TECHNICAL REQUIREMENTS FOR HOUSEHOLD SHELTERS 2012
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CHAPTER 1: INTRODUCTION

1.1 GENERAL

A household shelter (HS) is designed and constructed for the protection of people against weapon effects during a war emergency. It should not be used for protection during other emergency situations such as a fire in a building. For the convenience of the occupants, HS is located inside the individual house or flat.

HS shall be incorporated as part of the house or flat. This can be achieved by efficient space planning as well as optimal integration of the HS location with other spaces in a house or flat.

1.2 APPLICATION OF HS TECHNICAL REQUIREMENTS

The Technical Requirements for HS are applicable to all houses or flats, which are intended as complete and separate units for purpose of private dwelling.

1.3 PEACETIME USE

Every HS shall be designed to a specific peacetime use. The other statutory requirements governing the design and use of the HS space shall also be complied with.

1.4 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Household Shelter*</td>
<td>HS</td>
</tr>
<tr>
<td>2.1</td>
<td>Non-Shelter</td>
<td>NS</td>
</tr>
<tr>
<td>2.4.1 (b)</td>
<td>External Building Line</td>
<td>EBL</td>
</tr>
<tr>
<td>2.5.2 (e)</td>
<td>Finished Floor Level</td>
<td>FFL</td>
</tr>
<tr>
<td>Table 2.2.1 (b)</td>
<td>Gross Floor Area</td>
<td>GFA</td>
</tr>
</tbody>
</table>

*Under the Civil Defence Shelter Act (CDSA), a household shelter would be required in a “new building” which means a building that is constructed on a vacant land or in place of building which has been or would be demolished
### 1.5 DEFINITIONS

<table>
<thead>
<tr>
<th>Clause</th>
<th>Definition</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>The space in the HS tower that is not intended for use as a shelter.</td>
<td>Non-Shelter</td>
</tr>
<tr>
<td>2.2.1 (d)</td>
<td>Relevant Authority means the Commissioner of Singapore Civil Defence Force and includes officers authorised by him generally or specifically to exercise the powers, functions and duties conferred by the Civil Defence Shelter Act.</td>
<td>Relevant Authority</td>
</tr>
<tr>
<td>2.2.2 (a)</td>
<td>Height of HS measured from its FFL to the soffit of the HS ceiling slab.</td>
<td>HS Clear Height</td>
</tr>
<tr>
<td>2.2.2 (b)</td>
<td>Height of NS measured from its FFL to the soffit of the NS ceiling slab.</td>
<td>NS Clear Height</td>
</tr>
<tr>
<td>2.3.2 (a)</td>
<td>The HS located below top-most roof level.</td>
<td>Topmost HS</td>
</tr>
<tr>
<td>2.4.1 (a)</td>
<td>Distance from external face of a HS wall to the nearest EBL.</td>
<td>Setback Distance</td>
</tr>
<tr>
<td>2.4.1 (b)</td>
<td>The edge line of the ceiling slab above the HS wall under consideration.</td>
<td>External Building Line (EBL)</td>
</tr>
<tr>
<td>2.4.1 (c)</td>
<td>A storey which is below the first storey and has at least half of the height of the storey below the level of the ground adjoining its perimeter walls.</td>
<td>Basement Storey</td>
</tr>
<tr>
<td>2.4.2</td>
<td>Where HS (or NS, where applicable) on every storey is located one on top of the other to form a vertical tower.</td>
<td>HS Tower</td>
</tr>
<tr>
<td>2.4.5</td>
<td>HS located in the basement storey of a landed house.</td>
<td>Basement HS</td>
</tr>
</tbody>
</table>
CHAPTER 2: ARCHITECTURAL REQUIREMENTS

2.1 HS OR NS FORM

The configuration of a HS or NS on plan shall be rectangular, square, trapezoidal or L-shaped.

2.2 SIZE OF HS

2.2.1 Area and Volume

(a) The maximum internal length of any floor and roof slab of a HS shall be 4000 mm. The minimum internal width of a HS shall be 1200 mm. The internal length and width of HS walls shall be designed with an increment of 50 mm. See FIGURE 2.2.1(a).

(b) If the configuration of HS on plan is rectangular or square, the minimum internal floor area and minimum internal volume of a HS shall be in accordance with TABLE 2.2.1(b).

(c) If the configuration of HS on plan is trapezoidal or L-shaped, the minimum internal floor area, minimum internal volume of a HS and the number of 0.6 m x 0.6 m square units shall be as specified in TABLE 2.2.1(c) and as illustrated in FIGURE 2.2.1(a).

(d) The maximum internal floor area of a HS shall be 4.8 m². Internal floor area exceeding 4.8 m² may be allowed subject to the approval from the relevant authority.

2.2.2 Height

(a) The minimum and maximum HS clear height shall be 2400 mm and 3900 mm respectively. See FIGURE 2.2.2(a).

(b) The maximum NS clear height shall be 3900 mm. Where NS clear height is more than 3900 mm, intermediate RC slab or RC beams shall be provided. The RC beams shall be designed with at least equivalent stiffness to RC slab. If the NS is designed with 2 walls, RC beams shall be provided at the peripheral of NS. See FIGURE 2.2.2(b).
2.3 WALL AND SLAB THICKNESS OF HS AND NS

2.3.1 Wall Thickness of HS and NS

(a) The minimum HS and NS wall thickness shall be in accordance with TABLE 2.3.1(a) and TABLE 2.3.1(b).

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

(c) Internal common wall between two adjacent HS - 200 mm for non-landed and landed cluster housing developments. See FIGURE 2.3.1(c).

(d) For landed developments where the two HS are abutting each other, the common wall shall be cast as two separate adjoining walls. See FIGURE 2.3.1(d).

(e) The minimum thickness of the basement HS wall which is in direct contact with earth throughout its entire height shall be 250 mm thick. See FIGURE 2.4.5(a) and FIGURE 2.4.5(b).

(f) The minimum thickness of the basement HS wall facing a reinforced concrete basement storey wall without any opening within the influence zone shall be 200 mm. See FIGURE 2.4.5(a) and FIGURE 2.4.5(b).

(g) The minimum thickness of the basement HS wall facing a reinforced concrete basement storey wall with opening within the influence zone shall be in accordance with TABLE 2.3.1(a).

2.3.2 Slab Thickness of HS and Enclosed NS

(a) Ceiling slab of top-most HS in non-landed development - 300 mm. See FIGURE 2.3.2.

(b) Slab between 2 HS - 175 mm. See FIGURE 2.3.2.

(c) Floor slab of bottom-most HS or NS in contact with soil – 200 mm. See FIGURE 2.3.2.

(d) Slab between 2 enclosed NS – 175 mm. See FIGURE 2.3.2.

(e) Slab between HS and enclosed NS – 175 mm. See FIGURE 2.3.2.

(f) Ceiling slab of top-most HS in landed development – 300 mm or 250 mm (if there is a RC roof or another RC slab above the HS that is equal or extend beyond the required setback distance of that HS wall. See FIGURE 2.3.2(f).
2.3.3 **Slab Thickness of HS and Non-Enclosed NS**

(a) Floor slab of HS that is directly supported by non-enclosed NS or NS wall or column – 300 mm. See FIGURE 2.3.2.

