

HDB Design, Building & Quality Requirements for A&A work on HDB Premises

(The list is non-exhaustive and shall be read in conjunction with the conditions for the lodgement and exemption items)

1.0 CIVIL AND STRUCTURAL ENGINEERING DESIGN

1.1 GENERAL

It is the duty and responsibility of the QP (ST) to ensure that his/her designs satisfy the strength, stability, safety and serviceability requirements of the building. His/her design calculations and drawings for his/her proposed structural system shall comply with the latest Singapore Standard or British Code of Practice (eg. SS CP 65, BS5950 etc), other regulatory and statutory requirements.

1.2 MATERIAL

Minimum grade 40 concrete shall be used for the substructures and superstructures of the building including precast reinforced concrete piles, pilecap and building precast concrete components except for Grease Trap, Inspection Chamber and Screen Chamber whereby the minimum grade use shall be grade 30. A single grade of concrete shall be used for the cast-in-situ substructure (excluding piling) and superstructure.

All surfaces of existing concrete to be joined to new concrete shall be roughened, washed, cleaned, dried and rubbed in with 20mm thick of 1:2 cement/sand fresh mortar immediately before placing fresh concrete.

1.3 LOADING

1.3.1 Imposed Load

The characteristic minimum imposed loads adopted in the QP (ST)'s design shall comply with the Building Control Act and Regulations 2004 and its latest amendments.

The following minimum imposed loads shall be used in the design of flat, car park, precinct pavilion, linkways, linkbuilding and related building structures :

(1) <u>Flat</u>	<u>Imposed Load</u>
(a) Ground floor (void deck, apron)	4.0kN/m ²
Ground floor (shop apron, ORA slab etc)	5.0kN/m ²
(b) Reinforced concrete (RC) flat roof (with access or with no access to roof)	1.5kN/m ²
(c) Access balcony, stairs, landing and lift lobby	3.0kN/m ²
(d) Horizontal force acting at handrail or coping level	0.75kN/mrun
(e) Wind (based on typical floor to floor height of 2.8m)	
- For building up to 13 storeys	0.60kN/m ²
- For building from 14 storeys to 30 storeys	0.75kN/m ²
- For buildings from 31 storeys to 40 storeys	1.0kN/m ²
(f) Maximum allowable strengthened load for change of use from living quarter to commercial usage	4.0kN/m ²
 (2) <u>Carpark and Services Road</u>	
(a) Accidental vehicle impact load acting horizontally onto columns adjacent to service road at a height of 0.610m from road level.	150kN
(b) Fire Engine access on building structures	16KN/m ²
- Point load	75KN per wheel
(c) Accidental vehicular impact load for Crash Barrier/Bollard at Outdoor Refreshment Area	
(i) parallel to the collision load acting at a visible height of 0.75m above the carriageway	
- Point load	50kN
(ii) perpendicular collision load acting at a visible height of 0.75m above the carriageway	
- Point load	150kN

(3) Precinct Pavilion/Linkbuilding

Ground floor (used as multi-purpose function hall) 5.0kN/m²

(4) Linkway

Ground floor/passageway 4.0kN/m²

(5) Non-Reinforced Concrete Roof

(with no access provided to roof other than maintenance)

(a) Metal roof 0.5kN/m²

(b) Clay tile roof 0.5kN/m²

(6) Other Load Consideration

Imposed load reduction for foundation and column shall not be implemented in the structural design.

The roof fascia shall be designed to support the load of suspended cradle which is used for architectural works and subsequent maintenance works.

1.3.2 Dead Load

Other minimum dead loads to be considered in the design are

(1) Flat

(a) Floor-Finishes and internal partition wall

All floor finishes shall be designed as a uniformly distributed load of 1.2kN/m².

Self-weight of internal partition wall (100mm thick x 2.65m high) shall be taken as minimum uniformly distributed load of 1.5kN/m² when supporting on floor slab or minimum line load of 6.4kN/m run when supporting on floor beam.

