

TECHNICAL REQUIREMENTS FOR STOREY SHELTERS 2015

CONTENTS

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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. Where the staircase or scissor-staircase doubles up as a SS, it is used as a fire exit staircase. The other statutory requirements governing the design and use of the SS space for the specific peacetime use shall also be complied with.

1.3 ABBREVIATIONS

<u>Clause</u>	<u>Description</u>	<u>Abbreviation</u>
1.1	Storey Shelter	SS
2.1	Non-Shelter	NS
2.1	Staircase Storey Shelter	S/C SS
2.2.1	Finished Floor Level	FFL
2.2.1	Gross Floor Area	GFA
2.4.3	External Building Line	EBL



1.4 **DEFINITIONS**

<u>Clause</u>	<u>Definition</u>	<u>Term</u>
2.1	The space in the SS tower that is not intended for use as a shelter.	Non-Shelter
2.1	Building exit staircase used as SS	S/C SS
2.2.2 (a)	Height of SS measured from its FFL to the soffit of the SS ceiling slab.	SS Clear Height
2.2.2 (a)	Height of NS measured from its FFL to the soffit of the NS ceiling slab.	NS Clear Height
2.3.1	Distance from external face of a SS wall to the nearest EBL.	Setback Distance
2.3.2(a)	The SS located below the top-most roof level	Top-most SS
2.4.3	The edge line of the ceiling slab above the SS wall under consideration.	External Building Line



CHAPTER 2: ARCHITECTURAL REQUIREMENTS

2.1 SS OR NS FORM

The configuration of a SS or Non-Shelter (NS) on plan shall be rectangular or square shape. In the case of a staircase storey shelter (S/C SS) and scissor S/C SS, there can be slight deviations from the rectangular or square shape.

2.2 SIZE OF SS

2.2.1 Area and Volume

The minimum internal floor area and minimum internal volume of a SS or a S/C SS shall be based on gross floor area (GFA) of dwelling unit and nominal occupancy of dwelling unit in accordance with TABLE 2.2.1.

The maximum internal floor area of a SS shall be 32 m².

For the S/C SS, 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 its internal floor area.

The product of the internal floor area of the S/C SS and its clear height, measured from the finished floor level (FFL) to the soffit of the ceiling staircase slab, is taken as the internal volume of the S/C SS.

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. See FIGURE 2.2.1.

2.2.2 Heights

- (a) The minimum SS clear height shall be 2400mm. Refer to FIGURE 2.2.1. The minimum NS clear height shall be 2400mm.
- (b) The minimum clear height in S/C SS or scissor S/C SS shall be 2400mm for typical storey height of the building.
- (c) Within the S/C SS or scissor S/C SS tower, where the storey height deviated from the typical storey height, the minimum clear height of NS in S/C SS or scissor S/C tower shall be 2000mm.



- (d) The maximum clear height of a SS, S/C SS, scissor S/C SS and NS shall be 3900mm. Refer to FIGURE 2.2.1 and 2.2.2.

2.3 WALL AND SLAB THICKNESS OF SS AND NS

2.3.1 SS Wall Thickness

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

- (a) The minimum SS wall thickness shall be accordance with TABLE 2.3.1.
- (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) Internal common wall between 2 adjacent SS shall be 200mm. Refer to FIGURE 2.3.1.

2.3.2 Slab Thickness of SS and Enclosed NS

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

- (a) Ceiling slab of top-most SS or S/C SS or scissor S/C SS - 300 mm. Refer to FIGURE 2.3.2.
- (b) Slab between two SS or S/C SS or scissor S/C SS - 200mm. Refer to FIGURE 2.3.2.
- (c) Floor slab of bottom-most SS/NS in contact with soil - 300mm. Refer to FIGURE 2.3.2.
- (d) Slab between SS or S/C SS and enclosed NS - 200mm - Refer to FIGURE 2.3.2.

2.3.3 Slab Thickness of SS and Non-Enclosed NS

- (a) Floor slab of SS that is directly supported by non-enclosed NS or NS wall or column - 300mm. Refer to FIGURE 2.3.2.



- (b) Ceiling slab of SS which is below non-enclosed NS or NS wall or column - 300mm.
- (c) Slab between two non-enclosed NS - 300mm.

2.4 LOCATION OF SS

2.4.1 SS Position

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

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. Refer to FIGURE. 2.4.1.

2.4.2 SS Tower

- (a) 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 founded directly to the foundation. Refer to FIGURE 2.4.2.
- (b) The space within the NS of the SS tower is not intended for protection of occupants during war emergency.

2.4.3 Setback Distances of SS Walls (without Reinforced Concrete Down-hang Beams along External Building Line (EBL))

- (a) The SS walls shall be located at minimum setback distances from the EBL as shown in FIGURE 2.4.3(a), 2.4.3(b), 2.4.3(c) & 2.4.3 (d) and shall comply with TABLE 2.4.3.
- (b) For SS wall (with door), the setback distance requirement shall be read in conjunction with Clause 2.5.4.
- (c) Where the storey height of a SS on the first storey is up to 3.6m and 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.



- (d) 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. Refer to FIGURE 2.4.3(e). 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 2.4.3(f) and 2.4.3(g).

2.4.4 Setback Distances of SS Walls (with Reinforced Concrete Down-hang Beams along EBL)

- (a) Where RC 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 2.4.4. The effective storey height is determined by the storey height less the depth "d" of the RC down-hang beam. Refer to FIGURE 2.4.4(a). If a RC 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 2.4.4.
- (b) For SS wall (with door), the setback distance requirement shall be read in conjunction with Clause 2.5.4.
- (c) Clause 2.4.4 shall apply only if the width of the reinforced concrete down-hang beam is at least 125 mm.
- (d) Where the storey height of a SS on the first storey is up to 3.6m and is greater than the storey height of the SS directly above it, the minimum setback distances of the SS on the 1st storey shall be at least the same as the setback distances of the SS above it. Where a RC down-hang beam is provided at the 2nd storey ceiling slab, the same down-hang beam shall be provided at the 1st storey ceiling slab.
- (e) 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 as shown in FIGURE 2.4.4(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 2.4.3(f) and 2.4.3(g).



2.4.5 Services Riser, Gas/ Water Riser and RC Refuse Chute within Setback Distances of SS Walls

Services risers for electrical and telecoms are allowed within the setback distance envelope of the SS wall (with or without door) provided that the ceiling slab at the roof level is of reinforced concrete.

Gas/ water riser and/or RC refuse chute are allowed within the setback distance envelope of the SS wall (without door) provided that the design of the gas/water riser and RC refuse chute walls and ventilated openings at the roof level comply with the details as shown in FIGURE 2.4.5(a) and 2.4.5(b) for RC refuse chute and FIGURE 2.4.5(c) and 2.4.5(d) for gas/ water riser respectively. The gas/ water riser and/or RC refuse chute are also allowed within the setback distance envelope of the SS wall (with door) except that it shall be located away from 45° influence zone from SS door. Refer to FIGURE 2.5.4(e).

2.5 SS DOOR

2.5.1 Opening Dimensions

The opening dimensions of SS door shall be:

- (a) For Storey Shelter (SS)
900(W) mm x 1900(H) mm
- (b) For S/C SS and scissor S/C SS
 - (i) For entrance SS door, the dimension shall be 900 (W) mm or 1000(W) mm x 2055(H) mm.
 - (ii) For internal SS door at mid-landing or main landing in the staircase, the dimension shall be 1000(W) mm x 2055(H) mm.
- (c) SS door frame that is cast together with the SS wall shall have single or double door rebate. Refer to FIGURE 2.5.1(a) and Figure 2.5.1(b)

2.5.2 Location

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



2.5.3 Door Frame

- (a) There shall be a minimum 150mm reinforced concrete nib next to vertical edge of the SS door frame. Refer to FIGURE 2.5.3(a).
- (b) For pre-cast door frame panel of Type 1, the reinforced concrete next to two vertical edges of the SS door frame shall be 300mm each. Refer to FIGURE 3.5.5(a).
- (c) For pre-cast door frame panel of Type 2, the reinforced concrete next to vertical edges of the SS door frame shall be 300mm on one side, and 150mm plus the SS wall thickness on the other side. FIGURE 3.5.5(f).
- (d) For pre-cast door frame panel of Type 3, the reinforced concrete panel with full length or width of SS wall must be properly connected to the in-situ SS walls and slabs. Refer to FIGURE 3.5.5(k).
- (e) The door frame must be positioned such that its door is above FFL and can be opened at least 90°. Refer to FIGURE 2.5.3(a).

2.5.4 Shielding Wall

A full-height reinforced concrete shielding wall, with a minimum thickness of 200 mm (with protective slab extended by at least $\frac{1}{2}$ of storey height from the shielding wall) or 300mm (if the protective slab is extended by less than $\frac{1}{2}$ of storey height), has to be provided in front of the entrance SS door.

The shielding wall to the SS door can be positioned and arranged in the following manner:

- (a) A continuous shielding wall has to be positioned such that it is at least 1200mm but not more than 3000 mm from the SS door and is within influence zone of 45-degree from the SS door. Refer to FIGURE 2.5.4(a), 2.5.4(b), 2.5.4(c), 2.5.4(d), 2.5.4(e) and 2.5.4(f). The shielding wall forming part of the dwelling unit's wall shall be clearly indicated on plans.
- (b) The shielding wall shall be protected by floor slab or trellis of at least half the storey height measured from the shielding wall. Refer to FIGURE 2.5.4(a), 2.5.4(b), 2.5.4(e) and 2.5.4(f).
- (c) Where the lift shaft is facing the SS door, the RC wall of the shaft can be used as a shielding wall provided its thickness is at least 200mm. Refer to FIGURE 2.5.4(c). For such case, the surrounding lift shaft wall and roof slab of lift motor room shall be reinforced concrete.



- (d) Where the shielding wall located within influence zone is not continuous, the opening in this wall shall not be in the line of sight of SS door. Refer to FIGURE 2.5.4(d).
- (e) In the case of service risers, the RC wall of the riser can be used as shielding wall provided its thickness is at least 200mm. Refer to FIGURE 2.5.4(e).
- (f) In the case of discontinuous shielding wall with the opening outside the direct line of sight of SS door, there shall be a minimum setback distance of 8000mm measured from SS door to EBL. Refer to FIGURE 2.5.4(f).

2.5.5 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 2.5.5.

2.6 FIXTURES IN SS

2.6.1 General

The following electrical and communication fixtures (Refer to FIGURE 2.6.1, FIGURE 2.12.2(a), FIGURE 2.12.2(d) & FIGURE 2.12.2(f)) in steel or PVC conduit system shall be provided inside each SS, S/C SS or scissor S/C SS compartment to provide adequate basic stay-in and/or communication facilities:

- (a) 13A switch socket outlets;
- (b) Switch and lighting points;
- (c) TV and radio outlets;
- (d) Communication line for telephony outlet.

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

The communication line for telephony outlet in each SS compartment shall have its own independent line where it is connected from the fibre termination point in



the SS compartment to the fibre interface point in the electrical riser of the development.

A maximum of five numbers of 25 mm diameter service conduits for electrical cables serving the SS are allowed. Refer to clause 3.6.1 for embedment details.

The electrical and communication fixtures shall be located away from the rescue hatch openings in the SS. Refer to FIGURE 2.6.1.

The mounting height of the lighting switch shall not exceed 1200 mm from the FFL. The other electrical and communication fixture shall be mounted at between 450 mm and 1200mm from the FFL to comply with the requirement as stipulated in the building codes. Refer to FIGURE 2.6.1(c).

Other fixtures, such as cabinets and shelves, which are required for peacetime use in SS, are allowed provided they are easily dismantled and removed.

2.6.2 Switch Socket Outlets

(a) For SS

Three (3) 13A switch socket outlets shall be provided inside each SS. Two switch socket outlets shall be in the vicinity of the TV and radio outlets and communication for telephony outlet located away from the SS door. The third switch socket outlet shall be located near the ventilation sleeve opening. Refer to FIGURE 2.6.1.

(b) For S/C SS

Three (3) 13A switch socket outlets shall be provided inside each S/C SS compartment. At least one switch socket outlet shall be provided at the main landing. The other two switch socket outlets shall be provided at the intermediate landing together with the TV and radio outlets and communication for telephony outlet. Refer to FIGURE 2.12.2 (a) and 2.12.2(d) for details.

(c) For Scissor S/C SS

Three (3) 13A switch socket outlets shall be provided inside each scissor S/C SS compartment. At least one switch socket outlet shall be provided at the main landing at the upper floor of the SS compartment. The other two switch socket outlets shall be provided at the main landing, together with the TV and radio outlets and communication for telephony outlet at the lower floor of the SS compartment. Refer to FIGURE 2.12.2(f) for details.



2.6.3 Light Fitting

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

2.6.4 Cable Entries and Openings

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

2.7 NS IN SS TOWER

2.7.1 Aggregate Wall Height of NS

- (a) 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. Refer to FIGURE 2.7.1.
- (b) 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 perimeter of the SS tower at those levels are structurally connected by floor slabs or tie beams to the structural frame of the building. Where tie beams are used, they shall be designed with at least equivalent stiffness to the floor slabs.

2.7.2 Shielded and Unshielded NS Walls

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

2.8 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.

2.9 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.

If the exit staircase and exit scissors-staircase are designed as the S/C SS, the waist of the staircase shall be minimum 200mm.

2.10 DOOR RECESS ON SS WALL

A door recess on SS wall to accommodate the protrusion of the SS door handle when the SS door is fully open, is allowed provided that (Refer to FIGURE 2.10):

- (a) The dimensions are not larger than 160mm (length) x 80mm (height) x 40mm (depth) for SS wall of minimum 300mm thickness.
- (b) The clear spacing between the SS door handle recess and the external socket outlet or other fixtures or internal fixture shall be at least 300mm apart.

2.11 DESIGN REQUIREMENTS OF SS

2.11.1 Rescue Hatch

- (a) 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 rescue hatch in its floor and the top-most SS shall not have a rescue hatch in its ceiling. The hatch shall be made of airtight sealed galvanised steel and be fire rated *.
(* QP is advised to look into the fire safety requirements of their designs for compartmentation of the SS).
- (b) The rescue hatch opening in an SS shall be positioned adjacent to the SS walls with minimum dimensions as shown in FIGURE 2.11.1(a). The vertical centreline of the rescue hatch opening in the ceiling shall be offset from the centreline of the rescue hatch in the floor of the same SS by at least 1400 mm. Refer to FIGURE 2.11.1(b).
- (c) The clear opening of the rescue hatch shall be 700 mm x 700 mm. The dimensions of the rescue hatch are as shown in FIGURE 2.11.1(c).



2.11.2 Cat-Ladder

Cat-ladder shall be provided for access through rescue hatch opening. The cat-ladder shall be made of either stainless steel or aluminium or equivalent. The mounting connections of cat-ladder to the SS wall shall be designed to withstand shock loads of at least 12.5g in all directions, where g is the gravitational acceleration, details and dimensions as shown in FIGURE 2.11.2.

2.12 DESIGN REQUIREMENTS OF S/C SS AND SCISSOR S/C SS

2.12.1 General

The protection carcass shall be formed by external SS wall, floor slab of the bottom-most shelter compartment and the ceiling slab of the top-most shelter compartment. In the case of NS interspersed between the SS compartments, all opening leading to the NS space shall be provided with SS doors and vertical blast hatches. Refer to FIGURE 2.12.1 (a), 2.12.1(b) and 2.12.1(c). All SS doors are to be kept opened permanently during peacetime. As such, a door holder shall be provided to hold the door in open position. Refer to FIGURE 2.12.1(d).

S/C SS and scissor S/C SS have to be mechanically-ventilated for peacetime purpose. The number of mechanical ventilation (MV) openings is based on the peacetime MV design. Where there are MV openings, grille openings for entry of ventilating air via mechanical ventilation (MV) riser are permitted. Typically, for a scissor S/C SS, the MV openings are at alternate floors of each SS tower as shown in Figure 2.12.2(f) and 2.12.2(g).

Except for the two ventilation sleeves, which are placed in closed position, and the MV opening wherever required, no other openings in each SS compartment are permitted.

2.12.2 S/C SS Doors at Shelter Entrance

At every storey, one SS door with removable door kerb, is to be provided at the shelter entrance and shall be kept in the open position during peacetime. Refer to FIGURE 2.12.2(a) to 2.12.2(f). As this SS door swing against the direction of exit travel, it shall be not doubled up as the peacetime fire-rated door. A separate peacetime fire-rated door swinging in the direction of exit travel is required.

Where the staircase leads to the roof level, an external SS door swinging outwards from the staircase, has to be provided at the staircase entrance. This external SS door shall also be permanently kept open during peacetime and shall be suitably protected from the weather if it is exposed to external space.



2.12.3 Internal S/C SS Wall and SS Door

Inside the S/C SS, there has to be a continuous reinforced concrete internal wall of minimum 200 mm thickness running through the full height of the S/C SS tower. At every storey, one internal 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. Refer to FIGURE 2.12.2(a) to 2.12.2(f). The SS door clear opening dimensions shall be:

- a Door opening width - 1000 mm.
- b Door opening height - 2055 mm.

This SS door is to be kept permanently open during peacetime. A door holder shall be provided to hold the internal SS door in open position. Refer to FIGURE 2.12.1(d).

The RC wall and the internal SS door (when placed in closed position) serve to compartmentalise the staircase shaft into a series of staircase SS i.e. one SS compartment for each storey.

2.12.4 Shelter Compartment

- (a) S/C SS comprises one SS compartment each storey. Each shelter compartment shall be made up of one entrance SS door and 2 internal SS doors, i.e. one at each intermediate landing or main landing. Refer to FIGURE 2.12.2(a) to 2.12.2(e).
- (b) Scissor S/C SS comprises two SS at each storey. Each SS compartment shall be made up of one entrance SS door and 2 internal SS doors. Refer to FIGURE 2.12.2(f). Signage shall be provided adjacent to each SS door entrance showing the designated dwelling units assigned to each shelter compartment.
- (c) The slopping soffit of the staircase waist shall be continuous to meet the staircase. This shall include the part of slopping soffit projected from the 200mm thick internal wall as shown in FIGURE 2.12.2 (c) and 2.12.2 (e).

2.12.5 Blast Hatch at MV Duct Opening

As the S/C SS and scissor S/C SS are to be mechanically-ventilated during peacetime, there would be vertical grille openings in S/C SS or scissor S/C SS wall. Where there are such openings (subject to the mechanical ventilation design), there shall be vertical blast hatch, swung open into the MV riser, provided at these openings. See FIGURE 2.12.2(a) to 2.12.2(f). These openings shall be closed and



made airtight by vertical blast hatches when the S/C SS or scissor S/C SS is converted for use as SS.

2.12.6 Blast Hatch at MV Chamber

- (a) Horizontal blast hatch shall be provided at the MV chamber at roof level as shown in FIGURE 2.12.7(a) to 2.12.7(d).
- (b) Safety hook shall be provided in the protective wall next to the horizontal blast hatch opening at roof level as shown in FIGURE 2.12.7(a) to 2.12.7(d).
- (c) An unobstructed passageway shall be provided to the roof level for the operation and maintenance of the blast hatch in the MV chamber.
- (d) Ceiling light, switch, single power socket outlet and safety steel mesh shall be provided in the MV chamber as shown in FIGURE 2.12.7(a) to 2.12.7(d).

2.12.7 Dimensions and Other Requirements of Blast Hatch

- a. The minimum size of the vertical panel or MV grille for access to open/close the vertical blast hatch between the MV riser and staircase SS shall be 600/700mm by 700mm. Refer to FIGURE 2.12.2(a) to 2.12.2(f). The internal SS door shall be positioned such that it swings away from the vertical blast hatch opening.
- b. There shall be reinforced concrete ledge or steel ledge provided around the MV duct for inspection and maintenance of the vertical blast hatch. Refer to FIGURE 2.12.2(a) to 2.12.2(f).
- c. The details of the nib dimensions for horizontal blast hatch opening at the MV chamber are as shown in FIGURE 2.12.7(a) to 2.12.7(d).
- d. The net clear opening of the vertical and horizontal blast hatches shall be 600/700 mm x 700 mm as shown FIGURE 2.12.7(e) and 2.12.7(f).
- e. “Unlocking” or “Locking” label or sticker to indicate the unlocking or locking position at the locking device shall be provided for all blast hatches. Refer to FIGURE 2.12.7(e) and 2.12.7(f)

2.12.8 Provision of cut-off Sprinkler outside S/C SS and Scissor S/C SS

Where cut-off sprinkler is required to be provided in the fire-protected space for the compliance to fire safety, the cut-off sprinkler compartment shall be provided outside the S/C SS. Refer to FIGURE 2.12.8.



TABLE 2.2.1: 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.

$$\text{Area of Storey Shelter} = TNO \times 0.6m^2$$

$$\text{Volume of Storey Shelter} = TNO \times 1.8m^3$$

TNO = Total Nominal Occupancy of units served by Storey Shelter



TABLE 2.3.1 REQUIRED MINIMUM SS AND NS WALL THICKNESS

Storey Height (SH) (mm)	SS Clear Height (Ht) (mm)	Setback Distance of SS Wall (mm)	Wall Thickness (mm)
$SH \leq 4000$	$2400 \leq Ht \leq 3400$	≤ 6000	300
		> 6000	250
	$3400 < Ht \leq 3900$	≤ 6000	325
		> 6000	275
$4000 < SH \leq 6000$	$2400 \leq Ht \leq 3400$	≤ 7000	300
		> 7000	250
	$3400 < Ht \leq 3900$	≤ 7000	325
		> 7000	275
$6000 < SH \leq 8000$	$2400 \leq Ht \leq 3400$	≤ 8000	300
		> 8000	250
	$3400 < Ht \leq 3900$	≤ 8000	325
		> 8000	275
$8000 < SH \leq 10000$	$2400 \leq Ht \leq 3400$	≤ 9000	300
		> 9000	250
	$3400 < Ht \leq 3900$	≤ 9000	325
		> 9000	275



**TABLE 2.4.3: MINIMUM SETBACK DISTANCES OF SS WALLS WITHOUT
REINFORCED CONCRETE 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)
2200 < SH ≤ 2500	3000	2100
2500 < SH ≤ 2800	3000	2200
2800 < SH ≤ 3100	3200	2400
3100 < SH ≤ 3200	3250	2450
3200 < SH ≤ 3400	3300	2500
3400 < SH ≤ 3500	3400	2600
3500 < SH ≤ 4000	3600	2800
4000 < SH ≤ 4500	3850	3050
4500 < SH ≤ 5000	4100	3300
5000 < SH ≤ 5500	4300	3500
5500 < SH ≤ 6000	4550	3750
6000 < SH ≤ 6500	4800	4000
6500 < SH ≤ 7000	5000	4200
7000 < SH ≤ 7500	5250	4450
7500 < SH ≤ 8000	5500	4700
8000 < SH ≤ 8500	5750	4950
8500 < SH ≤ 9000	6000	5200
9000 < SH ≤ 9500	6250	5450
9500 < SH ≤ 10000	6500	5700



**TABLE 2.4.4: 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 Wall with SS Door (mm) Column (2)	Setback Distance of SS Walls without SS Door (mm) Column (3)
2200 < Ht ≤ 2500	3000	2100
2500 < Ht ≤ 2800	3000	2200
2800 < Ht ≤ 3100	3200	2400
3100 < Ht ≤ 3200	3250	2450
3200 < Ht ≤ 3400	3300	2500
3400 < Ht ≤ 3500	3400	2600
3500 < Ht ≤ 4000	3600	2800
4000 < Ht ≤ 4500	3850	3050
4500 < Ht ≤ 5000	4100	3300
5000 < Ht ≤ 5500	4300	3500
5500 < Ht ≤ 6000	4550	3750
6000 < Ht ≤ 6500	4800	4000
6500 < Ht ≤ 7000	5000	4200
7000 < Ht ≤ 7500	5250	4450
7500 < Ht ≤ 8000	5500	4700
8000 < Ht ≤ 8500	5750	4950
8500 < Ht ≤ 9000	6000	5200
9000 < Ht ≤ 9500	6250	5450
9500 < Ht ≤ 10000	6500	5700



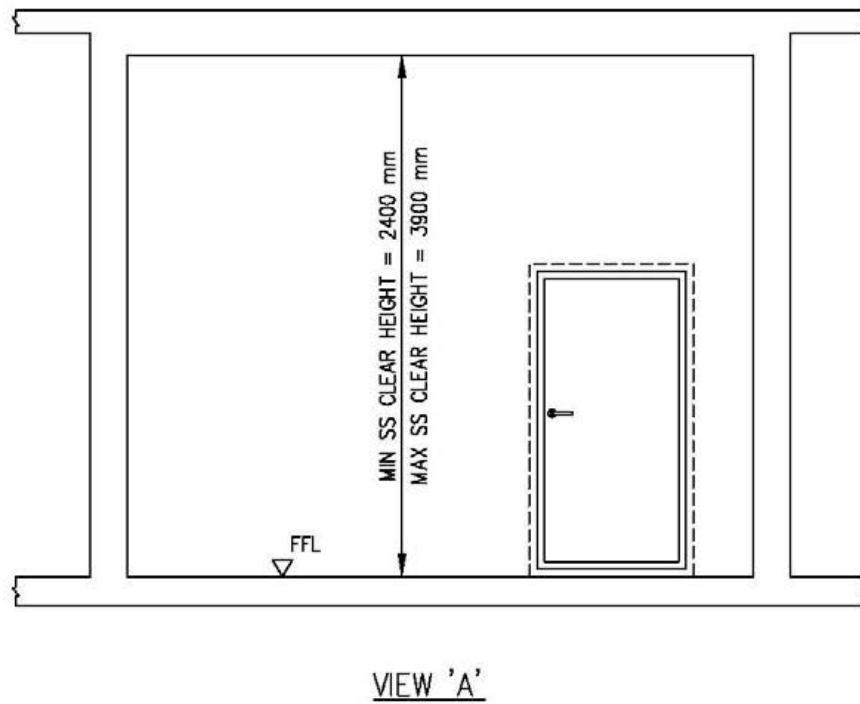
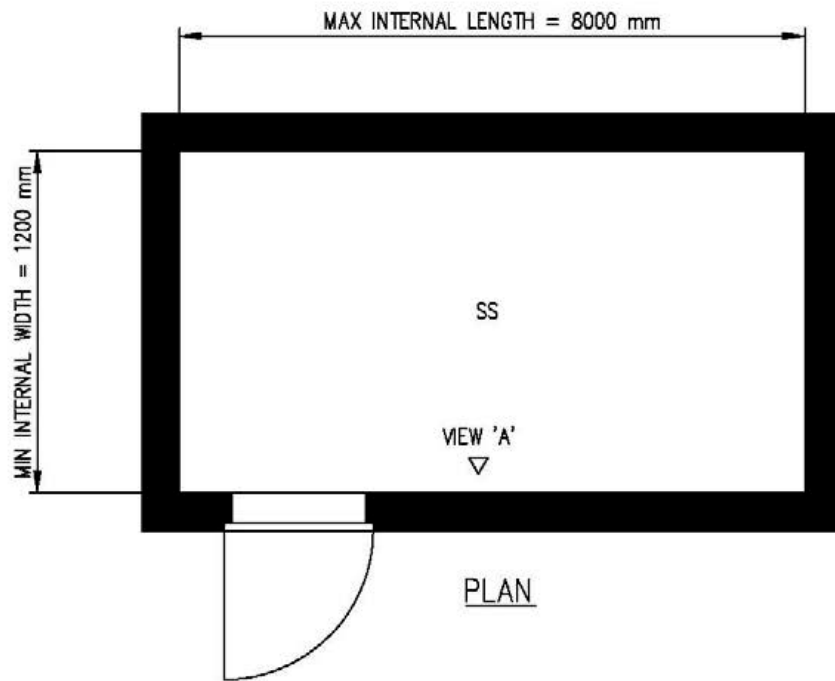


FIGURE 2.2.1 TYPICAL LAYOUT OF SS

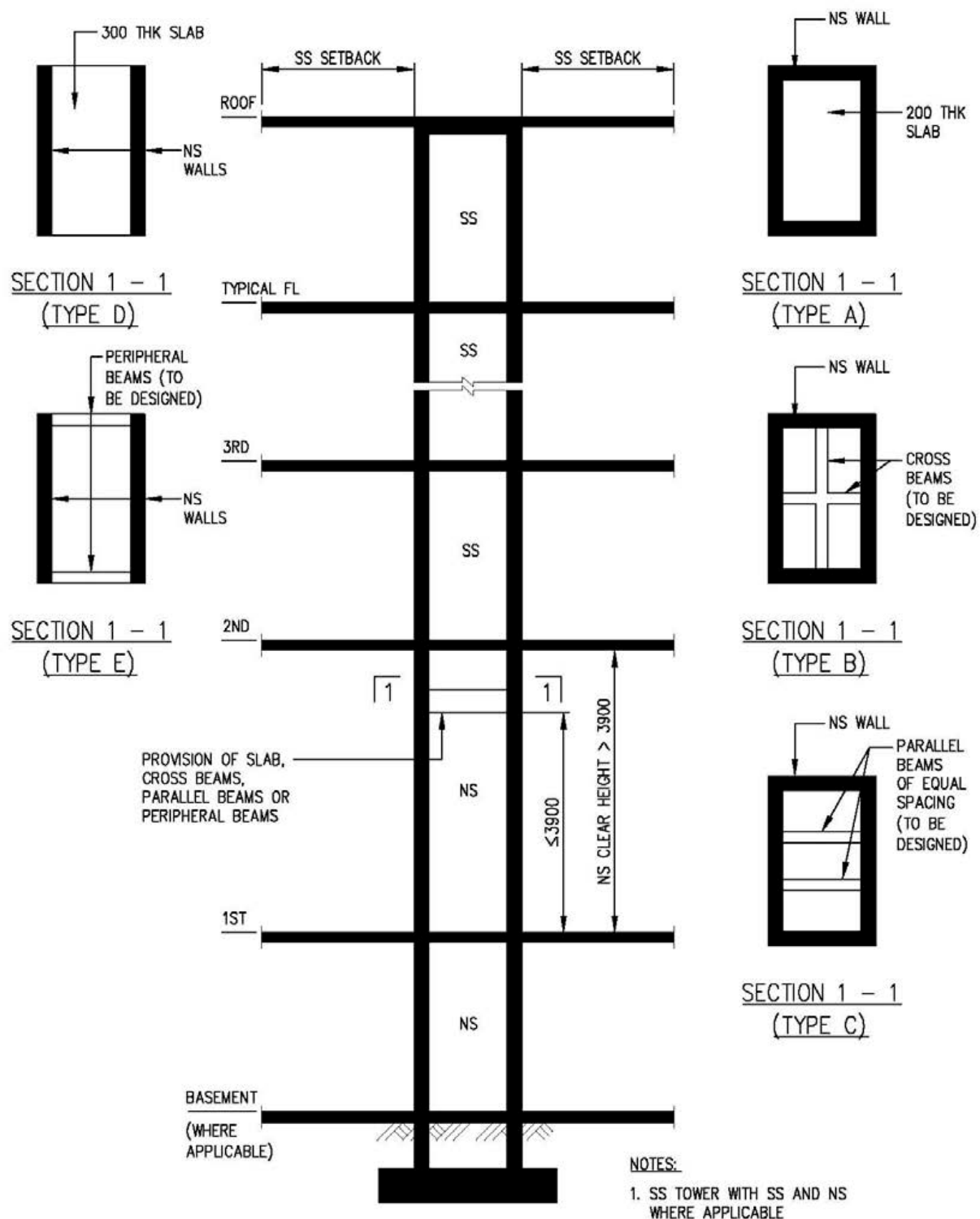
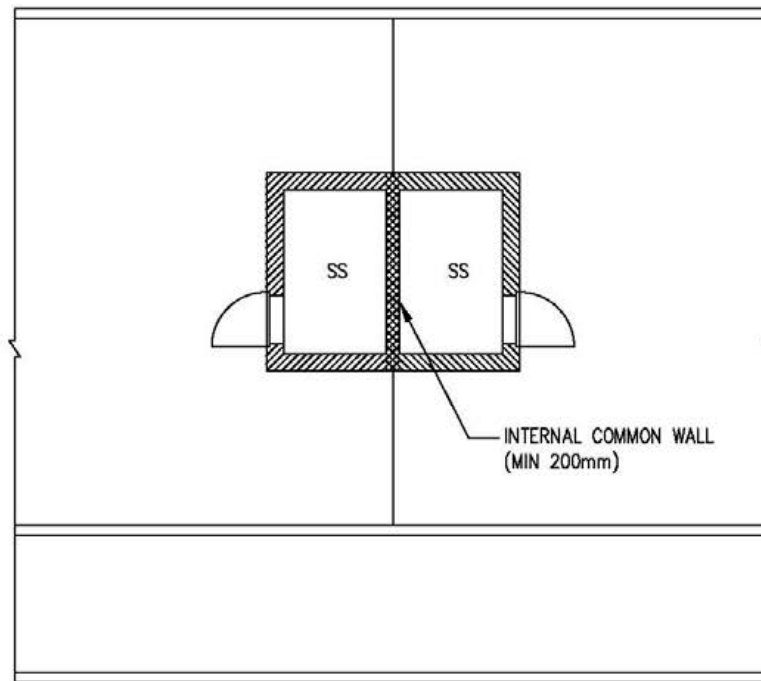
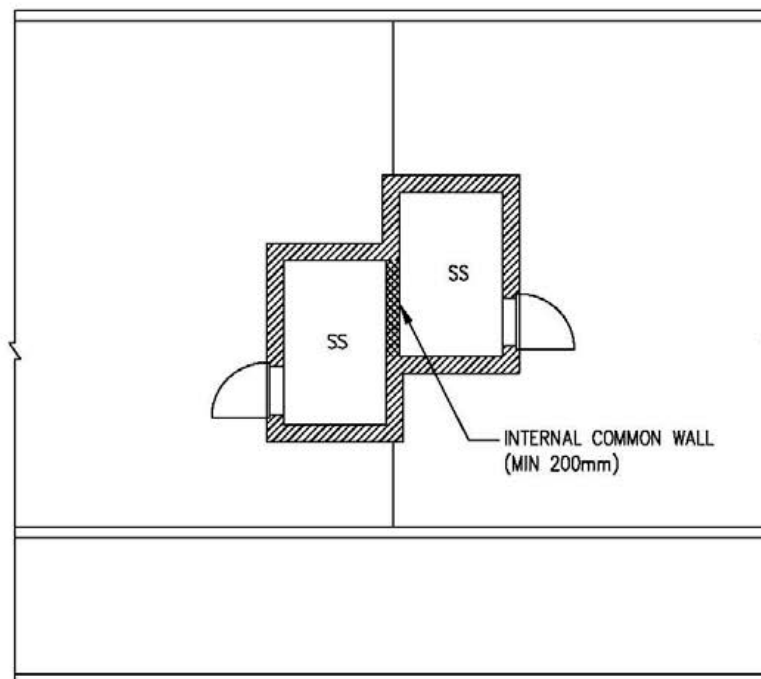


FIGURE 2.2.2 SECTION OF SS TOWER SHOWING SS AND NS CLEAR HEIGHT



ALTERNATIVE 1



ALTERNATIVE 2

FIGURE 2.3.1 INTERNAL COMMON WALL BETWEEN TWO SS

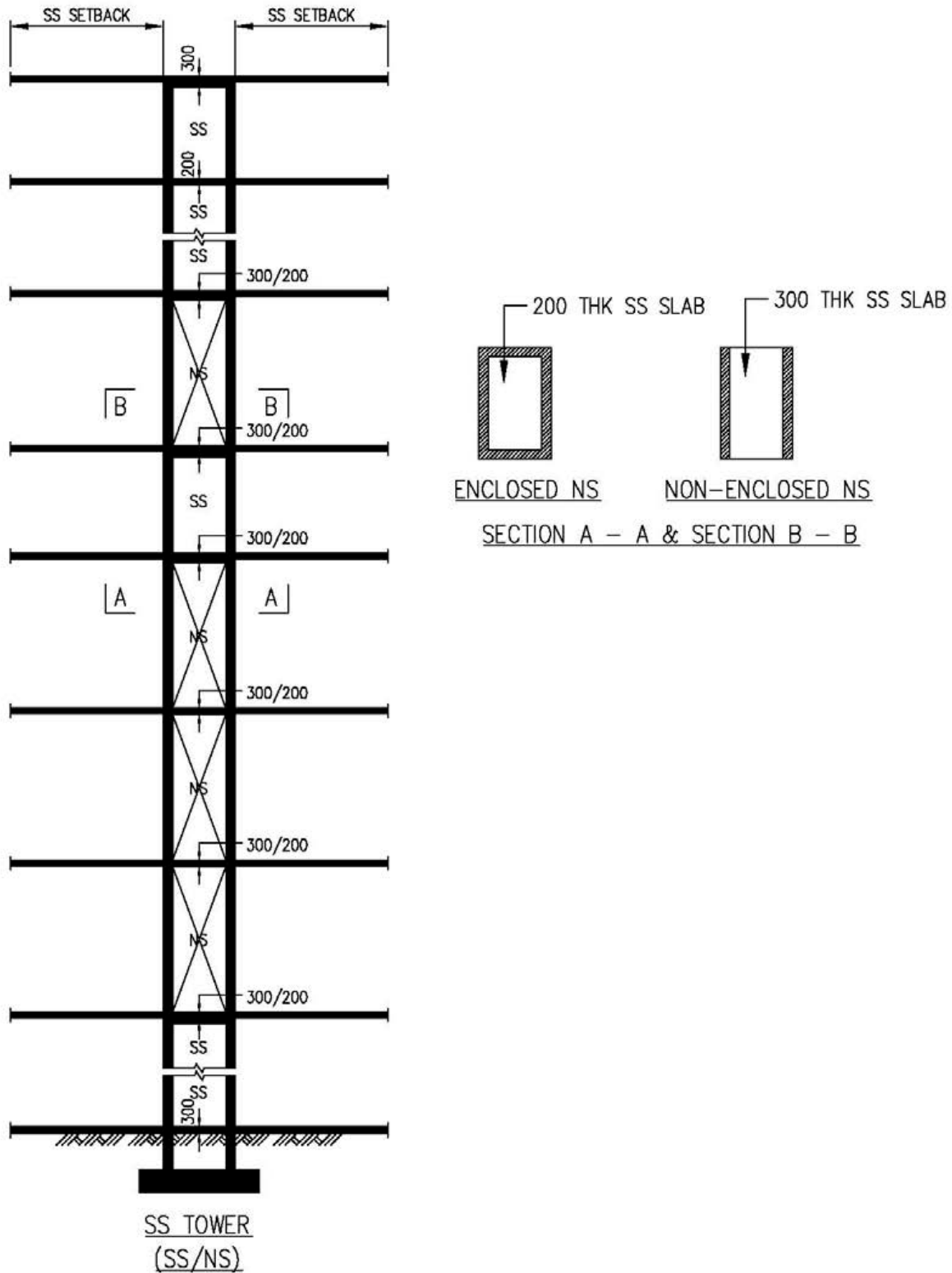


FIGURE 2.3.2 SS TOWER SHOWING SS AND NS (WITH ENCLOSED AND NON-ENCLOSED NS WALL) SLAB THICKNESS

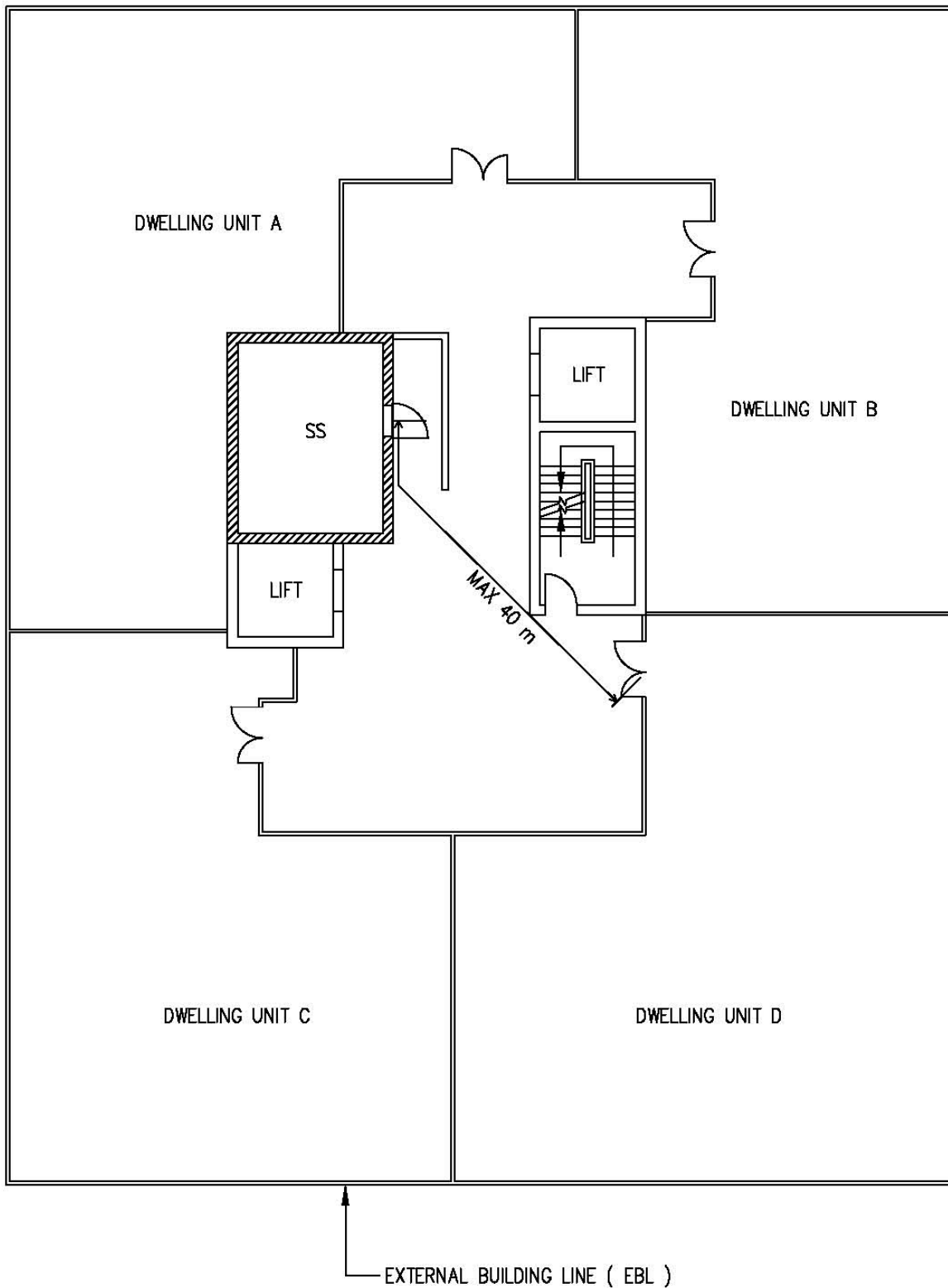
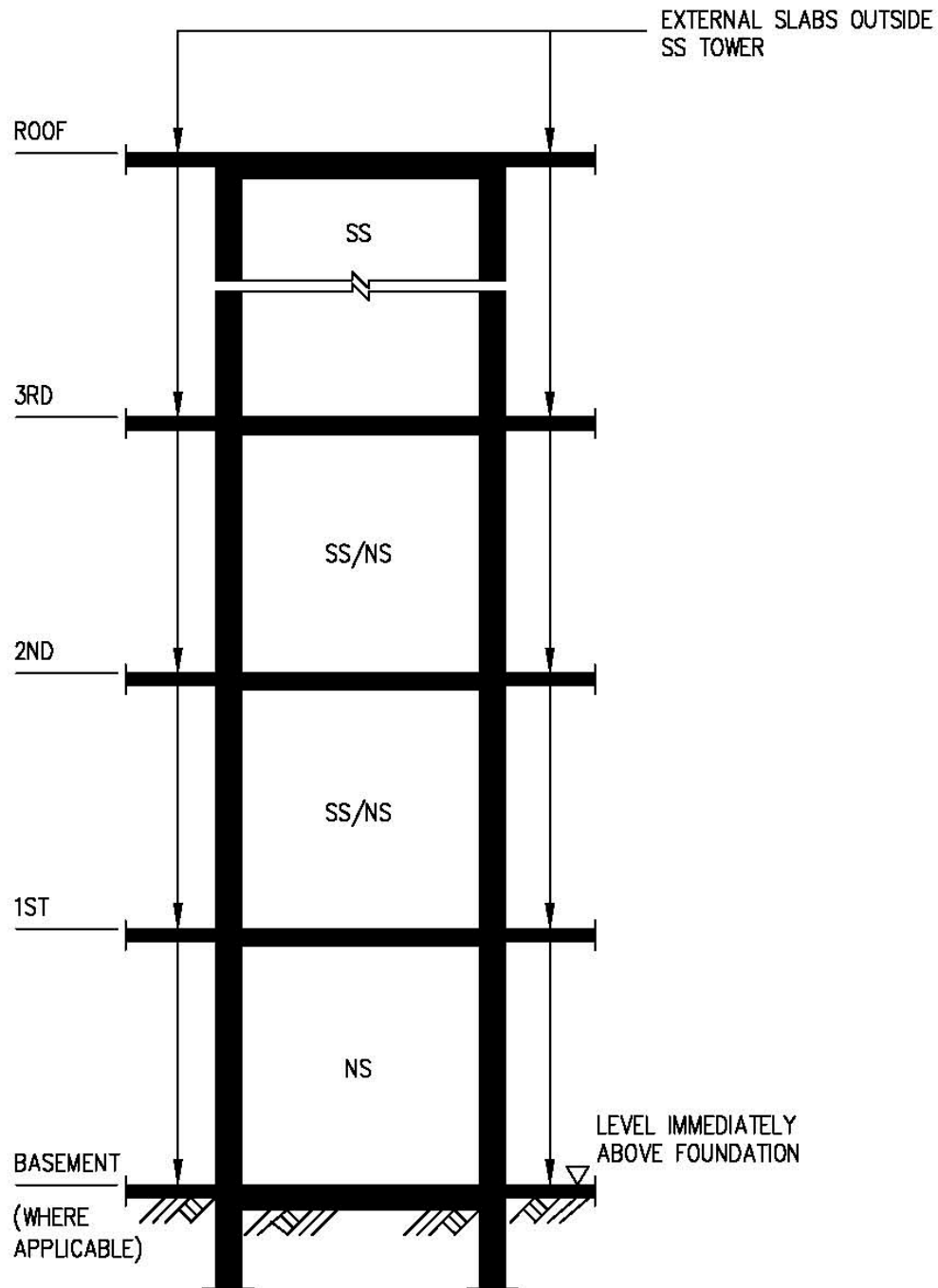


