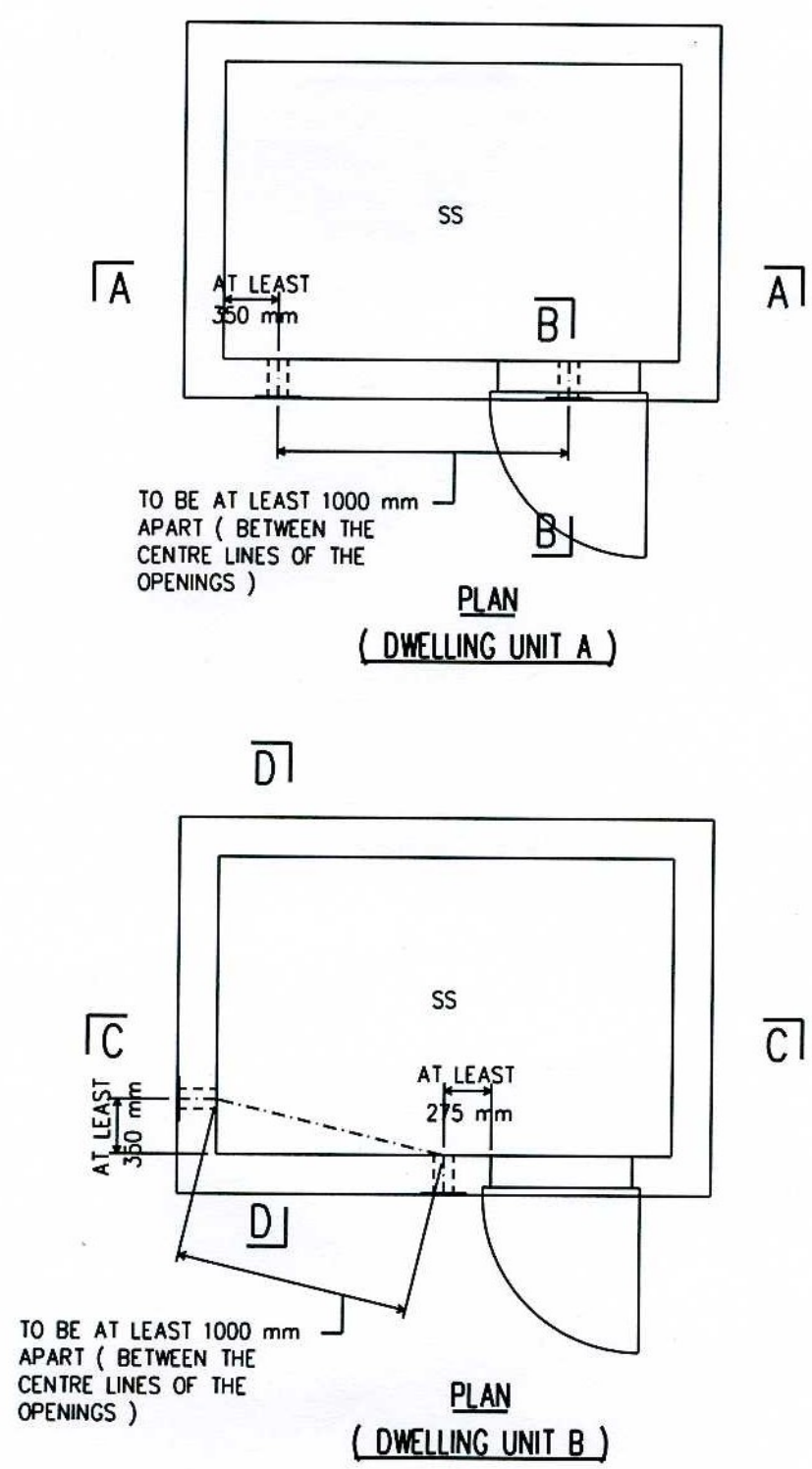


FIGURE 4.2(a) POSITION OF VENTILATION SLEEVES

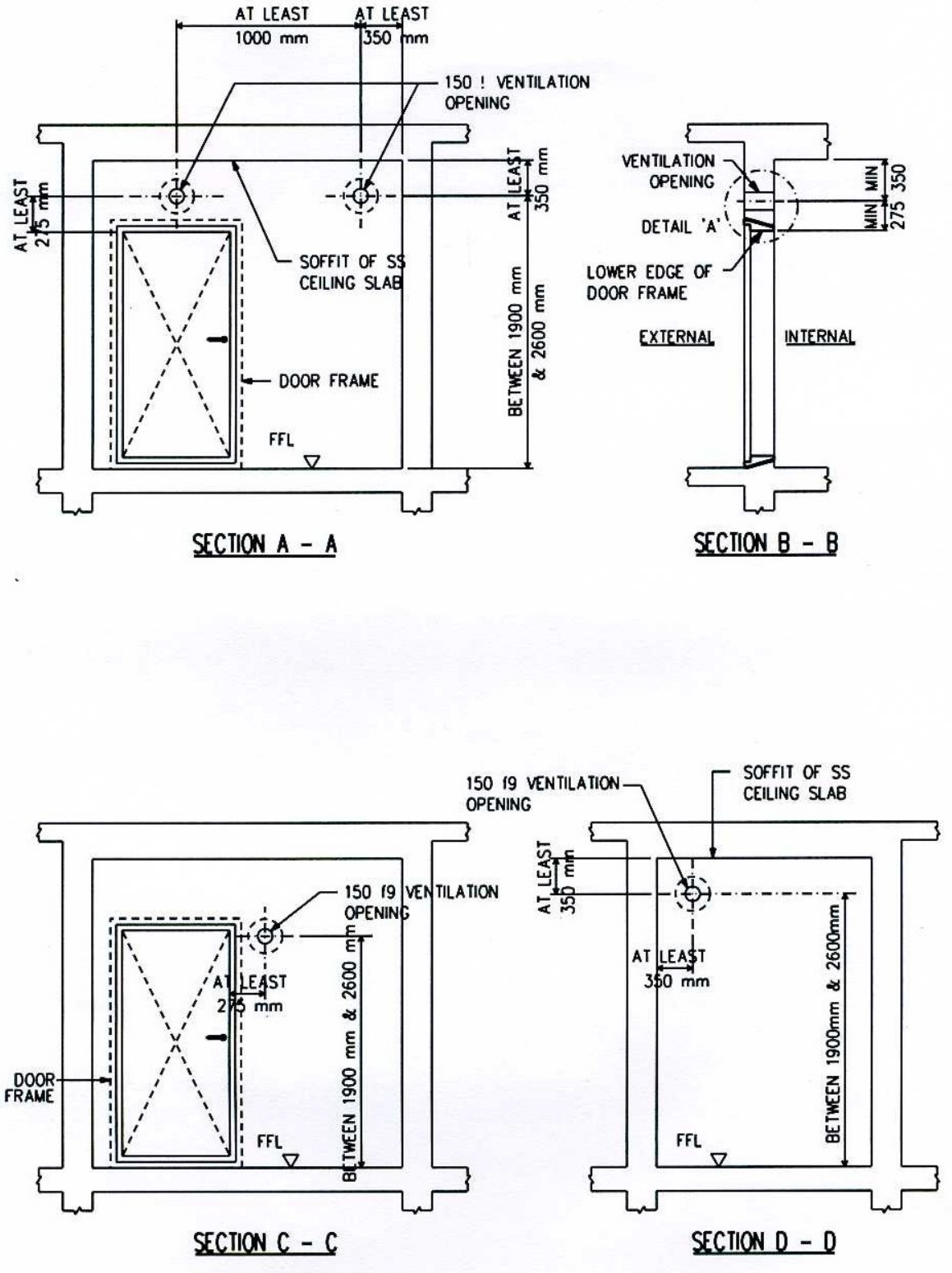


FIGURE 4.2(b) SECTIONAL VIEW OF VENTILATION SLEEVES

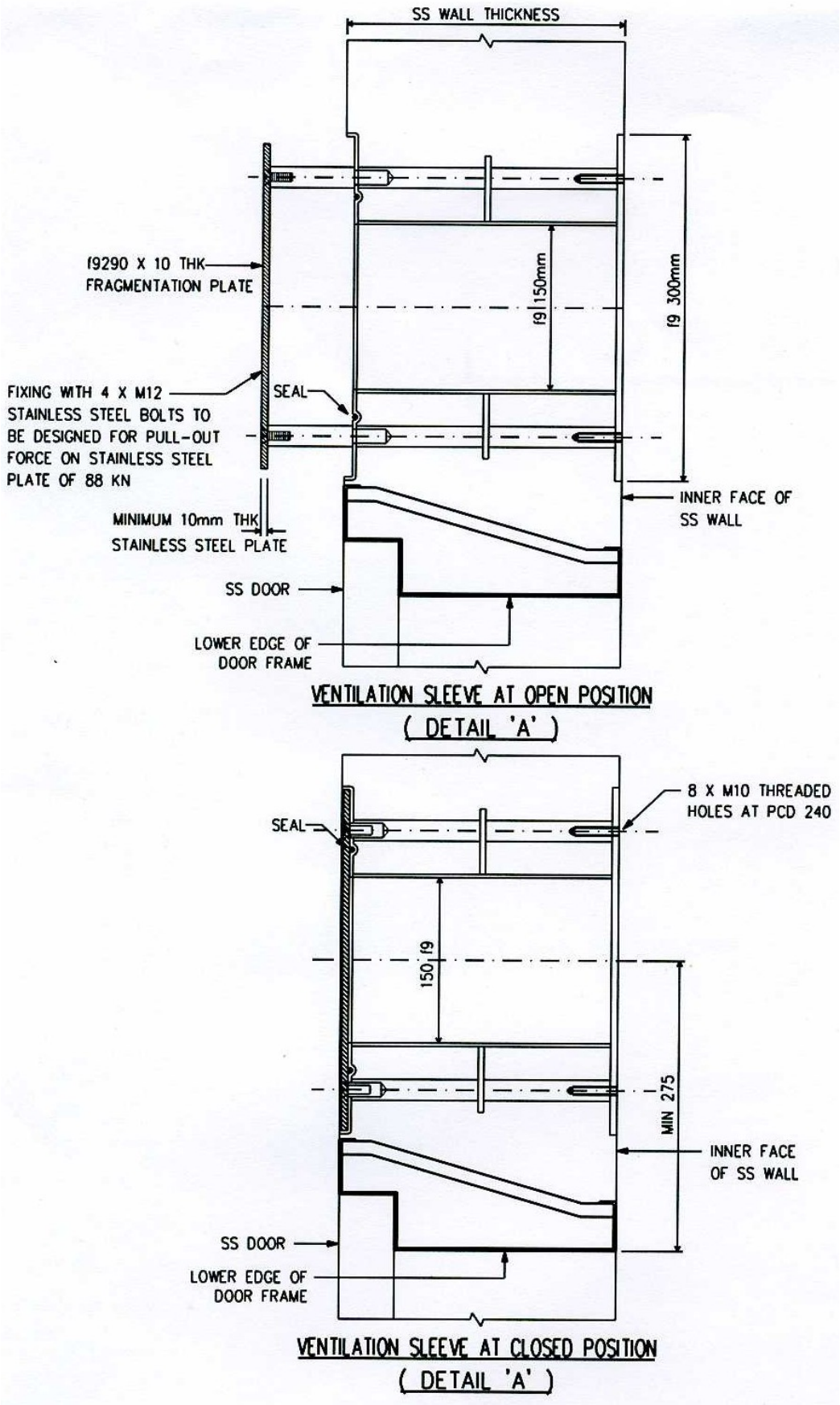


FIGURE 4.2(c) DETAILS OF VENTILATION SLEEV

CHAPTER 5

SS DOOR

CHAPTER 5: SS DOOR

5.1 GENERAL

The SS door shall provide an airtight closure to the SS. The SS door providing entry into the SS from the outside shall be designed to open outwards from the SS.

5.2 APPROVED SS DOOR

Only SS doors of an approved design shall be used. A list of approved SS doors is available from the relevant authority.

5.3 REMOVABLE DOOR KERB FOR STAIRCASE SS

The removable SS door kerb is to be mounted on the wall above the door frame inside the staircase shaft.

5.4 SS DOOR NOTICE

Every SS door providing entry into the SS from the outside shall have a SS door notice affixed on its internal face (See FIGURE 5.3(a)). Sample notices are shown in FIGURE 5.3(b) and FIGURE 5.3 (c).