(b) Ceiling slab of HS which is below non-enclosed NS, NS walls or columns – 300mm. See FIGURE 2.3.2.

(c) Slab between 2 non-enclosed NS – 175 mm. See FIGURE 2.3.2.

2.4 **LOCATION OF HS**

2.4.1 **HS Position**

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

(b) A HS with minimum 300mm thick ceiling slab in a landed house may have one of its walls (in which the HS door is not located) abutting or near to an air well. The air well, has to be located such that it abuts a party wall and/or is surrounded by reinforced concrete slab at ceiling slab level of the HS or any reinforced concrete slab above ceiling slab of HS. The air well edge line shall not be regarded as EBL for the purpose of determining the minimum setback distance. The area of the air-well shall not be larger than 4.2m² and the longer side of the air-well shall not be larger than 2.8m. See FIGURE 2.4.1(b).

(c) A HS can also be located in the basement storey of a landed house. Where the HS is located underground away from basement of landed house, an underground access route leading to HS must be provided with a reinforced concrete ceiling slab of minimum thickness of 125 mm.

2.4.2 **HS Tower**

(a) In a building of more than one-storey, the HS (or NS, if any) on every storey shall be located one on top of the other to form a vertical tower with its walls (where applicable) continuing to the foundation. See FIGURE 2.4.2(a).

(b) Up to 2 larger HS below main roof level are allowed to be located at the top of the HS tower. Only one wall of the larger HS is allowed to be projected beyond the HS walls below it. The minimum thickness of the projected slab shall follow the wall thickness of the larger HS. See FIGURE 2.4.2(b).

(c) The space within a NS is not intended for protection of occupants during a war emergency.
2.4.3 Setback Distances of HS Walls (Without Reinforced Concrete Down-hang Beams along EBL)

(a) The HS walls shall be located at minimum setback distances from the EBL (See FIGURE 2.4.3a(i) and FIGURE 2.4.3a(ii)). The setback distances of the HS wall with HS door and the remaining 3 HS walls shall comply with TABLE 2.4.3(a).

(b) Where the storey height of a HS on the first storey is up to 3.6 m and is greater than the storey heights of the HS directly above it, the minimum setback distances of the HS on the first storey shall be at least the same as the setback distances of the HS above it.

(c) For HS walls (where the HS 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 1000 mm RC ceiling slab from the HS wall shall be provided. A perpendicular or parallel trellis arrangement, or a combination of both, with respect to the HS wall concerned, shall comply with the geometrical configuration as shown in FIGURE 2.4.3(c).

2.4.4 Setback Distances of HS Walls (With Reinforced Concrete Down-hang Beams along EBL)

(a) Where a down-hang beam is provided along the EBL in front of HS walls, the minimum setback distance of that HS wall can be reduced based on the effective storey height and in accordance with TABLE 2.4.4(a). The effective storey height is determined by the storey height less the depth ‘d’ of the down-hang beam (See FIGURE 2.4.4 (a)). If a down-hang beam is also provided along the EBL in front of the HS wall with HS door, the setback distance of this wall shall be in accordance with TABLE 2.4.4(a).

(b) For HS walls (where the HS 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 1000 mm RC ceiling slab from the HS wall shall be provided (FIGURE 2.4.4(b)). A perpendicular or parallel trellis arrangement, or a combination of both, with respect to the HS wall concerned, shall comply with the geometrical configuration as shown in FIGURE 2.4.3(c).

(c) Where the storey height of a HS on the first storey is up to 3.6 m and is greater than the storey heights of the HS directly above it, the minimum setback distances of the HS on the first storey shall be at least the same as the setback distances of the HS above it. Where a down-hang beam is provided at 2nd storey ceiling slab, the same down-hang beam shall be provided at 1st storey ceiling slab.

(d) Clause 2.4.4 shall apply only if the width of the reinforced concrete down-hang beam is at least 125 mm.
2.4.5 **Setback Distances of Basement HS**

(a) For the HS in the basement, the minimum setback distances of the HS wall with HS door and the remaining 3 HS walls shall comply with the TABLE 2.4.5(a). (See FIGURE 2.4.5(a)).

(b) There is no setback distance requirement for basement HS wall with door if it faces a reinforced concrete basement storey wall not in direct contact with earth and the distance between them is at least 1500 mm (with no openings within the influence zone). (See FIGURE 2.4.5(b)).

(c) There is no setback distance requirement for basement HS wall (without HS door) of landed house (See FIGURE 2.4.5(c)) if the HS wall is:

   (i) in direct contact with earth throughout its full height and the earth extends out by a minimum distance of 1000 mm from the external face of the HS wall; or

   (ii) facing a reinforced concrete basement storey wall in direct contact with earth throughout its full height; or

   (iii) facing a reinforced concrete basement storey wall not in direct contact with earth and the distance between them is at least 800 mm (with no openings within the influence zone).

2.4.6 **Setback Distance of HS located next to RC Lift Core or/ and Refuse Chute or/ and Riser**

RC lift core or/and refuse-chute or/ and riser can be located within the area of setback distances of HS walls. See FIGURE 2.4.6(a) and FIGURE 2.4.6(b).

2.5 **HS DOOR**

2.5.1 **Dimensions**

(a) The opening dimensions of HS door shall be 700mm (W) x 1900mm (H) See FIGURE 2.5.1(a).

(b) HS door frame that is cast together with the HS wall shall have single or double door rebate. See FIGURE 2.5.1(a) and FIGURE 2.5.1(b).

2.5.2 **Door Frame**

(a) There shall be a minimum 150mm reinforced concrete nib next to vertical edge of the HS door frame. (See FIGURE 2.5.2(a)).
(b) For pre-cast door frame panel of Type 1, the reinforced concrete next to two vertical edges of the HS door frame shall be 300mm each. See FIGURE 3.5.4(k).

(c) For pre-cast door frame panel of Type 2, the reinforced concrete next to vertical edges of the HS door frame shall be 300mm on one side, and 150mm plus the HS wall thickness on the other side. FIGURE 3.5.4(p).

(d) For pre-cast door frame panel of Type 3, the reinforced concrete panel with full length or width of HS wall must be properly connected to the in-situ HS walls and slabs. See FIGURE 3.5.4(u).

(e) The door frame must be positioned such that its door is above FFL and can be opened at least 90°. (See FIGURE 2.5.2 (e)).

2.5.3 Strengthened Ceiling Slab Outside HS Door and HS Walls

The minimum thickness of the reinforced concrete ceiling slab immediately outside the HS wall with HS door shall be 125 mm and structurally connected to HS tower (See FIGURE 2.5.3). This requirement shall only apply to HS in non-landed houses.

2.6 FIXTURES IN HS

2.6.1 General

(a) The following electrical and communication fixtures in steel or PVC conduit system shall be provided inside the HS to provide basic stay-in and communication facilities:

i) Switch and lighting points;
ii) 13A switched socket outlets;
iii) Telephone outlet;
iv) TV and radio outlets.

(b) 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.

(c) The mounting height of the lighting switch shall not exceed 1200 mm from the FFL. The other electrical and communication fixtures shall be mounted at between 450 mm and 1200mm from the FFL to comply with the requirement as stipulated in the building codes. See FIGURE 2.6.1(c).
(d) Other fixtures, such as cabinets and shelves, which are required for peacetime use, are allowed provided they are easily dismantled and removed.