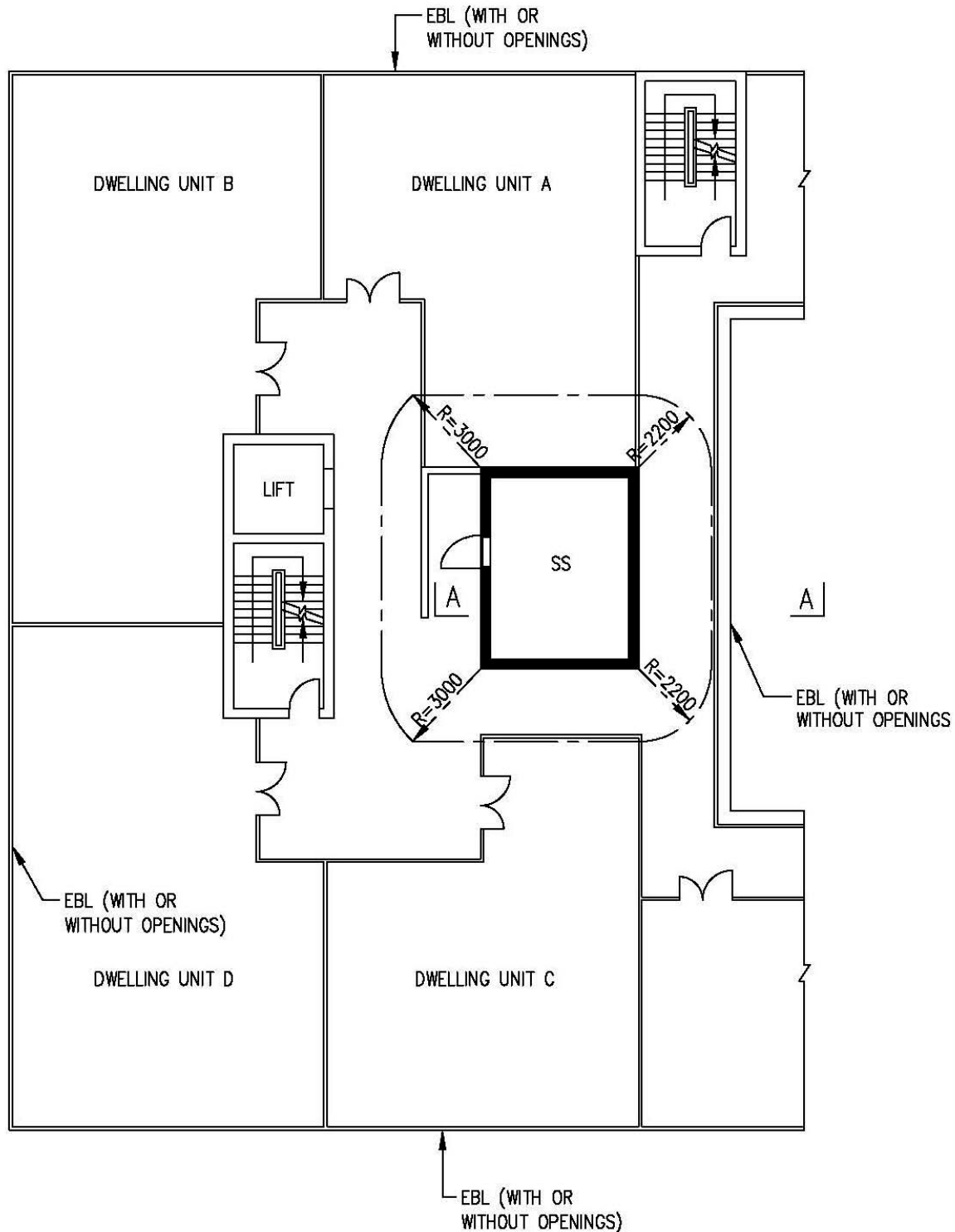
FIGURE 2.4.1 SS POSITION



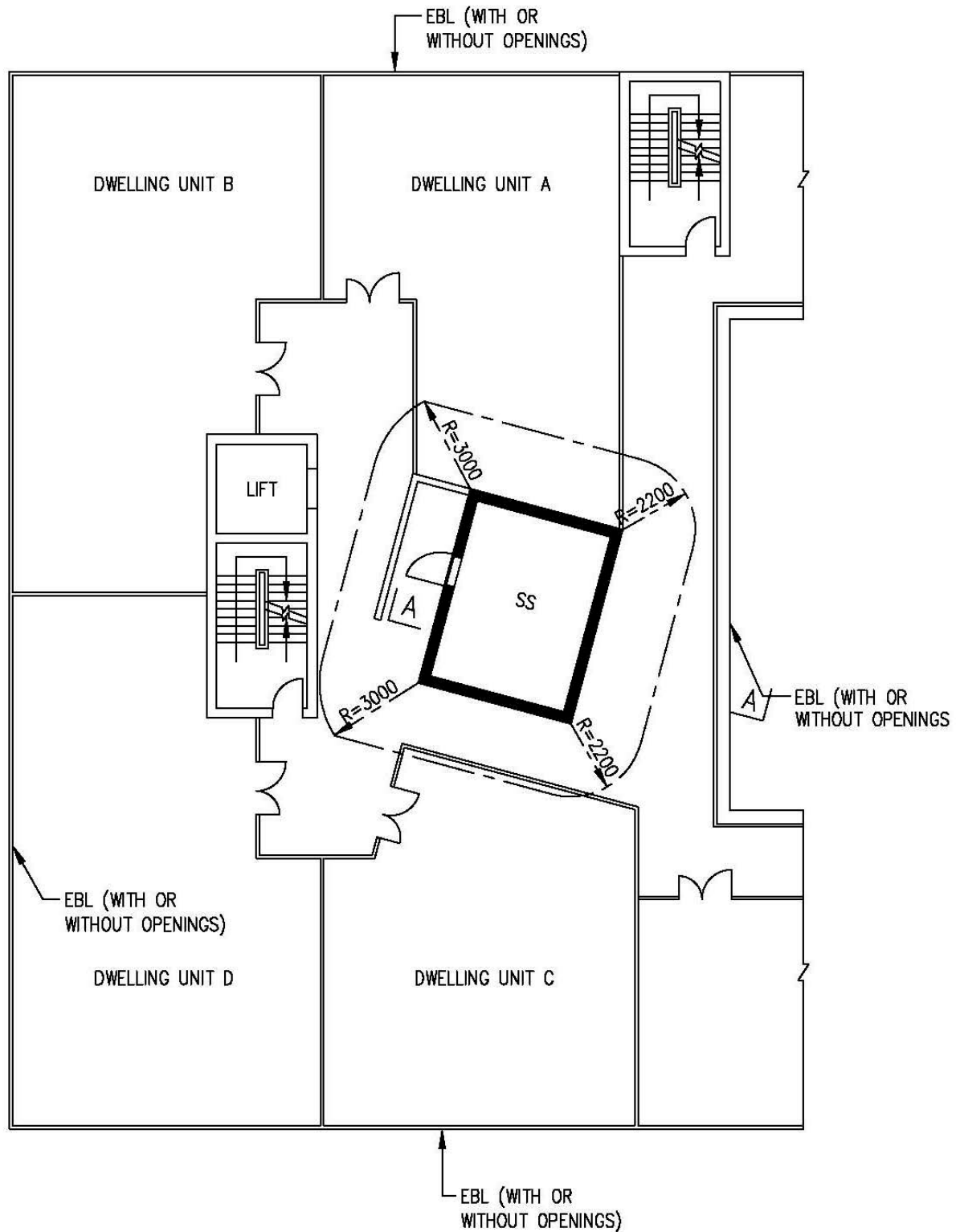
NOTES

1. SS TOWER WITH SS AND NS WHERE APPLICABLE

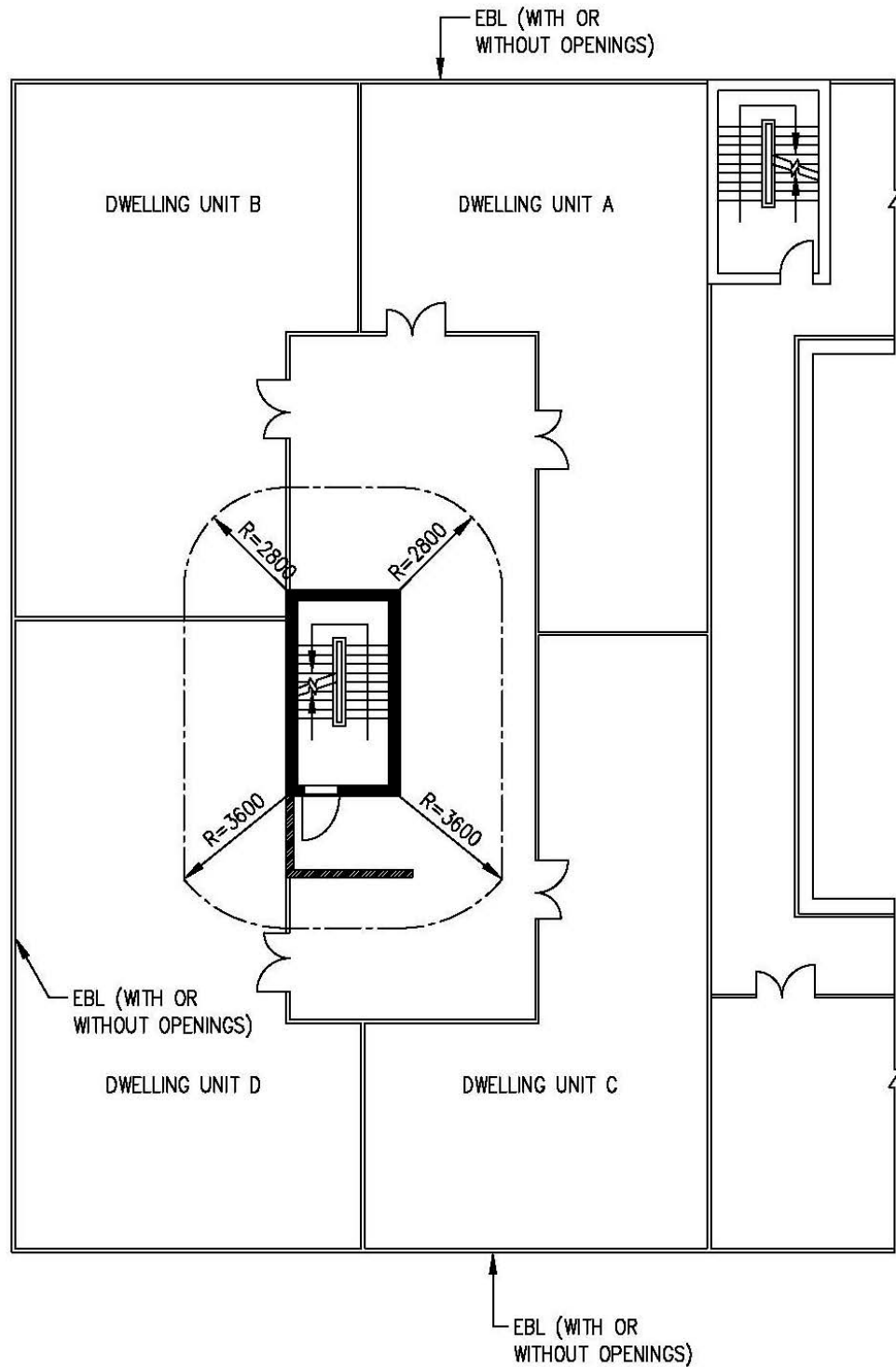
FIGURE 2.4.2 SCHEMATIC SECTION OF SS TOWER



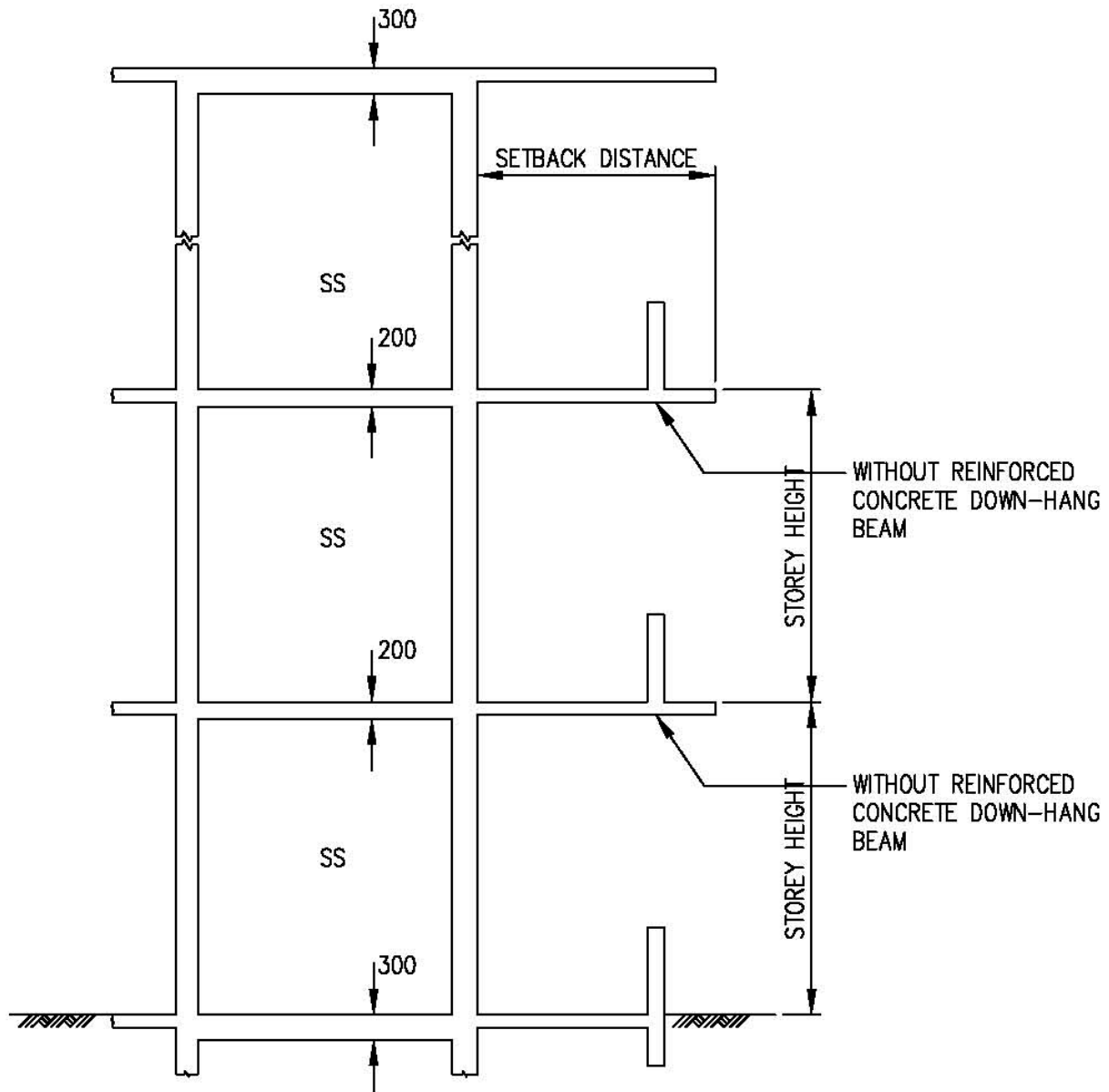
**FIGURE 2.4.3(a) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS
(WITHOUT DOWN-HANG BEAM)
(FOR $2500\text{MM} < \text{STOREY HEIGHT} \leq 2800\text{MM}$)
(FOR OTHER STOREY HEIGHTS, SEE TABLE 2.4.3)**



**FIGURE 2.4.3(b) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS
(WITHOUT DOWN-HANG BEAM)
(FOR $2500\text{MM} < \text{STOREY HEIGHT} \leq 2800\text{MM}$)
(FOR OTHER STOREY HEIGHTS, SEE TABLE 2.4.3)**

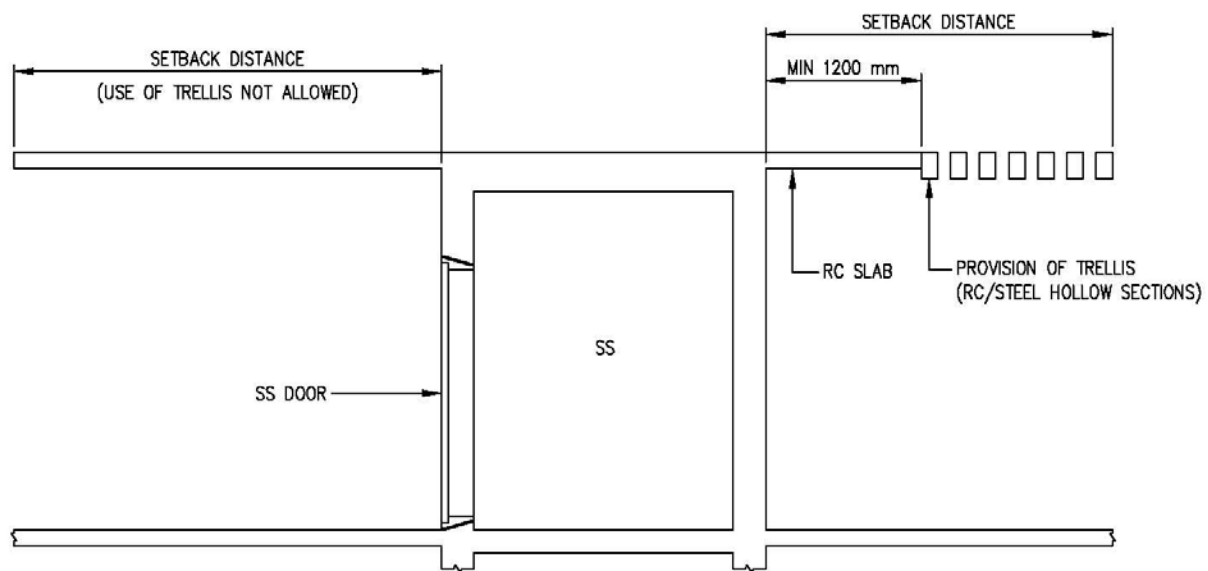


**FIGURE 2.4.3(c) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS
(WITHOUT DOWN-HANG BEAM)
(FOR $3500\text{MM} < \text{STOREY HEIGHT} \leq 4000\text{MM}$)
(FOR OTHER STOREY HEIGHTS, SEE TABLE 2.4.3)**



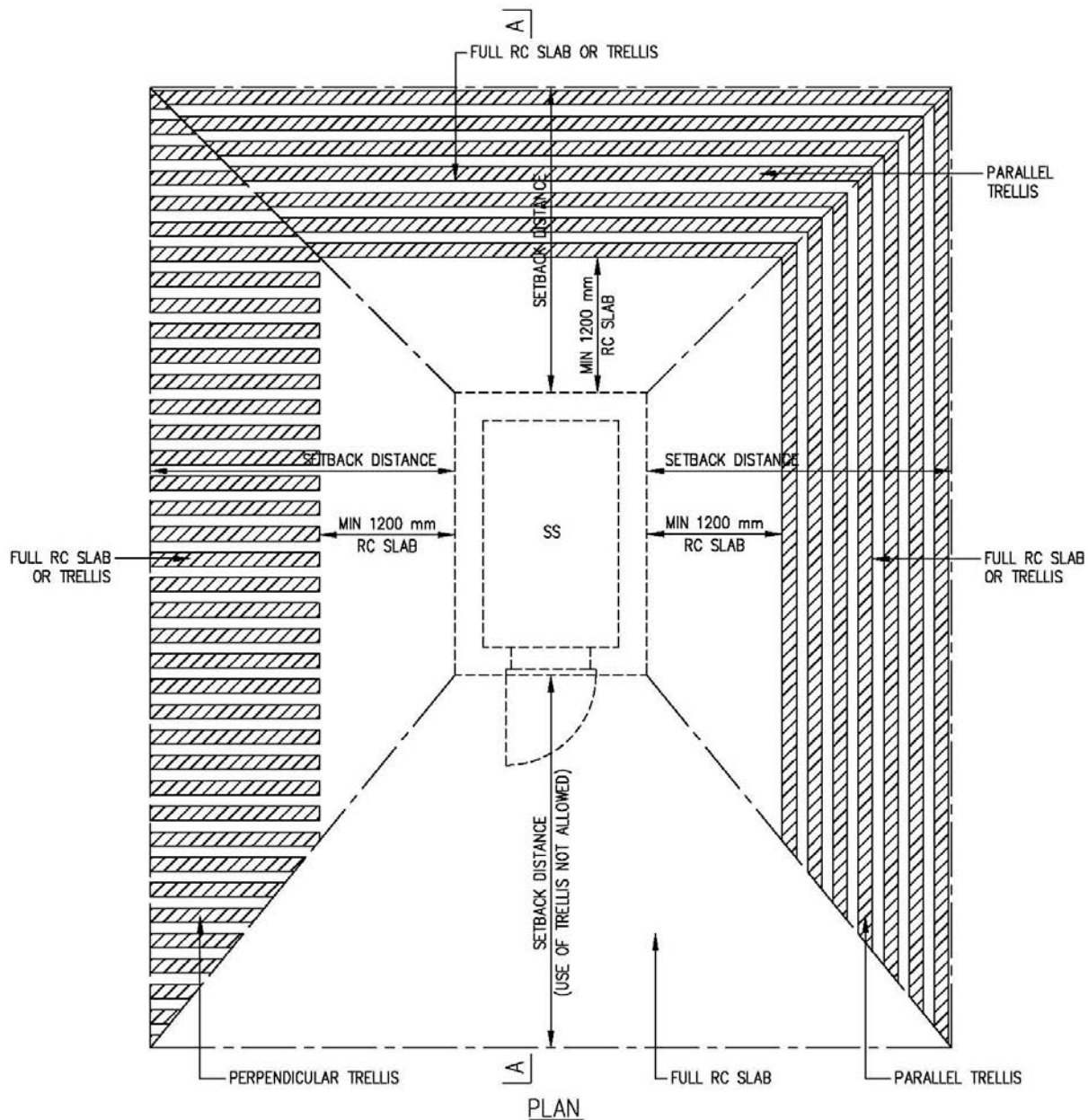
SECTION A – A

**FIGURE 2.4.3(d) SETBACK DISTANCE OF SS WALLS
(WITHOUT DOWN-HANG BEAM)**



SECTION A - A

**FIGURE 2.4.3(e) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTION)
TO MAKE UP FOR SHORTFALL IN SETBACK DISTANCE**



NOTE:

1. THICKNESS OF STEEL HOLLOW SECTIONS SHALL BE AT LEAST 6 mm

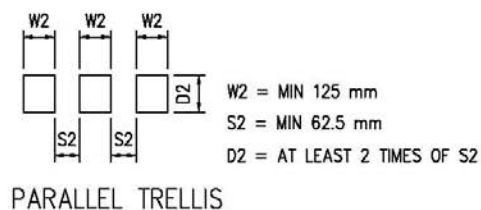
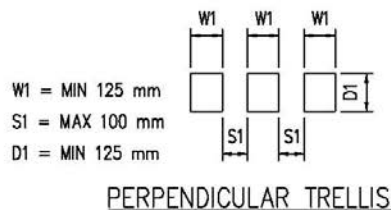


FIGURE 2.4.3(f) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTION) TO MAKE UP FOR SHORTFALL IN SETBACK DISTANCE

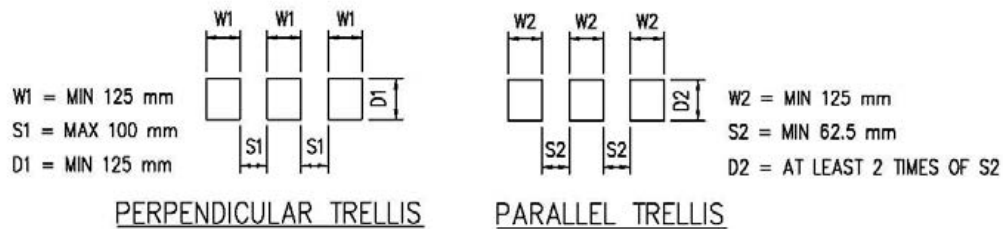
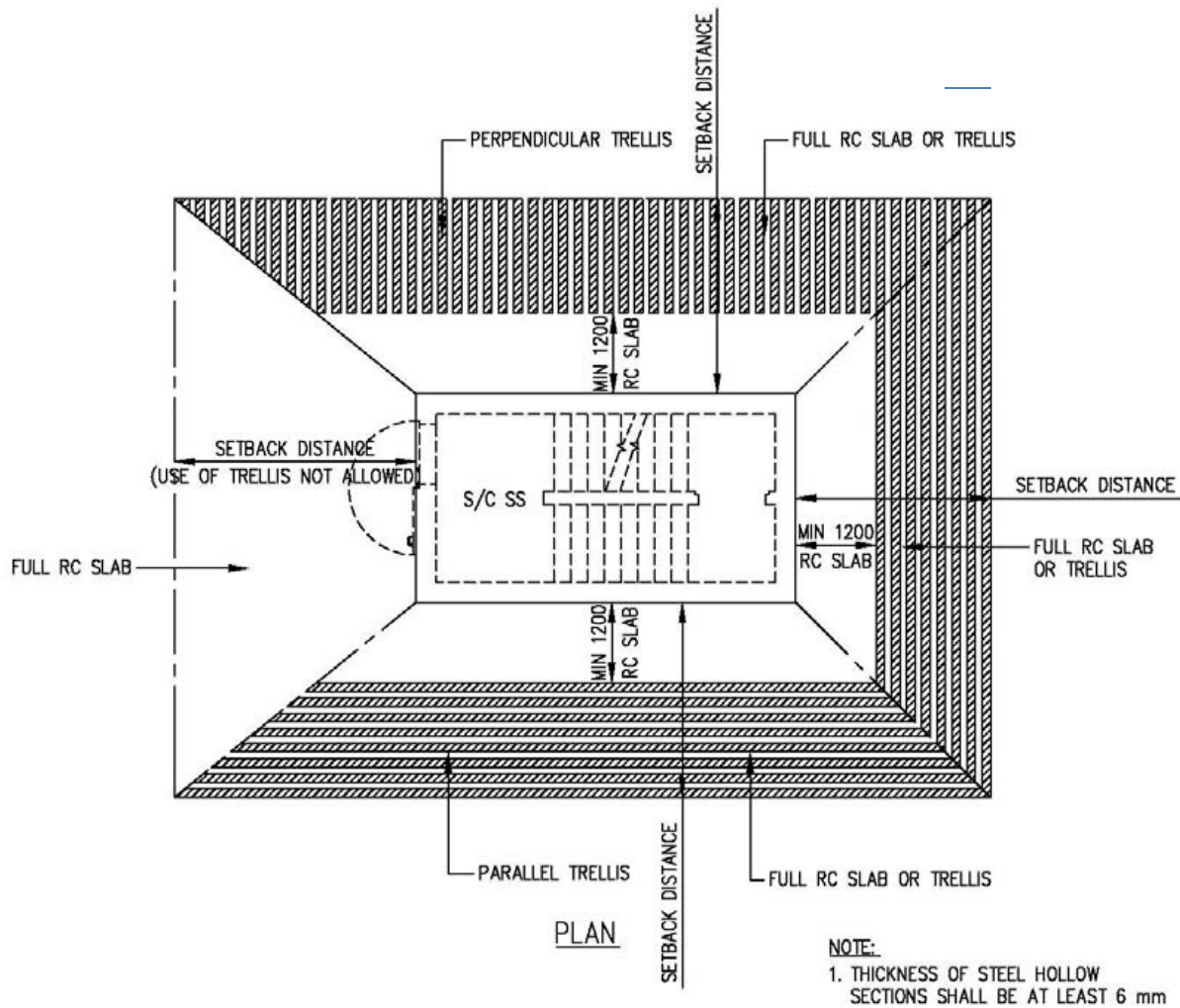
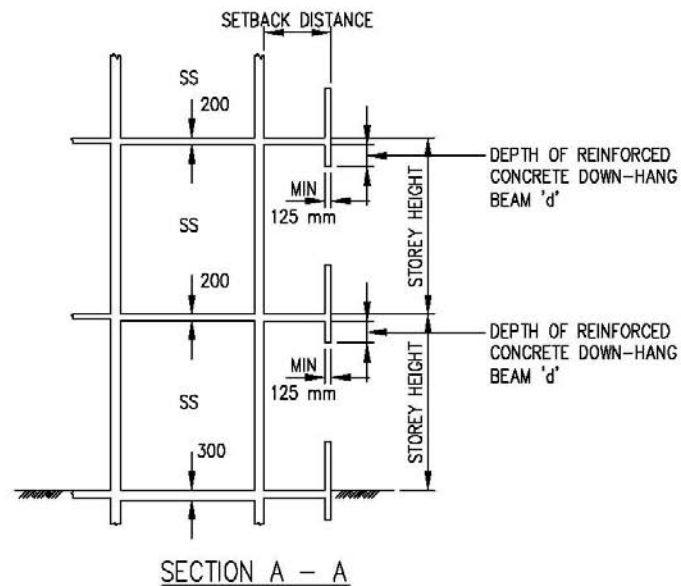
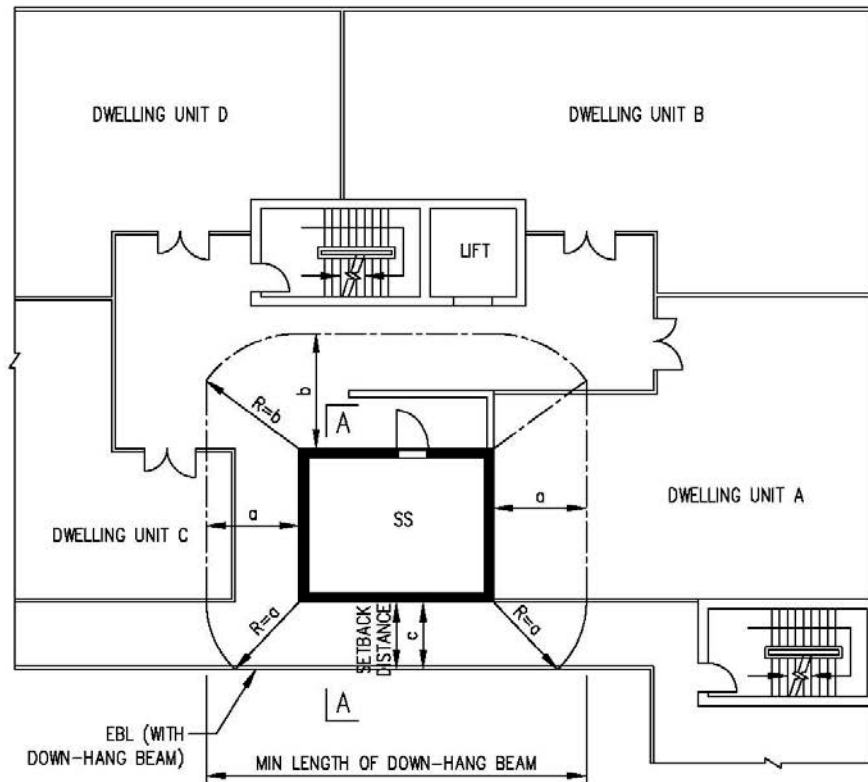


FIGURE 2.4.3(g) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTION) TO MAKE UP FOR SHORTFALL IN SETBACK DISTANCE



**FIGURE 2.4.4(a) REQUIREMENT ON SETBACK DISTANCE OF SS WALLS
(WITH DOWN-HANG BEAM)
(EFFECTIVE STOREY HEIGHT = STOREY HEIGHT - DEPTH "d" OF DOWN-HANG BEAM)**

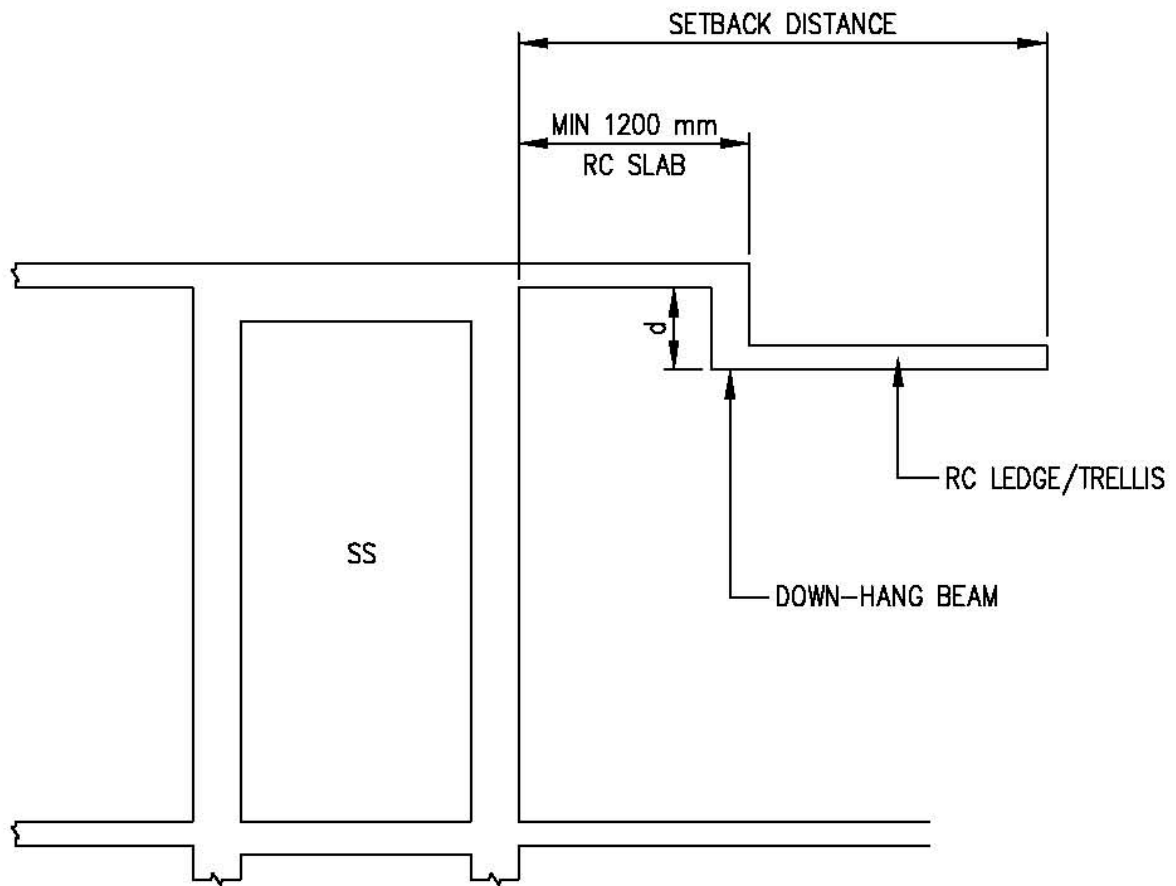
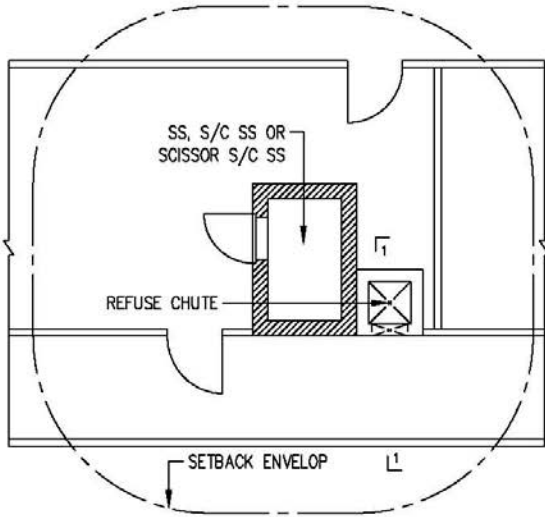
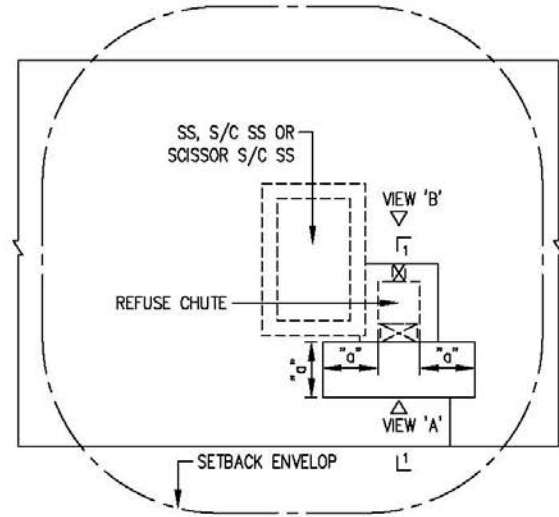


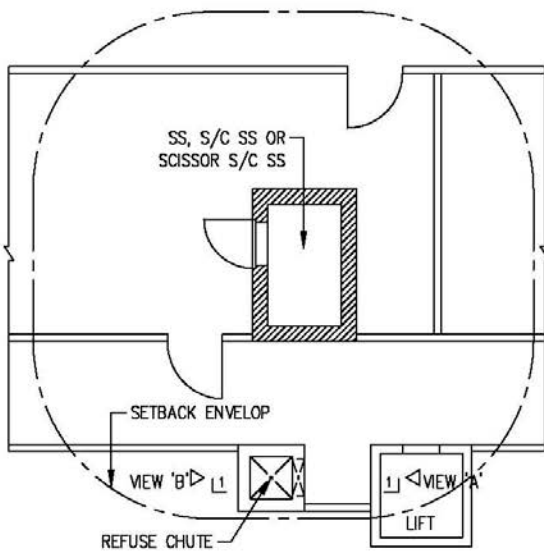
FIGURE 2.4.4(b) DOWN-HANG BEAM LOCATED AWAY FROM EXTERNAL BUILDING LINE



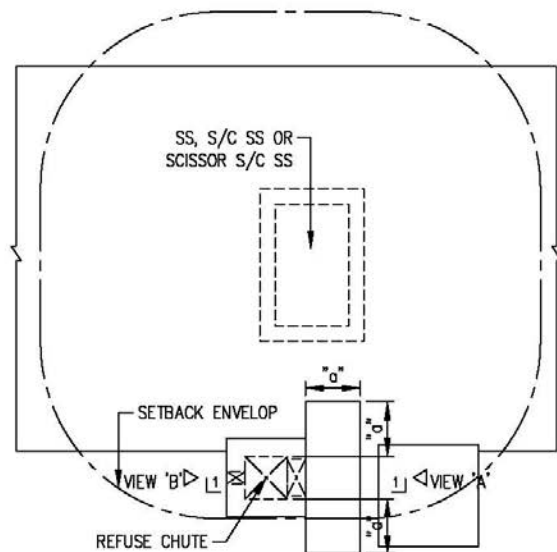
TYPICAL SHELTER PART PLAN
WITH REFUSE CHUTE ABUTTING
SS OR S/C SS



TYPICAL SHELTER ROOF PART PLAN
WITH REFUSE CHUTE ABUTTING
SS OR S/C SS

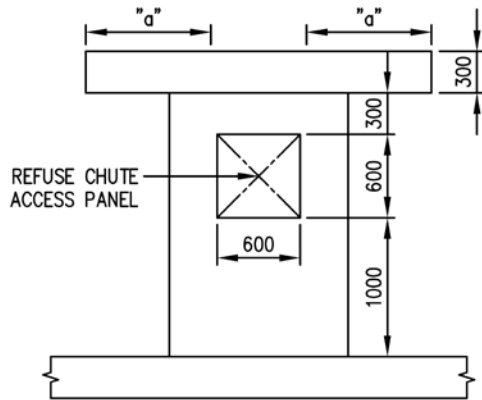


TYPICAL SHELTER PART PLAN WITH REFUSE
CHUTE WITHIN SETBACK ENVELOPE
SS OR S/C SS

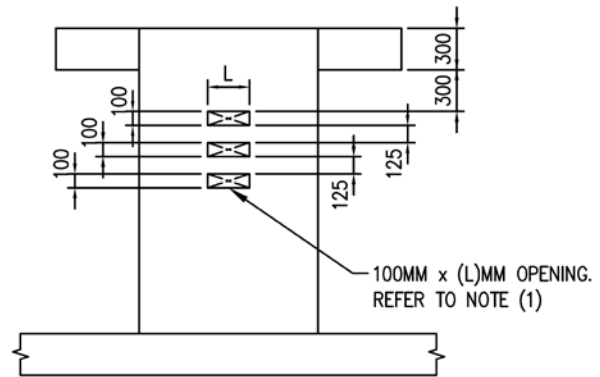


TYPICAL SHELTER ROOF PART PLAN WITH
REFUSE CHUTE WITHIN SETBACK ENVELOPE
SS OR S/C SS

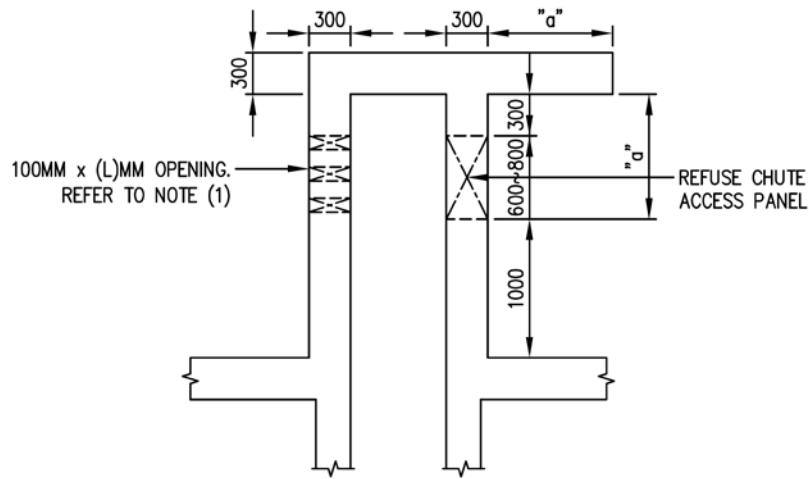
**FIGURE 2.4.5(a) PROTECTION REQUIREMENT AT ROOF LEVEL FOR PROVISION
OF RC REFUSE CHUTE LOCATED WITHIN SETBACK DISTANCE ENVELOP**



**RC REFUSE CHUTE
PROTECTION VIEW 'A'**



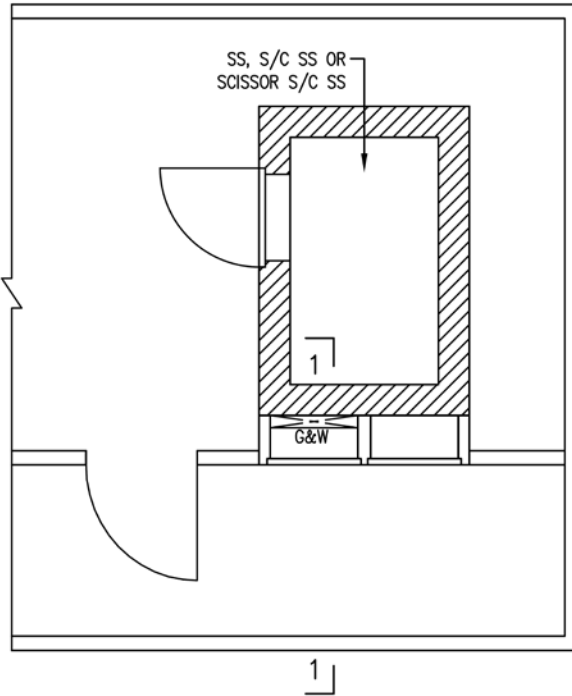
**RC REFUSE CHUTE
PROTECTION VIEW 'B'**



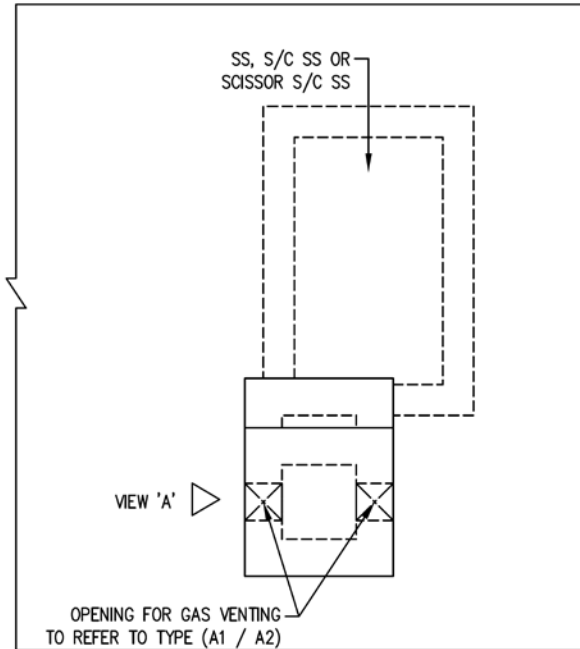
**RC REFUSE CHUTE
PROTECTION SECTION 1-1**

NOTE (1): TOTAL AREA OF OPENING
FOR REFUSE CHUTE VENTING SHALL BE
DESIGNED AND PROVIDED TO MEET THE
STATUTORY FUNCTIONAL REQUIREMENTS.