5.5 SPECIFICATION OF SS DOOR NOTICE

(a)	Manner of Application	:	For affixing onto painted steel door
(b)	Application Surface	:	Flat
(c)	Application Procedure	:	Hand applied
(d)	Adhesive	:	Pressure sensitive and strong adhesive
(e)	Special Features	:	Non-brittle, rub and mar resistant, storage stability and colour fastness under light
(f)	Text, Lettering, Layout	:	Conform to sample notice
(g)	Colours	:	Background is light yellow, lettering is black, subheadings, border and CD logo area are red

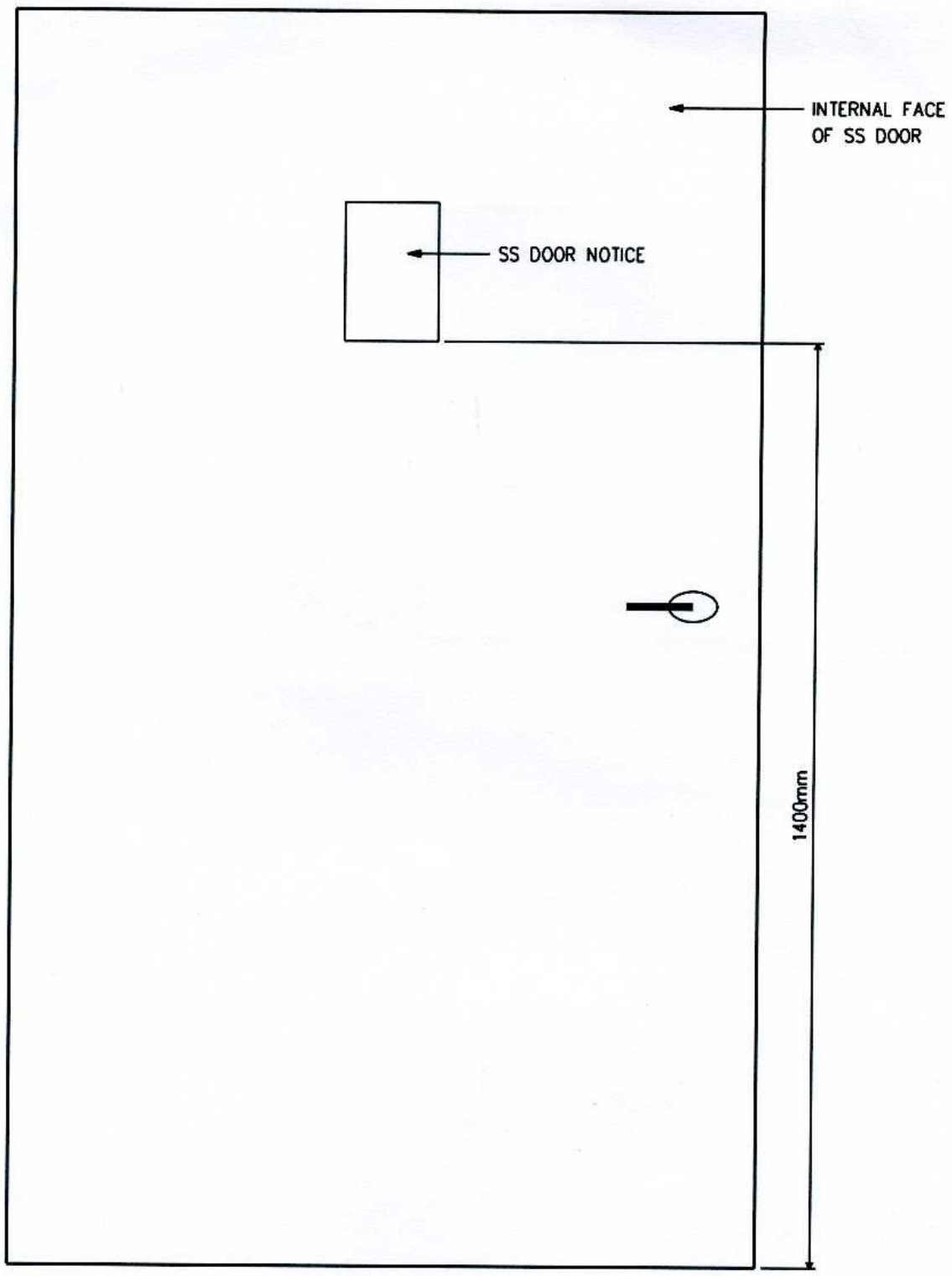


FIGURE 5.3(a) LOCATION OF NOTICE ON SS DOOR

NOTICE

This staircase is designed to serve as civil defence storey shelters (SS) during a war emergency for residents who do not have civil defence household shelters in their units. Staircase SS are provided under the Civil Defence Shelter Act 1997.