2.6.2 Power Points

One 13A switched socket outlet shall be provided in the vicinity of adjacent to the TV and radio outlets. An additional 13A switched socket outlet shall be provided for other electrical appliances such as fan.

2.6.3 Light Fittings

Light fittings shall be mounted on the soffit of HS ceiling slab using screws with non-metallic inserts. Wall-mounted light fittings are not permitted.

2.6.4 Cable Entries and Openings

All cable entry openings to the HS shall be fully and properly sealed to ensure air-tightness as required under Clause 3.6.

2.7 NS IN HS TOWER

2.7.1 Aggregate Wall Heights of NS

(a) Several NS can be stacked one on top of the other within an HS tower, without the need for NS floor slab to be connected to external floor slab, provided that the aggregate wall height of the NS does not exceed 12 m (See FIGURE 2.7.1(a)).

(b) Aggregate wall height of NS refers to the sum of the height(s) of NS between two levels of the HS tower where the full external perimeters of the HS tower at those levels are structurally connected by floor slabs or tie beams to the structural frame of the building. The tie beams shall be designed with at least equivalent stiffness to the floor slab.

(c) The minimum thickness of the intermediate slabs between 2 NS shall be 175 mm.

2.7.2 Shielded and Unshielded NS Walls/Columns

The relevant architectural technical requirements of the shielded and unshielded NS Columns/ Walls as stipulated in Chapter 3 Clause 3.3 shall be complied with.
2.8 TRANSFER STRUCTURE SUPPORTING HS TOWER

2.8.1 General

If the loads from walls of HS towers cannot be carried directly to the foundation, transfer structure can be used to carry the loads indirectly to the foundation. The transfer structure could take the form of slab, beams, or combination of both. When transfer structure is provided to carry HS tower, additional technical requirements described herein shall be complied with. Please note the following conditions in the HS tower design supported by transfer structure:

a) RC slab shall be used as the shielding element of the transfer structure and its supporting columns and walls. See FIGURE 2.8.1(a) and FIGURE 2.8.1(b).

b) The use of trellis or/and the adjacent building structure as shielding element of the transfer structure and its supporting columns and walls of HS is not allowed.

c) Only one transfer of HS loads in each tower by the transfer structure to its supporting columns and/ or walls is allowed. Multiple transfers of HS loads in the same HS tower are not allowed.

d) For unshielded exterior columns, the minimum size (either its diameter or the shorter dimension) shall be 500 mm.

e) The use of prestressed concrete for the transfer structure and its supporting columns and walls is not permitted.

2.8.2 Transfer Structure

Additional design checks on transfer structure supporting HS tower is required (See Chapter 3 Clause 3.3).

2.9 HS BENEATH AN INTERNAL STAIRCASE

If a HS is located beneath an internal staircase, the following requirements shall apply (See FIGURE 2.9):

(a) For the purpose of determining the minimum internal floor area of the HS in accordance with TABLE 2.2.1 (b) and TABLE 2.2.1(c), only the portion of the space with clear height of at least 1500 mm shall be taken into account.

(b) For the purpose of determining the minimum internal volume of the HS in accordance with TABLE 2.2.1(b) and TABLE 2.2.1(c), the entire enclosed space may be used.
(c) The minimum thickness of the HS ceiling slab and waist of the staircase shall be 300 mm.

(d) The minimum clear distance between any two opposite HS walls with ventilation sleeves shall be at least 1000 mm apart. This is to facilitate the installation of the ancillaries to the ventilation sleeves.

2.10 FINISHES IN HS

Finishes within a HS 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.

2.11 EXIT STAIRCASE

Where there is only one exit staircase or exit scissors-staircase serving the non-landed houses, 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.

2.12 DOOR RECESS ON HS WALL

A door recess on HS wall to accommodate the protrusion of the HS door handle when the HS door is fully open is allowed provided that (See FIGURE 2.12):

a) The dimensions are not larger than 160 mm (length) x 80 mm (height) x 40 mm (depth) for HS wall of minimum 250 mm thickness.

b) The spacing between the HS door handle recess and the external/ or internal socket points shall be at least 300 mm apart.
### TABLE 2.2.1(b): MINIMUM INTERNAL HS FLOOR AREA AND VOLUME

<table>
<thead>
<tr>
<th>GFA* of a House (m²)</th>
<th>HS Floor Area** (m²)</th>
<th>HS Volume (m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFA ≤ 45</td>
<td>1.6</td>
<td>3.6</td>
</tr>
<tr>
<td>45 &lt; GFA ≤ 75</td>
<td>2.2</td>
<td>5.4</td>
</tr>
<tr>
<td>75 &lt; GFA ≤ 140</td>
<td>2.8</td>
<td>7.2</td>
</tr>
<tr>
<td>GFA &gt; 140</td>
<td>3.4</td>
<td>9.0</td>
</tr>
</tbody>
</table>

* The GFA of the house 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. Service balconies, which are commonly provided at the utility areas for the purpose of drying clothes, would therefore not qualify for exclusion.

** Whenever possible a larger HS internal floor area (up to a maximum size of 4.8 m²) should be provided to enable a relatively more comfortable stay during a war emergency.

### TABLE 2.2.1(c): NUMBER OF SQUARE UNITS (0.6 m x 0.6 m) USED FOR THE ASSESSMENT OF TRAPEZOIDAL OR L-SHAPED HS

<table>
<thead>
<tr>
<th>GFA* of a House (m²)</th>
<th>HS Floor Area** (m²)</th>
<th>HS Volume (m³)</th>
<th>Number of Square Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>GFA ≤ 45</td>
<td>1.6</td>
<td>3.6</td>
<td>3</td>
</tr>
<tr>
<td>45 &lt; GFA ≤ 75</td>
<td>2.2</td>
<td>5.4</td>
<td>4</td>
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<tr>
<td>75 &lt; GFA ≤ 140</td>
<td>2.8</td>
<td>7.2</td>
<td>5</td>
</tr>
<tr>
<td>GFA &gt; 140</td>
<td>3.4</td>
<td>9.0</td>
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### TABLE 2.3.1(a): MINIMUM HS WALL THICKNESS (FOR LANDED DEVELOPMENT)

<table>
<thead>
<tr>
<th>HS Clear Height (mm)</th>
<th>Setback Distance of HS Wall (mm)</th>
<th>HS Wall Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 ≤ Ht ≤ 3900</td>
<td>≤ 6000</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>&gt; 6000</td>
<td>200</td>
</tr>
</tbody>
</table>

### TABLE 2.3.1(b): MINIMUM HS AND NS WALL THICKNESS (FOR NON-LANDED DEVELOPMENT)

<table>
<thead>
<tr>
<th>HS Clear Height (mm)</th>
<th>Setback Distance of HS Wall (mm)</th>
<th>Wall Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 ≤ Ht ≤ 3000</td>
<td>≤ 6000</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>&gt; 6000</td>
<td>200</td>
</tr>
<tr>
<td>3000 &lt; Ht ≤ 3200</td>
<td>≤ 6000</td>
<td>275</td>
</tr>
<tr>
<td></td>
<td>&gt; 6000</td>
<td>225</td>
</tr>
<tr>
<td>3200 &lt; Ht ≤ 3900</td>
<td>≤ 6000</td>
<td>300</td>
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<tr>
<td></td>
<td>&gt; 6000</td>
<td>250</td>
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</tbody>
</table>
### Table 2.4.3(a): Minimum Setback Distances of HS Walls Without Reinforced Concrete Down-Hang Beam Along EBL

