SINGAPORE CIVIL DEFENCE FORCE

Your Ref:

Our Ref: CD/SB/C/A1/3/4

Date: 26 Apr 2001

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President, Singapore Institute of Architects (SIA)
President, Institution of Engineers, Singapore (IES)
President, Association of Consulting Engineers, Singapore (ACES)

Dear Sirs,

REVISIONS TO HOUSEHOLD SHELTER SIZES, HOUSEHOLD SHELTER WALLS – SETBACK DISTANCE AND THICKNESS REQUIREMENTS

We would like to inform you that a review on the "Technical Requirements for Household Shelters 1997" jointly carried out by the Civil Defence Shelter Bureau of SCDF and Civil Defence Shelter Engineering Department of BCA has been completed. The review took into account lessons learnt and feedback received from the general public and building professionals (including HDB) after the CD Shelter Act was implemented from1st May 98. The review also considered the present and future trend of building smaller dwelling units and buildability requirements, etc.

2 While the review covered all aspects of the design and construction of household shelters (HS), two critical issues of its technical requirements, i.e. minimum HS size and its setback distances, became the central focus of the entire review process. Arising from the review, the technical requirements for HS size and wall/ slab of HS (with respect to setback distances, thickness and reinforcements) have been revised. The changes are shown below.

REVISED HS SIZE

3 The new minimum HS size corresponding to various GFA of the dwelling units are as shown in Table 1. With the reduction in the minimum internal floor area of the HS (when compared to Clause 1.3 of the current "Technical Requirements for Household Shelters 1997"), a new requirement, ie. the minimum internal volume of the HS has been introduced and has to be complied with.

Table 1: GFA, HS Area and Volume

Gross Floor Area (GFA) of Dwelling Unit	Minimum Internal Floor Area of HS	Minimum Internal Volume of HS
GFA $\leq$ 45 m^2	1.6 m^2	3.6 m^3
45 m^2 < GFA $\leq$ 75 m^2	2.2 m^2	5.4 m^3
75 m^2 < GFA $\leq$ 140 m^2	2.8 m^2	7.2 m^3
GFA > 140 m^2	3.4 m^2	9.0 m^3

4 The minimum internal volume of the HS is required to enable occupants to stay in an airtight mode for an acceptable duration when the need arises. This minimum internal volume of HS is not mentioned in Clause 1.3 of the current "Technical Requirements for Household Shelters 1997" as this has been accounted for in the minimum HS area specified in the said Clause 1.3.

REVISED HS WALLS - SETBACK DISTANCES AND THICKNESS

5 Under Clause 2.2 in the current "Technical Requirements for Household Shelters 1997", one of the HS walls should have a minimum setback distance of between 2000 mm to 2700 mm from the external building line (EBL), depending on the HS clear height. The other remaining three HS walls are to have setback distances of at least 4000 mm. Arising from the review, two different sets of minimum setback distance requirements to cater for HS in dwelling unit which has a GFA greater than or less than 45m^2 (see Table 2a and 2b) shall now apply together with the requirements in paragraph 6 below.

Table 2a: Storey Height and Minimum Setback Distances (GFA > 45 m^2)

Storey Height (SH) Col (1)	Minimum Setback Distance of any One HS Wall Col (2)	Minimum Setback Distance of Remaining Three HS Walls Col (3)
2500 mm < SH ≤ 2800 mm	2000 mm	2750 mm
2800 mm < SH≤ 3000 mm	2200 mm	2900 mm
3000 mm < SH ≤ 3500 mm	2500 mm	3100 mm
3500 mm < SH ≤ 4000 mm	2700 mm	3300 mm

Table 2b: Storey Height and Minimum Setback Distances (GFA ≤ 45 m^2)

Storey Height (SH) Col (1)	Minimum Setback Distance of any One HS Wall Col (2)	Minimum Setback Distance of Remaining Three HS Walls Col (3)
2500 mm < SH ≤ 2800 mm	2750 mm	2000 mm
2800 mm < SH≤ 3000 mm	2900 mm	2200 mm
3000 mm < SH ≤ 3500 mm	3100 mm	2500 mm
3500 mm < SH ≤ 4000 mm	3300 mm	2700 mm

6 Tables 2a and 2b above have to be read together with the following HS wall/ slab thickness and reinforcement requirements in the HS tower:

a HS Wall and Slab Thickness:

i The HS wall thickness to be provided may vary according to the HS clear height and setback distance of the HS wall, as shown in Table 3.

