



*Please quote our ref. no. in all future correspondences*

Our File Ref: CD/FSSB/12/01/03/04

DID: 68481470  
FAX: 68481493

27 May 2003

President, Singapore Institute of Architects (SIA)  
President, Institution of Engineers, Singapore (IES)  
President, Association of Consulting Engineers, Singapore (ACES)  
President, Real Estates Development Association of Singapore (REDAS)  
Registrar, Board of Architects (BOA)  
Registrar, Professional Engineers Board (PEB)

Dear Sirs,

## **TECHNICAL REQUIREMENTS OF TRANSFER STRUCTURE AND NON-SHELTER (NS) WALLS SUPPORTING HOUSEHOLD SHELTER TOWER**

On 26 Mar 2003, we issued a circular pertaining to the above.

2 Since then, we have received queries from building professionals on the partial safety factors for load to be used when designing the transfer structure to resist additional collapse load of 20 kN/m<sup>2</sup>, in addition to dead, imposed and any other loads, where applicable.

3 For greater clarity of the technical requirements to be complied with when analysing and designing transfer structure or NS walls against different load combinations, reference tables which show partial safety factors for loads, are added in Annex A and Annex B. These two annexes supersede the earlier ones.

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

5 Should you require further clarifications, please contact Mr Victor Lian Choong Meng at 63258966 or Mr Tan See Ting of BCA at 63258920.



Yours faithfully,

**(Transmitted via e-mail)**

Maj Chong Kim Yuan  
for Commissioner  
Singapore Civil Defence Force

cc

Members of FSSB Standing Committee

President, SISV

CEO, HDB  
Attn: Mr Lau Joo Ming

CE, LTA  
Attn: Mohinder Singh

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



A PROUD MEMBER OF THE HOME TEAM

## TECHNICAL REQUIREMENTS FOR TRANSFER STRUCTURE SUPPORTING HOUSEHOLD SHELTER TOWER

### 1 General

If loads from walls of household shelter towers cannot be carried directly to the foundation, transfer structure can be used to carry loads indirectly to the foundation. The transfer structure could take the form of slab, beams, columns, walls or any of its combination. When transfer structure is provided to carry household shelter tower, additional technical requirements described herein shall be complied with. The use of prestressed concrete for the transfer structure is **not permitted**.

### 2 Design against Collapse Load

The design loads for the transfer structure shall include a collapse load of 20kN/m<sup>2</sup> 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 ( $\gamma_f$ ) given in **Table 1**.

**Table 1:** Load Combination and values of partial safety factors ( $\gamma_f$ ) for Ultimate Limit State

Load Combination	Load Types						Collapse
	Dead		Imposed		Earth and Water Pressure (if applicable)	Wind (if applicable)	
	Adverse	Beneficial	Adverse	Beneficial			
Dead and imposed and wind and collapse load (and earth and water pressure)	1.2	1.2	1.2	1.2	1.2	1.2	1.05

### 3 Shielded Transfer Structure

No additional design checks on transfer structure are required, besides the requirement in Clause 2 above, if the transfer structures are shielded by RC slab or other equivalent structural forms. The transfer structure is deemed adequately shielded if Clause 3.1 and 3.2 are complied with.

#### 3.1 Shielding of Transfer slab/beams

The transfer slab/beams are deemed to be shielded if RC shielding slab is provided directly above the transfer slab/beams and is extended beyond their external edges by a minimum length of  $0.5H_1$ , where  $H_1$  is the vertical distance between the top level of the RC shielding slab and that of the transfer slab/beams (See Figure 1).

### 3.2 Shielding of Exterior Columns

The transfer columns are deemed to be shielded if RC shielding slab is provided above the exterior columns and is extended beyond their exterior edges by a minimum length of  $0.5H_2$ , where  $H_2$  is the vertical distance between the top level of the RC shielding slab and the base of the exterior columns (See Figure 1).

## 4 Unshielded Transfer Structure

Additional design checks on unshielded transfer structure shall be carried out in accordance with the following requirements:

### 4.1 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 2).

### 4.2 Unshielded Exterior Columns

The minimum size (either its diameter or shorter dimension) of the exterior columns shall be 500 mm. The transfer structure shall be designed against the most severe effects as the result of the removal of any one exterior column (See Figure 2).

4.3 The following are the criteria to be used when performing design checks for requirements in clause 4.1 and 4.2:

- (a) 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 2**.

**Table 2:** Load Combination and values of partial safety factors ( $\gamma_f$ ) for Ultimate Limit State (only when considering requirements in clause 4.1 and 4.2 above)

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

- (b) 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.