<table>
<thead>
<tr>
<th>S/No</th>
<th>Storey Height (mm)</th>
<th>Setback Distance of HS Wall with HS Door (mm)</th>
<th>Setback Distance of HS Walls without HS Door (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Column (1)</td>
<td>Column (2)</td>
<td>Column (3)</td>
</tr>
<tr>
<td>1</td>
<td>2500 ≤ Ht ≤ 2800</td>
<td>2750</td>
<td>2000</td>
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<tr>
<td>2</td>
<td>2800 &lt; Ht ≤ 3100</td>
<td>2900</td>
<td>2200</td>
</tr>
<tr>
<td>3</td>
<td>3100 &lt; Ht ≤ 3200</td>
<td>2950</td>
<td>2300</td>
</tr>
<tr>
<td>4</td>
<td>3200 &lt; Ht ≤ 3400</td>
<td>3050</td>
<td>2400</td>
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<td>5</td>
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<td>3600</td>
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<tr>
<td>8</td>
<td>4500 &lt; Ht ≤ 5000</td>
<td>3850</td>
<td>3150</td>
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<tr>
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<td>3600</td>
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<tr>
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<td>3850</td>
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<td>12</td>
<td>6500 &lt; Ht ≤ 7000</td>
<td>4800</td>
<td>4100</td>
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<tr>
<td>13</td>
<td>7000 &lt; Ht ≤ 7500</td>
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### TABLE 2.4.4(a): MINIMUM SETBACK DISTANCES OF HS WALLS WITH REINFORCED CONCRETE DOWN-HANG BEAM ALONG EBL

<table>
<thead>
<tr>
<th>S/No</th>
<th>Effective Storey Height* (mm)</th>
<th>Setback Distance of HS Wall With HS Door (mm)</th>
<th>Setback Distance of HS Walls without HS Door (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Column (1)</td>
<td>Column (2)</td>
<td>Column (3)</td>
</tr>
<tr>
<td>1</td>
<td>Ht &lt; 2200</td>
<td>2750</td>
<td>1800</td>
</tr>
<tr>
<td>2</td>
<td>2200 ≤ Ht ≤ 2800</td>
<td>2750</td>
<td>2000</td>
</tr>
<tr>
<td>3</td>
<td>2800 &lt; Ht ≤ 3100</td>
<td>2900</td>
<td>2200</td>
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<tr>
<td>19</td>
<td>9500 &lt; Ht ≤ 10000</td>
<td>6250</td>
<td>5500</td>
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</tbody>
</table>

*Effective Storey Height = Storey Height – Depth ‘d’ of Down-hang Beam. Refer to Figure 2.4.4(a).
<table>
<thead>
<tr>
<th>S/No</th>
<th>Storey Height (mm)</th>
<th>Setback Distance of HS Wall with HS Door (mm)</th>
<th>Setback Distance of HS Walls without HS Door (mm)</th>
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<tr>
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<td>Column (1)</td>
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<td>18</td>
<td>$9500 &lt; Ht \leq 10000$</td>
<td>6250</td>
<td>5500</td>
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</table>
FIGURE 2.2.1(a) EXAMPLES OF HS OF DIFFERENT SHAPES
FOR GFA = 100 m², HS SIZE = 2.8 m², NUMBER OF SQUARE UNITS = 5
FIGURE 2.2.2(a) HS CLEAR HEIGHT IN NON-LANDED AND LANDED DEVELOPMENTS
FIGURE 2.2.2(b) SECTION OF HS TOWER SHOWING HS AND NS CLEAR HEIGHTS
FIGURE 2.3.1(c) INTERNAL COMMON WALL BETWEEN TWO HS IN NON-LANDED AND LANDED CLUSTER HOUSING DEVELOPMENTS
FIGURE 2.3.1(d) SEPARATE WALLS BETWEEN TWO HS IN INTERMEDIATE LANDED DEVELOPMENTS
FIGURE 2.3.2 HS TOWER SHOWING HS AND NS (WITH ENCLOSED AND NON-ENCLOSED NS WALL) SLAB THICKNESS
FIGURE 2.3.2(f) MINIMUM DIMENSIONS OF CEILING SLAB FOR HS IN LANDED DEVELOPMENT
FIGURE 2.4.1(b) HS WALL ABUTTING AN AIR WELL IN A LANDED DEVELOPMENT
FIGURE 2.4.2(a) SCHEMATIC SECTION OF HS TOWER

NOTES:
1. HS TOWER WITH HS AND NS
   WHERE APPLICABLE
FIGURE 2.4.2(b) HS TOWER WITH TWO LARGER HS AT THE TOP
FIGURE 2.4.3a (i) REQUIREMENT ON SETBACK DISTANCE OF HS WALLS (WITHOUT DOWN-HANG BEAM)
(STOREY HEIGHT ≤ 2800 mm)
(FOR OTHER STOREY HEIGHTS, SEE TABLE 2.4.3(a))
FIGURE 2.4.3a (ii) SETBACK DISTANCE OF HS WALLS (WITHOUT DOWN-HANG BEAM)
FIGURE 2.4.3(c) USAGE OF TRELLIS (RC/STEEL HOLLOW SECTIONS) TO MAKE UP FOR SHORTFALL IN SETBACK DISTANCE
FIGURE 2.4.4(a) REQUIREMENT ON SETBACK DISTANCE OF HS 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
FIGURE 2.4.5(a) PLAN OF A BASEMENT HS

FIGURE 2.4.5(b) PLAN OF A BASEMENT HS
(WITH HS DOOR FACES RC BASEMENT STOREY WALL)
FIGURE 2.4.5(c) SECTIONAL VIEW OF A BASEMENT HS
FIGURE 2.4.6(a) HS LOCATED NEXT TO LIFT SHAFT

FIGURE 2.4.6(b) HS LOCATED NEXT TO REFUSE CHUTE AND RISER
FIGURE 2.5.1(a) HS DOOR FRAME WITH SINGLE DOOR REBATE

FIGURE 2.5.1(b) HS DOOR FRAME WITH DOUBLE DOOR REBATES
FIGURE 2.5.2(a) CONCRETE WALL SEGMENT AT HS DOOR

FIGURE 2.5.2(e) HS DOOR KERB
FIGURE 2.5.3 REQUIREMENTS FOR STRENGTHENED CEILING SLAB IN FRONT OF HS DOOR IN NON-LANDED DEVELOPMENT
FIGURE 2.6.1(c) FIXTURES IN HS
FIGURE 2.7.1(a) HS TOWER
FIGURE 2.8.1(a) SHIELDING OF TRANSFER STRUCTURES SUPPORTING HS TOWER
FIGURE 2.8.1(b) SHIELDING OF TRANSFER SLAB/BEAMS/EXTERIOR COLUMNS/WALLS
FIGURE 2.9  HS BENEATH AN INTERNAL STAIRCASE

SECTIONAL ELEVATION  
(TYPE A)

NOTE:
THE DIMENSION, L, OF THE FLOOR SHALL BE USED FOR COMPUTING THE INTERNAL
HS FLOOR AREA FOR THE PURPOSE OF TABLE 2.2.1(b) OR TABLE 2.2.1(c).