Table 3: HS Wall Thickness

HS Clear Height (Ht)	Setback Distance of HS Wall	HS Wall Thickness
2400 mm ≤ Ht ≤ 2700 mm	≤ 6000 mm	250 mm
	> 6000 mm	200 mm
2700 mm < Ht ≤ 2900 mm	≤ 6000 mm	275 mm
	> 6000 mm	225 mm
2900 mm < Ht ≤ 3900 mm	≤ 6000 mm	300 mm
	> 6000 mm	250 mm

ii The wall thickness of any HS or non-HS unit within the HS tower shall not be less than the wall thickness of the unit above.

iii The thickness of the internal common wall to two HSs in non-landed dwelling units shall be 200 mm.

iv Intermediate HS slabs - 175 mm.

v Ceiling of top-most HS - 300 mm.

vi Floor of bottom-most HS/non-HS - 200 mm.

vii Floor slab of non-HS above HS - 300 mm.

b <u>HS Wall and Slab Reinforcements:</u>

i Wall reinforcements for HS tower: Refer to Table 4

<u>Table 4: Wall Reinforcements for HS Tower</u>
(at minimum specified bar diameter and maximum spacing)

HS Clear Height (Ht)	Wall Reinforcements at both faces of wall (both directions)	Shear Links (both directions)
2400 mm ≤ Ht ≤ 2700 mm	T10 – 100	R6 - 600
2700 mm < Ht ≤ 3900 mm	T13 – 100	R6 - 600

ii Internal wall common to two HSs:
Two layers of reinforcements (both faces of HS wall) shall be T10-100 in both directions. The shear links shall be R6-600 in both directions.

iii Intermediate slabs:
Two layers of reinforcements (top and bottom) shall be T10-100 in both directions. The shear links shall be R6-600 in both directions.

iv Ceiling of top-most HS and Floor of bottom-most HS:
Two layers of reinforcements (top and bottom) shall be T10-100 in both directions. The shear links shall be R6-600 in both directions.

v Ceiling Slab in front of the HS door
The thickness of the ceiling slab shall be either 125 mm or 150 mm thick. The reinforcement for 150-mm or 125-mm thick slab shall consist of two layers of reinforcement (top and bottom) at T10-200 or T10-100 in both directions.

7 To further facilitate flexibility in design, HS door can be located on any HS wall provided that this wall has a minimum setback distance as stipulated in column 3 of Table 2a (or column 2 of Table 2b) above.

IMPLEMENTATION OF REVISED HS SIZE AND HS WALLS – SETBACK DISTANCES AND THICKNESS

8 The implementation of the above revised HS size and HS wall requirements shall take immediate effect. This means that qualified persons and/or owners or developers would have the option of following the current "Technical Requirements for Household Shelters 1997" or taking advantage of the relaxed HS size and HS wall requirements (setback distance, thickness and reinforcements) as stated in paragraphs 3 to 7 of this circular.

9 For ease of reference, we have included in Annex A the revised HS size and HS wall/ slab (setback distance, thickness and reinforcements) requirements. The annex also allows for the situation of downhang beams (located at the EBL) being used.

10 Please contact me or Cpt Chong Kim Yuan (at 8386429) should you require any further clarifications on the above.

11 We would appreciate it if you could disseminate the contents of this circular to members of your Institution or Association.