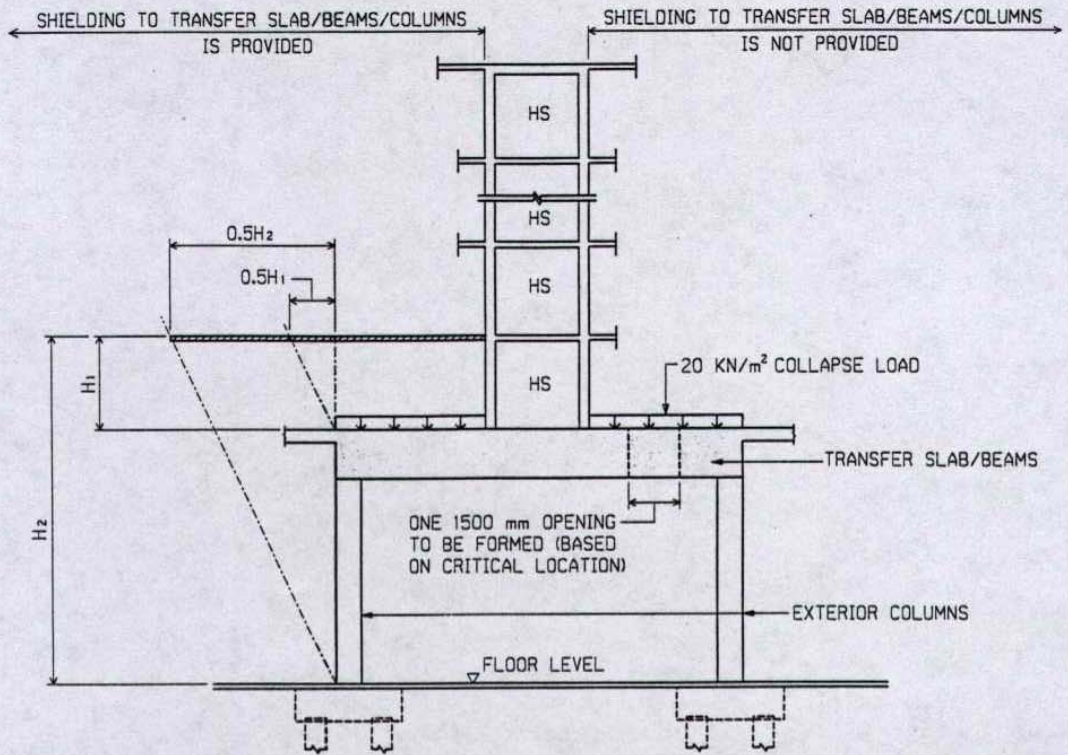


FIGURE 1 CROSS SECTION OF TRANSFER STRUCTURE

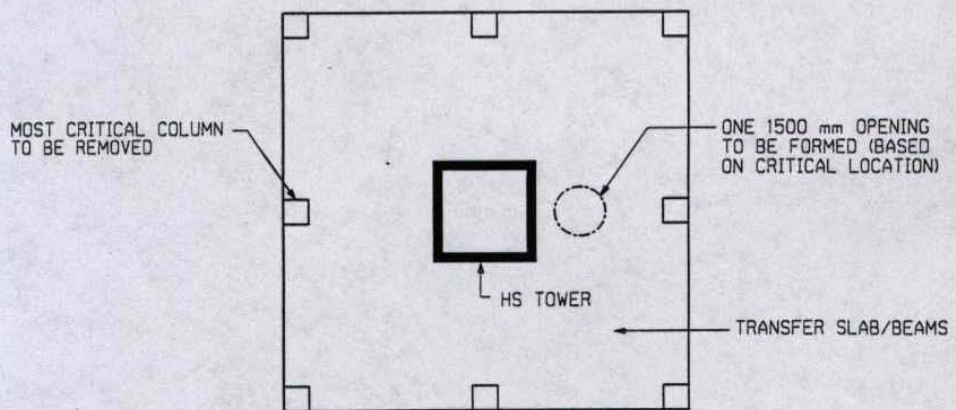


FIGURE 2 PLAN OF TRANSFER STRUCTURE

## Annex B

### TECHNICAL REQUIREMENTS FOR WALL(S) and/or COULUM(S) FORMING NON-SHELTER (NS)

1 Non-Shelter (NS) is defined as the space in the HS tower that is not intended for use as a shelter.

#### 2 **Shielded NS Wall(s) and/or NS Columns**

No additional design checks on HS tower is required if its supporting NS elements, either wall(s), column(s) or any of its combination, are shielded. These structural elements are deemed adequately shielded if RC slab or other equivalent structural forms provided above them and is extended beyond their edges by a minimum length of  $0.5H$ , where  $H$  is the aggregate wall height of NS (See Figure 1).

#### 3 Unshielded NS Wall(s) and/or NS Columns

The following requirements are to be complied with:

##### 3.1 **Unshielded NS Wall(s)**

The minimum thickness of each NS wall shall be 300 mm. The HS tower shall be designed against the most severe effects as the result of the removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter on the NS wall at its most critical location (See Figure 2).

##### 3.2 **Unshielded NS Column(s)**

The minimums size (either its diameter or the shorter dimension) of each 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).