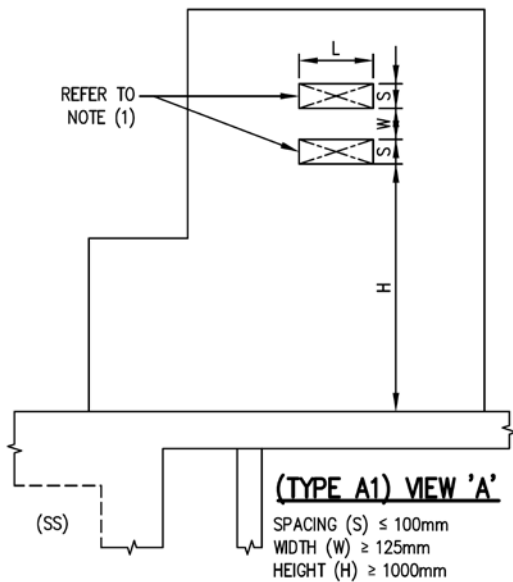
**FIGURE 2.4.5(b) PROTECTION REQUIREMENT AT ROOF LEVEL FOR PROVISION
OF RC REFUSE CHUTE LOCATED WITHIN SETBACK DISTANCE ENVELOP**



TYPICAL SHELTER PART PLAN OF GAS AND WATER OPENING WITH ELBOW (TYPE A)



TYPICAL SHELTER PART ROOF PLAN OF GAS AND WATER OPENING WITH ELBOW (TYPE A)



NOTE (1): TOTAL AREA OF OPENING FOR GAS VENTING SHALL BE DESIGNED AND PROVIDED TO MEET THE STATUTORY FUNCTIONAL REQUIREMENTS.

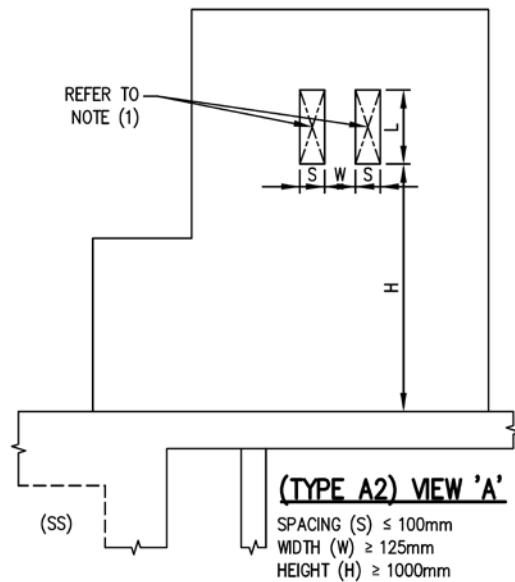
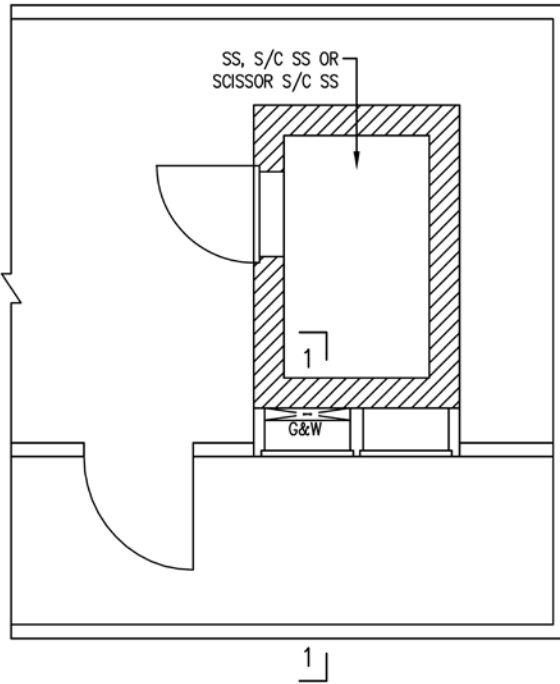
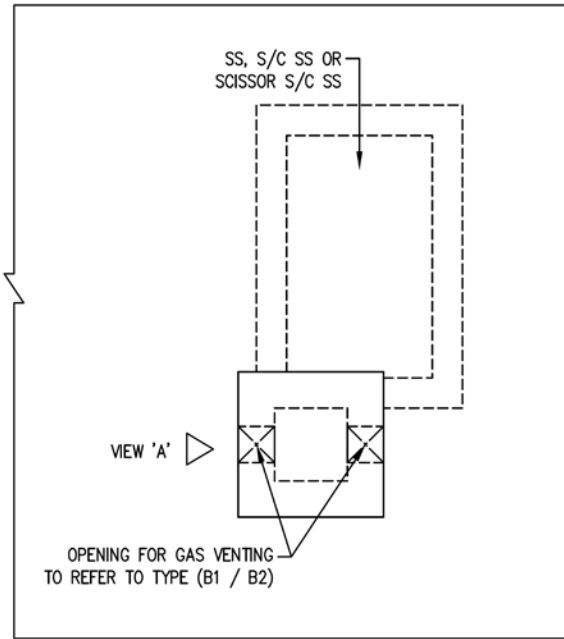


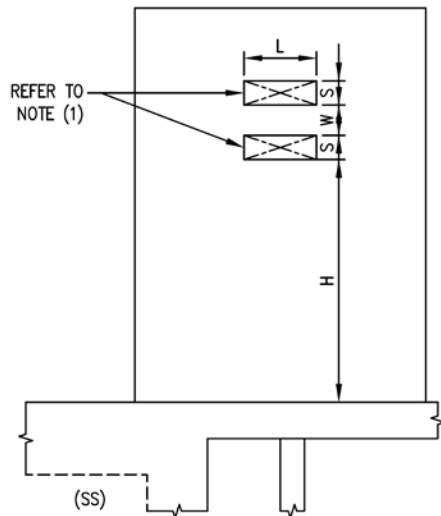
FIGURE 2.4.5(c) PROTECTION REQUIREMENT AT ROOF LEVEL FOR PROVISION OF WATER & GAS RISER LOCATED WITHIN SETBACK DISTANCE ENVELOP



TYPICAL SHELTER PART PLAN OF GAS AND WATER OPENING WITHOUT ELBOW (TYPE B)



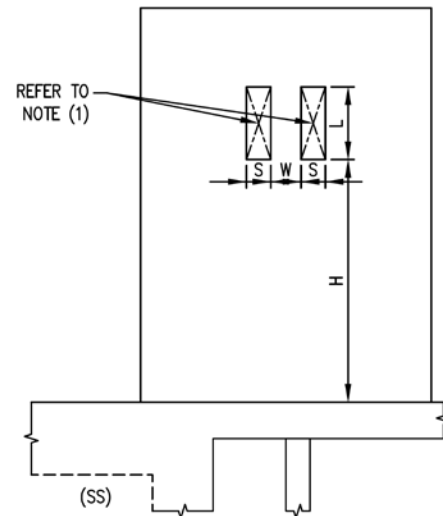
TYPICAL SHELTER PART ROOF PLAN OF GAS AND WATER OPENING WITHOUT ELBOW (TYPE B)



(TYPE B1) VIEW 'A'

SPACING (S) \leq 100mm
WIDTH (W) \geq 125mm
HEIGHT (H) \geq 1000mm

NOTE (1): TOTAL AREA OF OPENING FOR GAS VENTING SHALL BE DESIGNED AND PROVIDED TO MEET THE STATUTORY FUNCTIONAL REQUIREMENTS.



(TYPE B2) VIEW 'A'

SPACING (S) \leq 100mm
WIDTH (W) \geq 125mm
HEIGHT (H) \geq 1000mm

FIGURE 2.4.5(d) PROTECTION REQUIREMENT AT ROOF LEVEL FOR PROVISION OF WATER & GAS RISER LOCATED WITHIN SETBACK DISTANCE ENVELOP