Yours faithfully,

Maj Chan Keen Mun
Head Shelter Planning & Development
for Director Civil Defence Shelter Bureau
HQ Singapore Civil Defence Force

Enclosure: Annex A (7 pages)

cc

CEO, BCA - Attn: Deputy CEO (Building Control)
Director (Special Functions)
Senior Manager (CDSD)
Manager (CDAS)

Members of FSB Standing Committee

President, REDAS

President, IFE

President, SISV

CEO, HDB

Technical Requirements for Household Shelters 1997: Revised Household Shelter Size, Household Shelter Wall/ Slab – Setback Distance, Thickness and Reinforcement Requirements

1 HS Size

The minimum internal floor area and minimum internal volume of HS shall be in accordance to Table 1.

The maximum internal floor area of HS shall be 4.8 m^2. Where a HS internal floor area exceeding 4.8 m^2 is to be provided, approval shall be obtained from the Authority.

Table 1: GFA, HS Area and Volume

Gross Floor Area (GFA) of Dwelling Unit	Minimum Internal Floor Area of HS	Minimum Internal Volume of HS
GFA $\leq 45m^2$	$1.6m^2$	$3.6m^3$
$45m^2 <$ GFA $\leq 75m^2$	$2.2m^2$	$5.4m^3$
$75m^2 <$ GFA $\leq 140m^2$	$2.8m^2$	$7.2m^3$
GFA $> 140m^2$	$3.4m^2$	$9.0m^3$

2 HS Wall/ Slab

2.1 Requirements for Setback Distances of HS Walls (without downhang beams)

a. The HS walls shall be located at a minimum setback distance based on the storey height and GFA. For GFA of dwelling unit of more than $45m^2$, the HS walls shall comply with the setback distances in Table 2a. For GFA of dwelling unit of less than or equal to $45m^2$, the HS walls shall comply with the setback distances in Table 2b.

Table 2a: Storey Height and Minimum Setback Distances (GFA > 45m^2)

Storey Height (SH) Col (1)	Minimum Setback Distance of any One HS Wall Col (2)	Minimum Setback Distance of Remaining Three HS Walls Col (3)
2500mm < SH ≤ 2800mm	2000mm	2750mm
2800mm < SH ≤ 3000mm	2200mm	2900mm
3000mm < SH ≤ 3500mm	2500mm	3100mm
3500mm < SH ≤ 4000mm	2700mm	3300mm

Table 2b: Storey Height and Minimum Setback Distances (GFA ≤ 45 m^2)

Storey Height (SH) Col (1)	**Minimum Setback Distance of any One HS Wall** Col (2)	Minimum Setback Distance of Remaining Three HS Walls Col (3)
2500mm < SH ≤ 2800mm	2750mm	2000mm
2800mm < SH ≤ 3000mm	2900mm	2200mm
3000mm < SH ≤ 3500mm	3100mm	2500mm
3500mm < SH ≤ 4000mm	3300mm	2700mm

b. The HS door shall be located on a wall having a minimum setback distance as specified in Col (3) of Table 2a/ Col (2) of Table 2b.

c. In any HS tower containing more than one HS, the setback of the HS at ground level (where its storey height is greater than the storey heights above) shall be at least the same as the setback distances of the HS above it.

2.2 Requirements for Setback Distances of HS Walls (with downhang beams)

a. GFA > 45m^2

i. Where a downhang beam is provided along the external building line (EBL) of one HS wall, the setback distance of that HS wall shall be according to Col (2) of Table 2a using a storey height determined by the actual storey height less the depth 'd' of the downhang beam as shown in Fig 1. Where the storey height thus determined is:

Less than or equal to 2200mm, the minimum setback distance of that wall shall be 1800mm;

Between 2200mm and not more than 2500mm, the minimum setback distance of that wall shall be 2000mm.

ii. Where more than one HS wall has a downhang beam along the EBL, the setback distance for the 2nd (and subsequent) HS wall shall be according to Col (3) of Table 2a using a storey height determined by the actual storey height less the depth 'd' of the downhang beam as shown in Fig 1. Where the storey height thus determined is:

Less than or equal to 2200mm, the minimum setback distance of that wall shall be 2550mm;

Between 2200mm and not more than 2500mm, the minimum setback distance of that wall shall be 2750mm.

b. GFA ≤ 45m^2

i. Where downhang beams are provided along the EBL of up to three HS walls, the setback distances of these HS walls shall be according to Col (3) of Table 2b using a storey height determined by the actual storey height less the depth 'd' of the downhang beam as shown in Fig 1. Where the storey height thus determined is:

Between 2200mm and not more than 2500mm, the minimum setback distance of that wall shall be 2000mm.