SECTIONAL ELEVATION  
(TYPE B)
FIGURE 2.12 DETAILS OF WALL RECESS FOR HS DOOR HANDLE

NOTES:
1) BOTH INTERNAL AND EXTERNAL ELECTRICAL FIXTURES SHALL BE AT LEAST 300 mm APART FROM THE WALL RECESS
2) PROVISION OF WALL RECESS AT THE HS WALL BY HAKING / CUTTING IS NOT ALLOWED
CHAPTER 3: STRUCTURAL REQUIREMENTS

3.1 GENERAL

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

The HS 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 HS elements shall be Grade 30. The use of prestressed concrete for the HS tower, and the transfer structure and its supporting walls and columns is not permitted.

3.2.2 Steel Reinforcement

The steel reinforcement of concrete shall be welded steel fabric mesh and hot rolled steel bars. The minimum yield stress for the main reinforcements and shear links in the structural elements forming the HS or NS shall be 460 N/mm² and 250 N/mm² respectively.

3.3 ANALYSIS

3.3.1 General

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

3.3.2 Beam Supported on HS wall

The end of the beam that is supported on HS wall shall be designed and detailed as simply support. This requirement shall only apply to HS in non-landed houses.

3.3.3 Shielded NS walls and/or NS columns

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

3.3.4 **Unshielded NS Wall(s) and/or NS Columns**

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

(a) **Unshielded NS Wall(s)**

The minimum thickness of each NS wall shall be 300 mm. The HS tower shall be designed against the most severe effects as the result of the removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter on the NS wall at its most critical location (See FIGURE 3.3.4(a)).

(b) **Unshielded NS Column(s)**

The minimum size (either its diameter or the shorter dimension) of NS column shall be 500 mm. The HS tower shall be designed against the most severe effects as the result of the removal of any one NS column (See FIGURE 3.3.4(b)).

(c) **Combination of Unshielded NS Wall(s) and NS Column(s)**

The minimum thickness of each NS wall and minimum size (either its diameter or the shorter dimension) of NS column shall be 300 mm and 500 mm respectively. The HS tower shall be designed against the most severe effects as the result of the following (See FIGURE 3.3.4(c)):

(i) 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 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 3.3.4(a), 3.3.4(b) or 3.3.4(c):

(i) The design loads shall be based on the load combination and values of partial safety factors for loads ($\gamma_f$) 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 ($\gamma_m$), which shall be 1.3 for concrete and 1.0 for reinforcement.
3.3.5 Transfer Structure Supporting HS Tower

3.3.5.1 Design Against Collapse Load

The design loads for the transfer structure shall include a collapse load of 20kN/m² acting on transfer slab/beam. An additional load combination in the design, incorporating the collapse load, shall be considered with partial safety factors for loads (γf) given in Table 3.3.5.1. Only one transfer of HS loads in each tower by the transfer structure to its supporting columns and/or walls is allowed. Multiple transfers of HS load in the same HS tower is not allowed. See FIGURE 2.8.1(c).

3.3.5.2 Shielded Transfer Structure

No additional design checks on transfer structure are required, besides the requirement in Clause 3.3.5.1, if the transfer structures are shielded by RC slab or other equivalent structural forms. The transfer structure is deemed adequately shielded if Clause 3.3.5.2(a) and 3.3.5.2(b) are complied with:

(a) Shielding of Transfer slab/beams

The transfer slab/beams are deemed to be shielded if RC shielding slab or other equivalent structural forms is provided directly above the transfer slab/beams and is extended beyond their external edges by a minimum length of 0.5H₁, where H₁ is the vertical distance between the top level of the RC shielding slab and the soffit of transfer slab/beams (See FIGURE 3.3.5.2(a)).

(b) Shielding of Exterior Columns

The transfer columns are deemed to be shielded if RC shielding slab or other equivalent structural forms is provided above the exterior columns and is extended beyond their exterior edges by a minimum length of 0.5H₂ or 0.5H₃, where H₂ and H₃ are the vertical distances between the top level of the RC shielding slab and the base of the exterior columns (See FIGURE 3.3.5.2(a)).

3.3.5.3 Unshielded Transfer Structure

Besides the requirement in Clause 3.3.5.1, additional design checks on unshielded transfer structure (See FIGURE 3.3.5.3) shall be carried out in accordance with the following requirements:

(a) Unshielded Transfer Slab/Beams

The transfer structure shall be designed against the most severe effects as
the result of the removal of a portion of the transfer slab/beam equivalent to an opening of 1500 mm diameter on the transfer slab/beams at its most critical location (See FIGURE 3.3.5.3a (i) and FIGURE 3.3.5.3a (ii)).

(b) **Unshielded Exterior Columns and Walls**

The minimum size (either its diameter or shorter dimension) of the exterior columns shall be 500 mm and the minimum thickness of the wall shall be 300 mm. The transfer structure shall be designed against the most severe effects as the result of the removal of any one exterior column at a time or the removal of a portion of the exterior wall equivalent to an opening of 1500 mm diameter on the transfer wall at its most critical location. Alternative path for load transfer shall be designed for such cases (See FIGURE 3.3.5.3b (i) and FIGURE 3.3.5.3b (ii)).

(c) The following are the criteria to be used when performing design checks for Clause 3.3.5.3(a) and 3.3.5.3(b):

(i) The design loads including collapse load, shall be based on the load combination and values of partial safety factors for loads \( (\gamma_f) \) in accordance with Table 3.3.5.3.

(ii) The design strength for a given material is derived from the characteristic strength divided by the partial safety factor for strength of material \( (\gamma_m) \), 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 HS 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 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 HS and NS**

(a) Minimum Reinforcement in HS walls in landed development – refer to TABLE 3.4.2.1(a).

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

3.4.2.2 Slab Reinforcements of HS and NS

Top and bottom reinforcements of the slab shall be T10-100 c/c in both directions. The shear links shall be R6-600 c/c in both directions.

3.4.2.3 Ceiling Slab Immediately Outside the HS

(a) The ceiling slab immediately outside the HS wall with HS door shall be constructed of reinforced concrete. Two layers of reinforcement bars (top and bottom) of T10-100mm c/c in both directions shall be provided for the ceiling slab with minimum 125mm thick.

(b) The reinforcements of every floor slab immediately outside HS tower walls shall be structurally connected to HS tower.