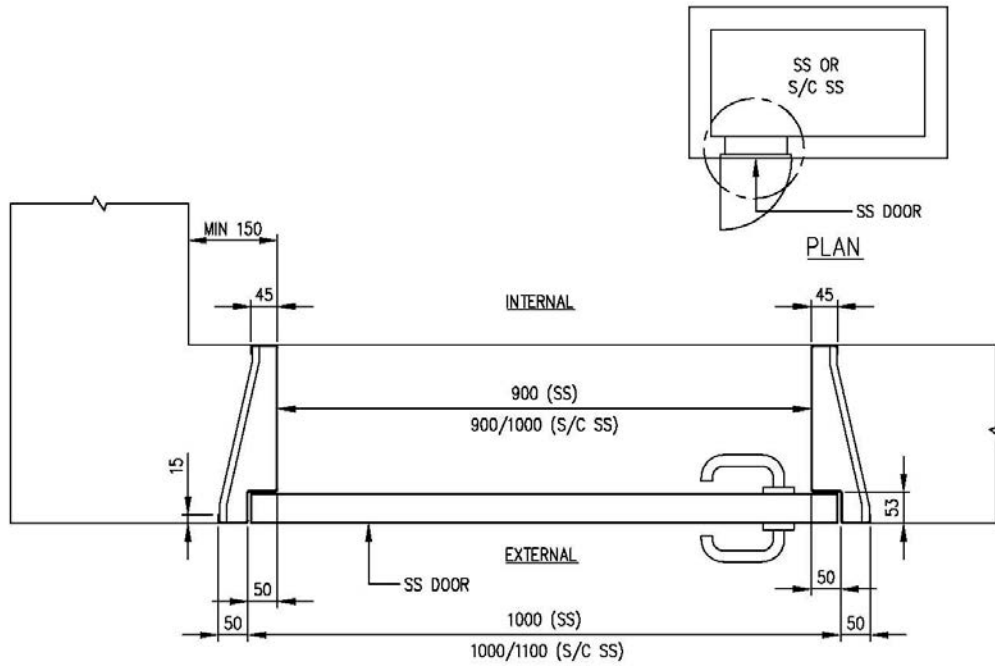


FIGURE 2.5.1(a) SS DOOR FRAME WITH SINGLE DOOR REBATE

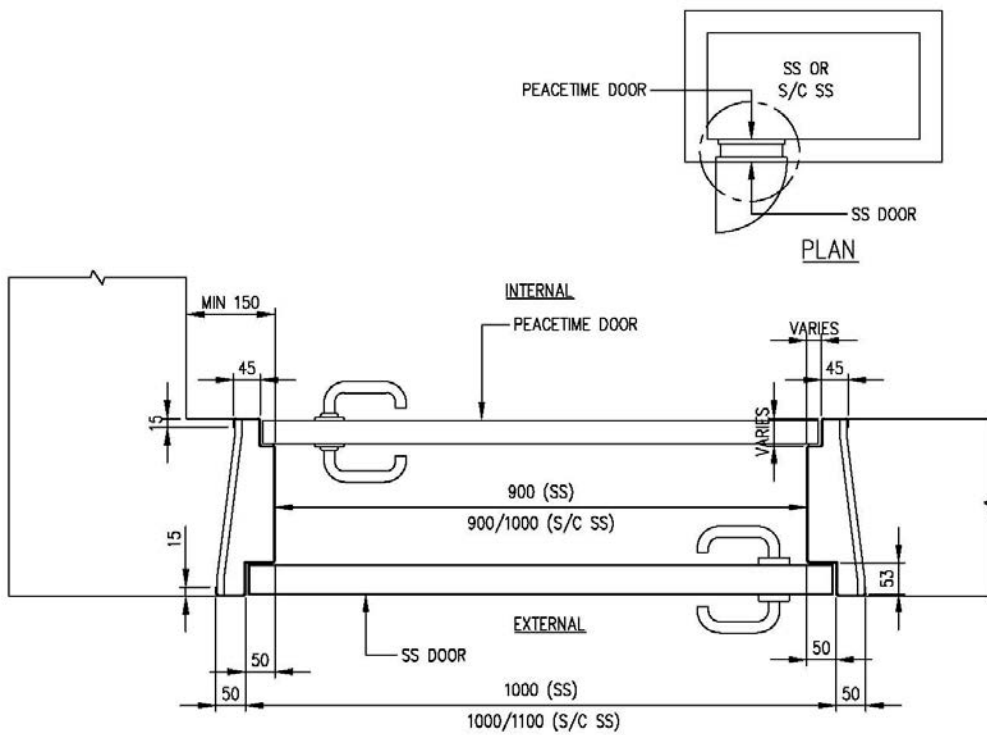


FIGURE 2.5.1(b) SS DOOR FRAME WITH DOUBLE DOOR REBATES

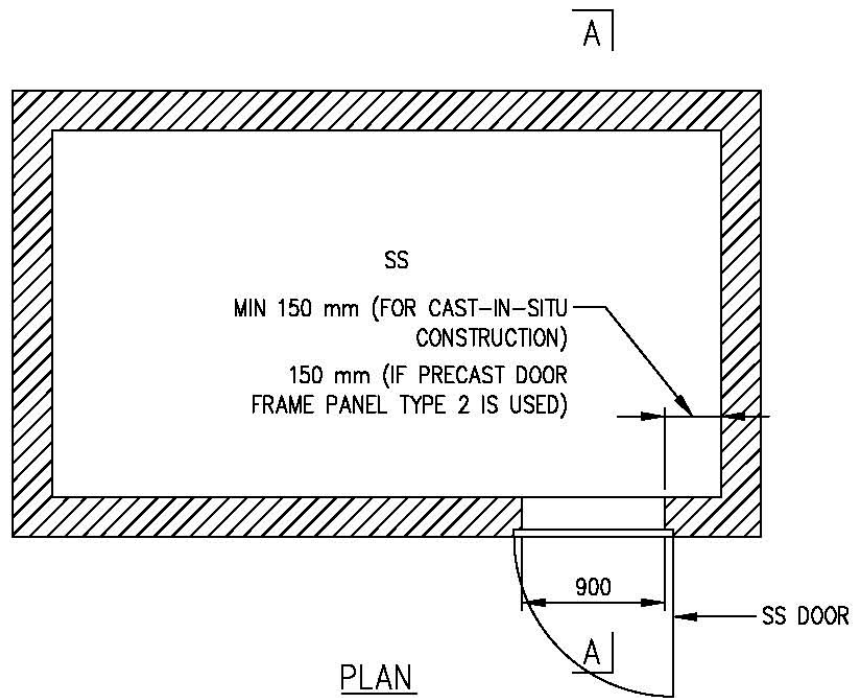


FIGURE 2.5.3(a) CONCRETE WALL SEGMENT AT SS DOOR

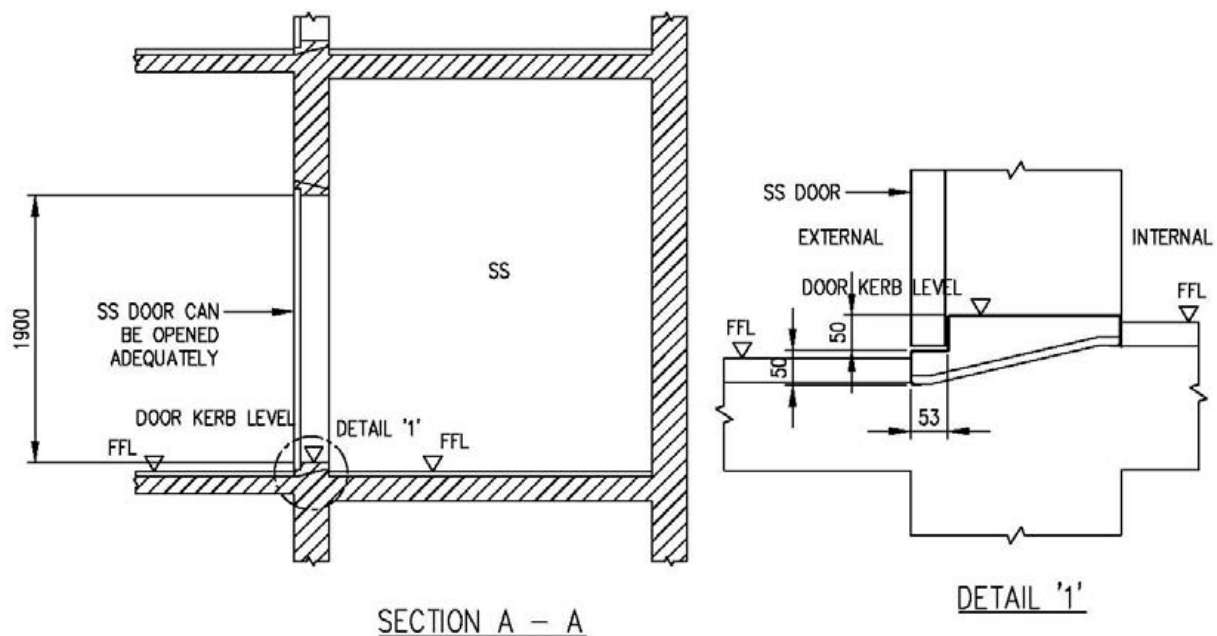


FIGURE 2.5.3(b) SS DOOR KERB

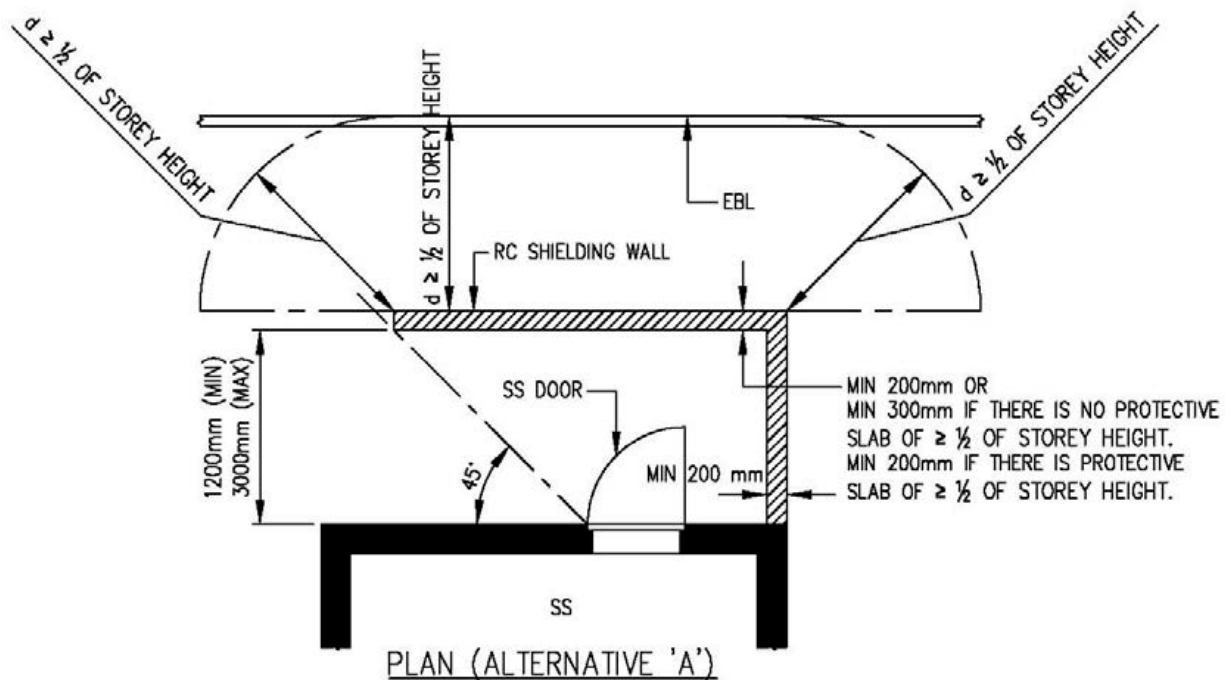


FIGURE 2.5.4(a) SHIELDING FOR SS DOOR

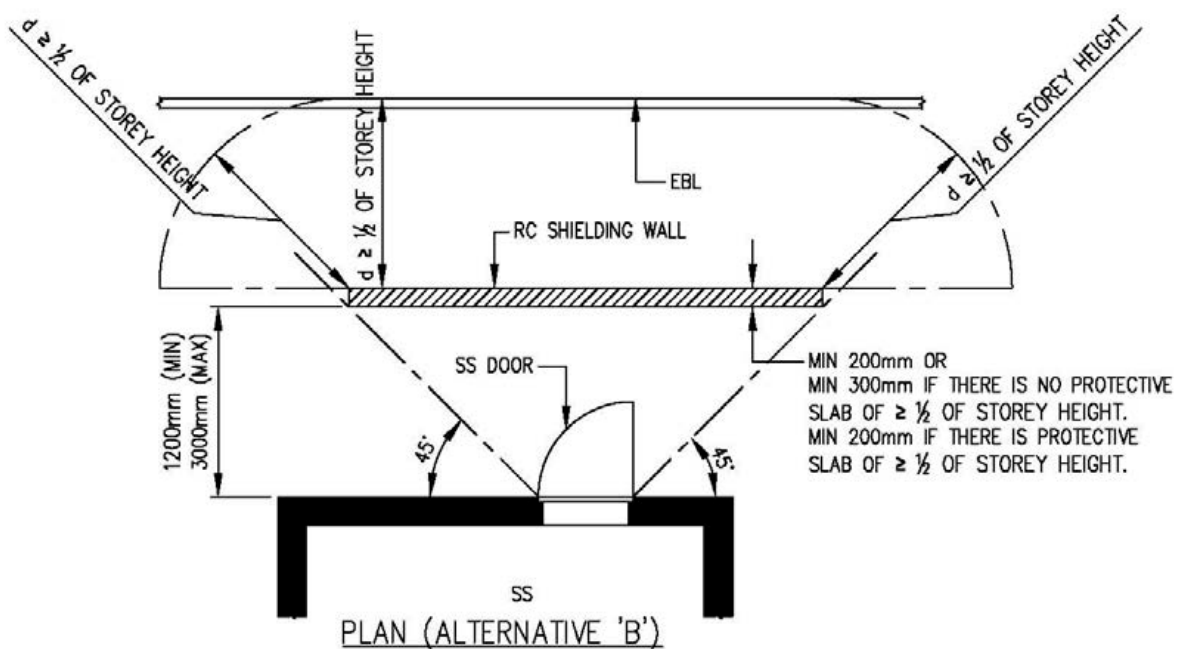


FIGURE 2.5.4(b) SHIELDING FOR SS DOOR

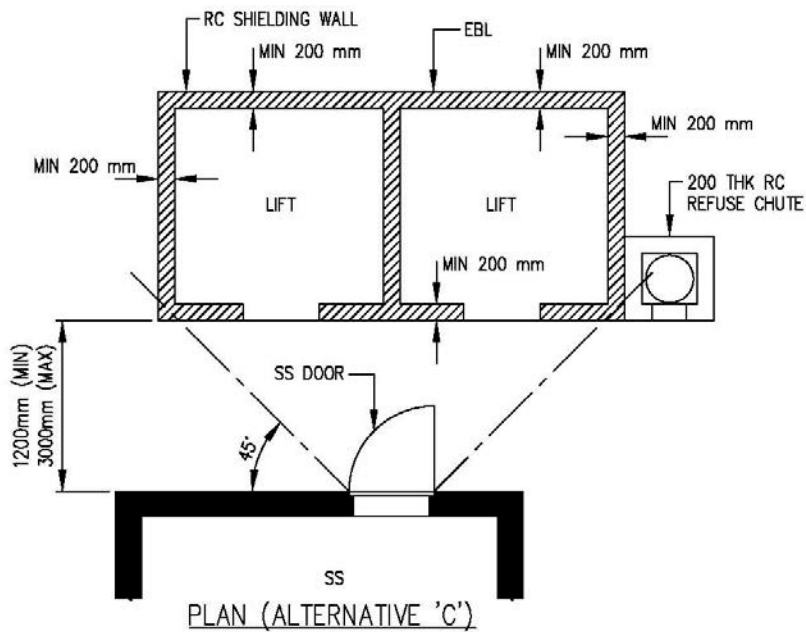


FIGURE 2.5.4(c) SHIELDING FOR SS DOOR

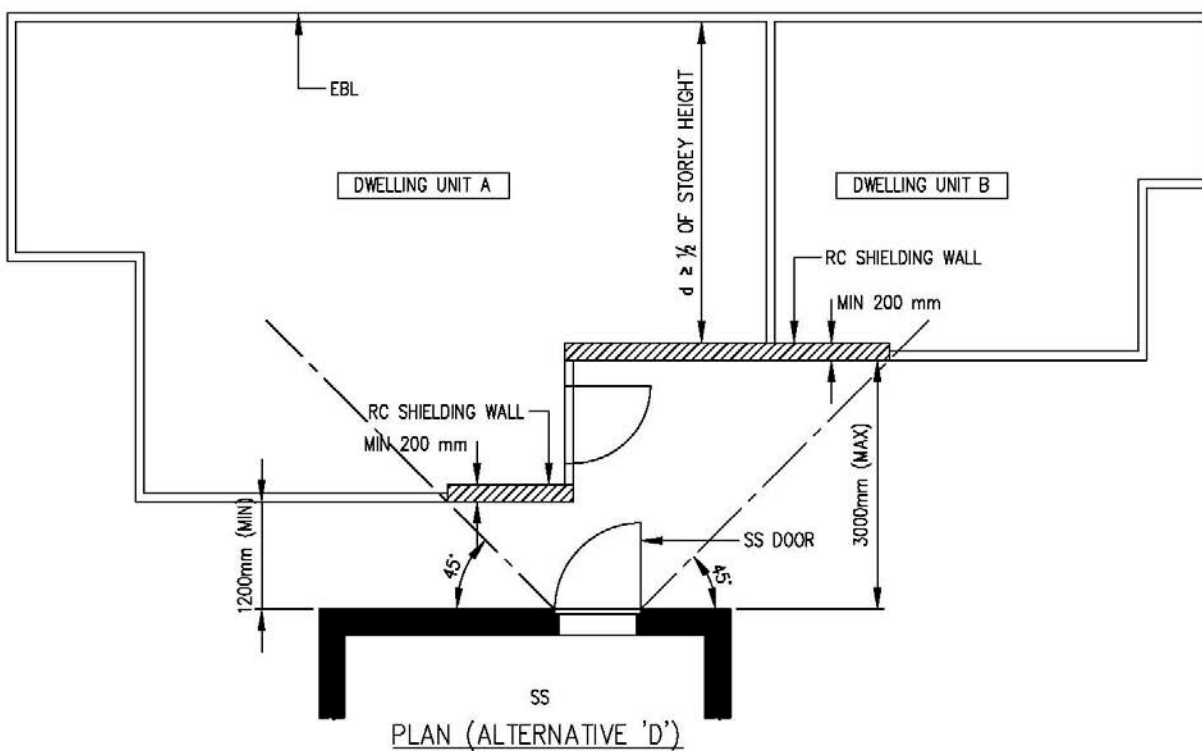


FIGURE 2.5.4(d) SHIELDING FOR SS DOOR

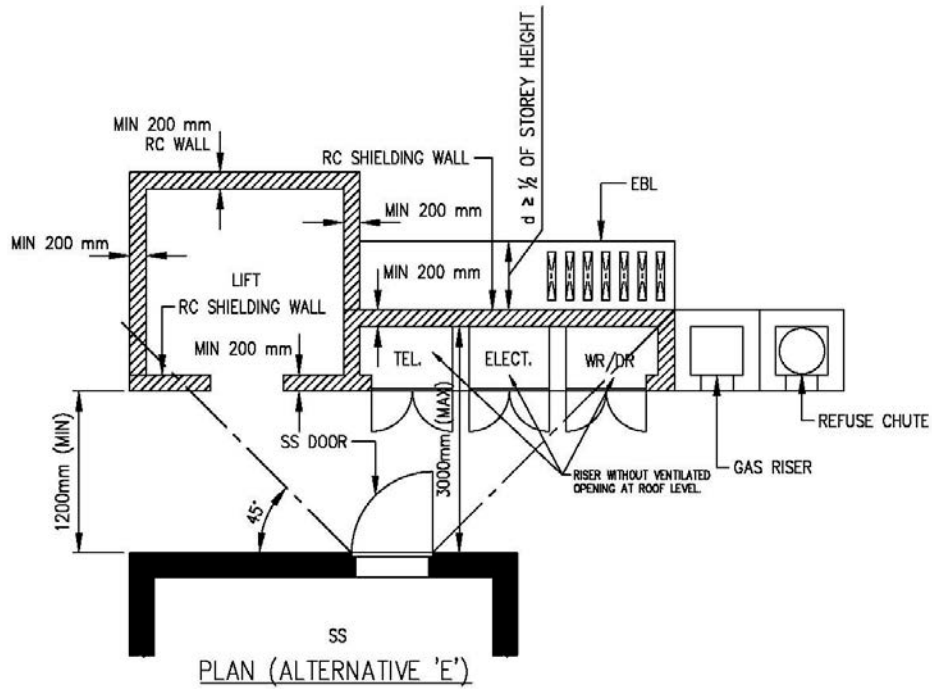


FIGURE 2.5.4(e) SHIELDING FOR SS DOOR

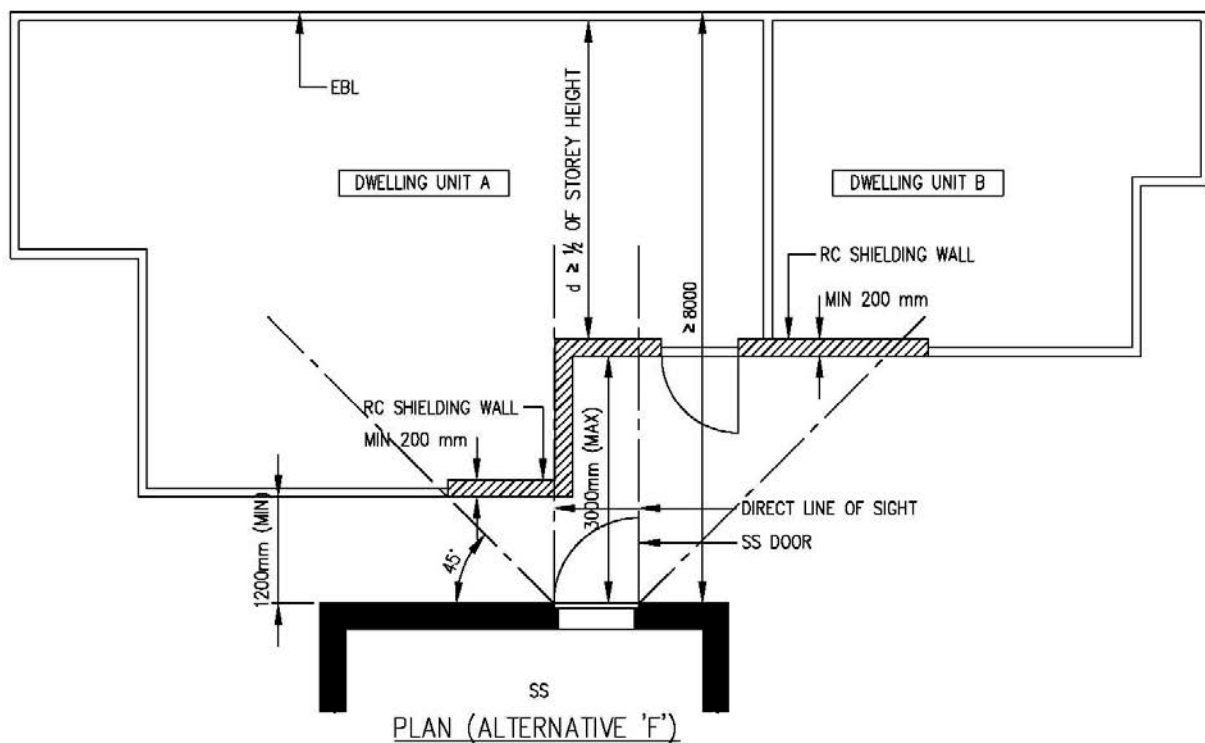


FIGURE 2.5.4(f) SHIELDING FOR SS DOOR

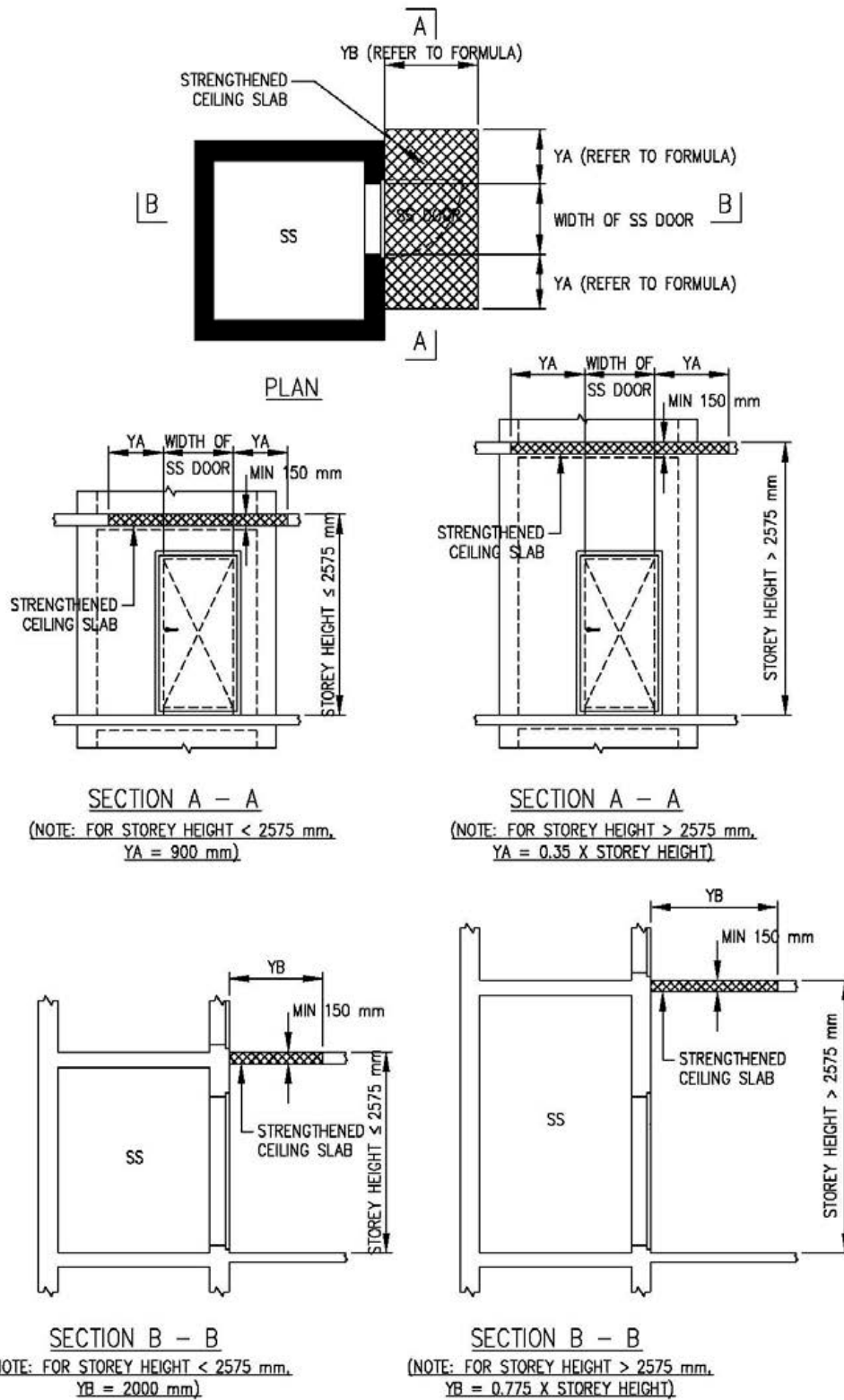


FIGURE 2.5.5 REQUIREMENTS FOR STRENGTHENING CEILING SLAB IN FRONT OF SS DOOR

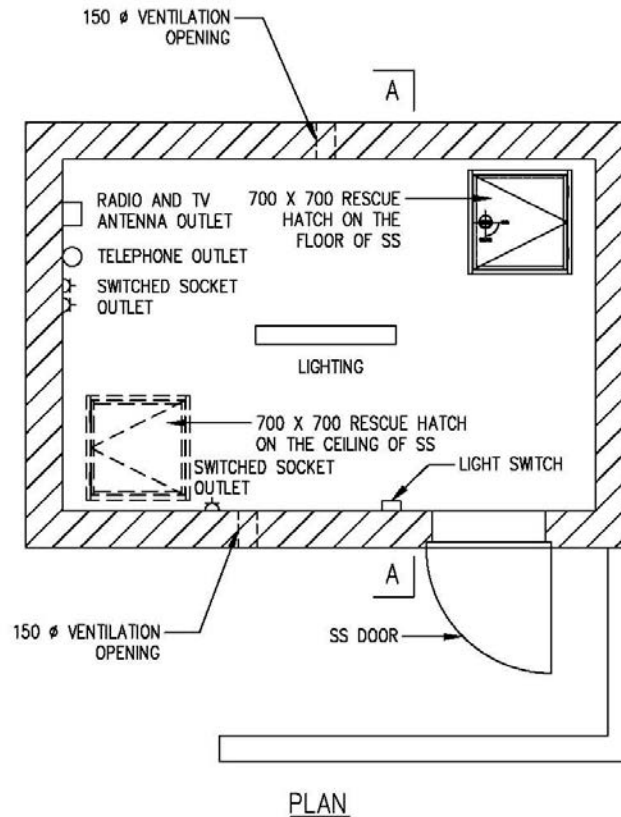


FIGURE 2.6.1 SPECIFIC SS FIXTURE AND OPENINGS

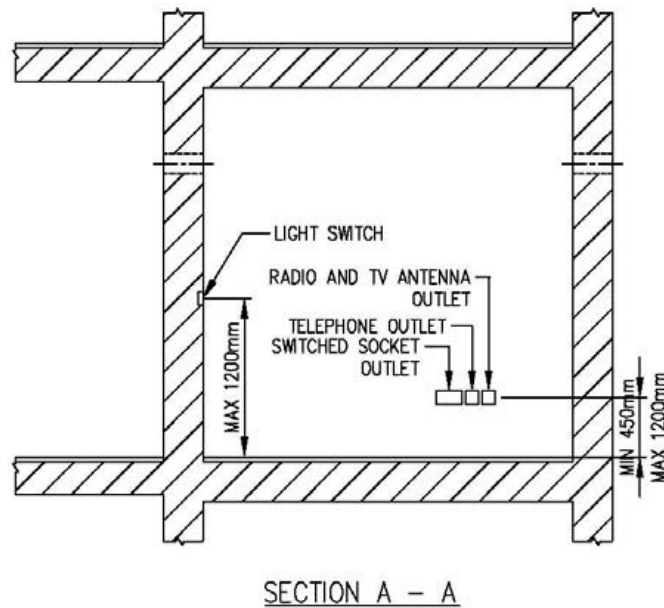


FIGURE 2.6.1(c) FIXTURE IN SS

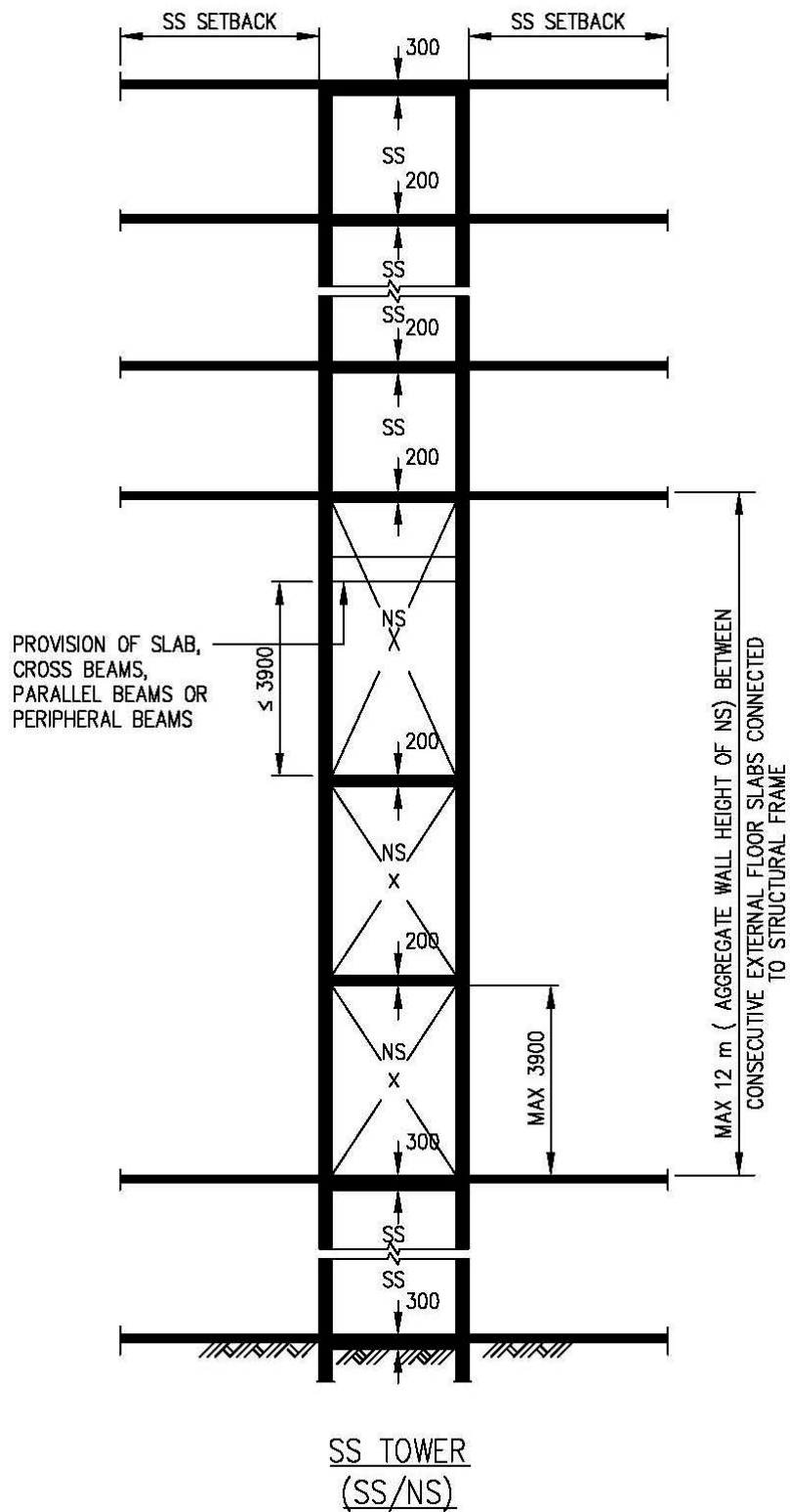


FIGURE 2.7.1 NS IN SS TOWER

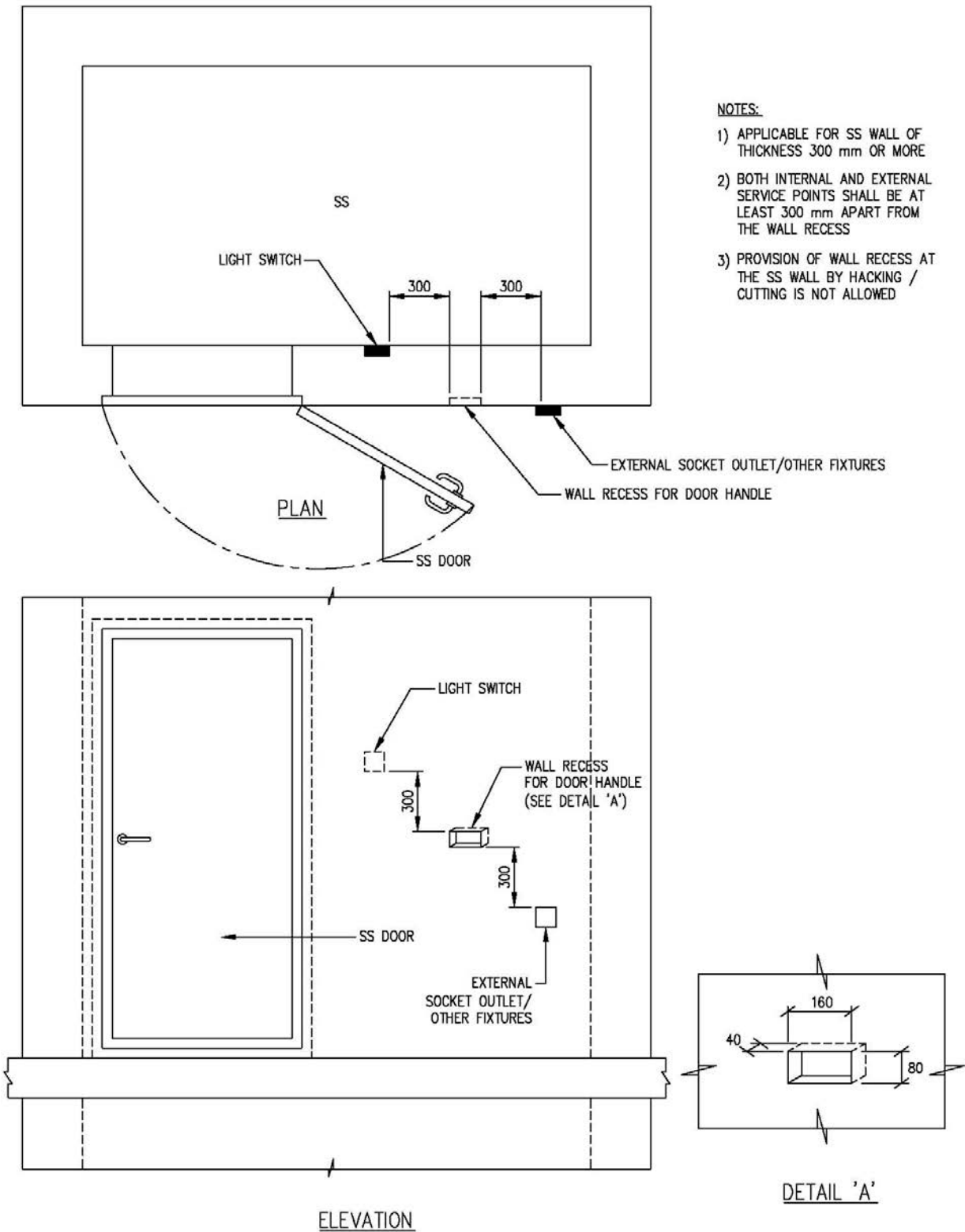


FIGURE 2.10 DETAILS OF WALL RECESS FOR SS DOOR HANDLE

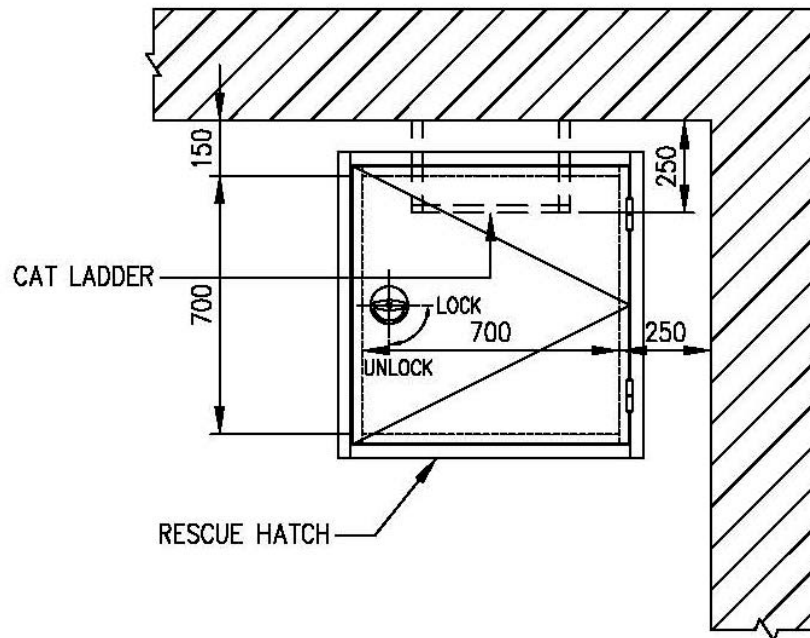


FIGURE 2.11.1(a) MINIMUM DISTANCE OF RESCUE HATCH FROM SS WALL

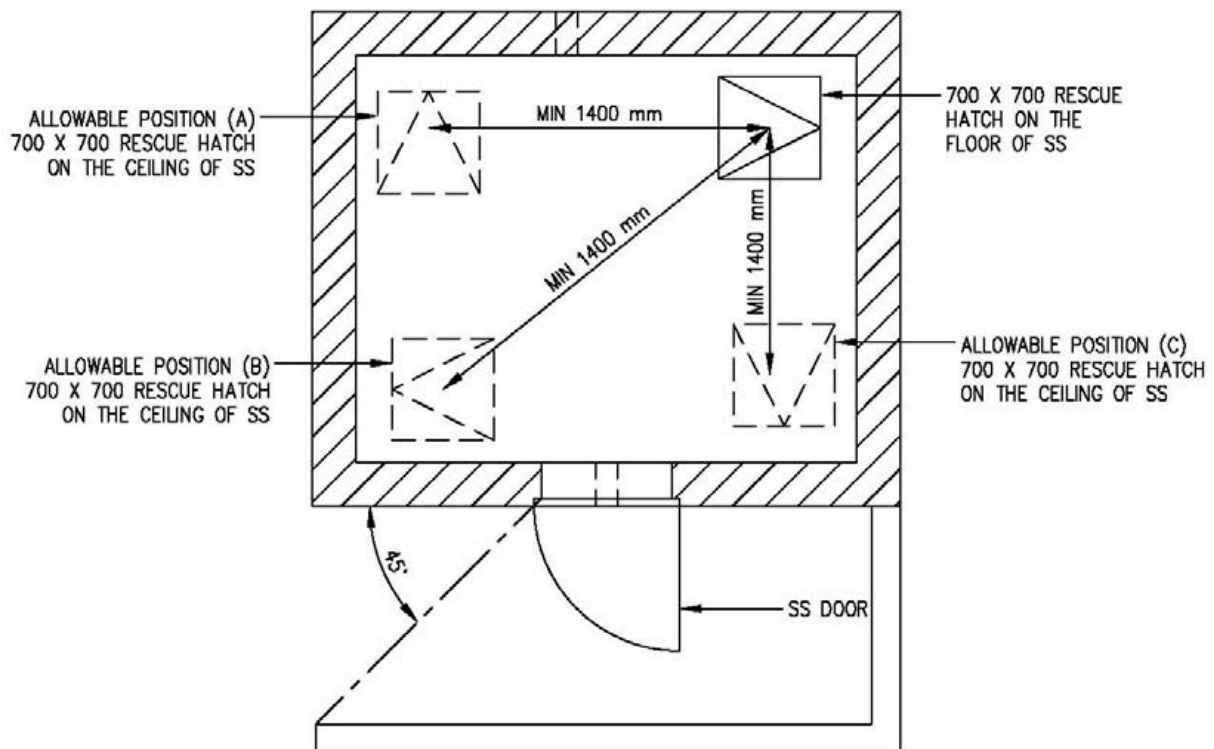
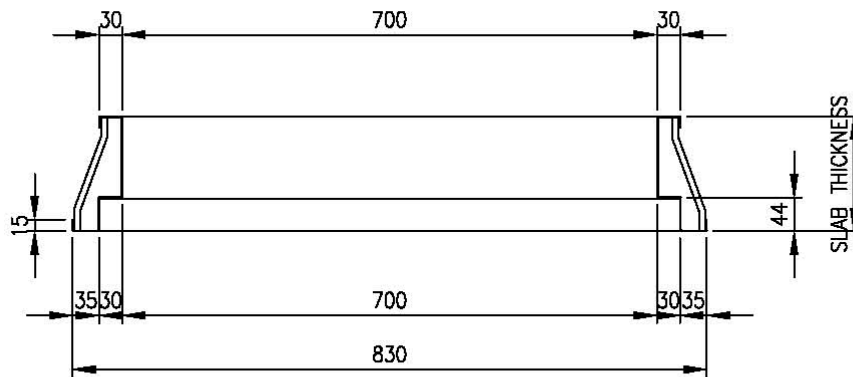
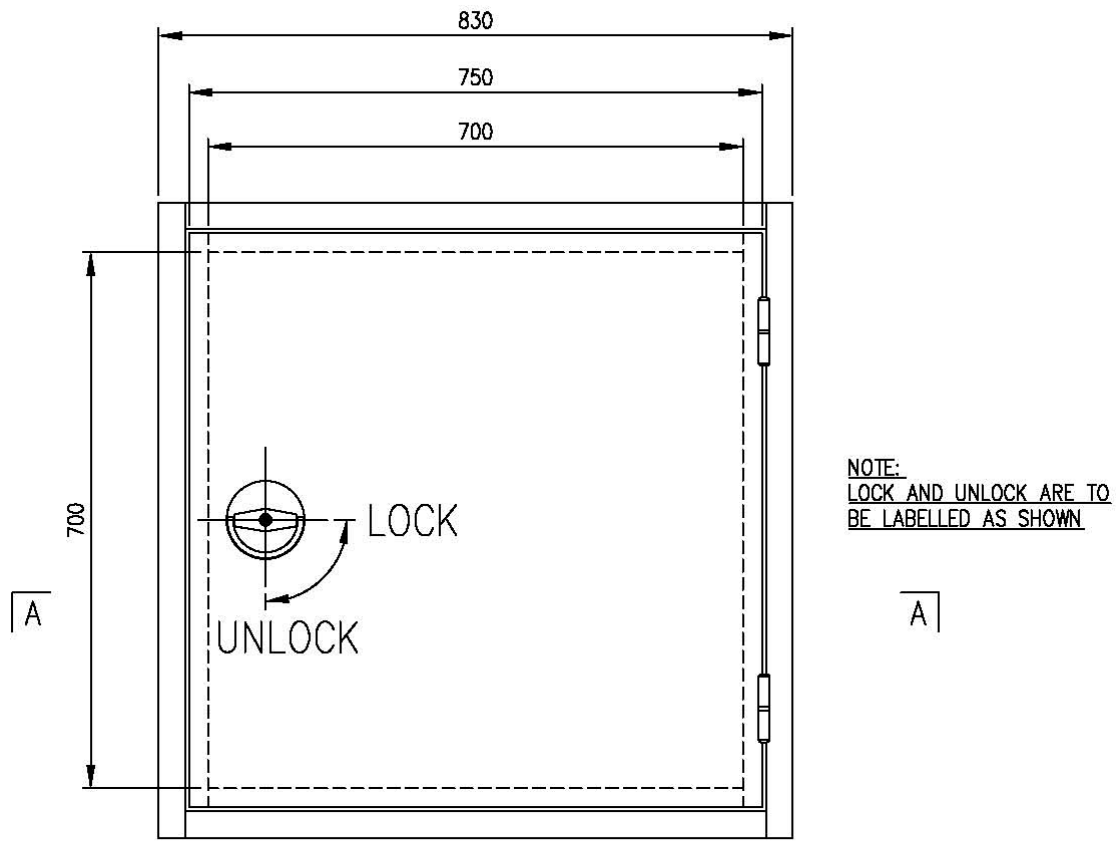


FIGURE 2.11.1(b) MINIMUM DISTANCE BETWEEN CENTRE LINES OF RESCUE HATCH



SECTION A – A

2.11.1(c) MINIMUM DIMENSIONS OF RESCUE HATCH

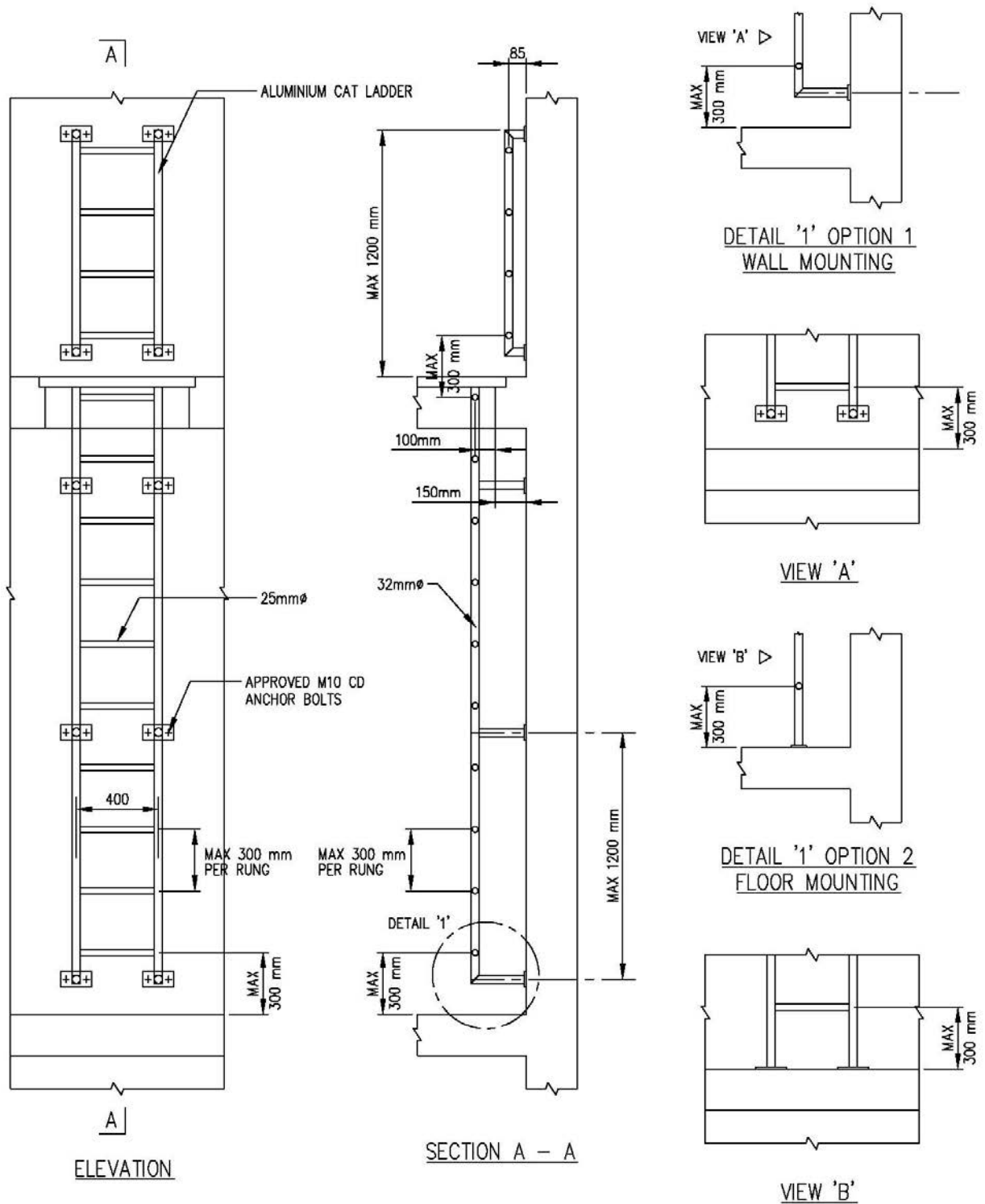


FIGURE 2.11.2 DETAILS OF CAT LADDER TO SS WALL

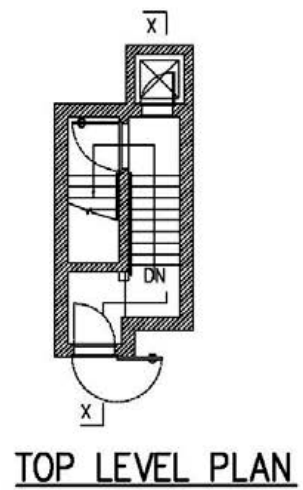
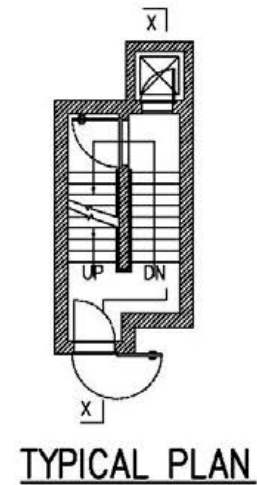
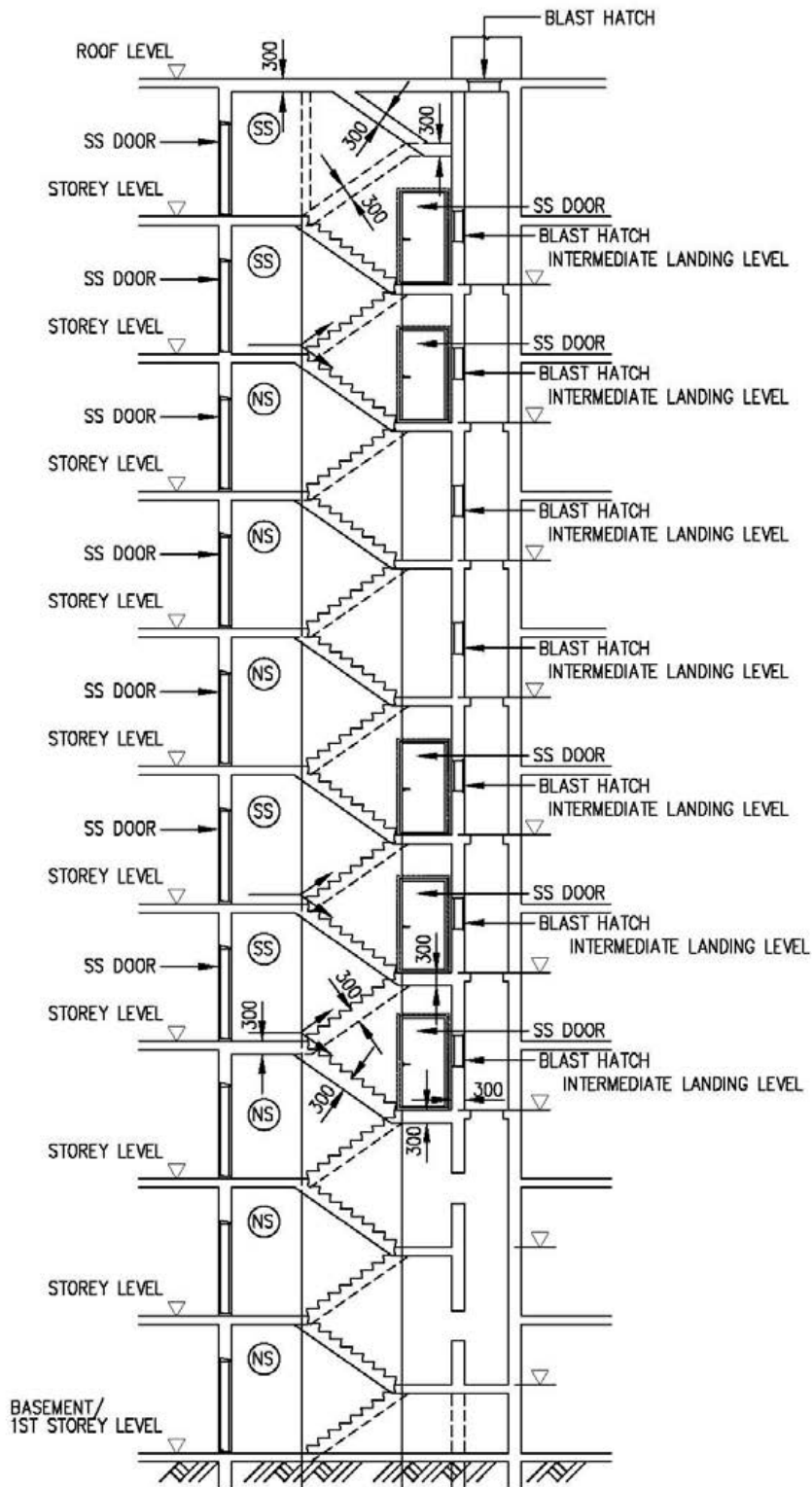
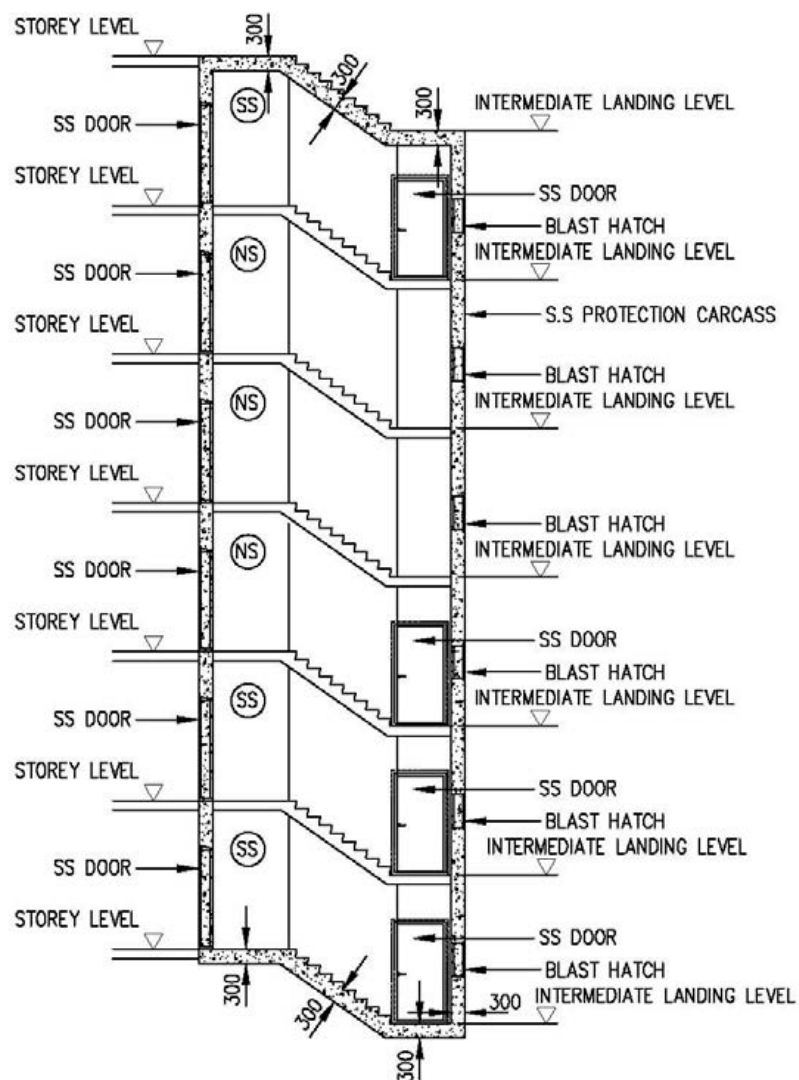
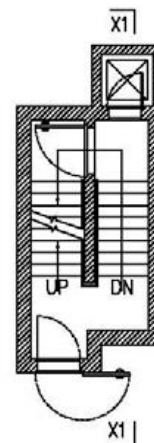