Conversion of Staircase into Civil Defence Storey Shelters:

In the event of an impending war emergency, the Singapore Civil Defence Force (SCDF) will announce appropriate instructions to the population. Within the time period specified in the announcement, the building Management Corporation (MC) will manage the conversion of the staircase into a series of adjoining SS, compartmented from one another by SS doors at staircase entrances and landings. The conversion tasks may be found in the Staircase Storey Shelter Operation and Maintenance Manual held by the MC.

During a War Emergency:

The MC is expected to manage the staircase SS according to guidelines given in the aforesaid manual. Generally, for their own protection when the **"Alarm"** signal has been sounded or given, residents are to:

- Move into their allocated SS without delay, close the entrance SS door and all adjoining landing SS doors by putting the door handles to **"Position B"** as shown in the diagram below.
- Remain in their allocated SS and not move into adjoining SS. For protection reasons, it is important to ensure all SS doors are fully closed and the door handles kept in **"Position B"**, to maintain every SS as a separate compartment.
- Switch on the radio or TV set to receive information on the war emergency and any instructions from the SCDF. Use the telephone set as necessary.
- Open the entrance SS door and leave the SS only after the **"All Clear"** signal has been sounded or given.

通 告

根据1 9 9 7年民防防空壕法令的规定，在战争期间，住家内没有防空壕的居民，可以利用特别设计的楼梯空间作为民防楼层防空壕（SS）。

将楼梯改装成民防楼层防空壕（SS）：

在面临战争危机时，新加坡民防部队(SCDF)将对民众发布相应的指令。在通告所规定的时间内，大厦管理机构（MC）会将负责把楼梯改装成一排排毗邻的楼层防空壕（SS），并在楼梯入口和平台之间用SS大门隔成不同的空间。MC都持有楼层防空壕的操作和维修手册，手册中对改装步骤也有说明。

战争期间：

根据维修手册的指导，MC将负责楼层防空壕（SS)的管理工作。为了保障自己的生命，当**"警惕"**信号响起时，居民应该:

- 立刻进入指定的SS，关闭SS及其相邻平台之间的大门，将把手转至如下图所示的**"位置（B）"**。
- 停留在指定的SS中，不要闯入隔壁。出于安全考虑，应确保每个SS都隔成单独空间，所有门完全关闭及其门把手位于**"位置（B）"**，这是至关重要的。
- 扭开收音机或电视机，接收紧急信息和来自新加坡民防部队（SCDF）的指令。如有所需，请使用电话。
- 只有当听到**"警报解除"**信号，才可以打开SS门，并离开SS。

NOTIS

Tangga ini direka untuk bertindak sebagai kubu bertingkat (SS) pertahanan awam semasa kecemasan peperangan bagi penduduk yang tidak mempunyai kubu pertahanan awam di dalam rumah mereka.

Penukaran Tangga Menjadi Kubu Bertingkat Pertahanan Awam:

Dalam masa akan berlakunya kecemasan peperangan, Pasukan Pertahanan Awam Singapura (SCDF) akan membuat pengumuman mengenai arahan-arahan yang sesuai kepada semua para penduduk keseluruhannya. Dalam tempoh masa yang telah ditetapkan melalui pengumuman SCDF itu, Perbadanan Pengurusan (MC) bangunan akan mengurus penukaran tangga menjadi satu siri kubu bertingkat (SS) yang bercantum, dipisahkan antara satu sama lain oleh pintu SS di setiap laluan masuk dan pelantar tangga. Tugas bagi penukaran ini boleh didapati di dalam Buku Panduan Operasi dan Penyenggaraan Kubu Tangga Bertingkat yang diselaraskan oleh MC.