Less than or equal to 2200mm, the minimum setback distance of that wall shall be 1800mm.

c. The HS door shall be located on a wall with a setback of 2750mm or as specified in Col (3) of Table 2a/ Col (2) of Table 2b, whichever is greater.

2.3 Requirements for HS Wall/Slab Thickness

The following minimum requirements for thickness of HS wall/slab forming the HS tower (see Fig 2) shall be complied with:

a. The HS wall thickness for various HS clear height and setback distance of walls shall be in accordance to Table 3.

Table 3: HS Wall Thickness

HS Clear Height	Setback Distance of HS Wall	HS Wall Thickness
2400mm ≤ Ht ≤ 2700mm	≤ 6000mm	250mm
	> 6000mm	200mm
2700mm < Ht ≤ 2900mm	≤ 6000mm	275mm
	> 6000mm	225mm
2900mm < Ht ≤ 3900mm	≤ 6000mm	300mm
	> 6000mm	250mm

b. The wall thickness of any unit (HS or non-HS) within the HS tower shall not be less than the wall thickness of the unit above.

c. The thickness for the internal common wall to two HS of non-landed dwelling units shall be 200 mm.

d. Intermediate HS slabs - 175 mm.

e. Ceiling of top-most HS - 300 mm.

f. Floor of bottom-most HS/non-HS - 200 mm.

g. Floor slab of non-HS above HS - 300 mm.

2.4 Minimum HS Wall/ Slab Reinforcement

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

a. Wall reinforcements for HS tower : Refer to Table 4

Table 4: HS Wall Reinforcements
(at minimum specified bar diameter and maximum spacing)

HS Clear Height (Ht)	Wall Reinforcements at both faces of wall (both directions)	Shear Links (both directions)
2400mm ≤ Ht ≤ 2700mm	T10 – 100	R6 - 600
2700mm < Ht ≤ 3900mm	T13 – 100	R6 - 600

b. Internal wall common to two HSs :
Two layers of reinforcements (both faces of HS wall) shall be T10-100 in both directions. The shear links shall be minimum R6-600 in both directions.

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

d. Ceiling of top-most HS and Floor of bottom-most HS:
Two layers of reinforcements (top and bottom) shall be T10-100 in both directions. The shear links shall be minimum R6-600 in both directions.

e. Ceiling in front of the HS door
The ceiling shall be either 150 mm or 125 mm thick reinforced concrete slab. The reinforcement for 150 mm thick slab shall consist of two layers of reinforcement (top and bottom) at T10-200 in both directions. For 125 mm thick slab, the reinforcement shall consist of two layers of reinforcement (top and bottom) at T10-100 in both directions.