3.4.2.4 HS Slab Which Is Integrated With Pile-Cap/ Footing

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

3.5 DETAILING OF HS TOWER

3.5.1 General

The HS tower is to be detailed to allow for the installation of services and fixtures in HS and to resist spalling of the internal face of HS walls, soffit of ceiling slabs and/or finishes on HS 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 bars to attain tension anchorage length or tension lapped 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 and Precast Elements**

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

- FIGURE 3.5.4 (a) - Plan of HS
- FIGURE 3.5.4 (b) - Sectional details of HS slabs/walls
- FIGURE 3.5.4 (c) - Sectional details of HS slabs/walls
- FIGURE 3.5.4 (d) - Plan of two HS with an internal common wall
- FIGURE 3.5.4 (e) - Sectional details of two HS with an internal common wall
- FIGURE 3.5.4 (f) - Details of HS wall reinforcement bar near HS door
- FIGURE 3.5.4 (g) - Typical details of embedded conduit in HS wall
- FIGURE 3.5.4 (h) - Typical details of trimmer bars for ventilation sleeve
- FIGURE 3.5.4 (i) - Typical details of trimmer bars for wall recess
- FIGURE 3.5.4 (j) - Details of shear links in HS slabs/walls

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

- FIGURE 3.5.4 (k) - Plan of HS with pre-cast HS door frame panel (Type 1)
- FIGURE 3.5.4 (l) - Details and Sections of pre-cast HS door frame panel with ventilation sleeve above it (Type 1)
- FIGURE 3.5.4 (m) - Sections of pre-cast HS door frame panel with ventilation sleeve above it (Type 1)
- FIGURE 3.5.4 (n) - Details and Sections of pre-cast HS door frame panel with ventilation along its side (Type 1)
- FIGURE 3.5.4 (o) - Sections of pre-cast HS door frame panel with ventilation along its side (Type 1)
3.5.5 Joints

(a) Construction joints in an HS tower shall be properly executed to ensure that the strength and the integrity of the HS 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 HS walls located within each storey shall be cast in one operation.

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

3.6 PENETRATION OF SERVICES

3.6.1 Electrical Services

(a) All service conduits shall not penetrate through the walls and slabs of the HS. Service conduits for electrical and communication fixtures which are located at external HS walls can be embedded in the HS wall. Other than this, all service conduits which do not serve the HS shall not be embedded within the HS walls and slabs.

(b) Two cast-in service outlets located directly back to back on the internal and external faces of the HS wall are not permitted (See FIGURE 3.6.1(b)).
Service outlets shall be fixed with at least a clear distance of 300 mm between each other (See FIGURE 2.12).

c) Risers for services can be mounted on the external face of HS tower walls.

d) Where service cables and fixtures in the HS are exposed on internal walls, non-metallic inserts are to be used for their mounting. For embedded service cables and fixtures serving the HS, the details as shown in FIGURE 3.5.4(g) shall be followed. The encasement for the switch, 13A switched socket outlet, TV, radio and telephone outlets of Clause 2.6 shall be made of hot-dipped galvanised steel construction (See FIGURE 3.6.1(d)).

e) A maximum of 4 numbers of 25 mm diameter conduits are allowed to be embedded within the HS walls for electrical cables serving fixtures in the HS. Both ends of these conduits on the internal and the external of the HS shall be fully sealed with sealing material in accordance with the manufacturer’s specification and up to a depth of not less than 100 mm into the conduits to ensure air-tightness of HS.

(f) Where an HS or NS share a common wall with lift shaft or services risers, material used for connection of services on the common wall shall be made of stainless steel. For the purpose of installing M&E equipment in the lift core or services risers, cast-in bar with threaded end or anchor bolts shall be used in this common wall. Where anchor bolts are used, it shall be installed according to manufacturer’s technical specification. The spacing of the anchor bolts, measured between their centrelines, shall be more than 300 mm.

3.6.2 Water and Gas Services

(a) Service pipes for water or gas are allowed to penetrate through the HS walls provided that they are laid inside a stainless steel casing encased by 150 mm reinforced concrete all round (See FIGURE 3.6.2(a)). Joints in water pipe, gas pipe or the stainless steel conduit shall be located outside the HS.

(b) Risers for water and gas services can be mounted on the external face of HS walls.
### TABLE 3.3.4: LOAD COMBINATION AND VALUES OF PARTIAL SAFETY FACTORS ($\gamma_f$) FOR ULTIMATE LIMIT STATE
(Unshielded NS Walls, Unshielded NS Columns or a Combination of Unshielded NS Walls and NS Columns)

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>Load Types</th>
<th>Dead</th>
<th>Imposed</th>
<th>Earth and Water Pressure</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead and imposed and wind (and earth and water pressure)</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>1.05</td>
</tr>
</tbody>
</table>

### TABLE 3.3.5.1: LOAD COMBINATION AND VALUES OF PARTIAL SAFETY FACTORS ($\gamma_f$) FOR ULTIMATE LIMIT STATE
(Design against Collapse Load and Unshielded/Shielded Transfer Structure)

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>Load Types</th>
<th>Dead</th>
<th>Imposed</th>
<th>Earth and Water Pressure</th>
<th>Wind</th>
<th>Collapse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead and imposed and wind and collapse load (and earth and water pressure)</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>1.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

### TABLE 3.3.5.3: LOAD COMBINATION AND VALUES OF PARTIAL SAFETY FACTORS ($\gamma_f$) FOR ULTIMATE LIMIT STATE
(Unshielded Transfer Structure)

<table>
<thead>
<tr>
<th>Load Combination</th>
<th>Load Types</th>
<th>Dead</th>
<th>Imposed</th>
<th>Earth and Water Pressure</th>
<th>Wind</th>
<th>Collapse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead and imposed and wind and collapse load (and earth and water pressure)</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>Adverse</td>
<td>Beneficial</td>
<td>1.05</td>
<td>1.05</td>
</tr>
</tbody>
</table>
### TABLE 3.4.2.1(a): MINIMUM REINFORCEMENT OF HS WALLS FOR LANDED DEVELOPMENTS

<table>
<thead>
<tr>
<th>HS Clear Height (mm)</th>
<th>Reinforcements at both internal and external faces of wall (both directions)</th>
<th>Shear Links (both directions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 ≤ Ht ≤ 3900</td>
<td>T10 - 100</td>
<td>R6 - 600</td>
</tr>
</tbody>
</table>

### TABLE 3.4.2.1(b): MINIMUM REINFORCEMENT OF HS OR NS WALLS FOR NON-LANDED DEVELOPMENTS

<table>
<thead>
<tr>
<th>HS or NS Clear Height (mm)</th>
<th>Reinforcements at both internal and external faces of wall (both directions)</th>
<th>Shear Links (both directions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400 ≤ Ht ≤ 3000</td>
<td>T10 - 100</td>
<td>R6 - 600</td>
</tr>
<tr>
<td>3000 &lt; Ht ≤ 3900</td>
<td>T13 - 100</td>
<td>R6 - 600</td>
</tr>
</tbody>
</table>
FIGURE 3.3.3 SHIELDED NS WALLS AND/OR NS COLUMNS
FIGURE 3.3.4(a) UNSHIELDED NS WALL(S)

FIGURE 3.3.4(b) UNSHIELDED NS COLUMN(S)

FIGURE 3.3.4(c) COMBINATION OF UNSHIELDED NS WALL(S) AND/OR NS COLUMN(S)
FIGURE 3.3.5.2(a) SHIELDED TRANSFER SYSTEM THAT SUPPORTS HS TOWER
FIGURE 3.3.5.3 UNSHIELDED TRANSFER SYSTEM THAT SUPPORTS HS TOWER (UNSHIELDED SLAB/BEAM OR/AND COLUMNS/WALLS)
FIGURE 3.3.5.3a (i) UNSHIELDED TRANSFER BEAMS