FIGURE 2.12.1(a) SECTION X-X OF S/C SS WITH SS/NS

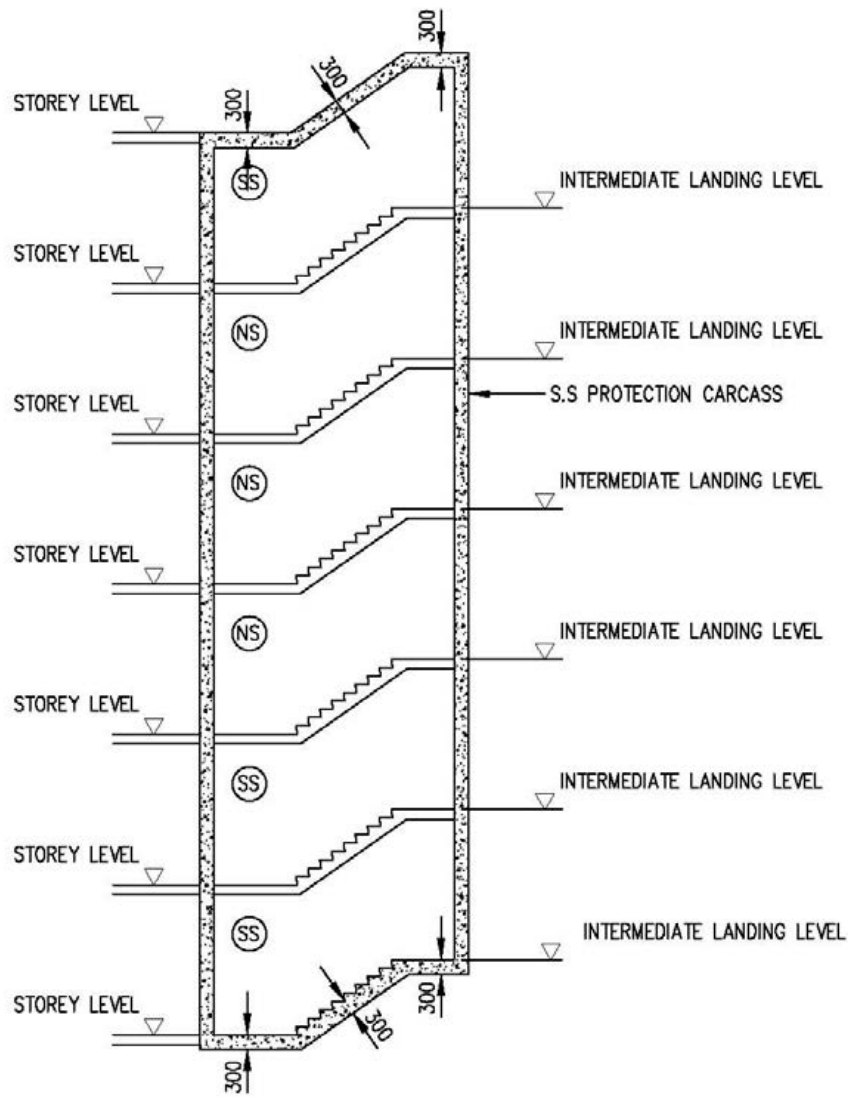


SECTION X1-X1



TYPICAL PLAN

FIGURE 2.12.1(b) PROTECTION CARCASS OF S/C SS TOWER



SECTION X2-X2

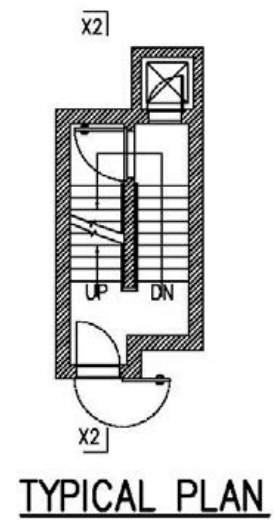


FIGURE 2.12.1(c) PROTECTION CARCASS OF S/C SS TOWER

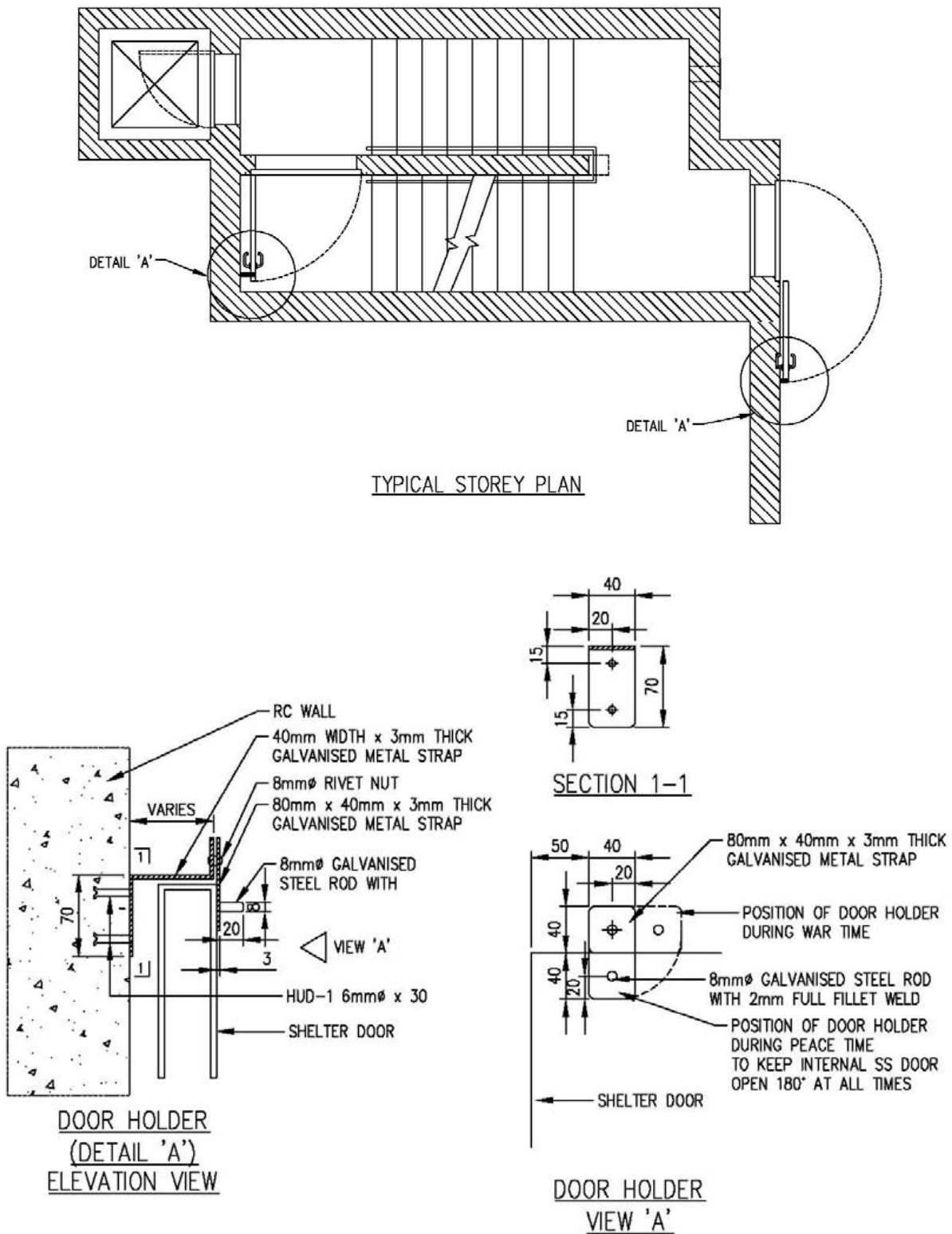


FIGURE 2.12.1(d) DETAILS OF SS DOOR HOLDER

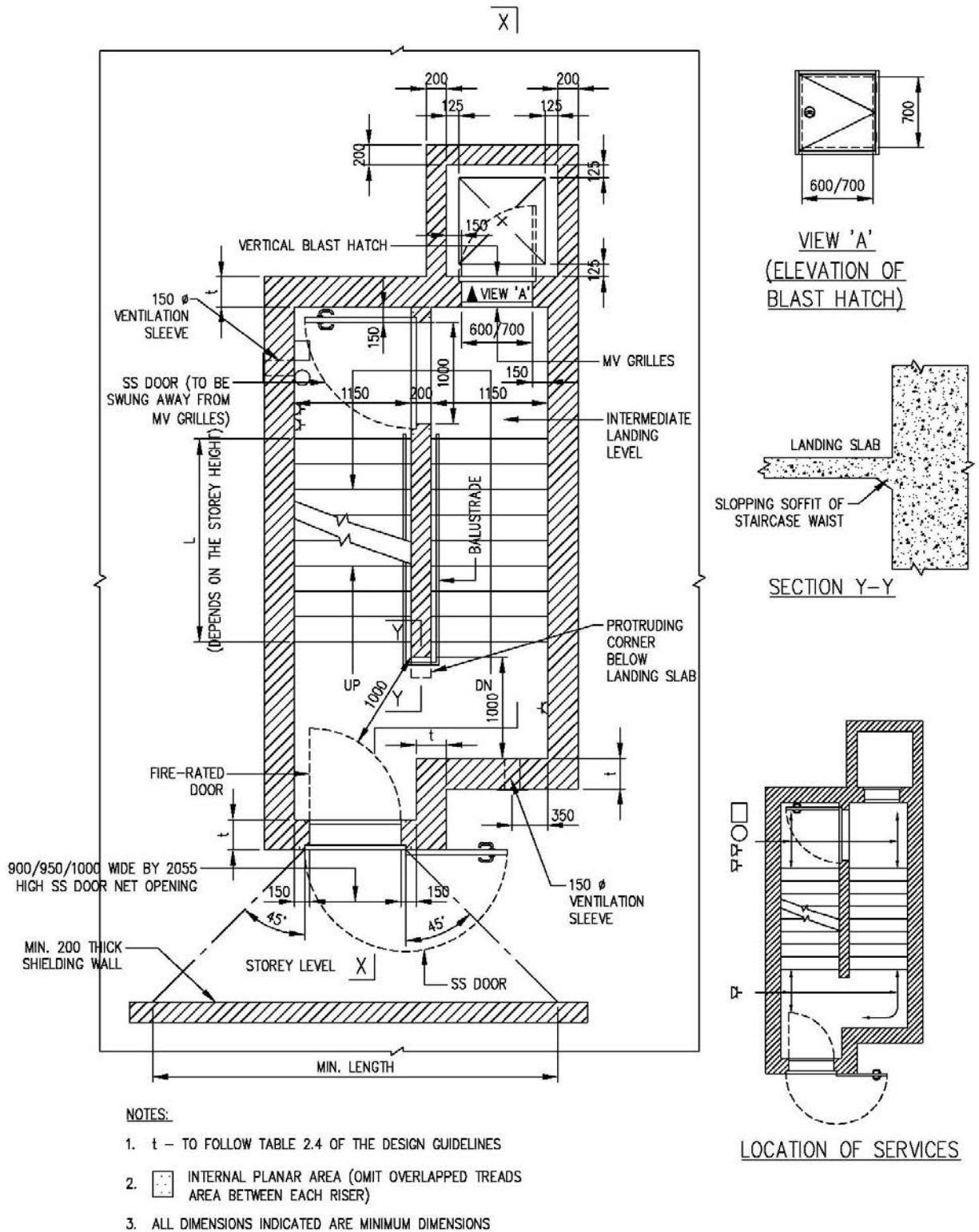


FIGURE 2.12.2(a) TYPICAL PLAN OF S/C SS

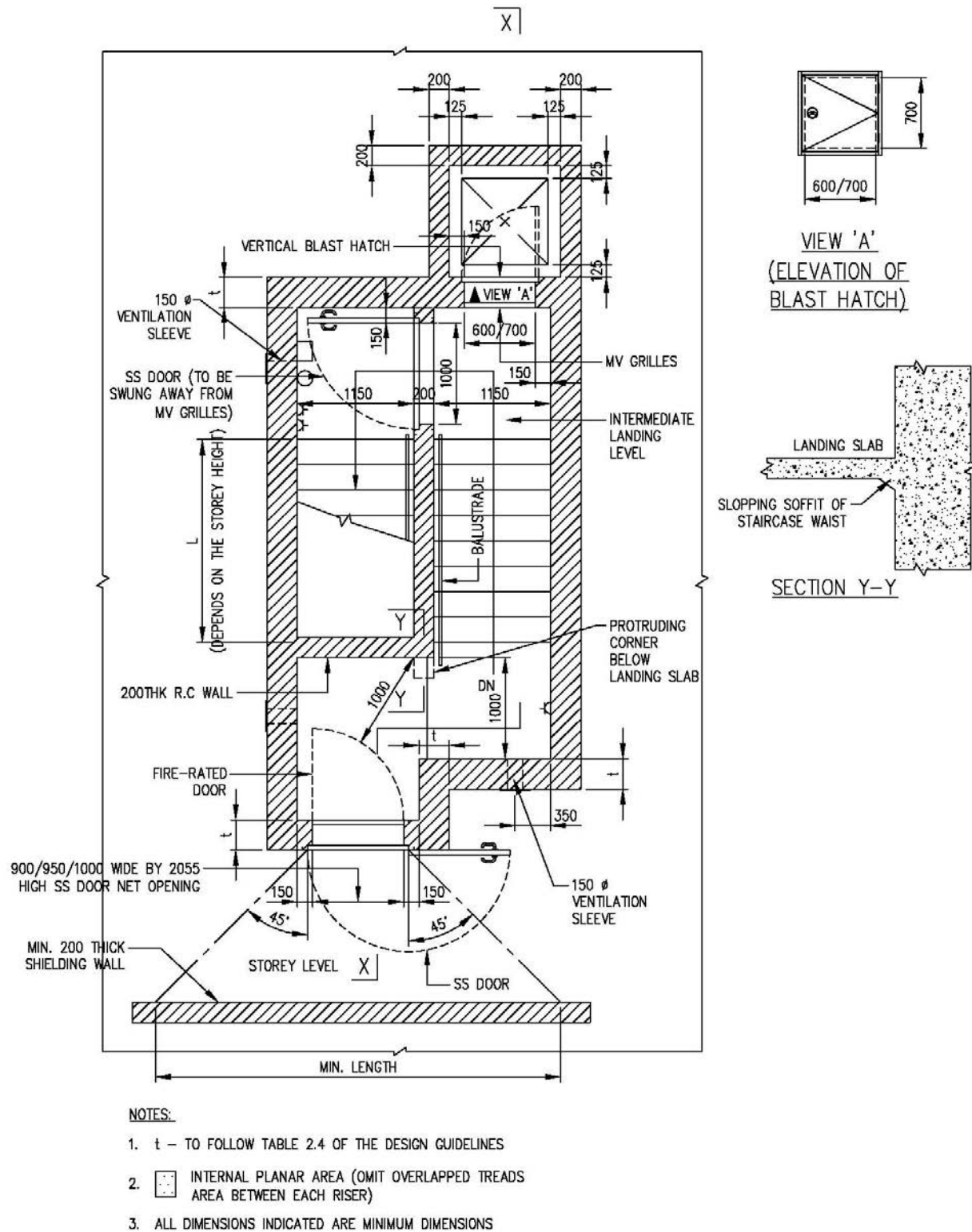


FIGURE 2.12.2(b) LOWER ROOF PLAN OF S/C SS

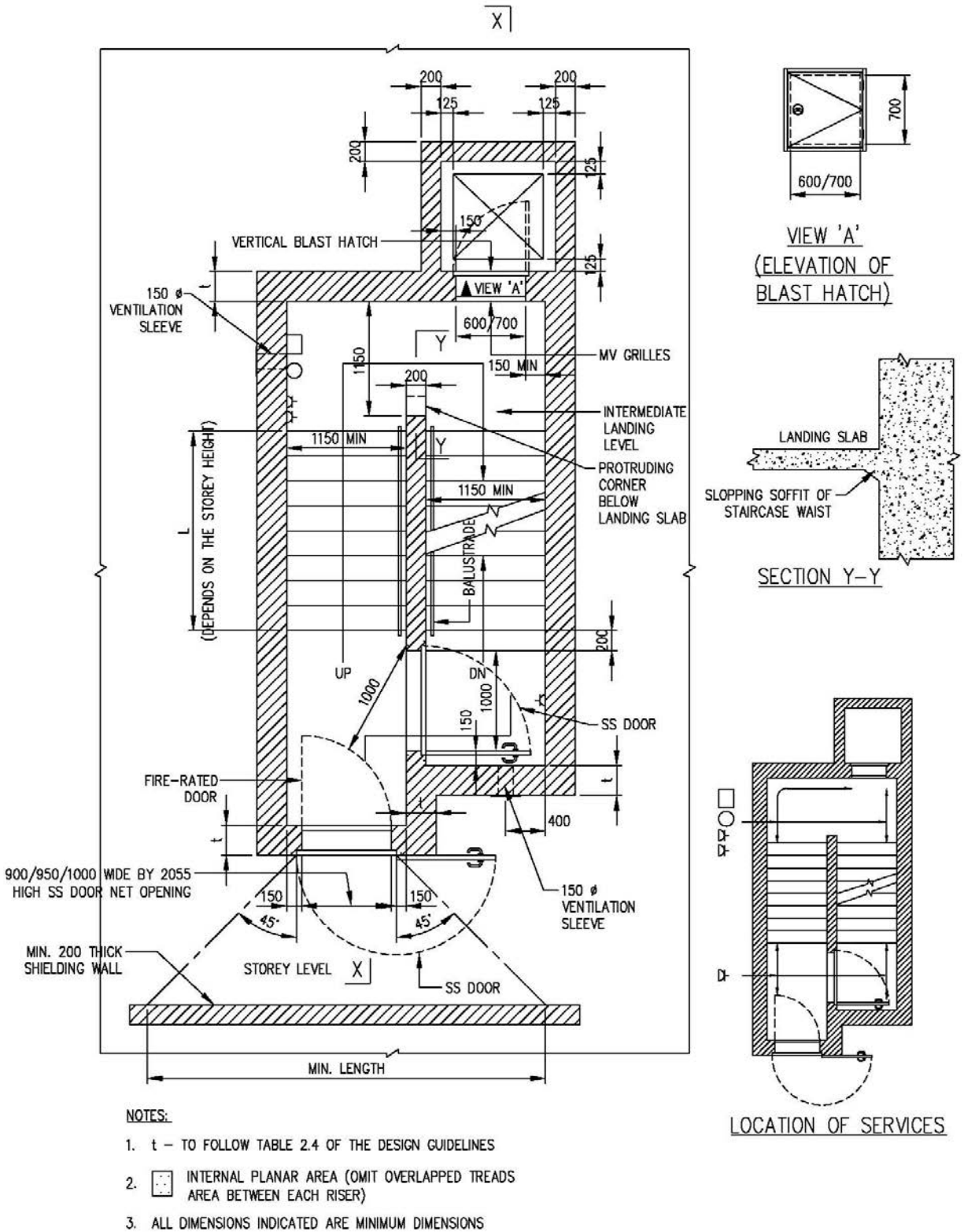
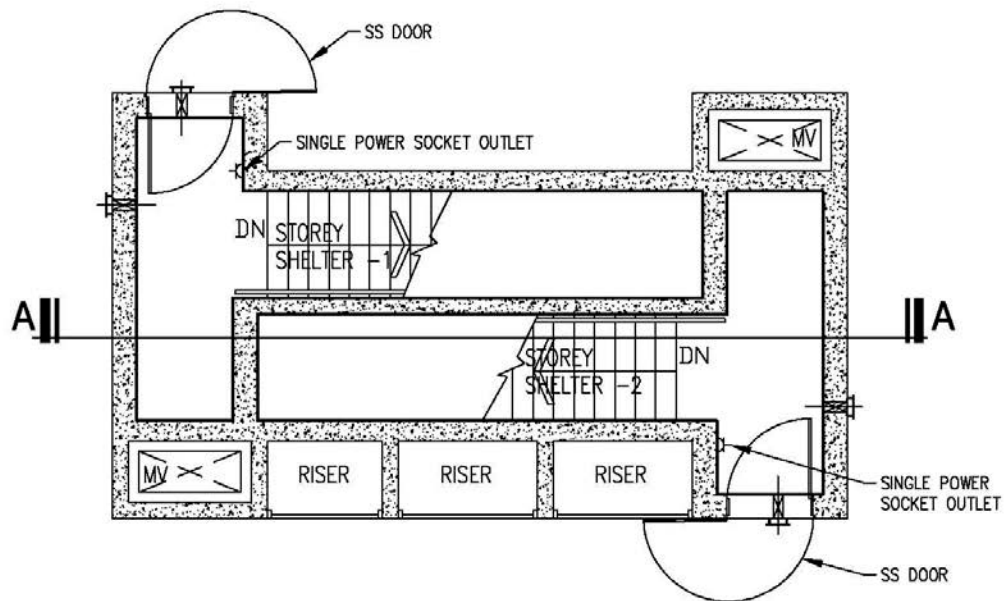
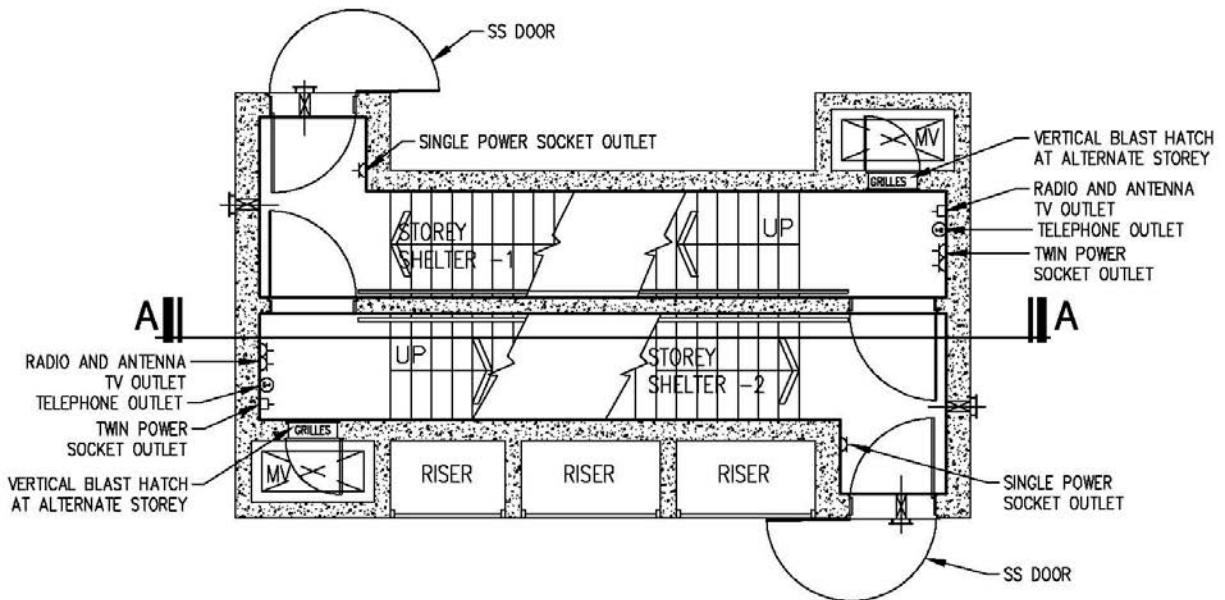


FIGURE 2.12.2(d) TYPICAL PLAN OF S/C SS



TOP MOST COMPARTMENT PLAN FOR
SCISSOR STAIRCASE STOREY SHELTER



TYPICAL STOREY COMPARTMENT PLAN FOR
SCISSOR STAIRCASE STOREY SHELTER

FIGURE 2.12.2(f) SCISSOR S/C SS COMPARTMENT



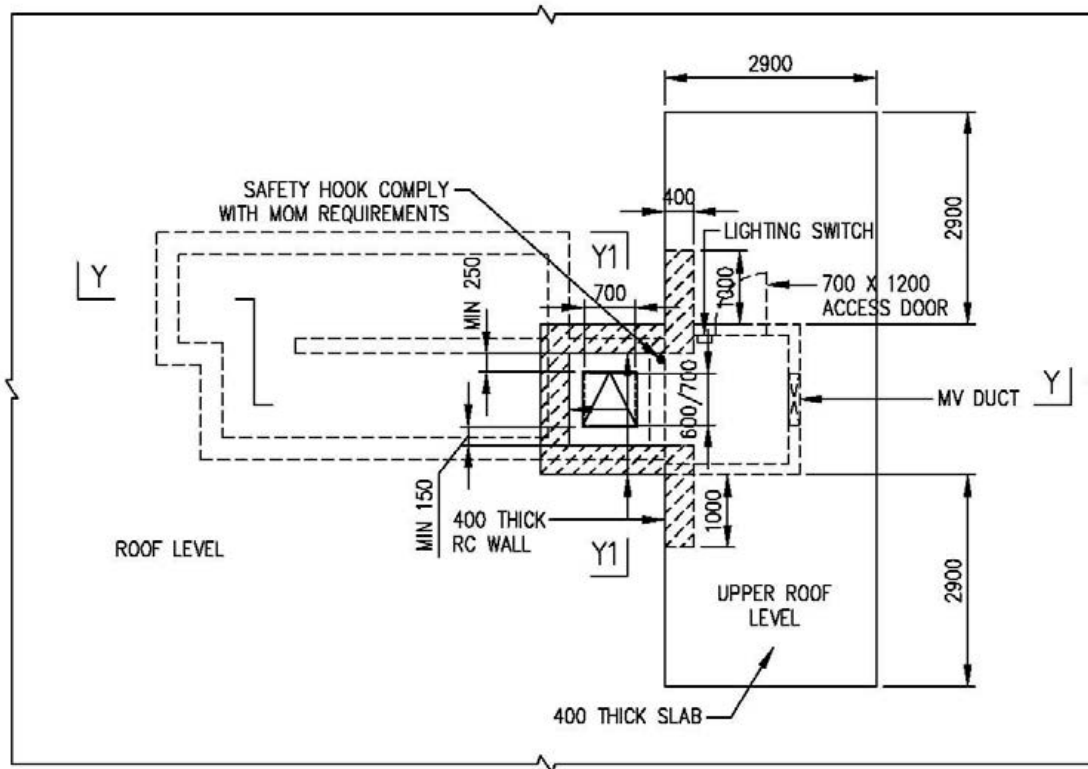


FIGURE 2.12.7(a) PLAN OF S/C SS AT UPPER ROOF LEVEL

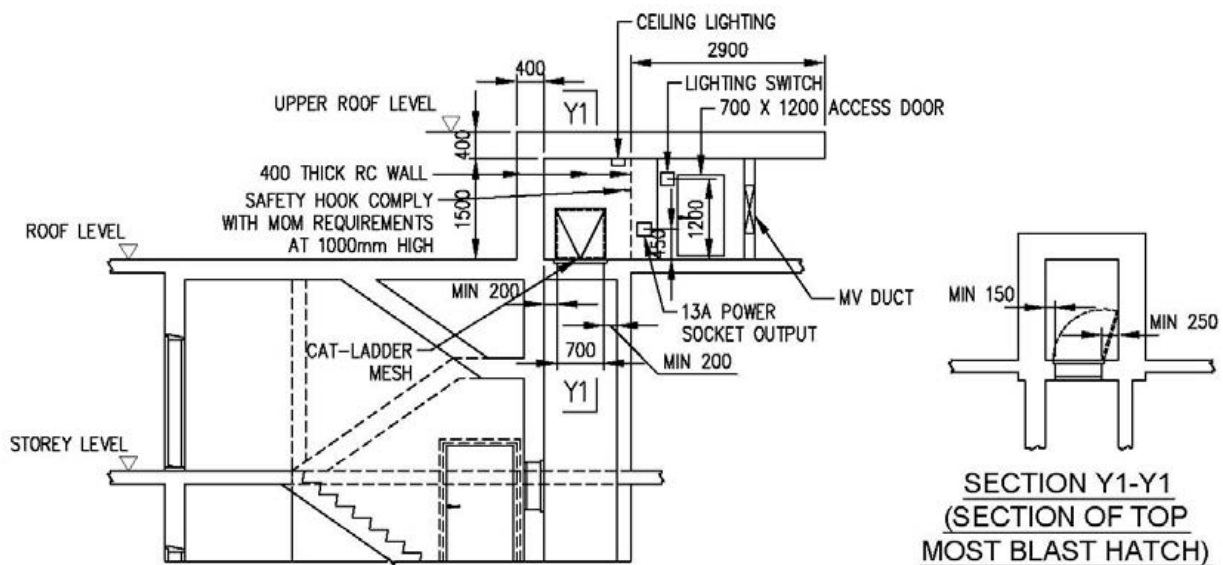


FIGURE 2.12.7(b) SECTION Y-Y OF S/C SS

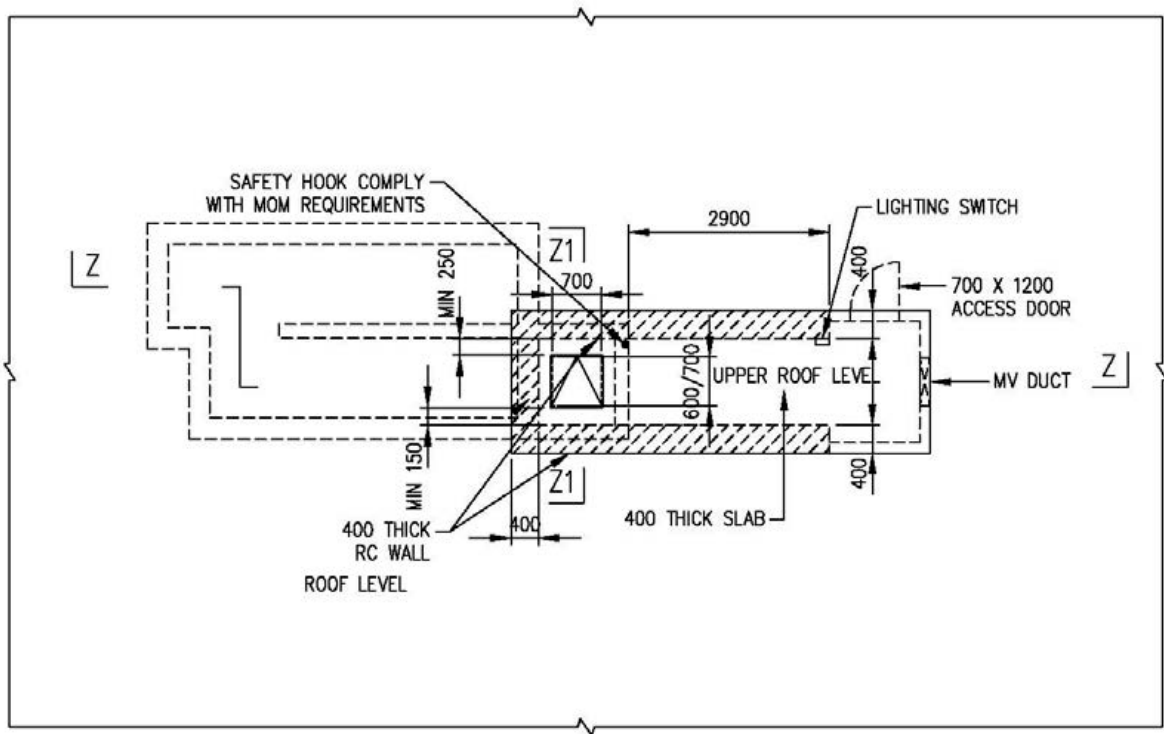


FIGURE 2.12.7(c) PLAN OF S/C SS AT UPPER ROOF LEVEL

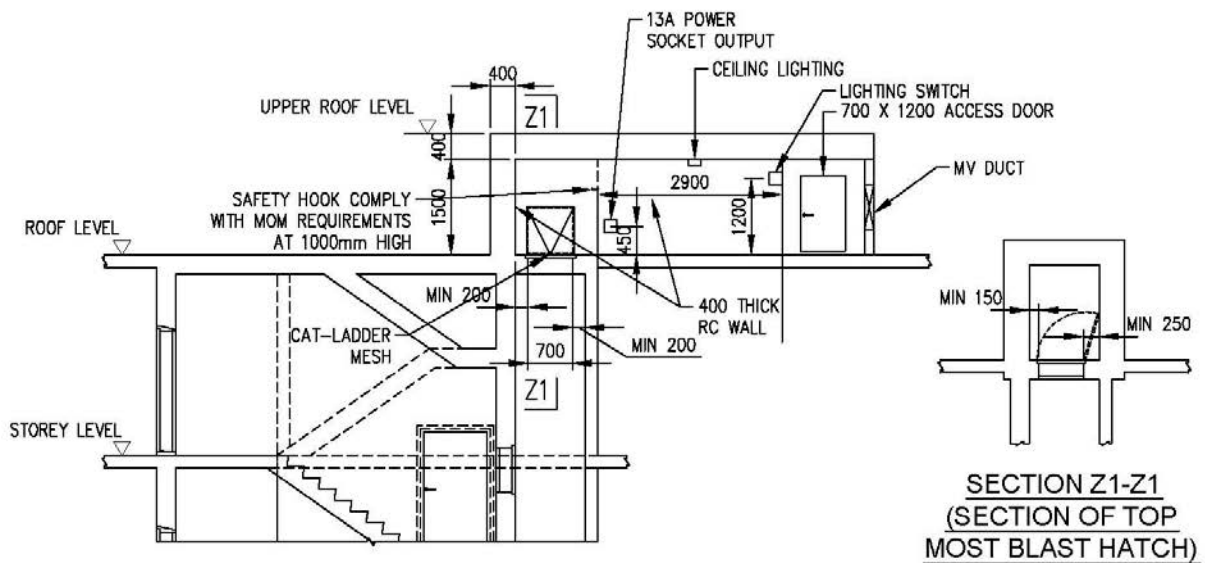
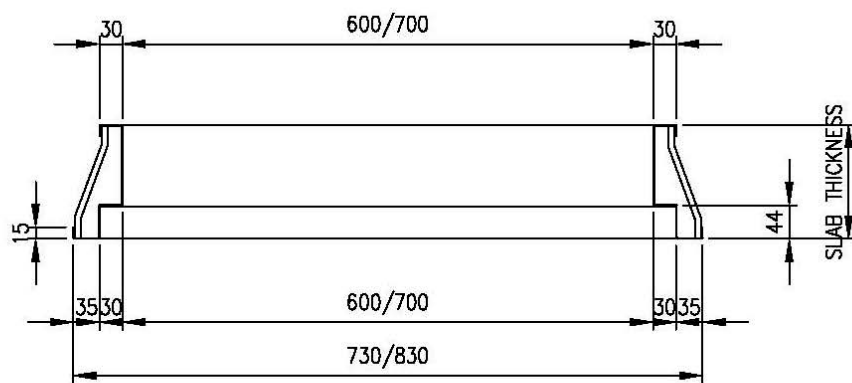
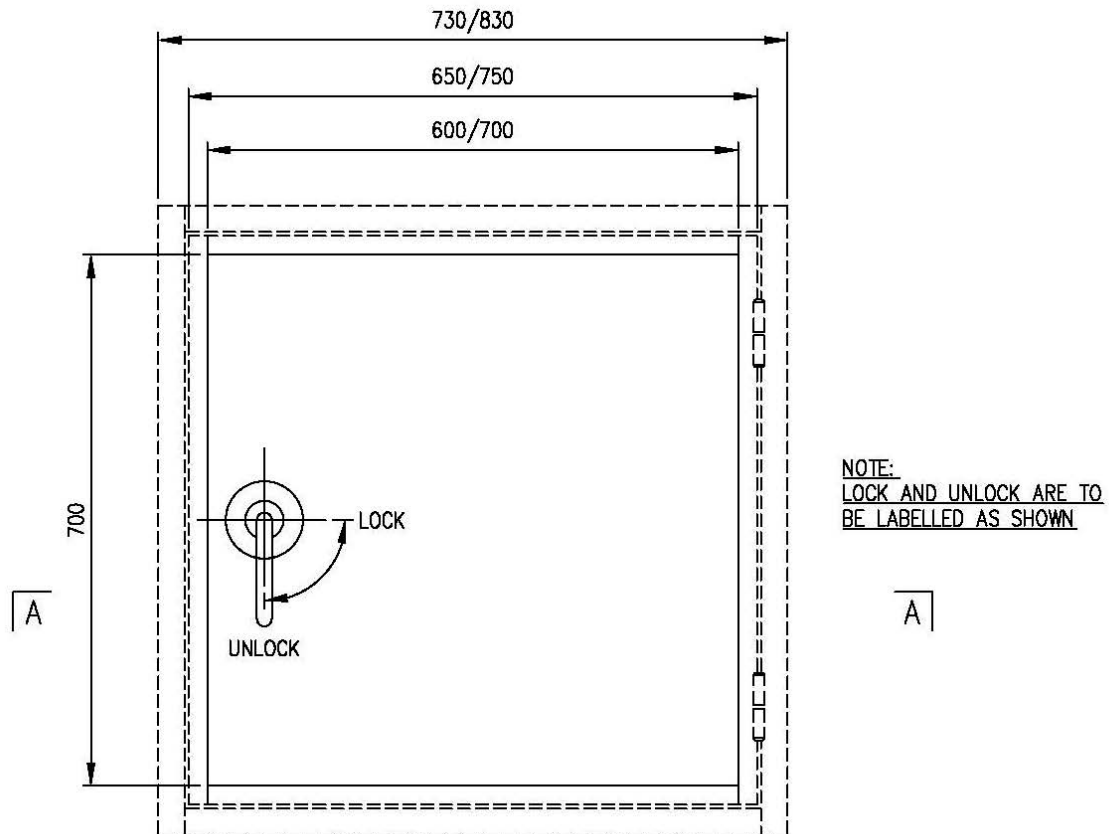
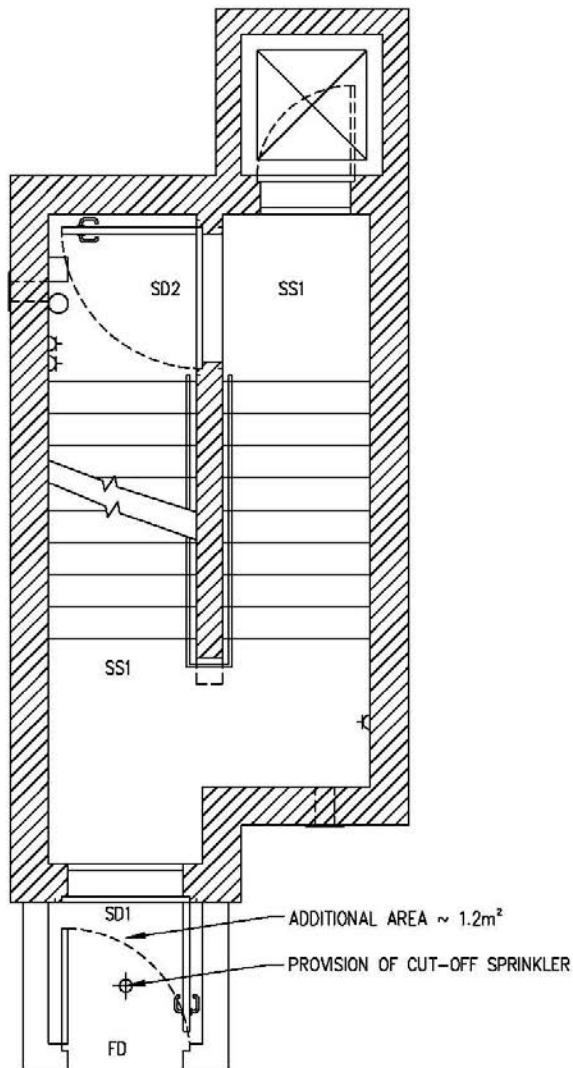


FIGURE 2.12.7(d) SECTION Z-Z OF S/C SS



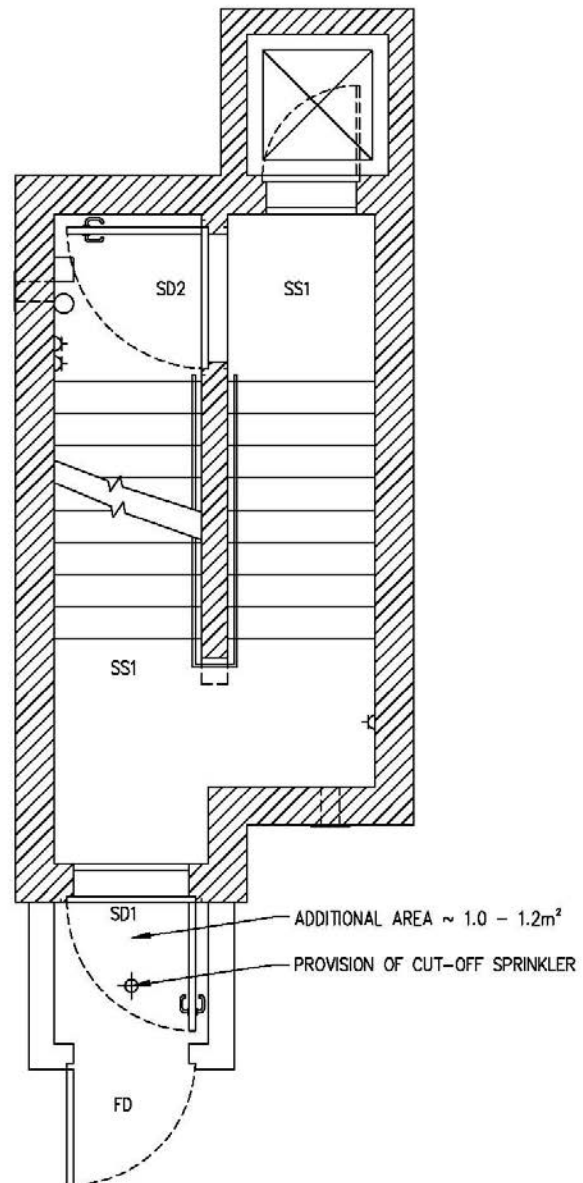
SECTION A – A

FIGURE 2.12.7(e) MINIMUM DIMENSION OF VERTICAL BLAST HATCH



BASEMENT LAYOUT PLAN

SS1 – STAIRCASE STOREY SHELTER.
SD1 – MAIN SHELTER DOOR.
SD2 – INTERMEDIATE SHELTER DOOR.
FD – FIRE RATED DOOR



1ST STOREY LAYOUT PLAN

SS1 – STAIRCASE STOREY SHELTER.
SD1 – MAIN SHELTER DOOR.
SD2 – INTERMEDIATE SHELTER DOOR.
FD – FIRE RATED DOOR

**FIGURE 2.12.8 PROVISION OF CUT-OFF SPRINKLER
IN STAIRCASE STOREY SHELTER**

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 pre-stressed concrete for SS wall/slab and NS wall/slab in the SS, S/C SS or scissor S/C SS tower is not permitted.

3.2.2 Steel Reinforcement

The steel reinforcement in SS/NS wall and slab shall be welded steel fabric mesh for steel bar diameter of up to 16mm and hot rolled steel bars. The minimum yield stress of main reinforcement bars and shear links in the structural elements forming the SS, S/C SS or scissor S/C SS or NS shall be minimum 460 N/mm² and 250 N/mm² respectively.

3.3 ANALYSIS

3.3.1 General

The vertical continuity of SS and NS walls, where applicable, to the foundation shall comply with clause 2.4.2.

In the case of S/C SS or scissor S/C SS tower, the SS and NS wall shall be continuous to foundation.

3.3.2 Beam Supported on SS wall

The end of the external beam that is supported on SS wall(s) shall be designed and detailed as simply support.



3.3.3 Shielded NS Walls and/or NS columns

(NS columns not applicable to S/C SS or scissor S/C SS Tower)

No additional design checks on SS tower is required if its supporting elements, wall(s), column(s) or any of its combination, are shielded. These structural elements are deemed shielded if reinforced concrete slab or other equivalent structural forms provided above them is extended beyond their edges by as minimum length of $0.5H$, where H is the aggregate wall height of NS (See FIGURE 3.3.3).

3.3.4 Unshielded NS Walls and /or NS Columns

(NS columns not applicable to S/C SS or scissor S/C SS Tower)

The following requirements are to be complied with if the design adopts:

(a) Unshielded NS Walls

The minimum thickness of each NS wall shall be 300 mm. The SS, S/C SS or scissor S/C SS 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 (Refer to FIGURE 3.3.4(a) and FIGURE 3.3.4(b)).

(b) Unshielded NS Columns

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 (Refer to FIGURE 3.3.4(c)).

(c) Combination of Unshielded NS Walls and NS Columns

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, S/C SS or scissor S/C SS tower shall be designed against the most severe effects as the result of the following (Refer to FIGURE 3.3.4(d)):

- (i) Removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter at its most critical location and
- (ii) Removal of any one NS column at a time.

The above removal of wall or column shall be considered one at a time.



- (d) The following criteria are to be used when performing design checks for Clause are the criteria to be used when performing 3.3.4(a), 3.3.4(b), 3.3.4(c) or 3.3.4(d):
 - (i) The design loads shall be based on the load combination and values of partial safety factors for loads (γ_f) in accordance with TABLE 3.3.4.
 - (ii) 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.

3.4 MEMBER DIMENSIONS AND REINFORCEMENT REQUIREMENTS

3.4.1 Member Dimensions

The minimum member size of SS and NS shall be as stipulated in Chapter 2 - Architectural Design.

3.4.2 Reinforcement Requirements

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

3.4.2.1 Wall Reinforcements of SS and NS

- (a) Minimum Reinforcement in SS or NS walls - refer to TABLE 3.4.2.1.
- (b) Reinforcements at both faces of the internal common wall shall be T10-100 c/c in both faces. The shear links shall be R6-600 c/c in both directions.

3.4.2.2 Slab Reinforcements of SS and NS Slabs

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

Top and bottom layer of slab reinforcements shall be T10 -100 c/c in both directions. The shear links shall be R6-600 c/c in both directions.
- (b) Ceiling slab of top-most SS:



- (i) Reinforcements at external face and internal face of the slab 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
- (c) Floor slab of bottom-most SS or NS and floor slab of NS located above an SS:
 - (i) Slab reinforcements at external face and internal face 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
- (d) Ceiling slab outside the SS tower which is immediately above SS door:

The minimum ceiling slab shall be constructed of 150mm thick reinforced concrete. The reinforcement shall consist of two layers of reinforcement (top and bottom) at T10-100 c/c in both directions. These top and bottom layers of reinforcement bars shall be continuous or anchored to the slab of SS with tension anchorage length.
- (e) Floor slab outside SS tower:

The reinforcements of every floor slab immediately outside SS tower walls shall be structurally connected to the SS tower.
- (f) SS slab which is integrated with pile-cap/footing:

For SS slab integrated with the pile-cap or footing of 500 mm thick or more, shear links is not required. The maximum spacing of main reinforcement shall be 200 mm c/c.
- (g) Shielding wall in front of SS door:

Reinforcements at both faces of the wall shall be minimum T10-200 c/c. The shear link with L-bend at two ends shall be R6 at 600 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 to attain full anchorage length and tension lap length 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 Elements for SS and S/C SS

Cast-In-Situ for 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) - Typical details of SS slabs/walls
- FIGURE 3.5.4(d) - Details of SS wall reinforcement bars near SS door
- FIGURE 3.5.4(e) - Typical details of embedded conduit in SS wall
- FIGURE 3.5.4(f) - Typical details of trimmer bars for ventilation sleeve
- FIGURE 3.5.4(g) - Typical details of trimmer bars for wall recess
- FIGURE 3.5.4(h) - Details of shear kinks in SS slabs/walls
- FIGURE 3.5.4(i) - Details of SS slab reinforcement near rescue hatch
- FIGURE 3.5.4(j) - Reinforcement plan details for S/C SS
- FIGURE 3.5.4(k) - Sectional details of SS slabs/walls for S/C SS
- FIGURE 3.5.4(l) - Sectional details of SS slabs/walls for S/C SS



3.5.5 Precast Elements for SS and S/C SS

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

- FIGURE 3.5.5(a) - Plan of SS walls with precast SS door frame panel (Type 1)
- FIGURE 3.5.5(b) - Details and sections of precast SS door frame panel with ventilation sleeve above it (Type 1)
- FIGURE 3.5.5(c) - Sections of precast SS door frame panel with ventilation sleeve above it (Type 1)
- FIGURE 3.5.5(d) - Details and sections of precast SS door frame panel with ventilation sleeve along its side (Type 1)
- FIGURE 3.5.5(e) - Details and sections of precast SS door frame panel with ventilation sleeve along its side (Type 1)
- FIGURE 3.5.5(f) - Plan of SS walls with precast SS door frame panel (Type 2)
- FIGURE 3.5.5(g) - Details and sections of precast SS door frame panel with ventilation sleeve above it (Type 2)
- FIGURE 3.5.5(h) - Sections of precast SS door frame panel with ventilation sleeve above it (Type 2)
- FIGURE 3.5.5(i) - Details and sections of precast SS door frame panel with ventilation sleeve along its side (Type 2)
- FIGURE 3.5.5(j) - Sections of precast SS door frame panel with ventilation sleeve along its side (Type 2)
- FIGURE 3.5.5(k) - Plan of SS walls with precast SS door frame panel (Type 3)
- FIGURE 3.5.5(l) - Details of precast SS door frame panel (Type 3)
- FIGURE 3.5.5(m) - Sections of precast SS door frame panel (Type 3)
- FIGURE 3.5.5(n) - Sections of precast SS door frame panel (Type 3)

3.5.6 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 conduits shall not penetrate through the walls and slabs of the SS. Service conduit for electrical and communication fixtures which are located on external SS wall can be embedded in the SS wall. Other than this, all services conduit which do not serve the SS shall not embed within the SS wall and slab.

Two cast-in embedded sockets mounted directly back to back on the internal and external faces of the SS wall are not permitted. 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. Refer to FIGURE 3.6.1(a)

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

Where fixture in the SS are exposed on internal walls and slab, non-metallic inserts are to be used for their mounting. For embedded service cables and fixtures serving the SS, the details shall be as shown in FIGURE 3.5.4(e). The encasement of switch socket outlets, TV and radio outlets, communication line for telephony outlet and switches of Clause 2.6 shall be galvanised steel. Refer to FIGURE 3.6.1(b).

A maximum of five 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 the SS.

Where an SS or NS share a common wall with lift shaft or service risers, mounting of services on the common wall is allowed on the external face of SS or NS wall. For the purpose of installing M&E equipment in the lift core or service risers, hot-dipped galvanised cast-in bar with threaded end shall be used in this common wall. Where anchor bolts are used, they shall be installed according to manufacturer's technical specification. The spacing the anchor bolts, measured between their centrelines, shall not be less than 300 mm.

3.6.2 Water and Gas Services



Water and gas 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. Refer to 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.