Semasa Kecemasan Peperang:

MC ditugaskan mengurus tangga SS mengikut garis panduan yang terdapat di dalam Buku Panduan Operasi dan Penyenggaraan Kubu Tangga Bertingkat. Umumnya, bagi perlindungan mereka sendiri, apabila isyarat **"Geraan"** (**"Alarm"**) dibunyikan atau diberikan, penduduk harus perlu:

- Bergerak ke SS yang telah disediakan tanpa berlengah, menutup pintu SS dan semua pintu pelantar SS yang bercantuman, dengan menggerakkan pemegang pintu tersebut ke **"Posisi B"** (**"Position B"**) seperti yang tertera di dalam gambar rajah di bawah ini.
- Kekal berada di dalam SS yang disediakan dan jangan bergerak ke SS yang bersebelahan. Atas sebab-sebab perlindungan, adalah penting untuk memastikan semua pintu SS ditutup dengan rapat dan pemegang pintu diletakkan pada **"Posisi B"** (**"Position B"**), bagi mengekalkan setiap SS sebagai petak yang berasingan.
- Bunyikan radio atau TV untuk menerima maklumat mengenai kecemasan peperangan dan sebarang arahan daripada SCDF. Gunakan telefon untuk membuat panggilan.
- Buka pintu masuk SS dan tinggalkannya hanya apabila isyarat **"Semua Selamat"** (**"All Clear"**) telah dibunyikan atau diberikan.

அறிவிப்பு

குடிமைத் தற்காப்பு காப்பறைகள் இல்லாத கட்டிடங்களில் வசிக்கும் குடியிருப்பாளர்கள், போர்க்கால அவசரநிலை சமயத்தில் படிக்கட்டுக் காப்பறைகளை குடிமைத் தற்காப்பு மாடி காப்பறையாக (எஸ்எஸ்) பயன்படுத்திக் கொள்ளும் வகையில் வடிவமைக்கப்பட்டுள்ளது. இத்தகைய படிக்கட்டுக் காப்பறைகள், குடிமைத் தற்காப்பு காப்பறை சட்டம் 1997 படி அமைக்கப்பட்டுள்ளது.

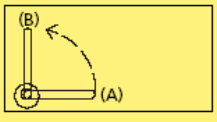
படிக்கட்டுகளை குடிமைத் தற்காப்பு மாடிக் காப்பறைகளாக மாற்றுதல் :

எதிர்காலத்தில் போர்கால அவசரநிலை ஏற்படுமாயின் அதைக் கருத்தில் கொண்டு, சிங்கப்பூர் குடிமை தற்காப்புப்படை மக்களுக்கு தகுந்த நெறிமுறைகளை அறிவிக்கும். குடிமை தற்காப்புப்படையின் அறிவிப்பில் குறிப்பிடப்பட்டுள்ள கால வரம்புக்குள், கட்டிட நிர்வாக கூட்டாண்மை கழகம், (எம்சி) படிக்கட்டுகளை தொடர்வரிசை மாடிக் காப்பறையாக மாற்றும் பணியை மேற்கொள்ளும். இவை படிக்கட்டு வாயில் மற்றும் இடை மேடைகளில் எஸ்எஸ் கதவுகளால் தனித்தனிப் பிரிவுகளாக பிரிக்கப்படும். இந்த மாற்றம் வேலை குறித்த விபரங்களை எம்சியிடம் உள்ள படிக்கட்டு மாடிக் காப்பறை செயற்பாடு மற்றும் பராமரிப்பு கையேட்டில் காணலாம்.

போர்க்கால அவசரநிலைக் காலத்தில் :

எம்சி, மேற்கூறிய கையேட்டில் கொடுக்கப்பட்டுள்ள வழிகாட்டு முறைகளை பின்பற்றி படிக்கட்டு மாடிக்காப்பறையை பராமரிக்கும் என்று எதிர்பார்க்கப்படுகிறது. பொதுவாக, **"அபய எச்சரிப்பு ஒலி"** ஒலிக்கும் போது குடியிருப்பாளர்கள் அவர்களின் பாதுகாப்புக்காக பின்வரும் செயல்முறைகளை கடைப்பிடிக்க வேண்டும்.