FIGURE 3.3.5.3a (ii) UNSHIELDED TRANSFER SLAB
FIGURE 3.3.5.3b (i) UNSHIELDED TRANSFER WALLS

SECTIONAL PLAN B – B

FIGURE 3.3.5.3b (ii) UNSHIELDED TRANSFER COLUMNS

SECTIONAL PLAN B – B
PLAN OF HS WALL AT DOOR OPENING

PLAN OF HS WALL ABOVE DOOR OPENING

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(c) 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 = 20 N/mm²

FIGURE 3.5.4(a) PLAN OF HS
FIGURE 3.5.4(b) SECTIONAL DETAILS OF HS SLABS/WALLS

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 27 TIMES THE DIAMETER OF THE REINFORCEMENT BAR.
FIGURE 3.5.4(c) SECTIONAL DETAILS OF HS SLABS/WALLS

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(c) FOR LANDED DEVELOPMENT OF 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 3.5.4(d) PLAN OF TWO HS WITH AN INTERNAL COMMON WALL

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 3.5.4(e) SECTIONAL DETAILS OF TWO HS WITH AN INTERNAL COMMON WALL

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

SECTION A - A
FIGURE 3.5.4(f) DETAILS OF HS WALL REINFORCEMENT BAR
NEAR HS DOOR

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANDED DEVELOPMENT OR TABLE 3.4.2.1(q) 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 3.5.4(g) TYPICAL DETAILS OF EMBEDDED CONDUIT IN HS WALL
FIGURE 3.5.4(h) TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE

VENTILATION SLEEVE LOCATED ABOVE DOOR

VENTILATION SLEEVE NOT LOCATED ABOVE DOOR

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

ELEVATION OF WALL RECESS
(IF WALL REINFORCEMENT BARS ARE CUT FOR WALL RECESS)
FIGURE 3.5.4(j) DETAILS OF SHEAR LINKS IN HS SLABS/WALLS

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
4. THE HOOK AND THE BEND OF R6 LINKS MUST BE TIED TO OUTERMOST REINFORCEMENT BARS OF HS WALL WHERE THE HS WALL MUST ALWAYS BE AT LEAST 1/8 INCH FROM STRUCTURAL FABRIC

MINIMUM HOOK AND BEND ALLOWANCE FOR SHEAR LINKS (R6)

MINIMUM R6 = 600 C/C (BOTH DIRECTIONS)
FIGURE 3.5.4(k) PLAN OF HS WITH PRE-CAST
HS DOOR FRAME PANEL (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 3.5.4(l) DETAILS AND SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 1)

NOTE:
1. WALL REINFORCMENT REFER TO TABLE 3.4.2.1(a) FOR LANCED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANCED DEVELOPMENT
2. TENSION LAP LENGTH AND TENSION ANCHORAGE LENGTH TO BE 3.5 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
3. MIN CONCRETE GRADE = 30 N/mm²
FIGURE 3.5.4(m) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 1)
FIGURE 3.5.4(n) DETAILS AND SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 1)
FIGURE 3.5.4(o) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 1)
NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANCED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANCED 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 3.5.4(p) PLAN OF HS WITH PRE-CAST HS DOOR FRAME PANEL (TYPE 2)
FIGURE 3.5.4(q) DETAILS AND SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 2)

1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(c) 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 3.5.4(r) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ABOVE IT (TYPE 2)

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

TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE
FIGURE 3.5.4(s) DETAILS AND SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 2)

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. MN CONCRETE GRADE = 30 N/mm².
FIGURE 3.5.4(t) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL WITH VENTILATION SLEEVE ALONG ITS SIDE (TYPE 2)

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.

TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE:

- Additional trimmer bars around ventilation sleeve on both face (size of bars to follow wall reinf bar).
- 125 # ventilation sleeve opening.
- Door opening.

SECTION D - D

SECTION E - E
FIGURE 3.5.4(u) PLAN OF HS WITH PRE-CAST DOOR FRAME PANEL (TYPE 3)

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.(a) FOR LANDED DEVELOPMENT OR TABLE 3.4.2.(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
ELEVATION

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANCED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANCED 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 3.5.4(v) DETAILS OF PRE-CAST HS DOOR FRAME PANEL (TYPE 3)
FIGURE 3.5.4(w) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL (TYPE 3)

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 3.7 TIMES THE DIAMETER OF THE REINFORCEMENT BAR
3. MIN CONCRETE GRADE = 30 N/mm²
FIGURE 3.5.4(x) SECTIONS OF PRE-CAST HS DOOR FRAME PANEL (TYPE 3)

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANCED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANCED 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

TYPICAL DETAILS OF TRIMMER BARS FOR VENTILATION SLEEVE

SECTION D – D

SECTION E – F

MIN R6 = 600 C/C (BOTH DIRECTIONS)
MIN T10 = 100
400

WALL REINFORCEMENT BARS AT 100 C/C (TO BE BEND INTO SLAB AFTER INSTALLATION)

WALL REINFORCEMENT MESH AT 100 C/C

NOTE:
1. WALL REINFORCEMENT REFER TO TABLE 3.4.2.1(a) FOR LANCED DEVELOPMENT OR TABLE 3.4.2.1(b) FOR NON-LANCED 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

WALL REINFORCEMENT BARS AT 100 C/C (TO BE BEND INTO SLAB AFTER INSTALLATION)

WALL REINFORCEMENT MESH AT 100 C/C

WALL REINFORCEMENT BARS AT 100 C/C (TO BE BEND INTO SLAB AFTER INSTALLATION)

WALL REINFORCEMENT MESH AT 100 C/C
FIGURE 3.6.1(b) MOUNTING OF SERVICES ON EXTERNAL WALL OF A HS
FIGURE 3.6.1(d)  TYPICAL DETAILS OF EMBEDDED SOCKET/SWITCH
FIGURE 3.6.2(a) ENCASEMENT DETAILS OF WATER/GAS SERVICE PIPES PENETRATING THROUGH HS WALLS
CHAPTER 4: VENTILATION SLEEVES

4.1 GENERAL

Two 125 mm diameter ventilation sleeves shall be cast into the wall/s of each HS.

4.2 POSITION

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

(a) The height of each opening of ventilation sleeve, measured from the centre of the opening to internal FFL of the HS shall be between 1900 mm and 3600 mm;

(b) The ventilation sleeve shall be positioned such that there is sufficient clearance from any structural elements and services. The centre of the ventilation sleeve to the soffit of ceiling and the nearest face of the internal HS walls shall be at least 300 mm;

(c) Where the ventilation sleeve is placed above or adjacent to the HS door frame, the centre of the ventilation sleeve shall be at least 250 mm from the nearest edge of the door frame; and

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

4.3 ACCESSIBILITY OF VENTILATION SLEEVES

4.3.1 Clearance in front of and around Fragmentation Plate

The minimum clearance from the fragmentation plate to RC beam or structure or service shall be 50 mm. 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 500 mm. See FIGURE 4.3.1.