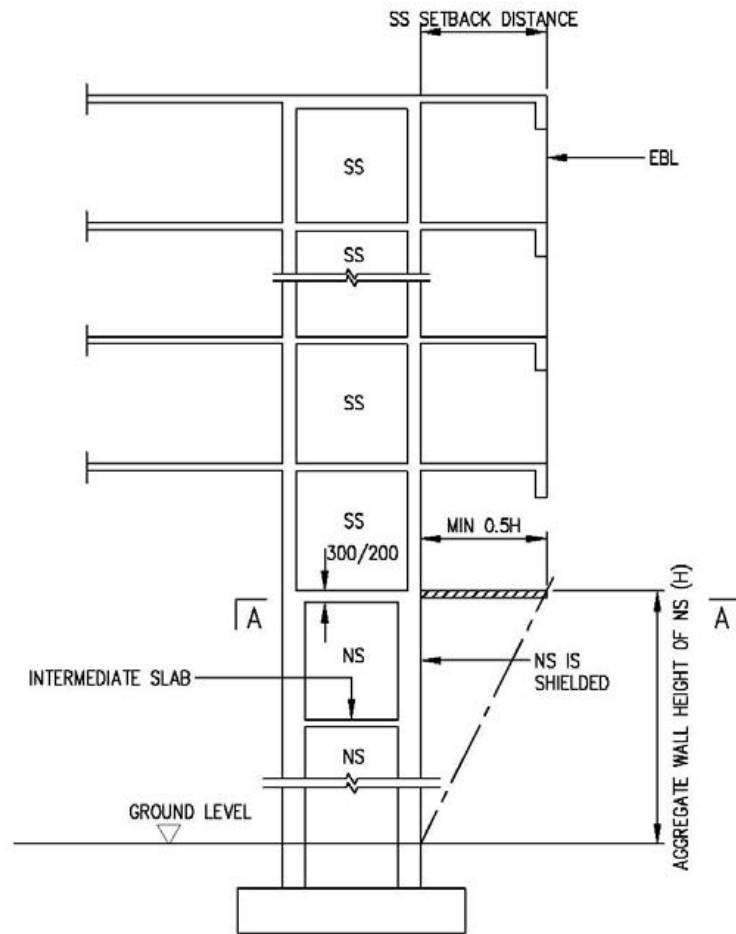
TABLE 3.3.4: LOAD COMBINATION AND VALUES OF PARTIAL SAFETY FACTORS (γ_f) FOR ULTIMATE LIMIT STATE

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 3.4.2.1: MINIMUM REINFORCEMENTS 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)
$2400 \leq H_t \leq 3400$	T13 - 100 c/c	T10 - 100 c/c	R6 - 600 c/c
$3400 < H_t \leq 3900$	T16 - 100 c/c	T13 - 100 c/c	R6 - 600 c/c





SECTION

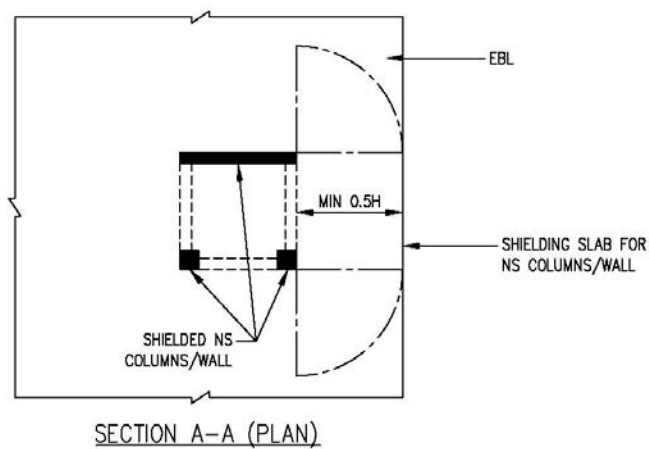
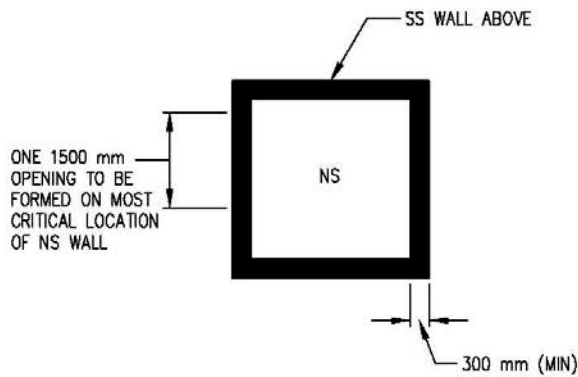
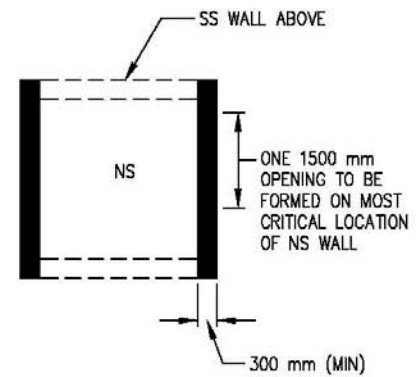


FIGURE 3.3.3 SHIELDED NS WALLS AND/OR NS COLUMNS
(NS COLUMNS NOT APPLICABLE TO S/C SS OR SCISSOR S/C SS TOWER)

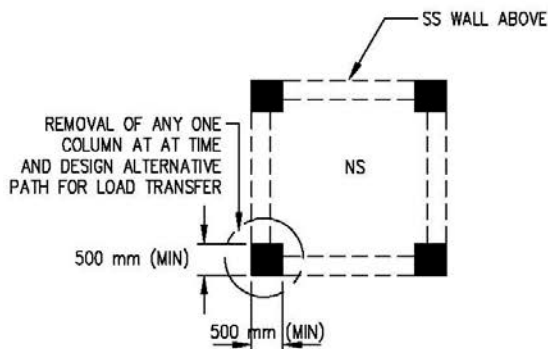




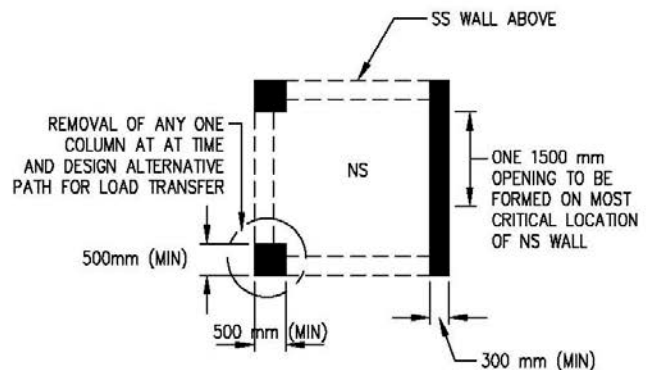
**FIGURE 3.3.4(a) UNSHIELDED
NS WALL(S)**



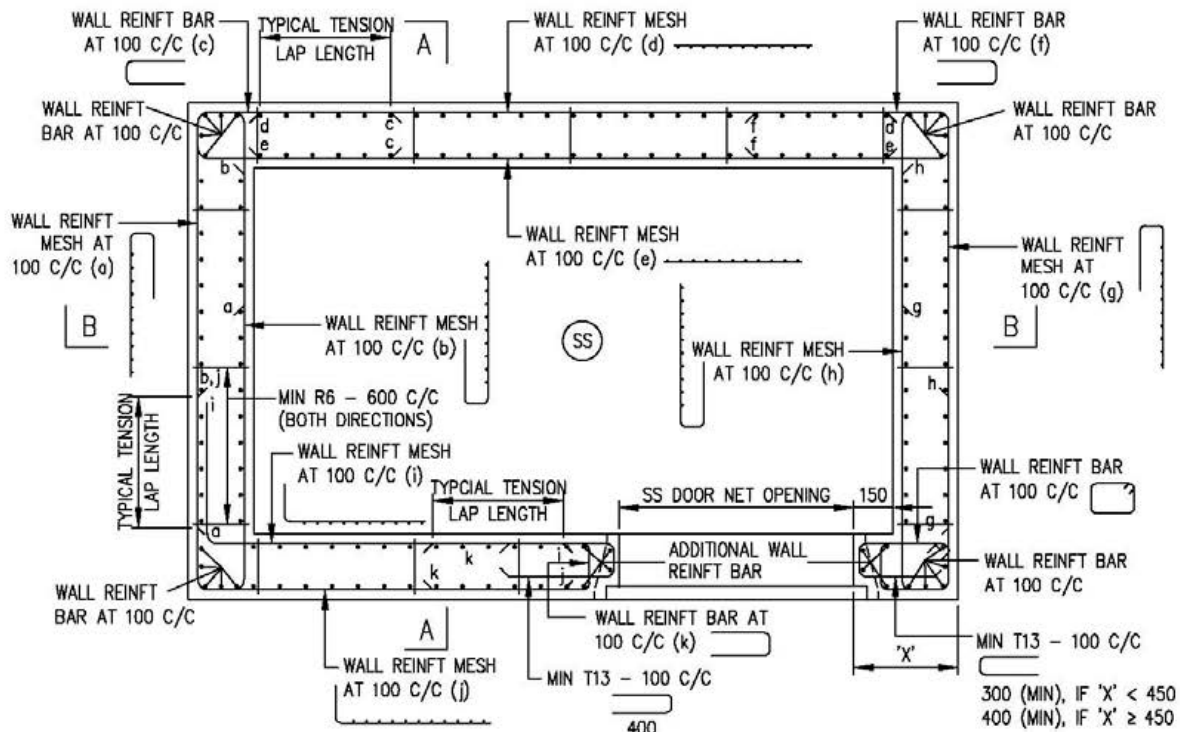
**FIGURE 3.3.4(b) UNSHIELDED
NS WALL(S)**



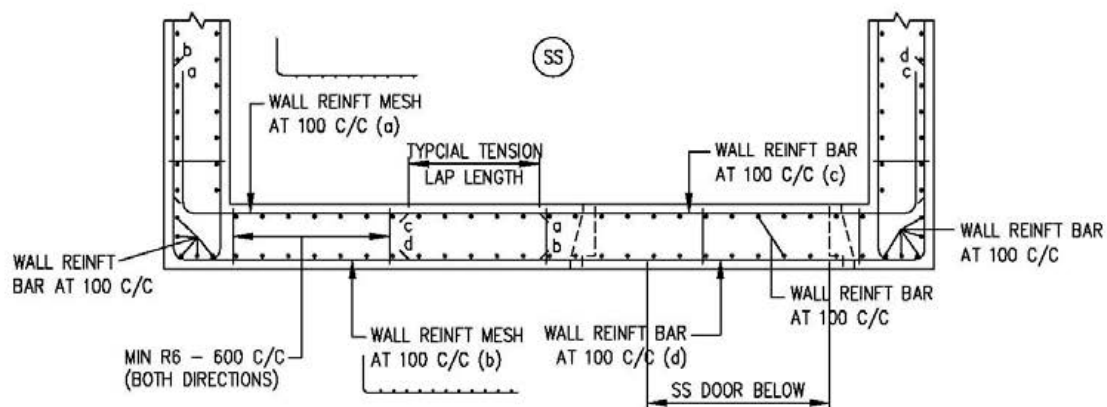
**FIGURE 3.3.4(c) UNSHIELDED
NS COLUMN(S)
(NS COLUMNS NOT APPLICABLE TO S/C
SS OR SCISSOR S/C SS TOWER)**



**FIGURE 3.3.4(d) COMBINATION OF
UNSHIELDED NS WALL(S) AND/OR
NS COLUMN(S)
(NS COLUMNS NOT APPLICABLE TO S/C
SS OR SCISSOR S/C SS TOWER)**



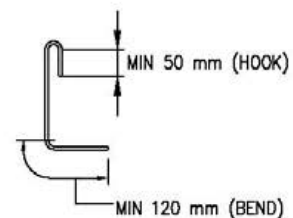
PLAN OF SS WALL AT DOOR OPENING



PLAN OF SS WALL ABOVE DOOR OPENING

NOTE:

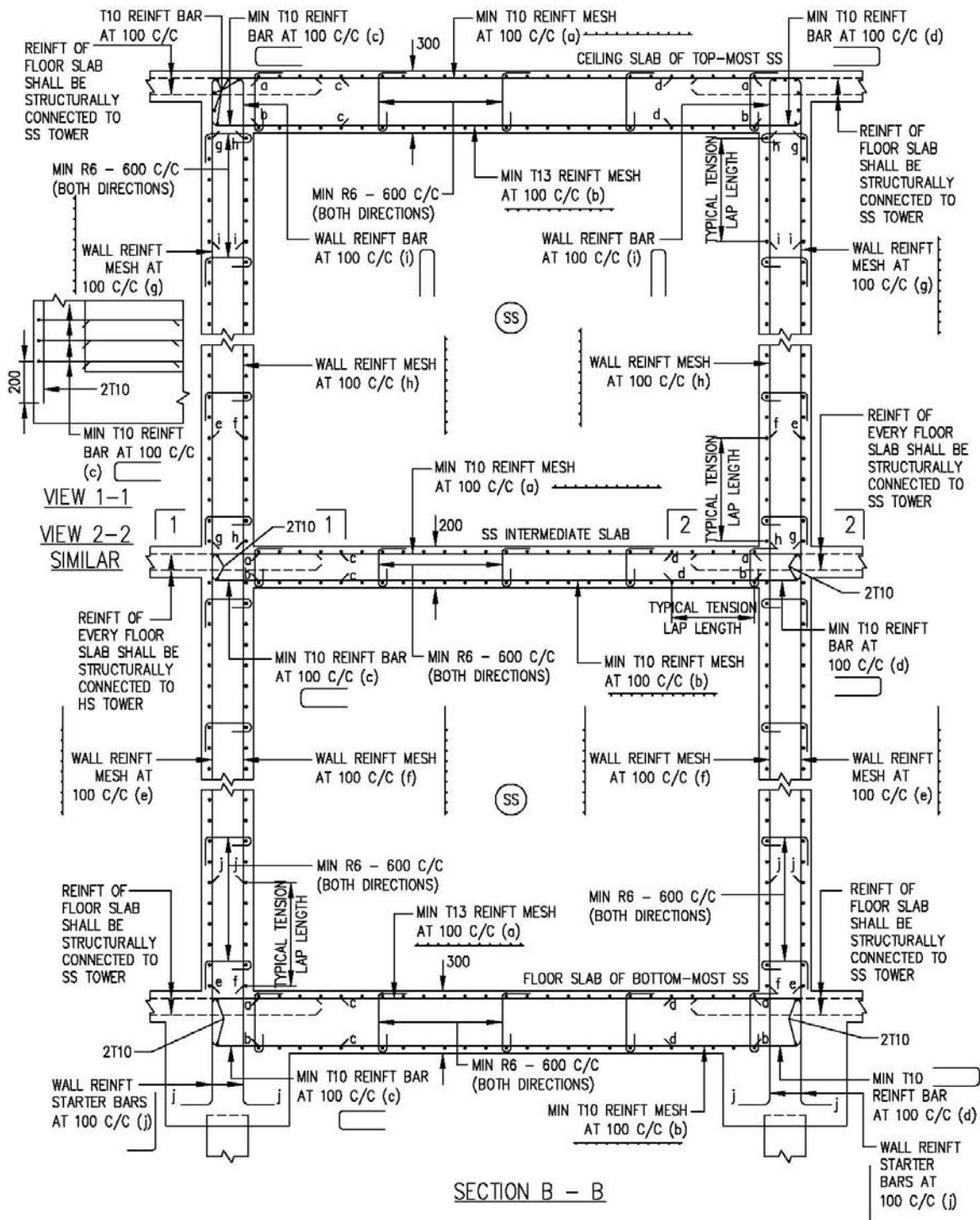
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
CONCRETE GRADE = 30 N/mm²



MINIMUM HOOK AND BEND ALLOWANCE FOR SHEAR LINKS (R6)

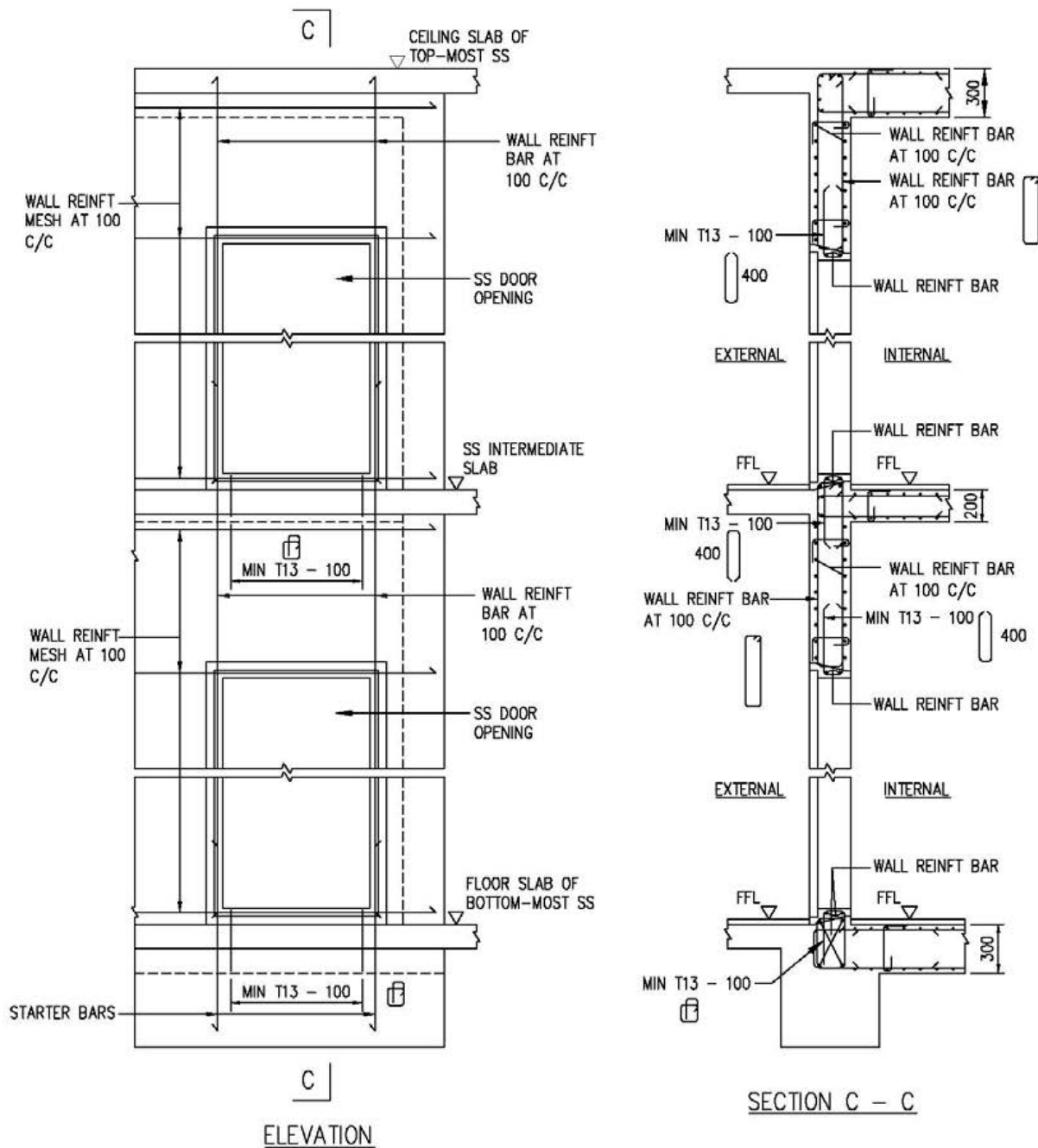
FIGURE 3.5.4(a) PLAN OF SS WALL





3.5.4(c) SECTIONAL DETAILS OF SS SLABS/ WALLS

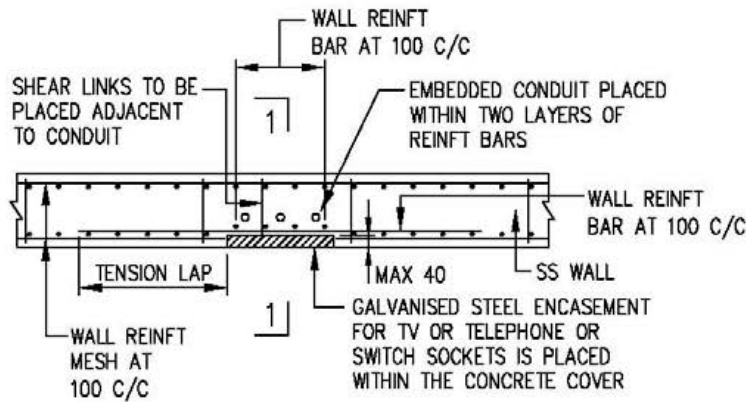




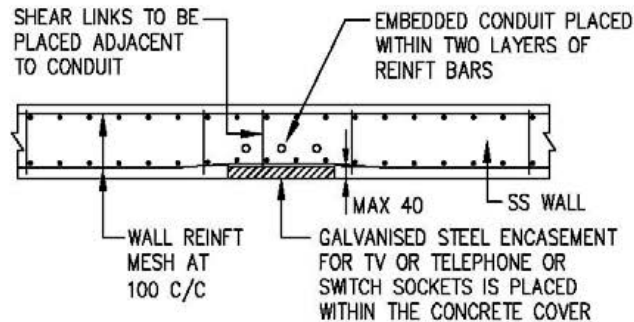
NOTE:

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/mm²

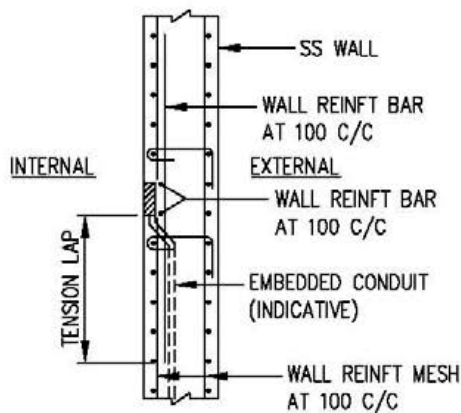
FIGURE 3.5.4(d) DETAILS OF SS WALL REINFORCEMENT BARS NEAR SS DOOR



PLAN
(IF REINFORCEMENT BARS ARE CUT)



PLAN
(REINFORCEMENT BARS ARE NOT CUT)



SECTION 1 - 1

NOTE:

1. WALL REINFORCEMENT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
3. MIN CONCRETE GRADE = 30 N/mm²

FIGURE 3.5.4(e) TYPICAL DEATILS OF EMBEDDED CONDUIT IN SS WALL



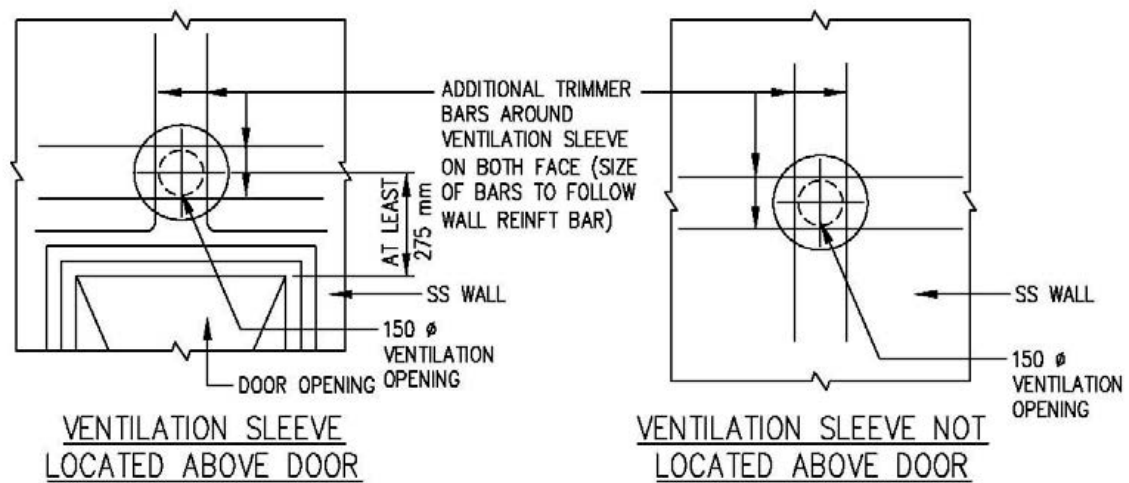
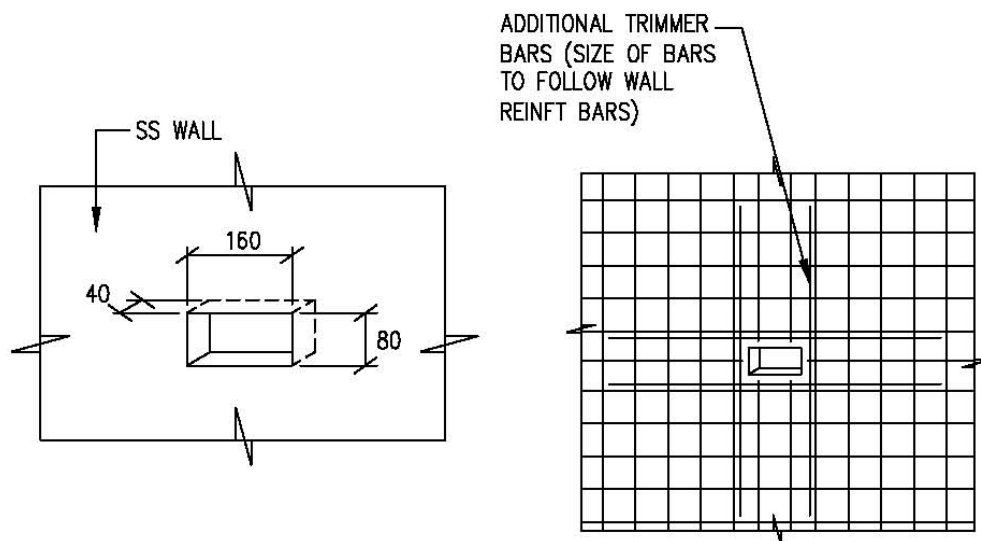
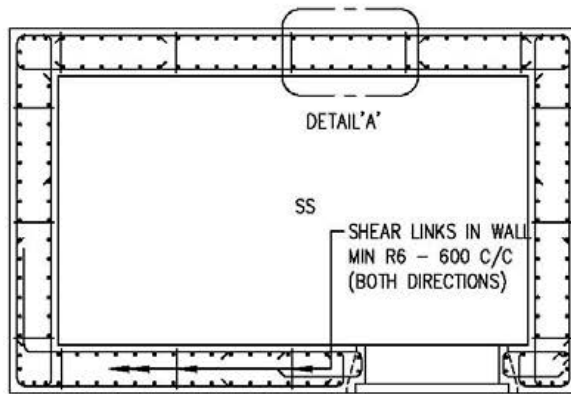


FIGURE 3.5.4(f) TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE

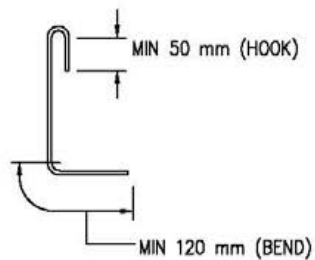


ELEVATION OF WALL RECESS
(IF WALL REINFORCEMENT BARS ARE CUT FOR WALL RECESS)

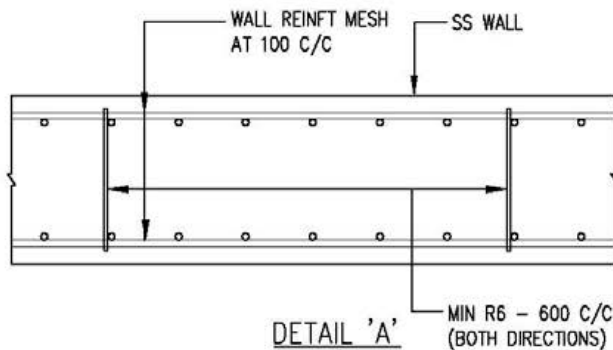
FIGURE 3.5.4(g) TYPICAL DETAILS OF TRIMMER BARS FOR WALL RECESS



PLAN OF SS SHOWING
SHEAR LINKS ARRANGEMENT

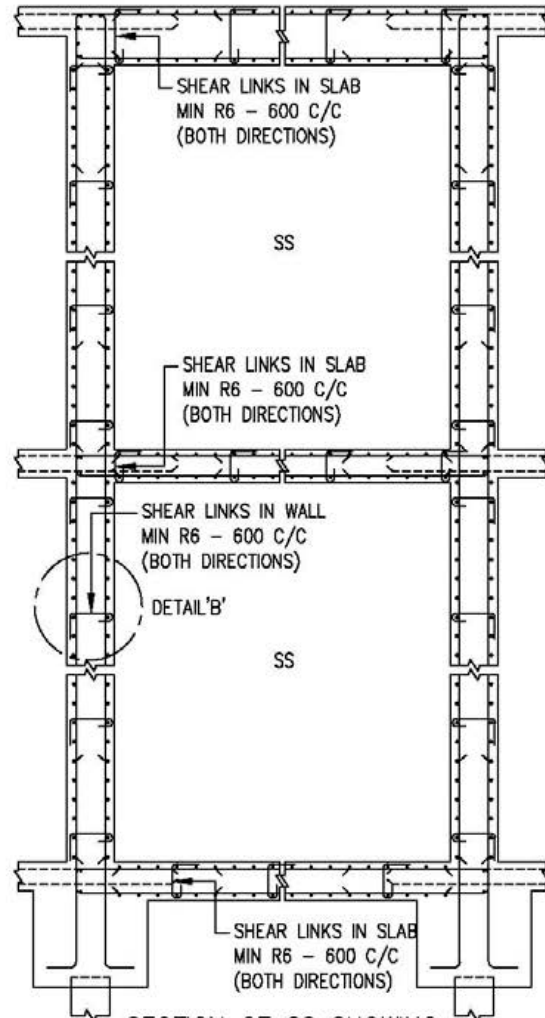


MINIMUM HOOK AND BEND
ALLOWANCE FOR SHEAR LINKS (R6)



NOTE:

1. WALL REINFORCEMENT REFER TO TABLE 3.4.2
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
3. MIN CONCRETE GRADE = 30 N/mm²
4. THE HOOK AND THE BEND OF R6 LINKS MUST BE TIED TO OUTERMOST REINFORCEMENT BARS OF SS WALL WHERE THE HOOK MUST ALWAYS BE PLACED NEAR TO INTERNAL FACE OF SS WALL.



SECTION OF SS SHOWING
SHEAR LINKS ARRANGEMENT

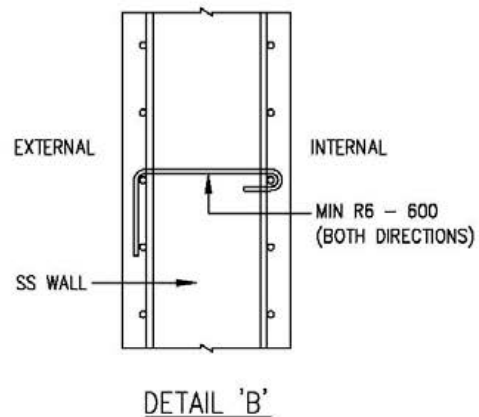
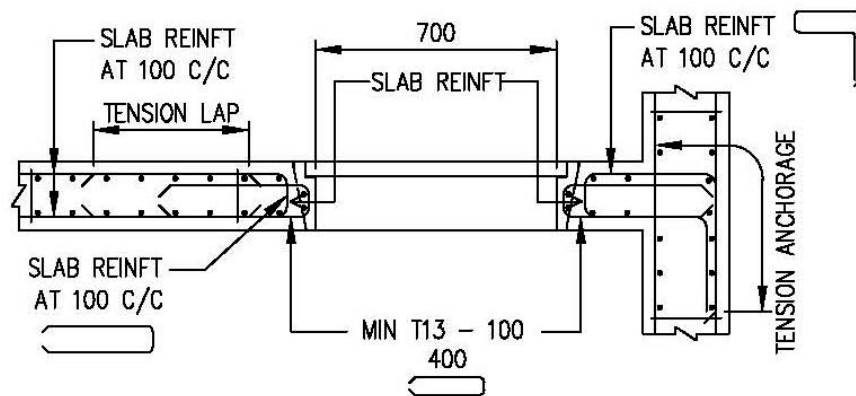
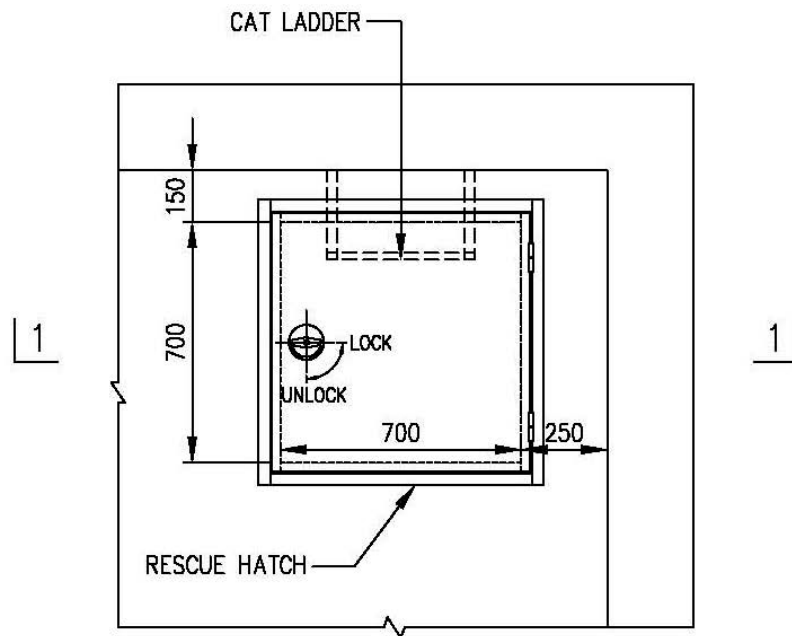


FIGURE 3.5.4(h) DETAILS OF SHEAR LINKS IN SS SLABS/ WALLS



SECTION 1 - 1

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

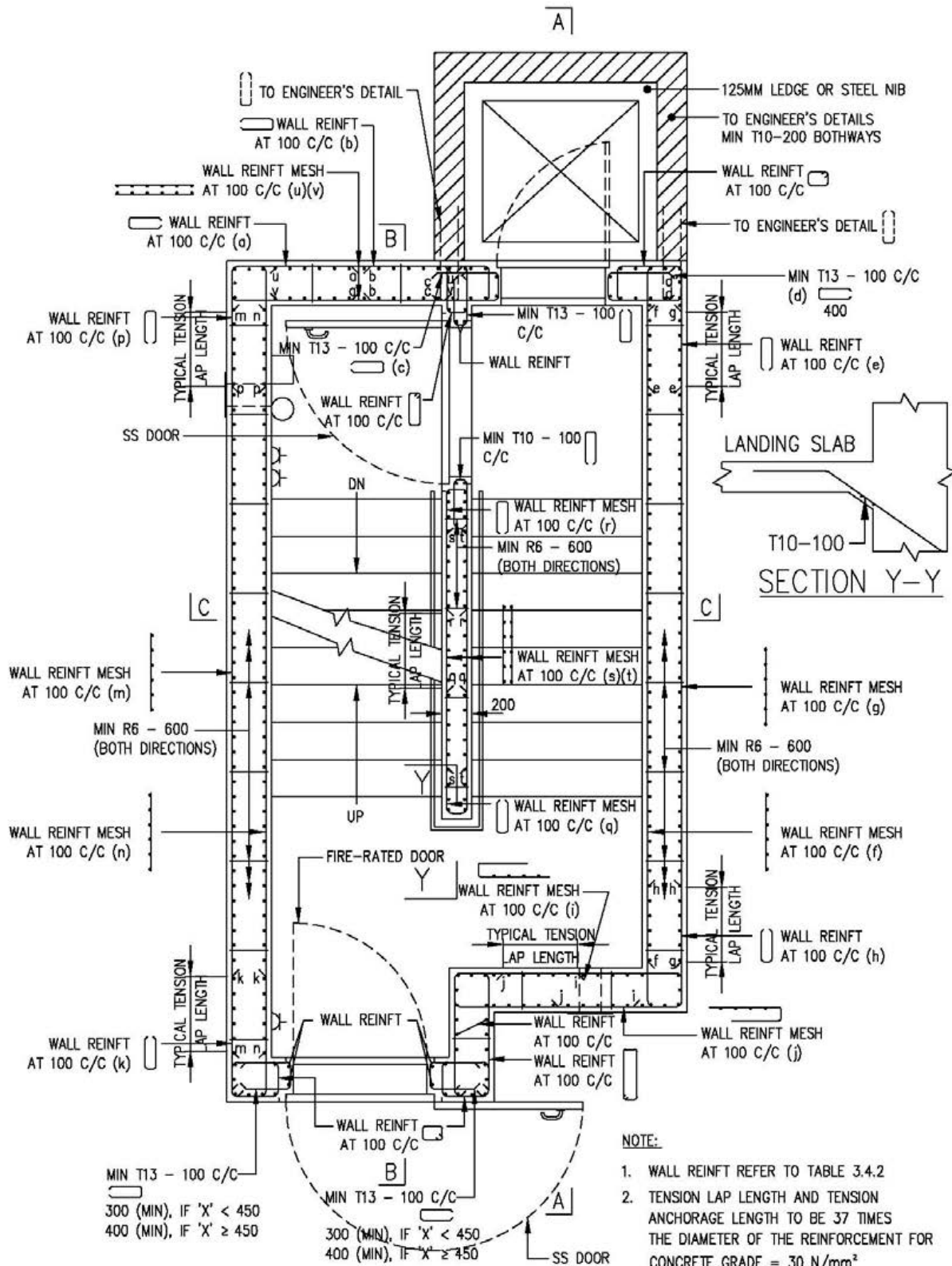
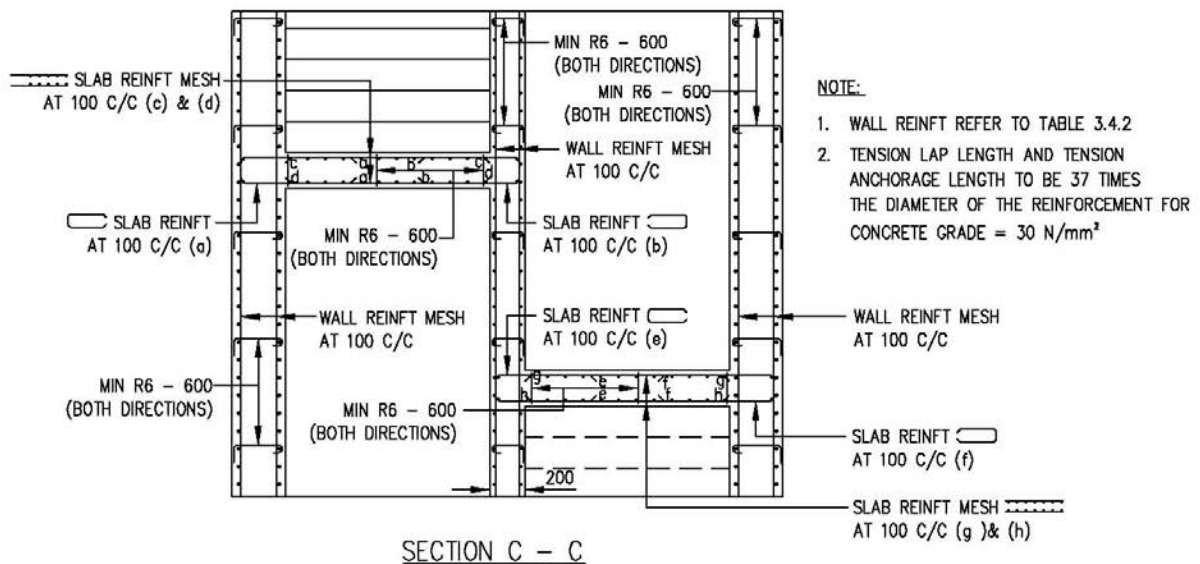
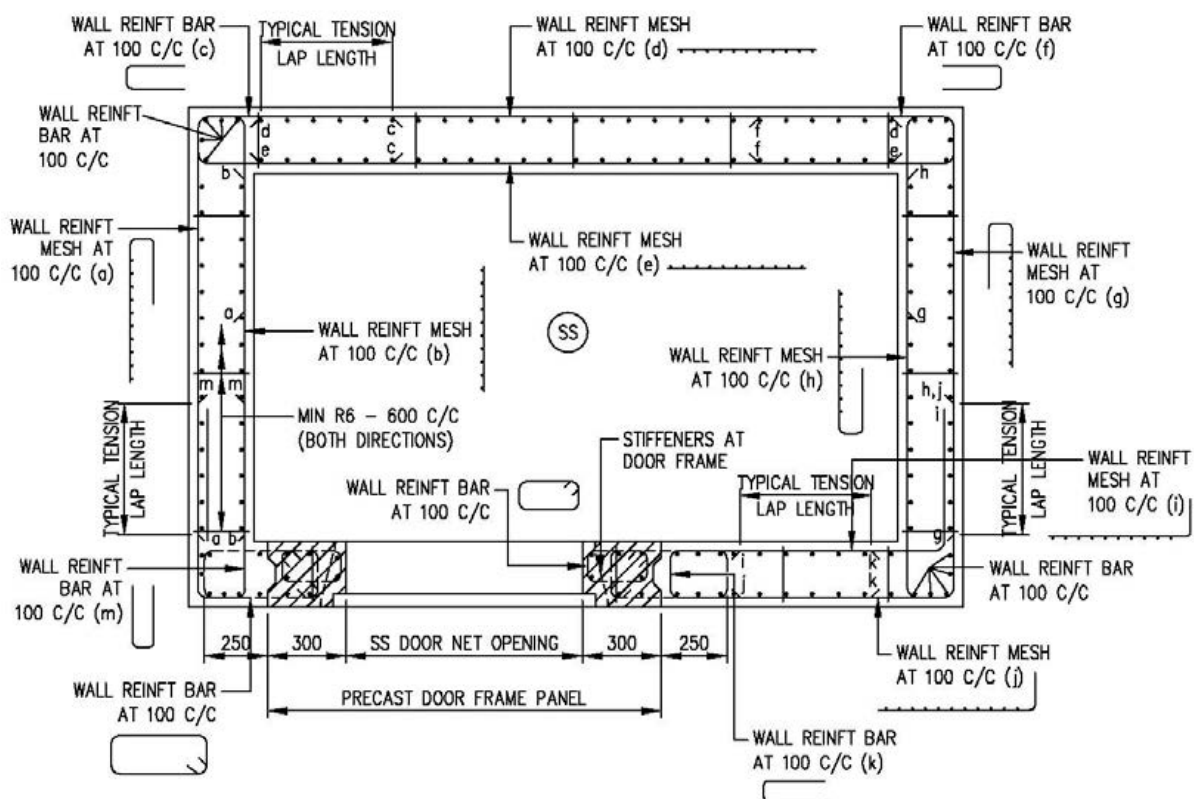


FIGURE 3.5.4(j) PLAN OF SS WALL FOR S/C SS



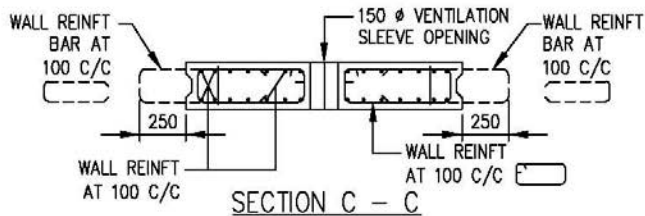
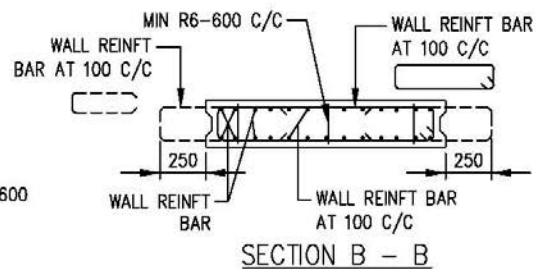
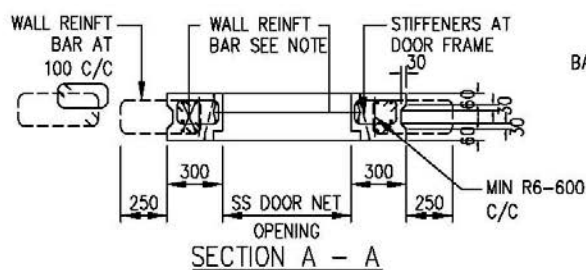
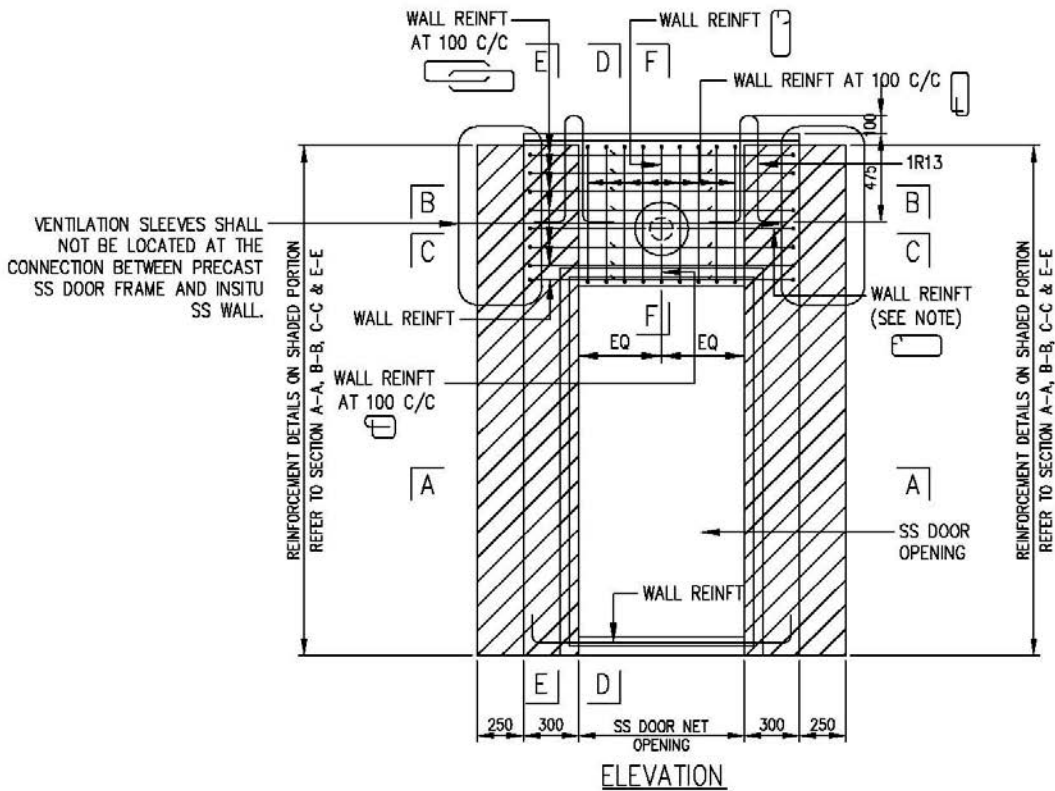


PLAN

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/mm²

FIGURE 3.5.5(a) PLAN OF SS WITH PRECAST SS DOOR FRAME PANEL (TYPE 1)