##### 3.3 **Combination of Unshielded NS Wall(s) and NS Column(s)**

The minimum thickness of each NS wall and minimum size (either its diameter or the shorter dimension) of each NS column shall be 300 mm and 500 mm respectively. The HS tower shall be designed against the most severe effects as the result of the following (See Figure 4):

- (a) Removal of a portion of the NS wall equivalent to an opening of 1500 mm diameter at its most critical location; or
- (b) Removal of any one NS column.

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

**3.4** The following are the criteria to be used when performing 3.1, 3.2 or 3.3:

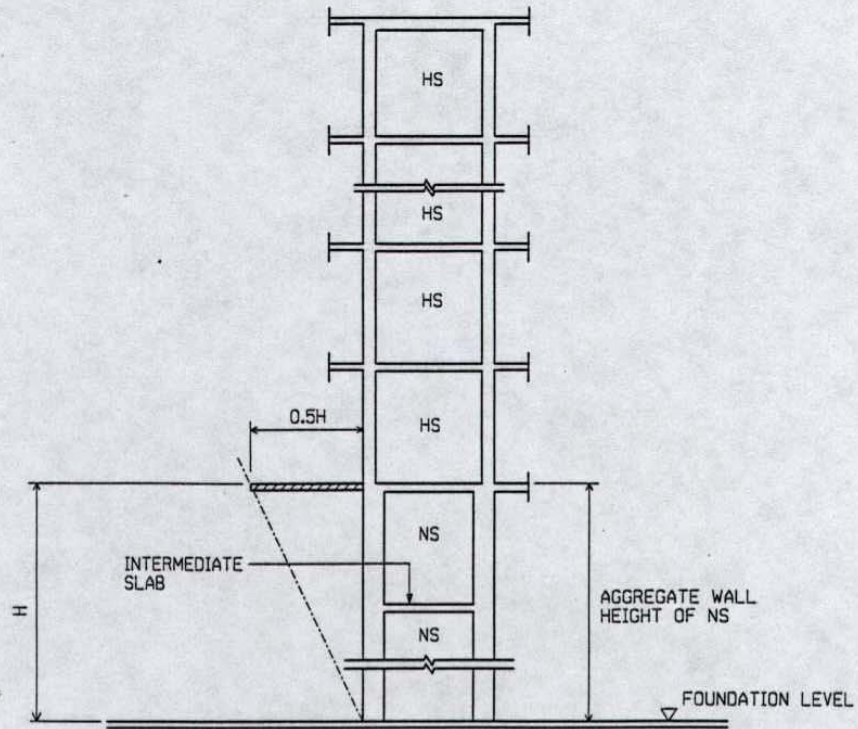
- (a) The design loads shall be based on the load combination and values of partial safety factors for loads ( $\gamma_f$ ) in accordance with Table 1.

**Table 1:** Load Combination and values of partial safety factors ( $\gamma_f$ ) for Ultimate Limit State (only when considering requirements in clause 3.1, 3.2 and 3.3 above)

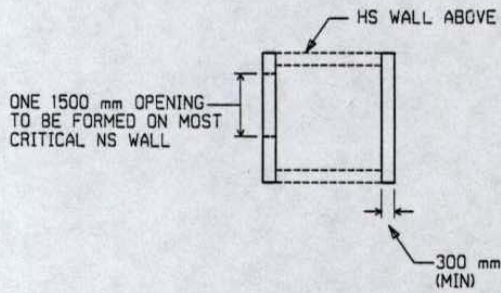
Load Combination	Load Types					
	Dead		Imposed		Earth and Water Pressure (if applicable)	Wind (if applicable)
	Adverse	Beneficial	Adverse	Beneficial		
Dead and imposed and wind (and earth and water pressure)	1.05	1.05	1.05	1.05	1.05	1.05

- (b) 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.

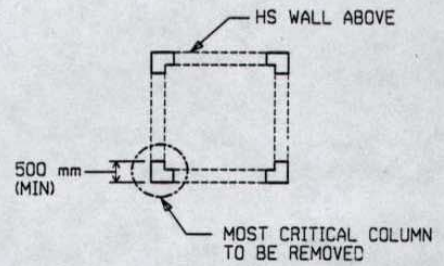




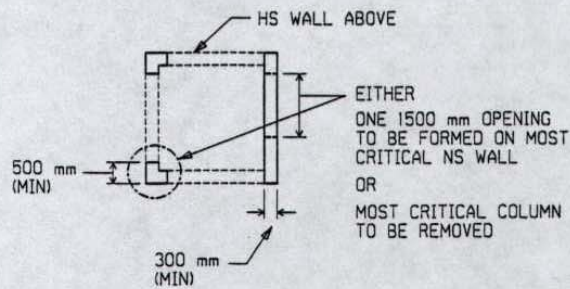
**FIGURE 1 CROSS SECTION OF HS TOWER**



**FIGURE 2  
PLAN OF NS WALLS**



**FIGURE 3  
PLAN OF NS COLUMNS**



**FIGURE 4  
PLAN OF NS WALL & COLUMNS**