4.3.2 False Ceiling below Ventilation Sleeves

Where false ceilings are provided outside the HS and below the ventilation sleeves, there shall be perforated access panels of minimum size of 600 mm x 600 mm positioned directly below each ventilation sleeve. See FIGURE 4.3.2.
4.4 **FRAGMENTATION PLATE**

Each ventilation sleeve shall have a 6 mm thick stainless steel fragmentation plate mounted on the external face using 10 mm stainless steel bolts (See FIGURE 4.4).
FIGURE 4.2(a) POSITION OF VENTILATION SLEEVES
FIGURE 4.2(b) SECTIONAL VIEWS OF VENTILATION SLEEVES
FIGURE 4.3.1  MINIMUM CLEARANCE FOR FRAGMENTATION PLATE

FIGURE 4.3.2  PERFORATED ACCESS PANEL BELOW VENTILATION SLEEVE
FIGURE 4.4 DETAILS OF VENTILATION SLEEVE AND FRAGMENTATION PLATE

VENTILATION SLEEVE AT OPEN POSITION
(DETAIL 'A')

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

VENTILATION SLEEVE AT CLOSED POSITION
(DETAIL 'A')
CHAPTER 5: HS DOOR

5.1 GENERAL

The HS door shall provide an airtight closure to the HS, and shall be designed to open outwards from the HS.

HS door frame that is cast together with the HS wall shall have single or double door rebate. See FIGURE 2.5.1(a) and FIGURE 2.5.1(b).

5.2 APPROVED HS DOOR

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

5.3 HS DOOR NOTICE

Every HS door shall have a HS door notice affixed on its internal face (See FIGURE 5.3(a)). A sample notice is shown in FIGURE 5.3(b).

5.4 SPECIFICATION OF HS DOOR NOTICE

(a) Manner of Application : To be affixed on the internal HS 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.
FIGURE 5.3(a) LOCATION OF NOTICE ON HS DOOR
This room is also a civil defence shelter provided under the Civil Defence Shelter Act 1997.

For your safety and protection,
- In the event of a fire, do not stay in the shelter. Leave the building.
- Keep every fixture installed in the shelter in good working condition at all times.
- Keep at least one of the 2 ventilation holes open to ventilate the shelter at all times.

For renovation works in the shelter,
- If this is a HDB apartment, consult the HDB branch office. If this is a private house or apartment, consult your building management corporation or the Singapore Civil Defence Force (SCDF).

During an emergency,
- Follow SCDF instructions or guidelines on what to do. These will be issued when the need arises.
- Please refer to the diagram below on how to operate the door to the shelter
- Civil Defence Mode
- Normal Mode

NOTIS


Untuk keselamatan dan perlindungan anda,
- Jika berisik kebakaan, jangan mengambil peralihan di dalam kubu. Tetapi keluar dari bangunan itu.
- Pastikan setiap alat yang dipasang di dalam kubu peralihan ditiup dengan rapi setiap masa.
- Pastikan selalu daripada dua satuan utama di dalam kubu peralihan tidak ditutup.

Untuk kerja ubah, tikar di tempat peralihan,
- Jika anda tinggal di perumahan HDB, rumah dengan pejabat daerah HDB bila anda ingin menunjuk bangunan atau bila rumah privat, rumah itu dengan jalan bangunan atau hubungi Pasukan Pertahanan Awam Singapura.

Di waktu keceemasan,
- Patuhi arahan atau panduan Pasukan Pertahanan Awam. Keterangan lanjut akan diumumkan bila perlu.

Silai rujuk pada gambar rajah yang tertera di bawah untuk mengetahui cara menggunakan pintu untuk ke bilik peralihan
- Kaedah keceemasan
- Kaedah biasa

(A) Normal Mode
- 普通操作法
- Kaedah biasa
- 實際使用方法

(B) Civil Defence Mode
- 民防操作法
- Kaedah keceemasan
- 防空使用方法

CIVIL DEFENCE
READINESS IS YOUR ONLY PROTECTION

FIGURE 5.3(b) SAMPLE HS DOOR NOTICE
CHAPTER 6: CONSTRUCTION AND COMMISSIONING

6.1 GENERAL

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

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

(d) The exposed surfaces of HS walls and soffit of HS ceiling slabs shall be cast with smooth concrete finish. A maximum of 2 mm thick skim coat on the internal face of the HS walls and ceiling slabs of HS 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 HS door frame, shall be approved by the Commissioner of Building Control.
6.3 **HS DOOR**

The following shall be observed:

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

(b) When casting the HS wall with HS 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 HS door frame during concreting.

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

6.4 **PEACETIME REQUIREMENT OF VENTILATION SLEEVES**

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

6.5 **COMMISSIONING REQUIREMENTS**

All electrical and communication fixtures such as switch and lighting point, switched socket outlets, TV, radio and telephone outlets including HS door notice shall be provided inside the completed HS. The service conduits with electrical cables serving the HS shall be provided prior to commissioning.

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

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

(b) Chalk mark test on the HS 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 HS – an acceptable test method is to pressurise the HS and measure the rate of pressure drop or the pressure difference between the interior and exterior of the HS. The water manometer and the *pressure gauge can be used for the test as follows:

(i) When using the water manometer, the HS is pressurised such that the water level difference in manometer is 25 mm. The HS is considered to have passed the test if the water level difference in manometer is more than or equal to 5 mm after 45 seconds.

(ii) When using the pressure gauge, the HS is pressurised by pumping air into the HS such that there is a pressure difference of 250 Pa* between inside and outside of HS. The HS is considered to have passed the test if the pressure gauge shows more than or equal to 50 Pa after 45 seconds.

The ventilation sleeves of the HS, 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 TO HS TOWER

7.1 GENERAL

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

7.2 PERMITTED AND NOT PERMITTED WORKS

7.2.1 Permitted Works to HS

(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 HS walls.

(c) Laying of vinyl or linoleum flooring.

(d) Applying splatter dash or equivalent to the external face of HS 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 HS door, owners shall not cover up or paint over the HS 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 paint thickness resulting in 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 when opening the door.

(f) Painting on only the exterior face of the 6mm fragmentation stainless steel plate of the ventilation sleeves.

(g) Drilling into internal face of HS walls and ceiling slabs to a depth of not more than 50mm to affix inserts and removable screws is allowed for. Fixtures such as pictures, posters, cabinets or shelves on internal face of HS 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 HS 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) Fragmentation plates (Clause 4.4) of the ventilation sleeves are allowed to be removed provided that the fragmentation plates and its bolts and nuts are mounted or kept together for use when needed. If the plate is to be mounted on the HS wall, it shall be done in accordance with Clause 7.2.1(g).

(j) 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.

(k) The minimum clearance from the fragmentation plate to RC beam or structure or service shall be 50 mm. 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 500 mm. See FIGURE 4.3.1.

(l) Where false ceilings are provided outside the HS and below the ventilation sleeves, there shall be perforated access panels of minimum size of 600 mm x 600 mm positioned directly below each ventilation sleeve. See FIGURE 4.3.2.

7.2.2 Not Permitted Works to HS

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

(e) Installation works with fixings using power driven nails into the internal HS walls.

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

(g) Indiscriminate hacking and drilling of HS walls, floor slabs, and ceiling slabs other than drilling permitted in Clause 7.2.1(g) and 7.2.1(h).

(h) Hacking to both internal and external face of the household shelter walls to form key for tiling.

(i) Hacking on external face of HS wall for mounting of feature wall panels or wall tiles installation.
(j) Modifying, changing, removing or tampering of HS 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 6mm 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 to NS

Indiscriminate hacking and drilling of NS walls, floor slabs and ceiling slabs are not permitted.