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/mm²

FIGURE 3.5.5(b) DETAILS AND SECTIONS OF PRECAST SS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 1)

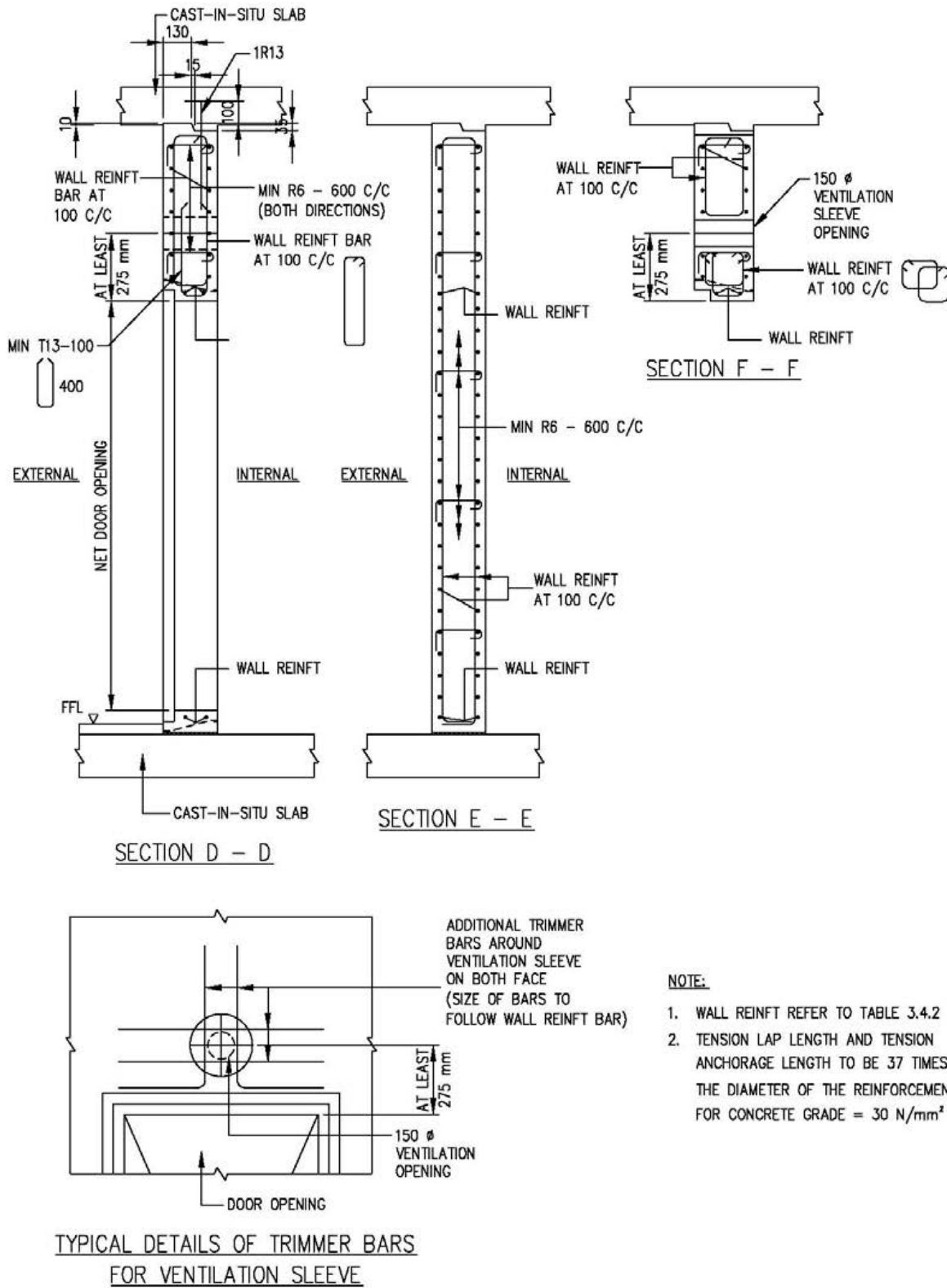


FIGURE 3.5.5(c) SECTIONS OF PRECAST SS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 1)

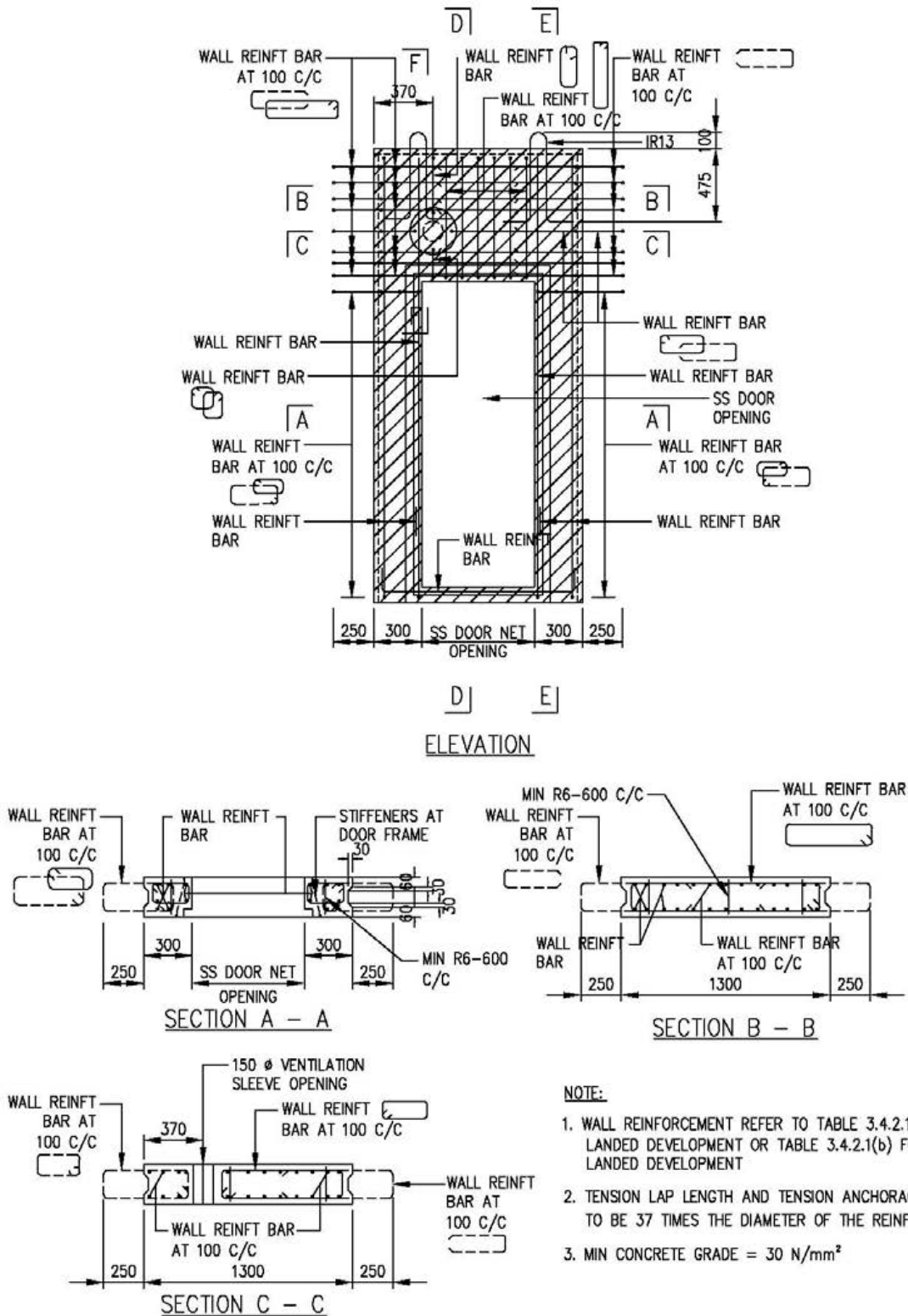


FIGURE 3.5.5(d) DETAILS AND SECTIONS OF PRECAST SS DOOR FRAME WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 1)

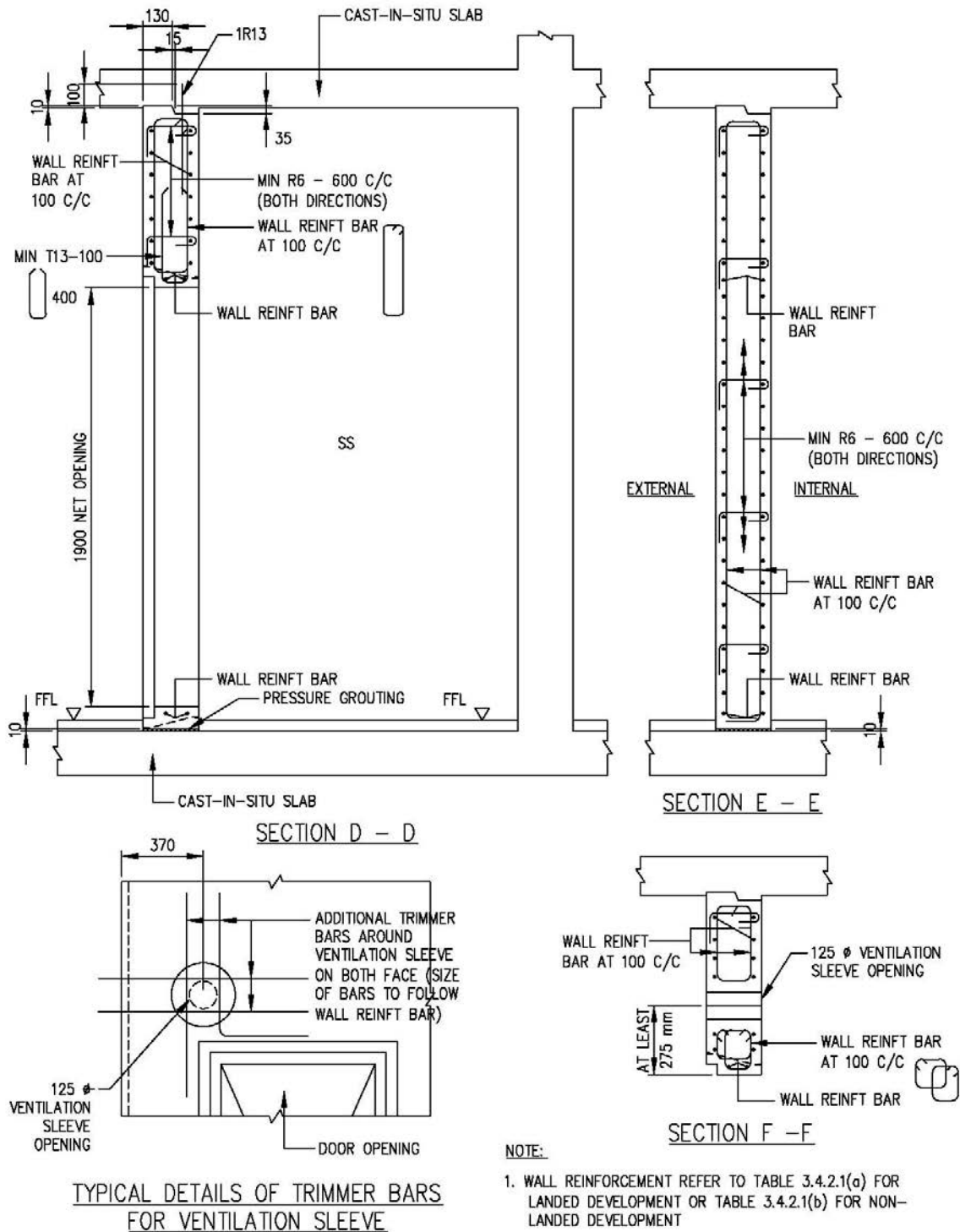
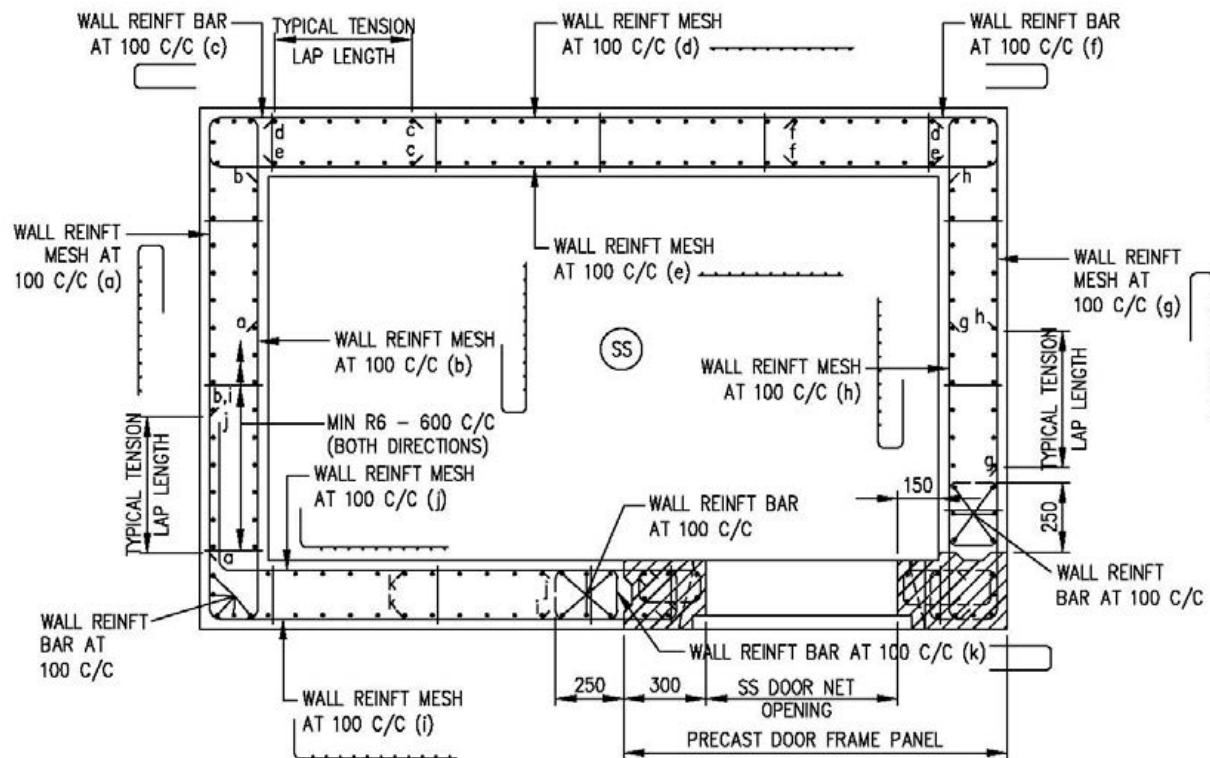


FIGURE 3.5.5(e) DETAILS AND SECTIONS OF PRECAST SS DOOR FRAME WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 1)



NOTE:

1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANDED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANDED DEVELOPMENT
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 37 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
3. MIN CONCRETE GRADE = 30 N/mm²

FIGURE 3.5.5(f) PLAN OF SS WITH PRECAST SS DOOR FRAME PANEL (TYPE 2)

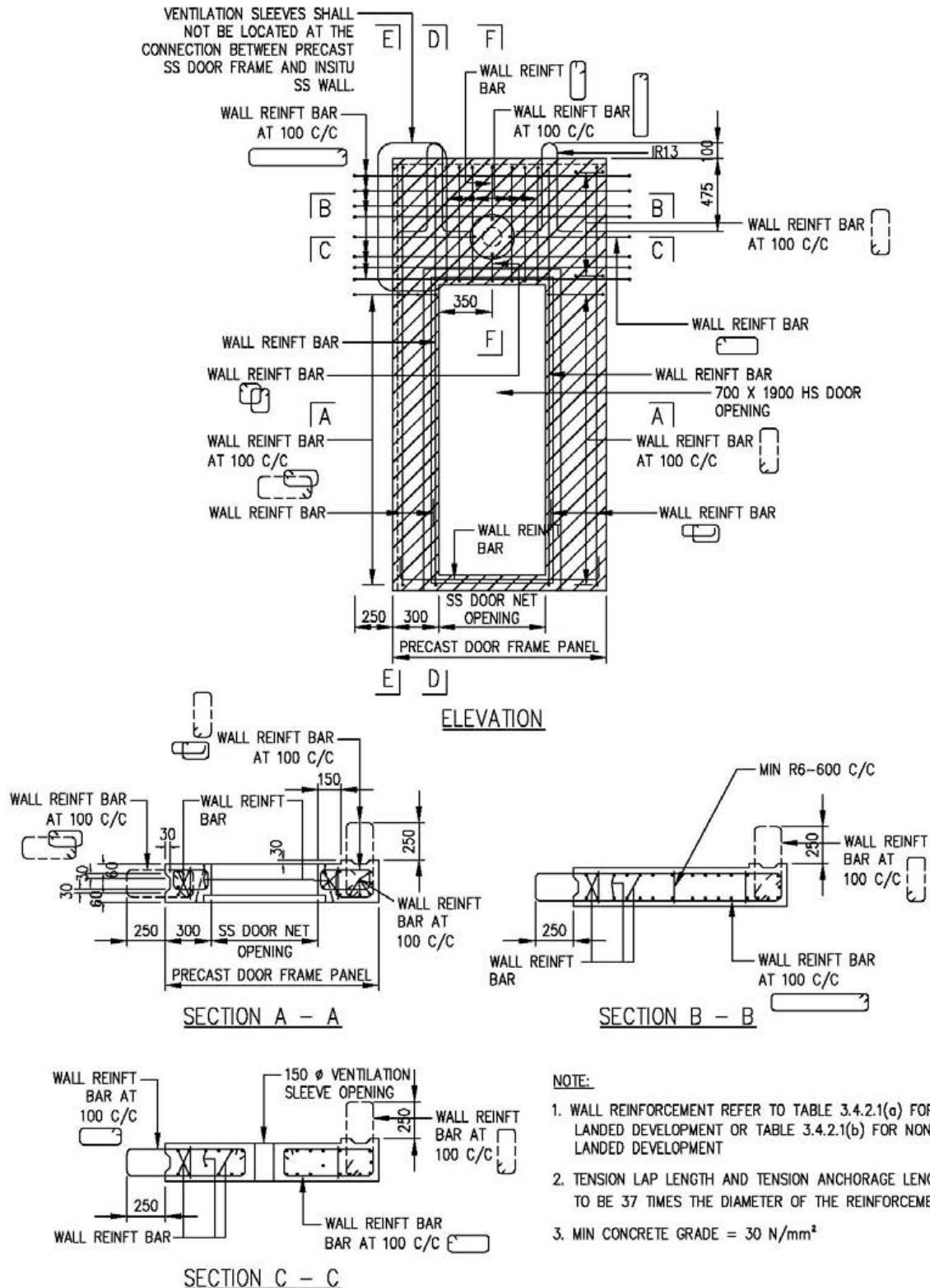


FIGURE 3.5.5(g) DETAILS AND SECTIONS OF PRECAST DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 2)

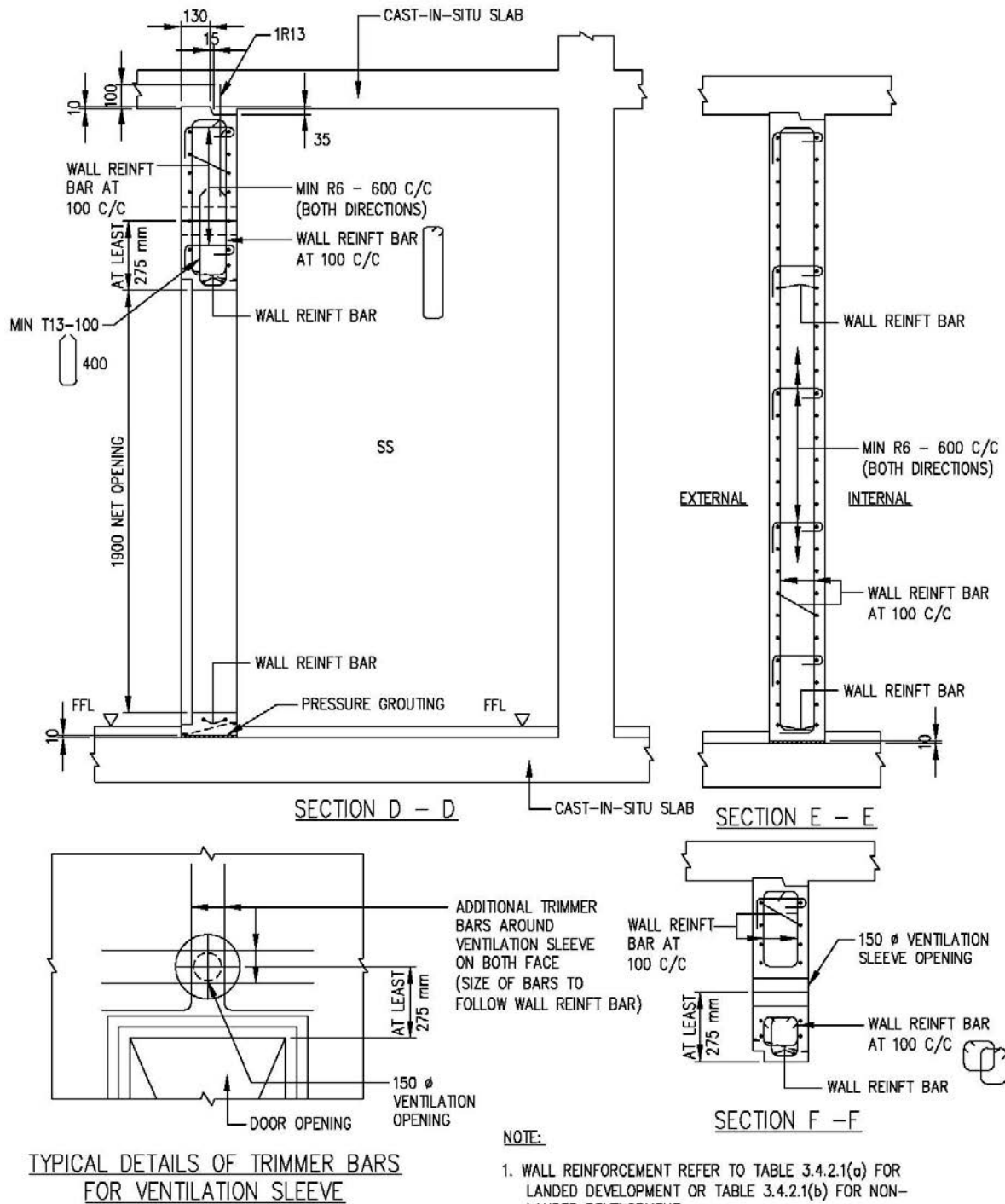


FIGURE 3.5.5(h) SECTIONS OF PRECAST SS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 2)

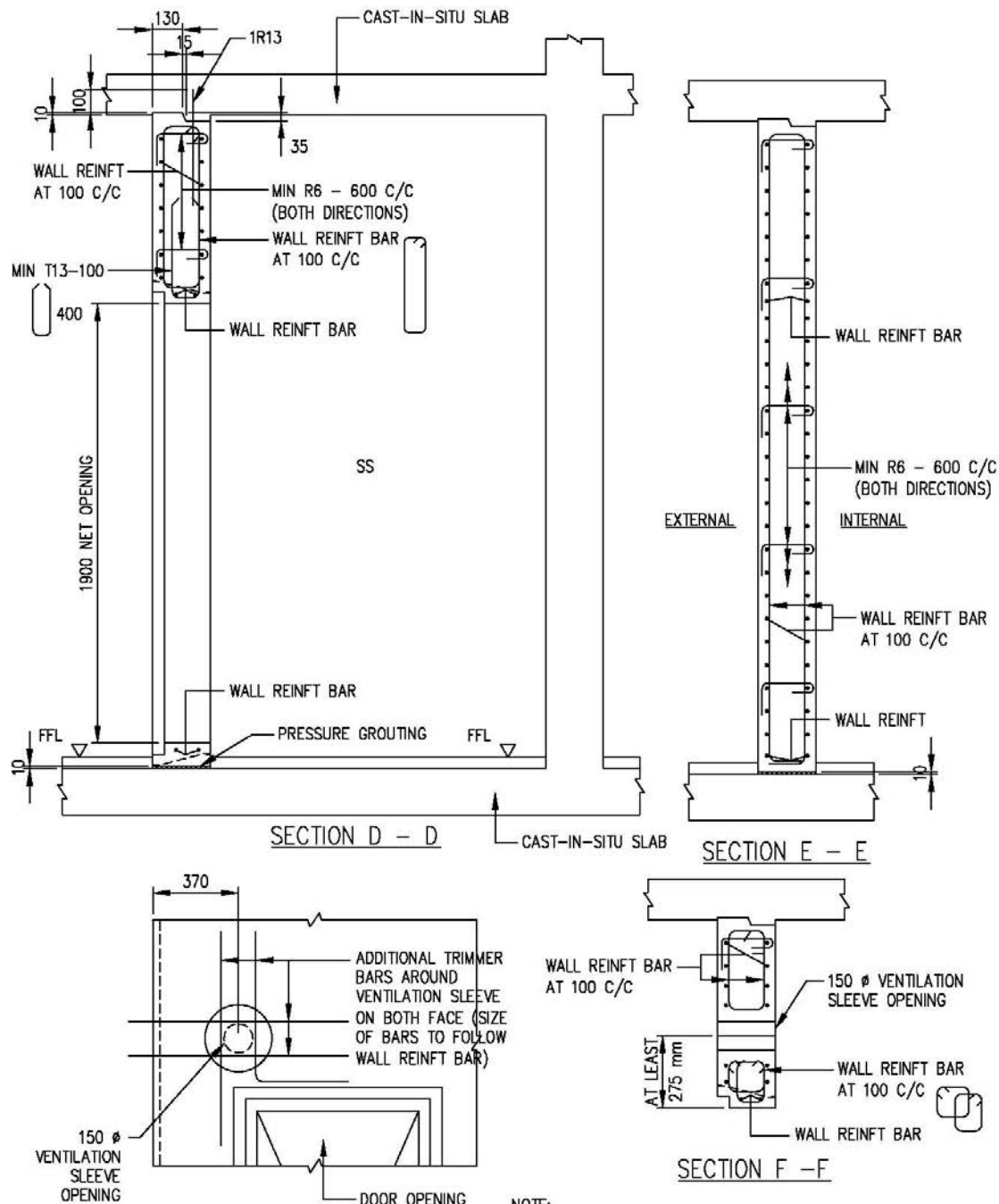
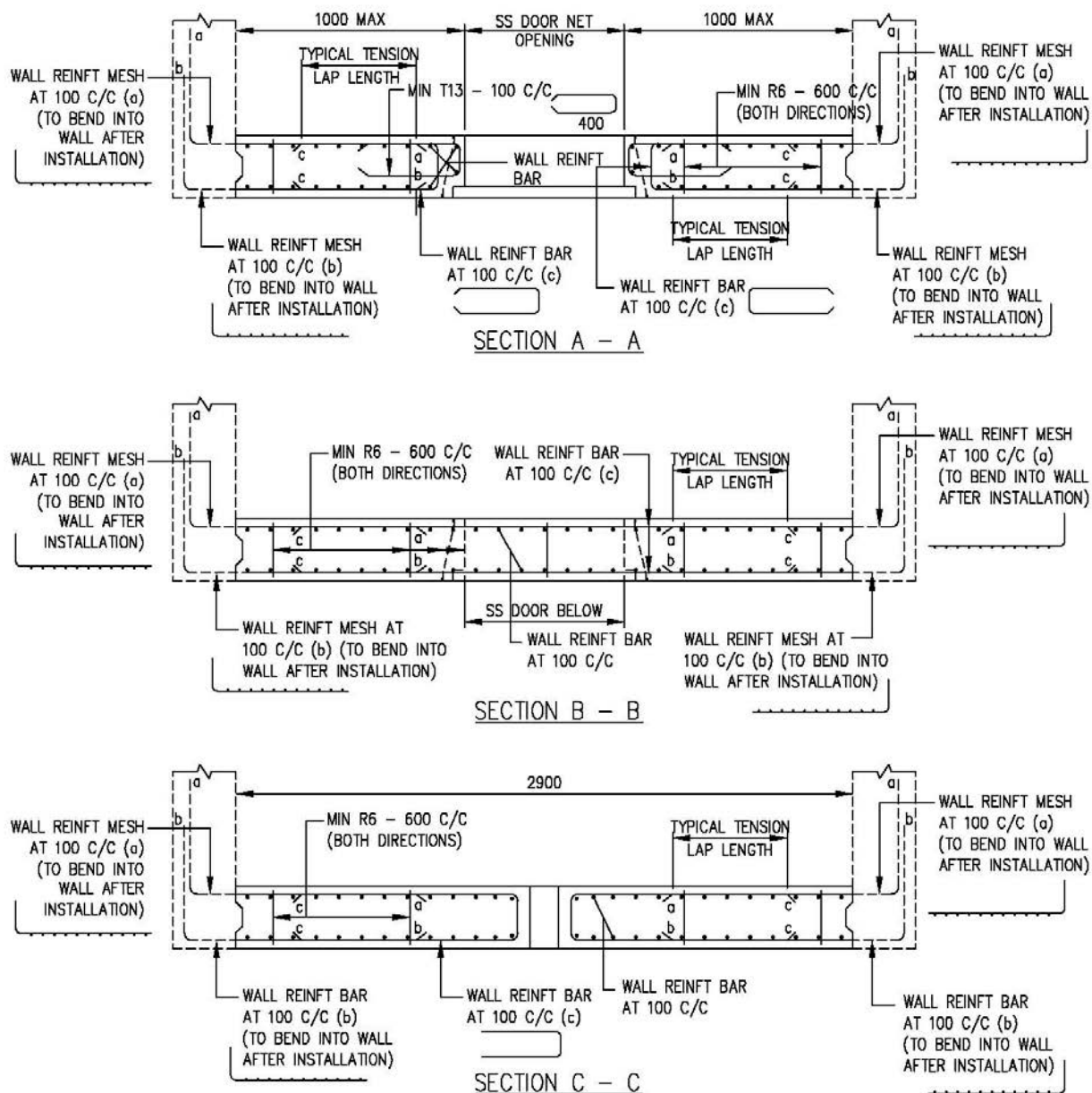


FIGURE 3.5.5(i) SECTIONS OF PRECAST SS DOOR FRAME PANEL WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 2)



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/mm²

FIGURE 3.5.5(m) SECTIONS OF PRECAST SS DOOR FRAME PANEL (TYPE 3)

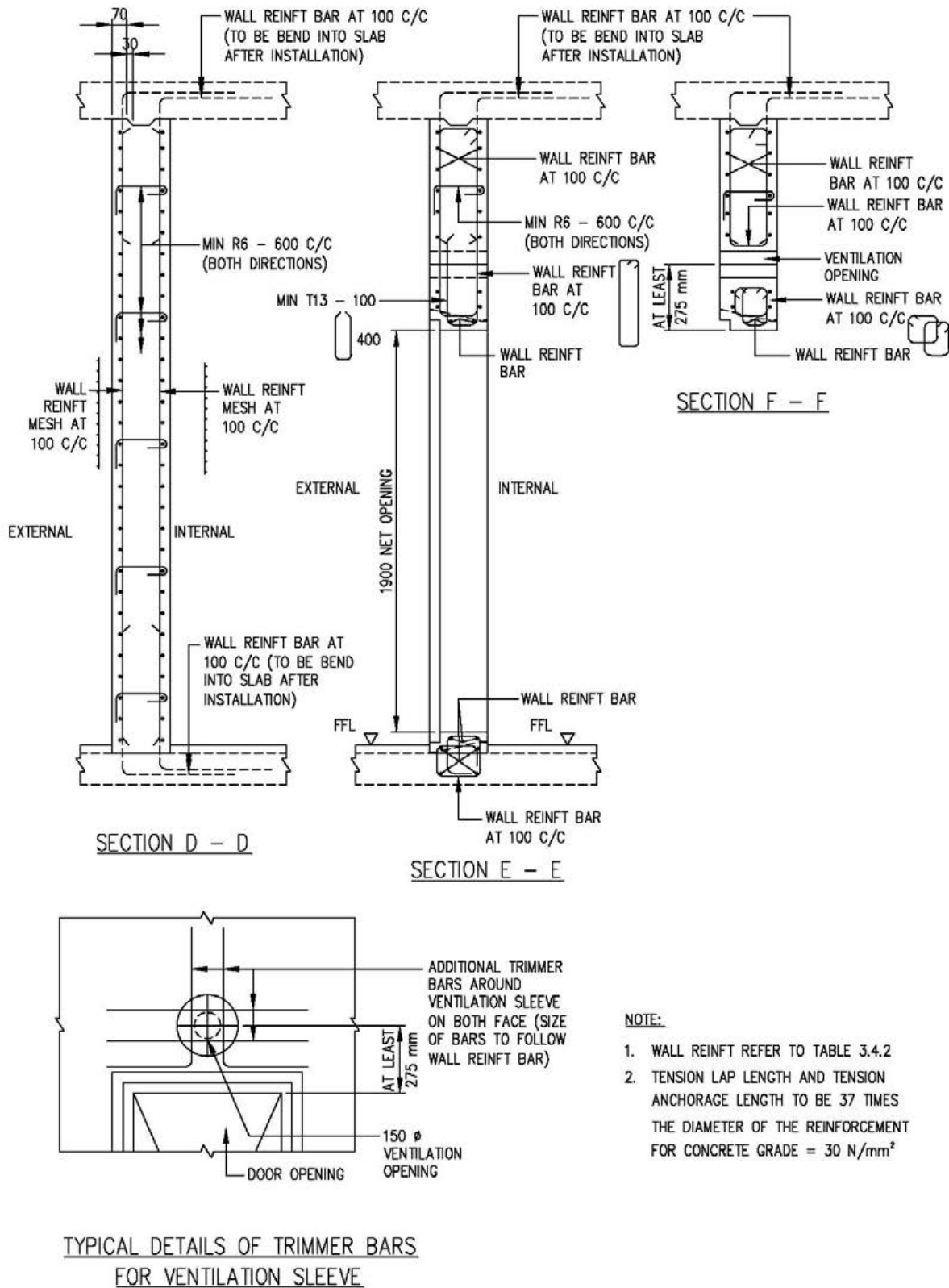
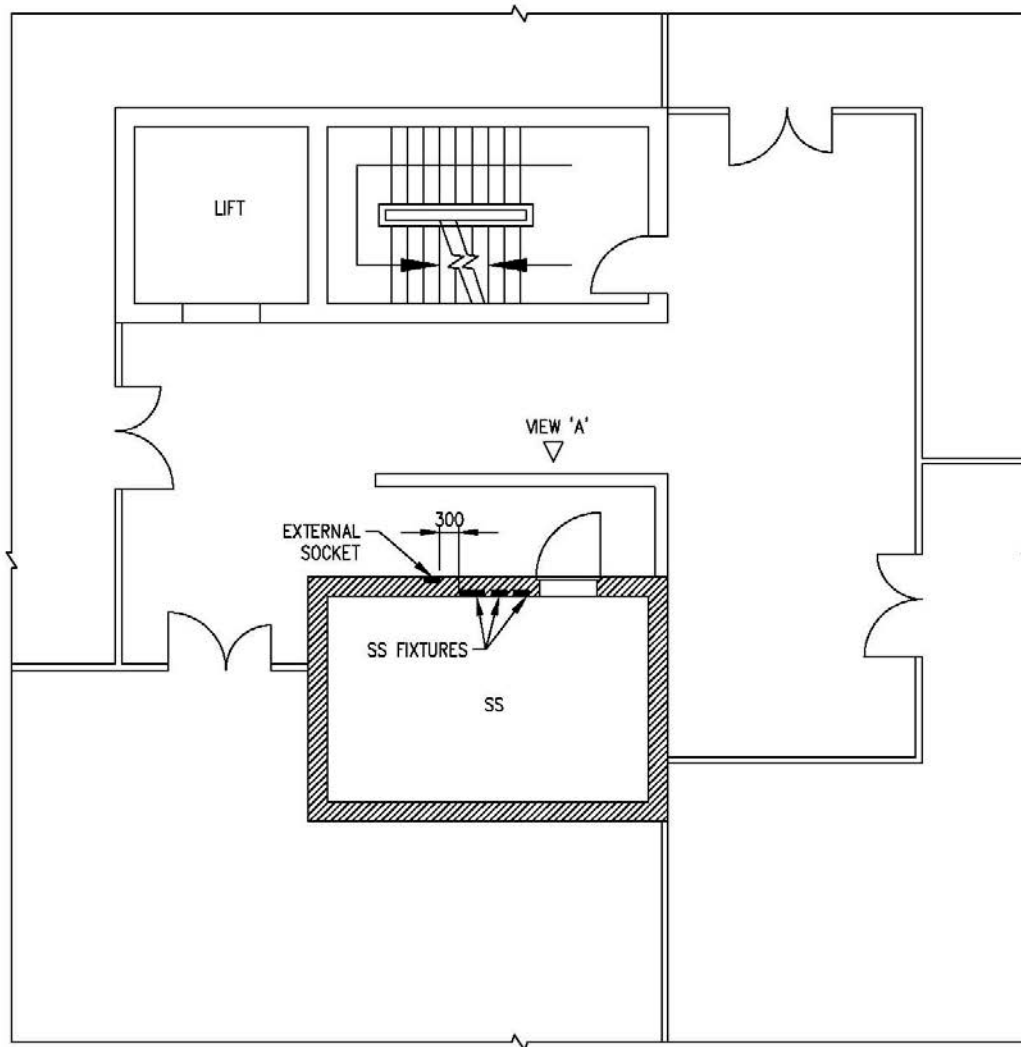


FIGURE 3.5.5(n) SECTIONS OF PRECAST SS DOOR FRAME PANEL (TYPE 3)



PLAN

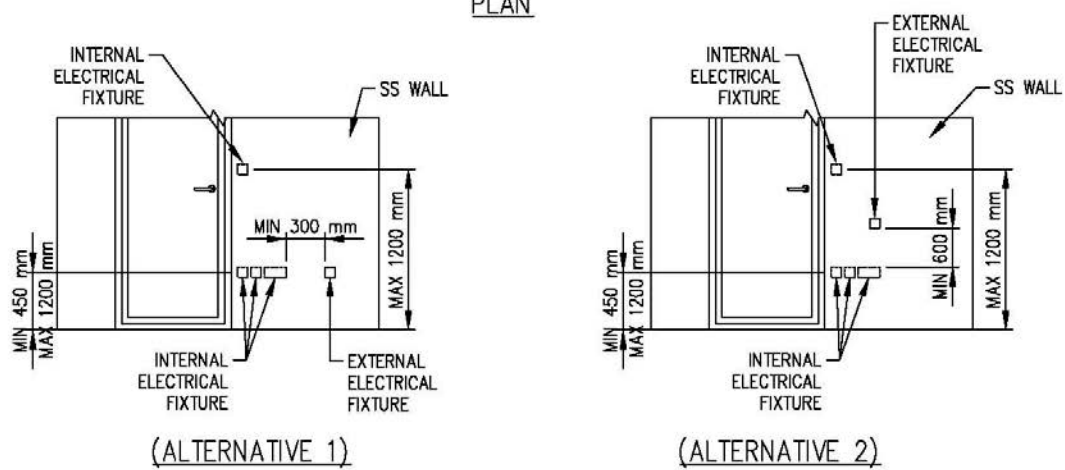
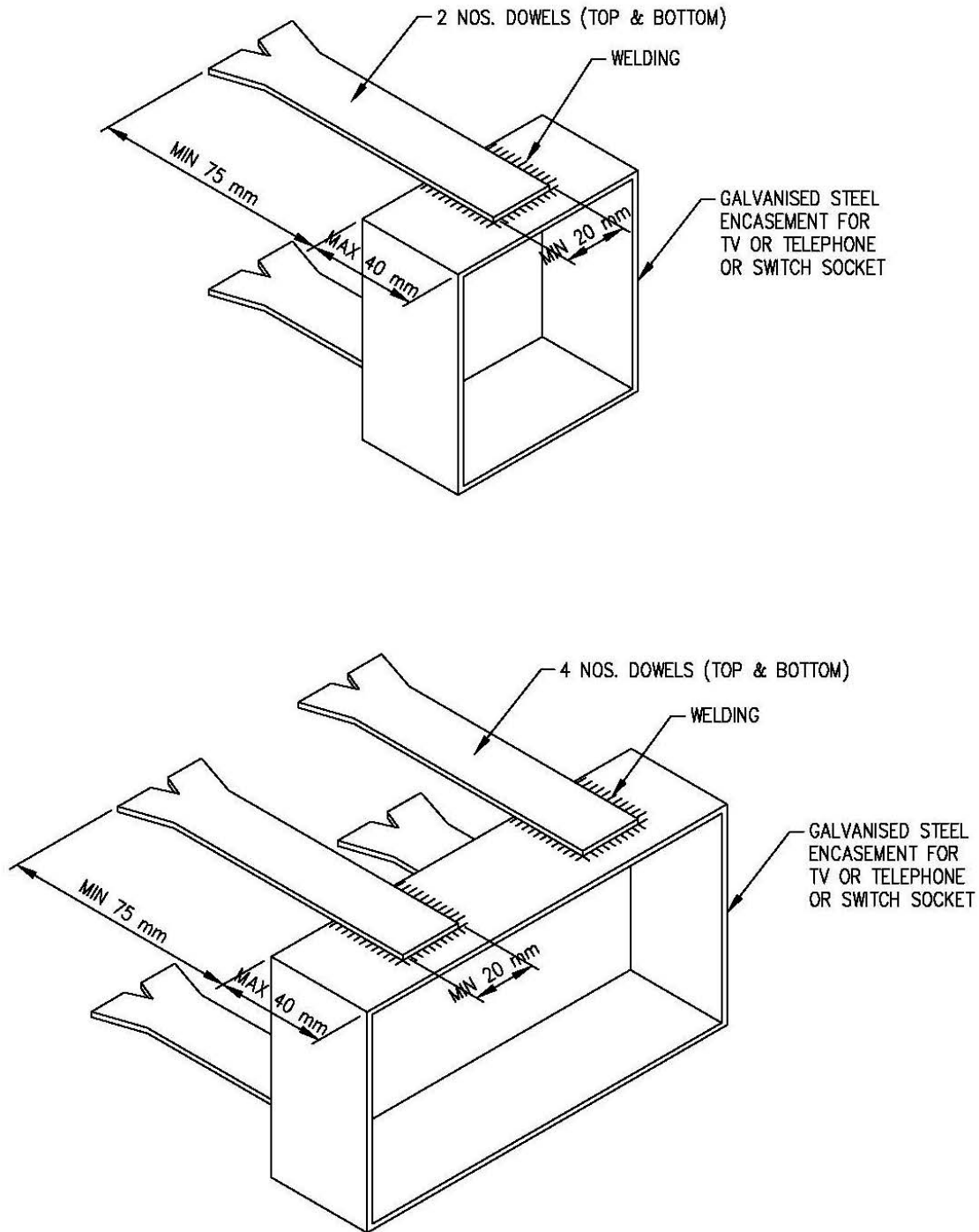
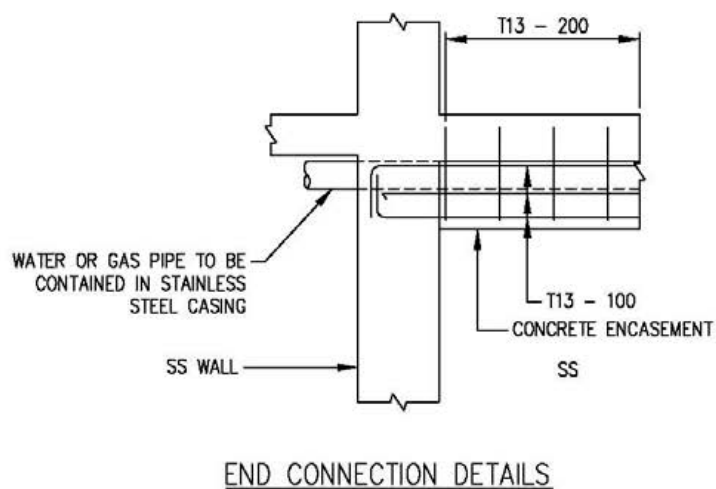
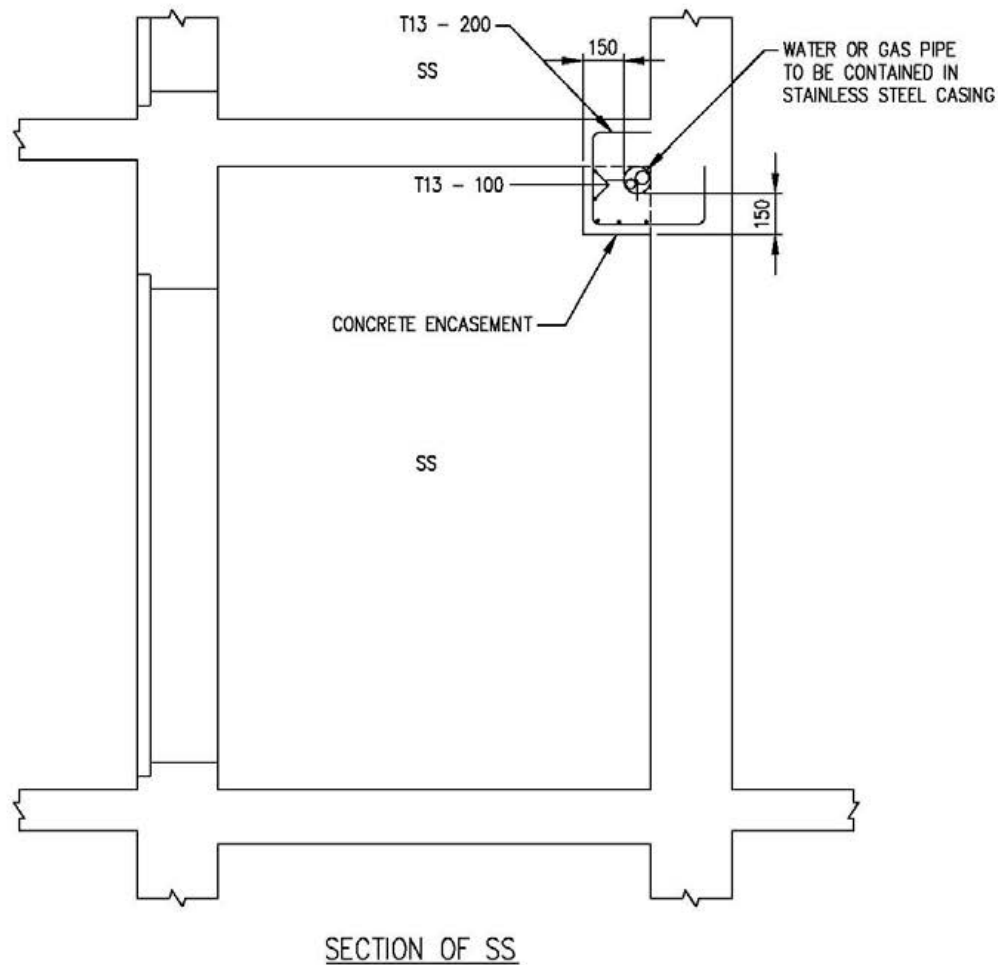


FIGURE 3.6.1(a) MOUNTING OF SERVICES ON EXTERNAL WALL OF A SS



NOTE: THICKNESS OF DOWELS SHALL BE AT LEAST THAT OF THE (MATERIAL) THICKNESS OF THE SOCKETS/SWITCH

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



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

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 S/C SS or scissor S/C SS, no fire rating is required for these fragmentation plates. The two ventilation sleeves shall be provided in the S/C SS or scissor S/C SS wall at the staircase entrance landing or intermediate landing at each storey or one each at the entrance landing and intermediate landing.