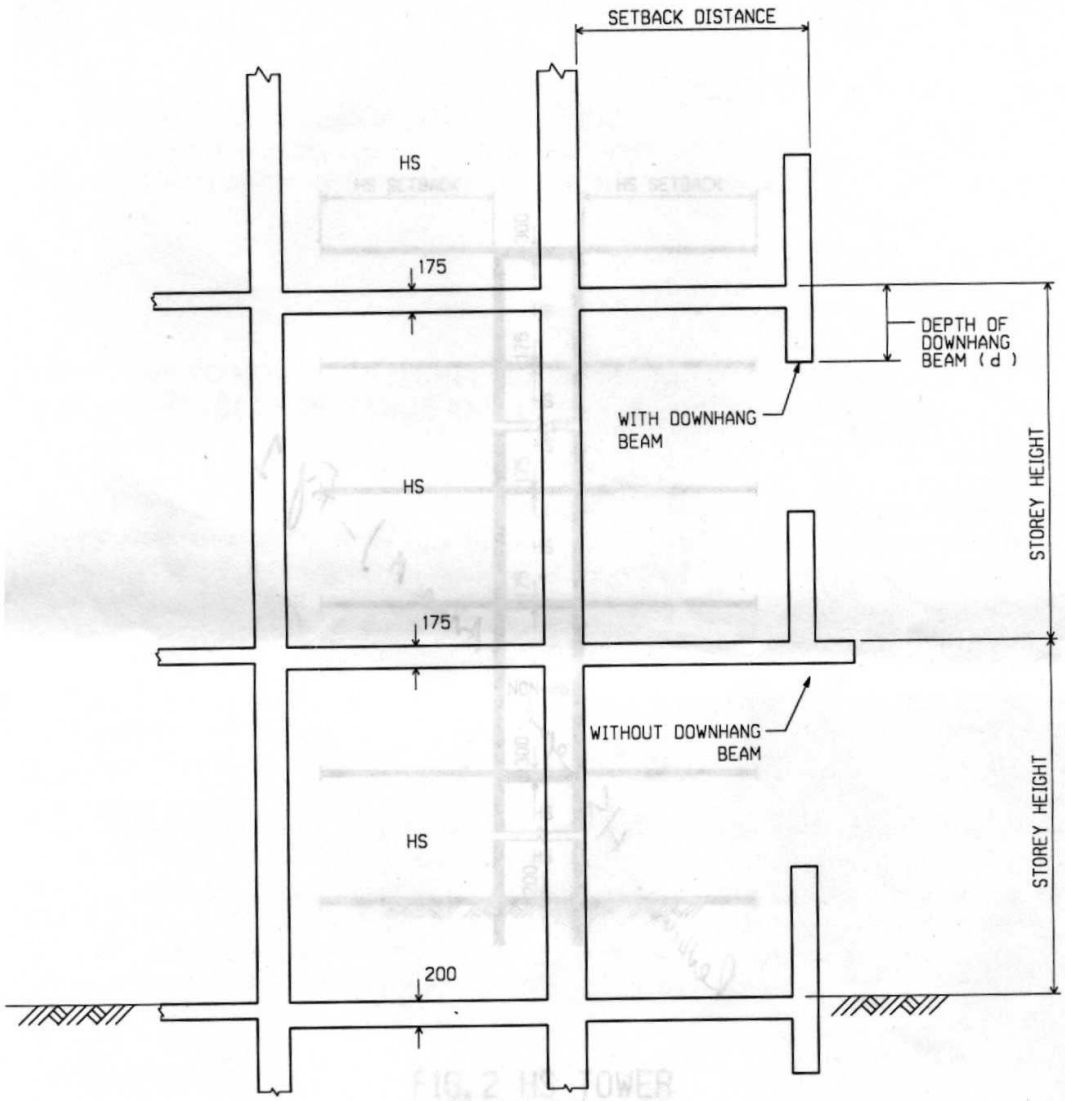

FIG. 1 PROVISION OF DOWNHANG BEAM

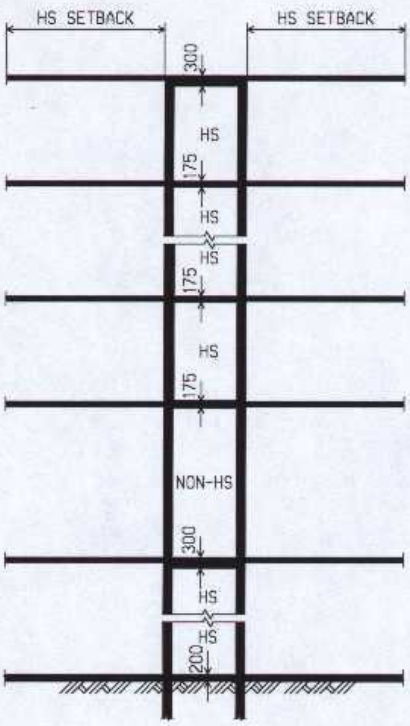

FIG. 2 HS TOWER