- ஒதுக்கப்பட்டுள்ள மாடிக் காப்பறைக்குள் எவ்வித தாமதமும் இன்றி சென்று விடவும். மாடிக்காப்பறையின் நுழைவாயில் கதவுகள் மற்றும் அருகிலுள்ள இடைமேடைகளில் உள்ள அனைத்து மாடிக்காப்பறை கதவுகளையும் மூடி விடவும். கதவுகளை மூடுவதற்கு கதவின் தாழ்ப்பாளை கீழே கொடுக்கப்பட்டுள்ள வரைபடத்தில் உள்ளது போல **"நிலை B"** க்கு கொண்டு வரவும்.
- உங்களுக்கென்று ஒதுக்கப்பட்டுள்ள காப்பறைகளிலேயே தங்கியிருக்கவும். அருகிலுள்ள மாடிக்காப்பறைகளுக்கு செல்ல வேண்டாம். பாதுகாப்பு காரணங்களுக்காக அனைத்து மாடிக்காப்பறை கதவுகளும் முழுவதுமாக மூடியிருக்க வேண்டும். மேலும் அவற்றின் தாழ்ப்பாள் **"நிலை B"** யில் இருக்க வேண்டும். இதன் படி ஒவ்வொரு மாடிக் காப்பறையும் தனித்தனி பிரிவுகளாகவே தொடர்ந்து இருப்பதை உறுதிசெய்ய முடியும்.
- வானொலி அல்லது தொலைக்காட்சியை இயக்கி போர்க்கால அவசரநிலை குறித்த தகவல்கள் மற்றும் சிங்கப்பூர் குடிமை தற்காப்புப்படையின் போதனை அறிவிப்புகளை செவிமடுக்கவும். தேவைப்பட்டால் காப்பறைகளில் உள்ள தொலைபேசி சாதனங்களை கொண்டு அழைத்து பேசவும்.
- **"அபாய நீங்கிய ஒலி"** ஒலித்த பிறகே மாடிக் காப்பறை நுழை வாயில் கதவுகளை திறந்து கொண்டு வெளியே வரவேண்டும்.



(A) Normal Mode
普通操作法
Kaedah biasa
இயல்பான முறை

(B) Civil Defence Mode
民防操作法
Kaedah kecemasan
குடிமைத் தற்காப்பு முறை

CIVIL DEFENCE
READINESS IS YOUR ONLY PROTECTION

FIGURE 5.3(b) SAMPLE SS DOOR NOTICE

CHAPTER 6

CONSTRUCTION AND COMMISSIONING

CHAPTER 6: CONSTRUCTION AND COMMISSIONING

6.1 GENERAL

As the SS is designed to resist weapon effects, good workmanship is essential to achieve the designed protection level.

6.2 STRUCTURAL WORKS

The following shall be observed:

(a) Only the non-removable type of form-tie (form-tie without through opening) to secure formwork before casting of SS wall is permitted. Upon the removal of every recessed type of plastic cones from the form-tie, the void shall be sealed with non-shrink grout. The use of reinforcement bar as form-tie is not permitted.

(b) All embedded items shall be placed in their planned location. They are to be tightly secured to ensure their stability during casting. Indiscriminate hacking and drilling of SS tower walls, ceiling slabs or floor slabs are not permitted.

(c) To avoid bending, warping or displacement of SS door frame and honeycombing due to inadequate compaction or leakage of cementitious grout, additional precaution shall be taken while casting the concrete near the SS door frame.

(d) The exposed surfaces of SS walls and soffit of SS ceiling slabs shall be cast with smooth concrete finish. A maximum of 2 mm thick skim coat on the internal face of the SS walls and ceiling slabs of SS is allowed.

(e) The concrete structural elements shall be adequately compacted to ensure air-tightness. Concrete areas with segregation or honeycombing shall not be accepted without acceptable rectification.

(f) Irregularities of exposed surfaces shall not be indiscriminately hacked and plastered back.

(g) Method statement of the remedial work on structural elements, including SS door frame, shall be approved by the Commissioner of Building Control.

6.3 SS DOOR

The following shall be observed:

(a) Allowing an opening in the SS wall and later erecting the SS door frame and door leaf in this opening, followed by casting concrete around it is not permitted.

(b) When casting the SS wall with SS door frame, a dummy door leaf of adequate design shall be placed to ensure the stability and prevent the bending, warping or displacement of the SS door frame during concreting.

(c) The FFL of the floor slab outside the SS shall be done such that the SS door can be opened adequately for the peacetime use of the SS.

6.4 PEACETIME REQUIREMENT OF VENTILATION SLEEVES

For ventilation purposes during peacetime, at least 25% of total area of the two ventilation sleeve openings shall be kept uncovered. In the case of S/C SS, all ventilation sleeve openings shall be fully closed.