4.2 POSITION

The position of each ventilation sleeve opening shall comply with the below clauses. Refer to FIGURE 4.2(a) and 4.2(b).

- (a) The height of each ventilation sleeve opening, measured from the centre of the opening to internal FFL of the SS shall be between 1900 mm and 3550mm;
- (b) The ventilation sleeve opening shall be positioned such that there is sufficient clearance from any structural elements and services. The centre of the ventilation sleeve opening to the soffit of ceiling slab and the nearest face of the internal SS walls shall be at least 350mm.
- (c) Where the ventilation sleeve is placed above or adjacent to the SS door frame, the centre of the ventilation sleeve opening shall be at least 275 mm from the nearest edge of the SS door frame.
- (d) The shortest distance between the centres of the two ventilation sleeves openings shall be at least 1000 mm.
- (e) Where the ventilation sleeve is located along the staircase flight of the S/C SS or scissor S/C SS, the maximum distance measuring between the edge of either end of staircase flight and the centre of the ventilation sleeve opening shall be 500mm.
- (f) The ventilation sleeve openings shall be accessible from common area outside the SS or S/C SS or scissor S/C SS. The ventilation sleeves shall not be located in the SS wall sharing with the dwelling unit. Refer to FIGURE 4.2(c).
- (g) In the case of SS, the ventilation sleeve shall be located away from the rescue hatch openings. Refer to FIGURE 2.6.1.



4.3 ACCESSIBILITY OF VENTILATION SLEEVES

4.3.1 Clearance in front of and around Fragmentation Plates

The minimum clearance from the fragmentation plate to RC beam or structure or service shall be 50mm. Where the RC beam or structure or service is fronting the fragmentation plate of ventilation sleeve, the clear distance between them shall be at least 500mm. Refer to FIGURE 4.3.1.

4.3.2 False Ceiling below Ventilation Sleeves

Where false ceilings are provided outside the SS, S/C SS or scissor S/C 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. In the case of SS, one of the access panels shall be perforated and the ventilation sleeve above it shall be left open during peacetime. Refer to FIGURE 4.3.2.

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. Refer to FIGURE 4.4.



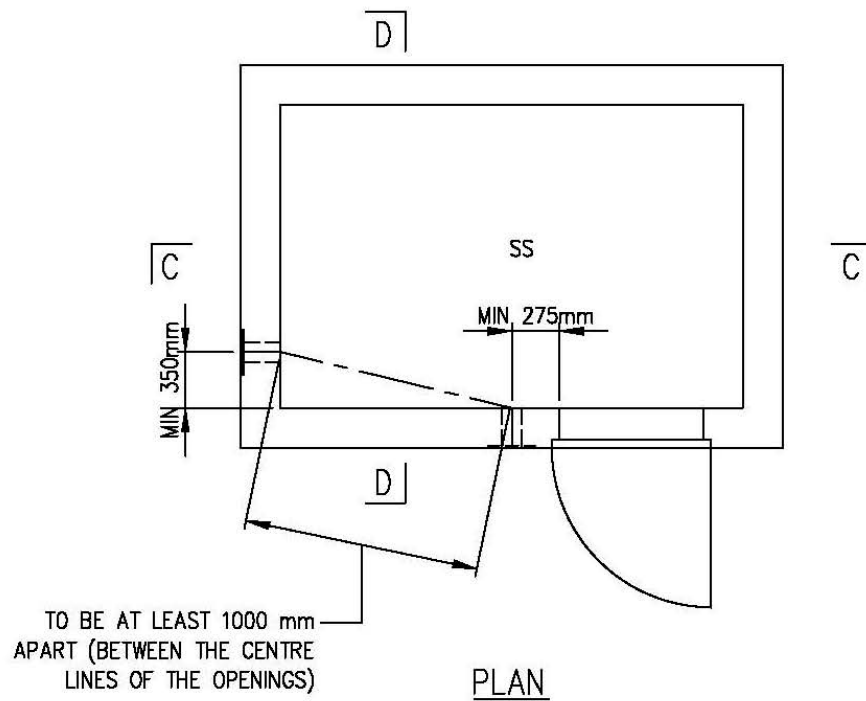
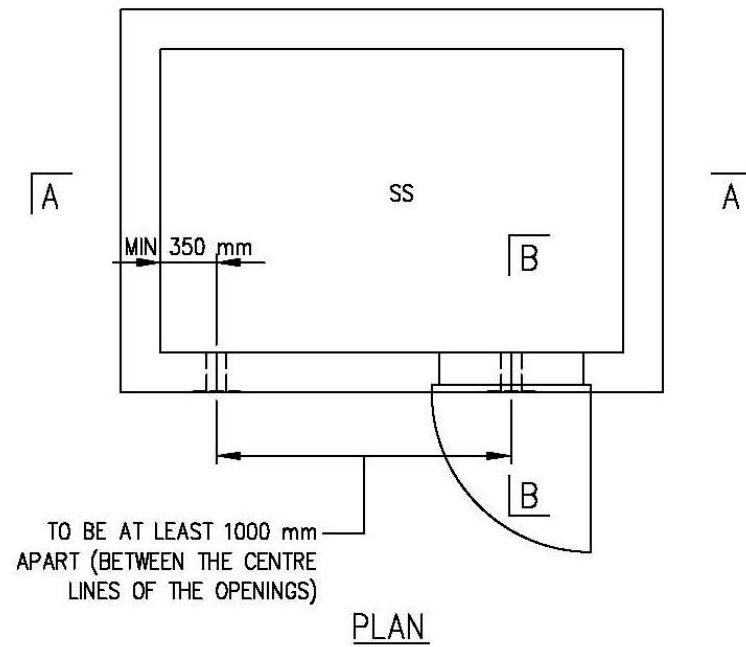


FIGURE 4.2(a) POSITION OF VENTILATION SLEEVES

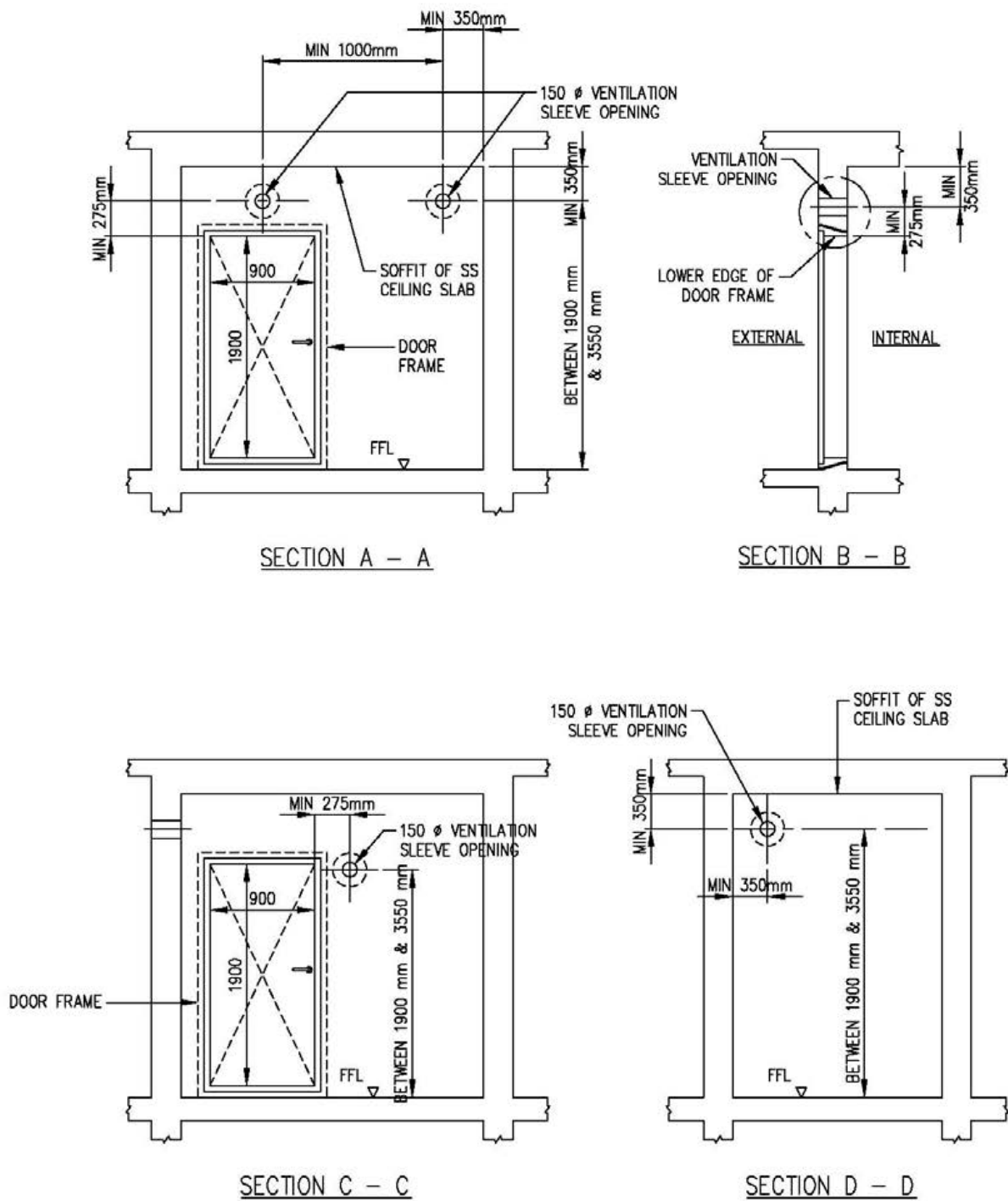


FIGURE 4.2(b) SECTIONAL VIEWS OF VENTILATION SLEEVES

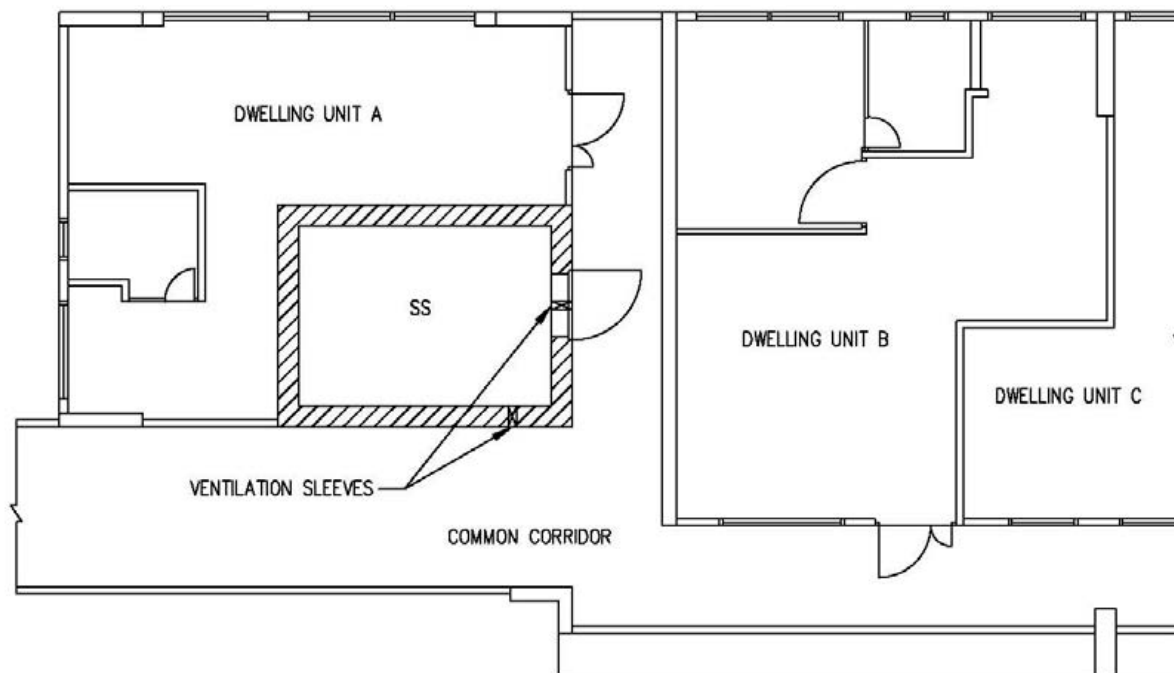


FIGURE 4.2(c) LOCATION OF VENTILATION SLEEVES

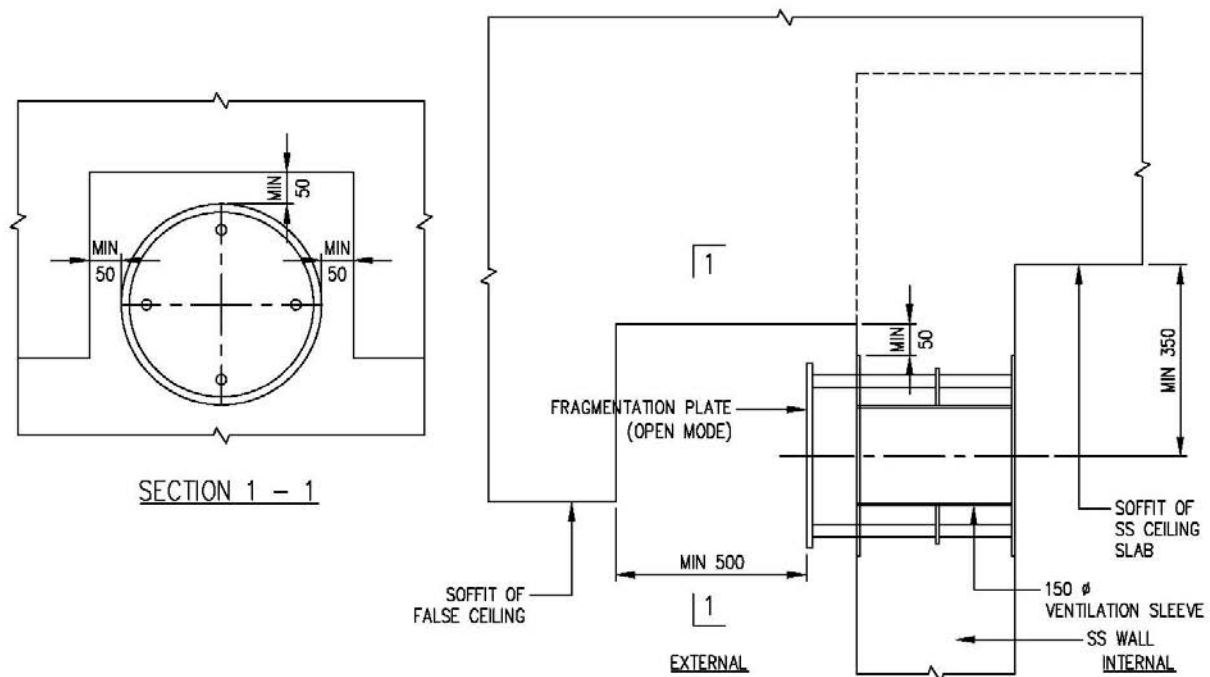


FIGURE 4.3.1 MINIMUM CLEARANCE FOR FRAGMENTATION PLATE

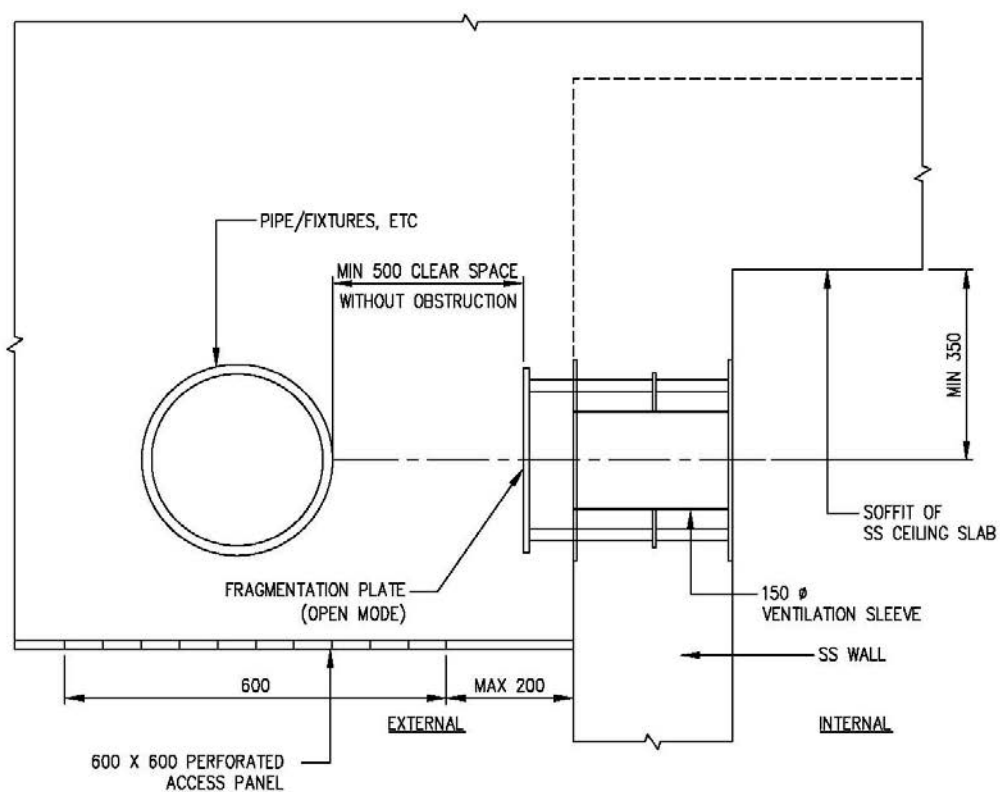
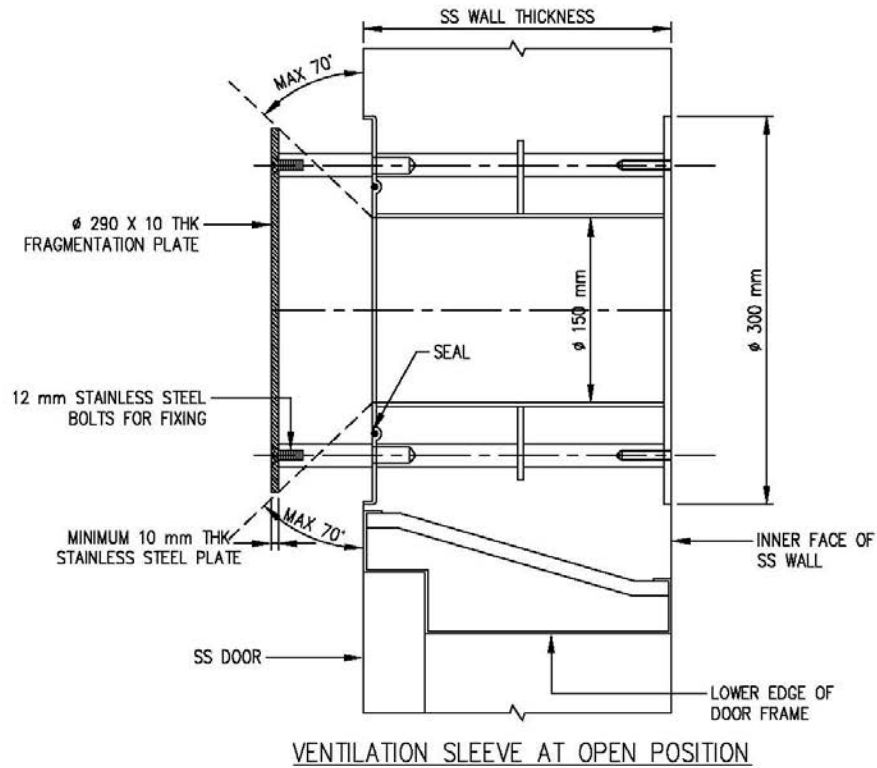


FIGURE 4.3.2 PERFORATED ACCESS PANEL BELOW VENTILATION SLEEVE



NOTE:

1. DETAILS OF VENTILATION SLEEVE REFER TO SHOP DRAWINGS OF APPROVED SUPPLIERS

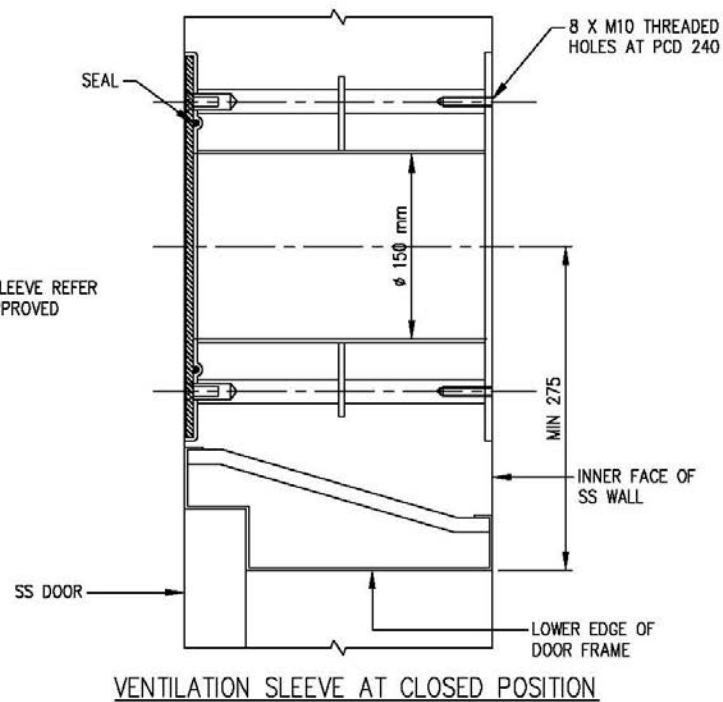


FIGURE 4.4 DETAILS OF VENTILATION SLEEVE AND FRAGMENTATION PLATE

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.

SS Door frame that is cast together with the SS wall shall have single or double door rebate. Refer to Figure 2.5.1(a) and Figure 2.5.1(b).

5.2 APPROVED SS DOOR

Only SS doors of an approved design shall be used and which have been certified and listed under the Product Listing Scheme shall be used.

5.3 REMOVABLE DOOR KERB - Applicable for S/C SS and Scissor S/C SS only

The removable SS door kerb shall be mounted on the top part of SS door frame during peacetime. Refer to FIGURE 5.3.

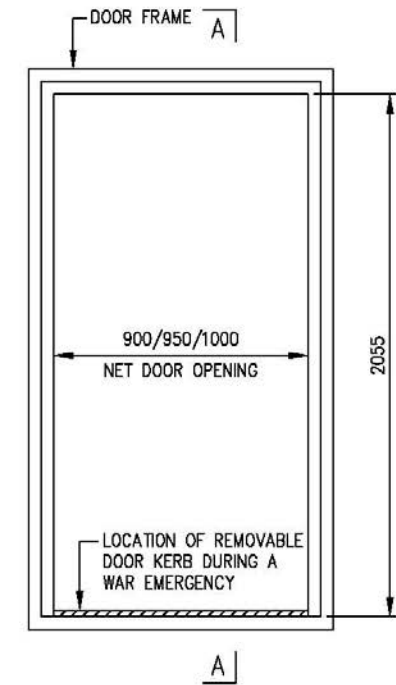
5.4 SS DOOR NOTICE

Every SS door shall have a SS door notice affixed on its internal face. Refer to FIGURE 5.4(a). A sample notices for SS and S/C SS or scissor S/C SS are as shown in FIGURE 5.4(b) and 5.4 (c).

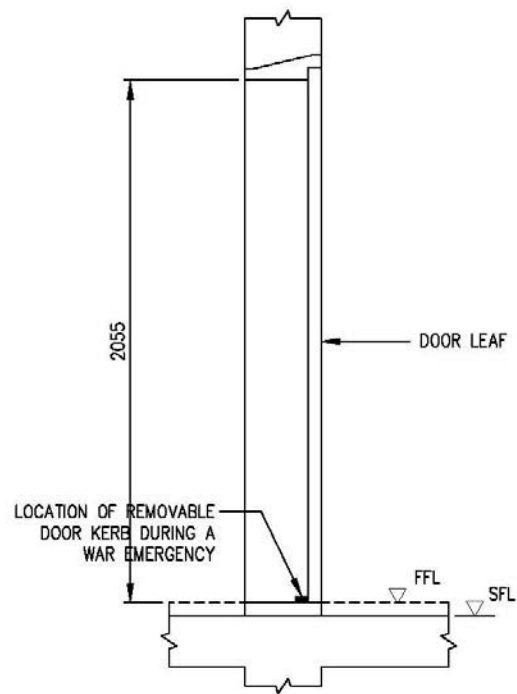
5.5 SPECIFICATIONS OF SS DOOR NOTICE

- | | | |
|-----|--------------------------|---|
| (a) | Manner of Application: | To be affixed on the internal SS door by pressure sensitive and strong adhesive. |
| (b) | Special Features: | Non-brittle, rub and mar resistant, storage stability and colour fastness under light |
| (c) | Text, Lettering, Layout: | Conform to sample notice |
| (d) | Colours: | Background is light yellow, lettering is black, sub-headings, border and triangular logo area are red |

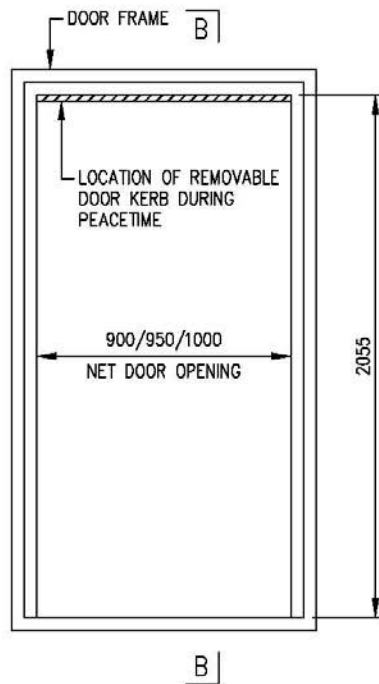




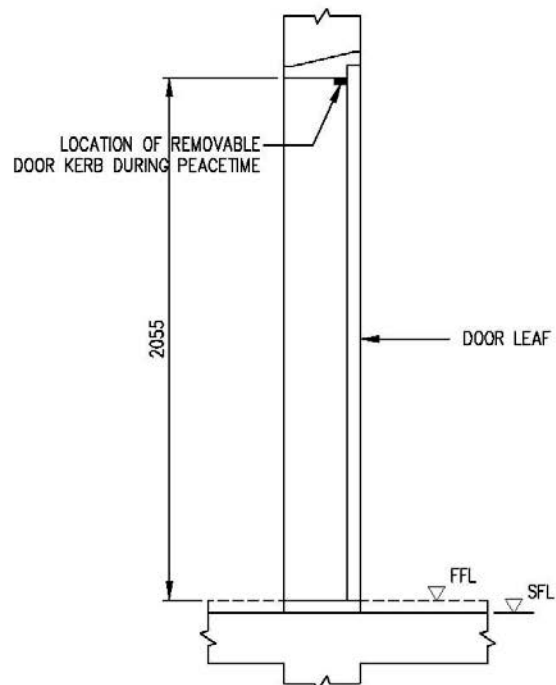
ELEVATION OF SHELTER DOOR



SECTION A - A



ELEVATION OF SHELTER DOOR



SECTION B - B

FIGURE 5.3 MOUNTING OF REMOVABLE KERB

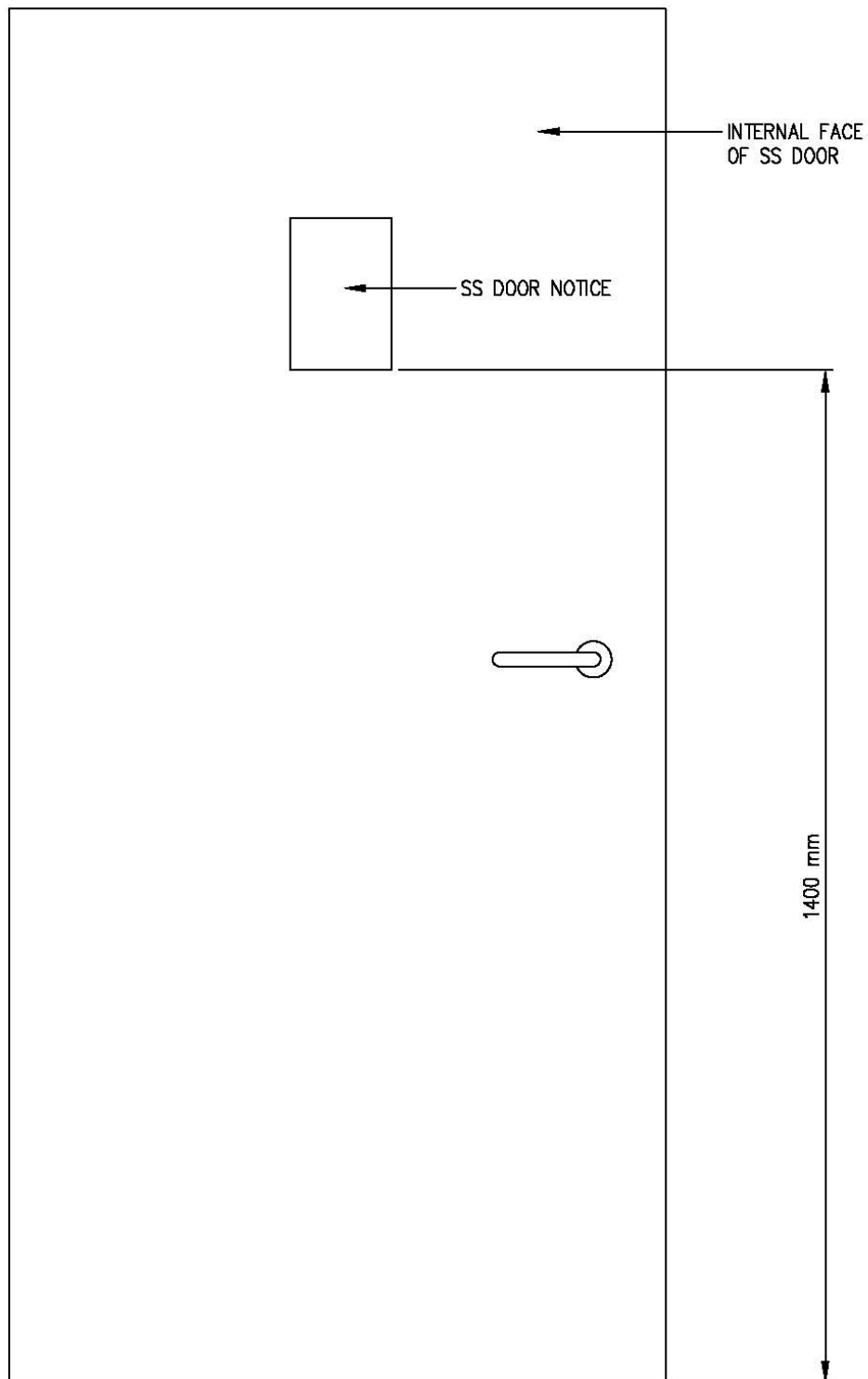


FIGURE 5.4(a) LOCATION OF NOTICE ON SS DOOR

NOTICE

Conversion of Staircase into Civil Defence Storey Shelters:

During a War Emergency:

- ▶ 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.

NOTIS

Penukaran Tangga Menjadi Kubu Bertingkat Pertahanan Awam:

Semasa Kecemasan Peperang:

- ▶ Bergerak ke SS yang telah disediakan tanpa berflegah, menutup pintu SS dan semua pintu pelantar SS yang bertamutan, dengan menggerakkan pemegang pintu tersebut ke "Positi 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 "Positi B" ("Position B"), bagi mengkalikan 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.



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

通告

將樓梯改裝成民防樓層防空壕（SS）：

战争期间：

- ▶ 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。

அறிவிப்பு

புதிதாய்வுகள் குறித்து தலைவர் கூறிய அம்சங்களைக் கவனத்தில் :

உயர்நீதிமன்றம் தீர்மானம் : உயர்நீதிமன்றம் தீர்மானம் :

● **திருக்கட்டுரை** : அங்கு கம்பாற்றத்தில் எவ்வளவு தூரமும் இனிதே சென்று விடும். அங்கு கம்பாற்றமே தற்போதும் கடிவரை மூன்று மூலத்தினால் சூழப்பட்டுள்ளது என்பது அங்கு திருக்கட்டுரை கடிவரைகளில் முடிவாகும். கடிவரை முழுமூலத்து கடிவரை அமைந்த சிறு தெருக்கட்டாண்டு வரைந்ததில் உள்ளது போது **“மீனா”** சிறு தெருவாக வரும்.

● **வடக்குக்கரை** : திருக்கட்டுரை கம்பாற்றமில்லையே தங்கியிருக்கவும். அருட்துள்ள மாங்காப்பாற்றத்துக்கு வலது வேளையால். பதவிபாடி காரையங்குருக்கால் அரைத்து மாங்காப்பாற்ற கடிவரைக்கு முழுமூலம் முழுவிலுக்கு சென்று மேலே அமர்ந்தது தற்போது **“மீனா”** மீனா வேளையால். இதை படி சென்று அங்கு கம்பாற்றம் தனித்தனி பிழிவாசலால் தொடுத்து திருப்புகழ் உறவிலேயும் முடியும்.

● **வலதுக்கரை** : தொலைக்காட்சியை இங்கு சிறுக்கால் அடியிலேயும் குறித்து தகவல்கள் மூன்று சிவப்பி குறுகை தற்போது கம்பாற்றமில்லாது போனது. அங்கு கம்பாற்றம் செல்லியதால். தொலைக்காட்சியை கம்பாற்றத்தில் உள்ள தொலைக்காட்சி எதிர்ப்புகளை வெளிறு அகலத்து போகும்.

● **“அபராத”** **“வடக்கு”** : செலுத்து பிறகு : அங்கு கம்பாற்ற தூறு வலது கடிவரைகள் திறந்து செலுத்து வலதுபுறம் வலதுபுறம்.



SCDF
The Life Saving Force

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 recessible type of plastic cones from the form-tie, the recess 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 and tightly secured in their intended location 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 indiscriminately hacked and plastered back.
- (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.



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.

6.3 PEACETIME REQUIREMENT OF VENTILATION SLEEVES

For ventilation purposes during peacetime, at least 25% of total area of the two ventilation sleeve openings in the SS walls shall be kept uncovered.

In the case of S/C SS and scissor S/C SS, all ventilation sleeve openings shall be fully closed.

6.4 COMMISSIONING REQUIREMENTS

All electrical and communication fixtures such as switch and lighting point, switched socket outlets, TV and radio outlets and communication line for telephony outlet, including SS door notice, rescue hatch (applicable to SS), blast hatch (applicable to S/C SS or scissor S/C SS) 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 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 or the pressure difference between the interior and exterior of the SS. The water manometer and the ^{*}pressure gauge can be used for the test as follows:
- (i) When using the water manometer, the SS is pressurised such that the water level difference in manometer is 25 mm. The SS is considered to have passed the test if the manometer level difference is more than or equal to 5 mm after 45 seconds.
 - (ii) When using pressure gauge, the SS is pressurised by pumping air into the SS such that there is a pressure different of 250 Pa^{*} between inside and outside of SS. The SS is considered to have passed the test if the pressure gauge shows more than or equal to 50 Pa after 45 seconds.

Except in the case of S/C SS or scissor 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.

^{*} The pressure gauge used should have a dial size with a scale of 0 to 50mm or 0 to 500 Pa. (Note: 1 mm = 10 Pa).



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. The total thickness of floor finishes and screed is not to exceed 50mm.
- (b) Laying of floor skirting tiles (up to a maximum of 100 mm high) by bonding them with wet cement mortar to SS walls
- (c) Laying of vinyl or linoleum flooring is permitted in SS but not permitted in S/C SS or scissor S/C SS.
- (d) Applying splatter dash or equivalent to the external face of SS walls only to provide rough surface for feature wall panels or wall tiles installation.
- (e) 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), locking bolts or door seal. The old paint coat on door and door frame is to be removed prior to repainting to avoid increase in paint thickness causing difficulty in closing and opening of the door. The new paint coat must be dried up completely before closing the door as wet or damp paint will cause the door/rubber gasket to stick onto the door frame resulted from opening the closed door.
- (f) Painting on only the exterior face of the 10mm fragmentation stainless steel plate of the ventilation sleeves.
- (g) Drilling into internal face of SS walls and ceiling slabs to a depth of not more than 50 mm to affix inserts and removable screws is permitted in SS but not permitted in S/C SS or scissor S/C SS. Fixtures such as pictures, posters, cabinets or shelves mounted on the internal face of SS walls will have to be removed by the owners within 48 hours upon notification. There is no restriction to the diameter of the non-metallic insert as long as it does not exceed 50mm in length. It is the owner's responsibility to ensure that the strength of the insert is adequately provided for the intended purpose.



- (h) Power driven nails are allowed only on external face of the SS walls to facilitate flexibility in mounting of features/fixtures by owners. The length of power driven nail shall not be more than 75 mm.
- (i) Removal of the fragmentation plates (Clause 4.4) covering the ventilation openings is permitted for SS but not permitted in S/C SS or scissor S/C SS. The removal of fragmentation for SS shall comply with the following conditions:
 - (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 removable 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.
- (j) 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 perforated 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) Laying of 2nd layer of tiles on floor or skirting tiles.
- (d) Installation of cornices within the SS.
- (e) Installation works with fixings using power driving nails into the internal SS walls
- (f) 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.



- (g) 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.
- (h) Hacking to both internal and external face of the SS walls to form key for tiling.
- (i) Hacking on external face of SS wall for mounting of feature wall panels or wall tiles installation.
- (j) Modifying, changing, removing or tampering of SS door.
- (k) Modifying, altering or tampering with any part of the ventilation openings, plates and the mounting devices such as bolts and nuts.
- (l) Painting to the interior face of the 10mm fragmentation stainless steel plate of the ventilation sleeves, the ventilation sleeves, “O” ring rubber gaskets and the four or eight numbers of stainless steel bolts which hold the steel plate to the sleeves.

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.