6.5 COMMISSIONING REQUIREMENTS

All fixtures such as SS door notice, rescue hatch, TV/ radio point, telephone points and electrical points shall be provided inside the completed SS. The service conduits with electrical cables serving the SS shall be provided prior to commissioning.

A SS is considered commissioned only if the SS passes all the following tests in one inspection:

(a) Light penetration test of SS door – an acceptable test method to check on light penetration into the SS is to use a torchlight from the exterior of SS door. The test is considered to have passed if no light could be seen from the inside of SS.

(b) Chalk mark test on the SS door – an acceptable test method is to apply chalk to the part of the door frame where the door seal will come into contact with when the door is closed. The test is considered to have passed if there is an unbroken and uniform transfer of the chalk markings onto the door seal when the door is closed and re-opened.

(c) Air-tightness test of the SS – an acceptable test method is to pressurise the SS and measure the rate of pressure drop. A water manometer is required to measure the pressure difference between the interior and exterior of the SS. The SS is pressurised to a manometer level difference of 25 mm. The SS is considered to have passed the test if the manometer level difference is not less than 5 mm after 45 seconds.

Except in the case of S/C SS, the ventilation sleeves of the SS, which have been closed for the commissioning tests, shall be opened after the tests to comply with Clause 6.4 for ventilation during peacetime.

CHAPTER 7

PERMITTED AND NOT PERMITTED WORKS IN SS TOWER

CHAPTER 7: PERMITTED AND NOT PERMITTED WORKS IN SS TOWER

7.1 GENERAL

Any repair or alteration or renovation works, which are likely to weaken or damage any structural elements of the SS or NS, is not permitted.

7.2 PERMITTED AND NOT PERMITTED WORKS

7.2.1 Permitted Works in SS

(a) Laying of floor tiles bonded to wet cement mortar.

(b) Laying of vinyl or linoleum flooring (Not permitted in S/C SS).

(c) Laying of floor skirting tiles (up to a maximum of 100 mm high) by bonding them with wet cement mortar to SS walls.

(d) Painting of walls, ceiling or door. In the case of SS door, owners shall not cover up or paint over the SS door notice (See Clause 5.3) or door seal.

(e) Fixing of removable screws with non-metallic inserts not exceeding 50 mm deep for fixtures and equipment e.g. pictures, posters, cabinets or shelves etc. Such fixtures that are installed inside the SS will have to be removed by the owners within 48 hours upon notification (Not permitted in S/C SS).

(f) Removal of the fragmentation plates (Clause 4.4) covering the ventilation openings shall be carried out subject to the following conditions (Not permitted in S/C SS):

(i) The plates (after removal) shall be securely mounted with removable screws on non-metallic inserts not exceeding 50 mm deep on one of the internal face of SS walls.

(ii) After the removal of plates, the bolts and nuts shall be installed back to their original positions on the ventilation sleeves.

(iii) Closing or covering up of ventilation openings by readily removable and reinstated aesthetic or architectural finishes is allowed, provided that at least 25% of the total area of the two openings shall be left uncovered for ventilation purposes during peacetime.

(g) Where false ceilings, which are provided on the exterior of the SS, are to be installed at a level below the ventilation sleeves, there shall be one access panel of a minimum size of 600 mm x 600 mm to be provided directly below each ventilation sleeve.

7.2.2 Not Permitted Works in SS

(a) Laying of wall tiles or spray of rock tone finish, cement sand finish and gypsum plastering on the internal faces of SS walls.

(b) Laying of floor tiles using adhesive materials.

(c) Installation of cornices within the SS.

(d) Installation works with fixings using power driving nails.

(e) Tampering with, removing or covering up of the SS door notice. The SS door notice provides important information to the occupants on the use of the SS.

(f) Indiscriminate hacking and drilling of SS walls, floor slabs, and ceiling slabs, other than drilling into SS walls and ceiling slabs to affix removable screws on inserts.

(g) Modifying, changing, removing or tampering of SS door.

(h) Modifying, altering or tampering with any part of the ventilation openings, plates and the mounting devices such as bolts and nuts.

7.2.3 Not Permitted Works in NS

Indiscriminate hacking and drilling of NS walls, floor slabs, and ceiling slabs, other than drilling into NS walls and ceiling slab to affix removable screws on inserts, provided the depth of the insert shall not exceed 50 mm.