- 1.3.3 The imposed and dead loads given in clauses 1.3.1 and 1.3.2 serve as a guide in the design of the building structures of flat, multi-storey car park, precinct pavilion, linkway/linkbuilding and non-reinforced concrete roof. It shall not relieve the QP (ST)'s responsibility to design for higher load should the actual load of his proposed plant, construction equipment, finishes and partition wall acting on any part of the building structures is heavier than the above minimum imposed and dead load

1.4 CONCRETE COVER

- (a) The minimum concrete cover to the top and bottom steel reinforcement of the slab shall be 20mm and 30mm respectively.
- (b) The minimum concrete cover to main reinforcement bars of the beam shall be 35mm.
- (c) The minimum concrete cover to main reinforcement bars of the column shall be 60mm.
- (d) The minimum concrete cover to the steel reinforcement bar at the inner face of water tank which is in contact with water shall be 40mm.
- (e) The minimum concrete cover to main reinforcement bar of the pilecap shall be 75mm measured from the side and top face of pilecap and 50mm measured from the pile head.
- (f) The minimum concrete cover to the main reinforcement bars of the footing shall be 75mm.

1.5 FOUNDATION

All types of pile foundation and footing shall be designed to comply with the latest Singapore Standard or British Code of Practice (eg. SS CP 65, BS5950 etc) and other statutory requirements.

1.5.1 All types of pile foundation

For The design of foundation shall take into consideration of the following :

- (a) All types of pile foundation refer to bored pile, steel H-pile, micropile, jack-in steel pipe pile, jack-in steel H-pile and precast reinforced concrete pile.

- (b) Minimum lean concrete of 50 mm thick shall be provided below pile cap.
- (c) The new/proposed foundations are to be located clear of existing foundations.
- (d) The new/proposed foundation must not encroached onto existing ground beams.
- (e) Connection between new foundation and existing floor slab/beam/foundation must be provided with 10mm gap and filled with bitumen.

The design considerations and preparation of plans for these piles shall comply with the following minimum requirements :

(a) Safety factor

All types of pile foundation shall be designed with safety factor of minimum 2.5 times the nominal working load.

(b) Pile penetration

The penetration length for each type of piles shall be indicated on the plans.

(c) Pilecap

- (i) Where pile foundations are used in the design, reinforced concrete pilecap shall be designed to support the column. The design of the pilecap shall be based on the pile load capacity.
- (ii) The minimum embedment of the piles in the pilecap shall be 100mm for precast reinforced concrete pile and 150mm for steel pile and bored pile. For grease trap, inspection chamber and screen chamber, the minimum embedment of the piles shall be 75mm.
- (iii) The minimum distance between the edge of piles and edge of pilecap shall be 250mm.

1.5.2 Bored pile

The bored pile shall be of minimum concrete grade 30

1.5.3 Timber pile

No timber pile foundation shall be used.

1.5.4 Precast reinforced concrete (RC)

Precast reinforced concrete (RC) piles shall only be used for linkways, linkbuilding, precinct pavilions and other single storey light structures.

1.5.5 Footing

- (a) The soil bearing capacity for design of footing at different depth below ground level shall be based on the borelog result of corresponding depth. The soil bearing capacity and the corresponding depth used in design shall be clearly indicated in the design calculation and footing plans.
- (b) The maximum soil bearing capacity of footing for light structures such as linkways, outdoor refreshment area and pergola shall be 50KN/m² at 1.5m below ground level if the relevant soil borelog result is not available. For grease trap, inspection chamber and screen chamber if the minimum depth of 1.5m below ground level cannot be achieved, bakau piles shall be provided to strengthen the soil.
- (c) Minimum lean concrete of 50 mm thick shall be provided below the footing.
- (d) The new/proposed footings are to be located clear of existing foundations and their depths are not more that those of the existing ones.
- (e) The new/proposed footings must not encroached onto existing ground beams.
- (f) Connection between new/proposed footing and existing floor slab/beam/foundation must be provided with 10mm gap and filled with bitumen.
- (g) Backfill to excavation shall be of the same or better quality materials and mechanically compacted to its original condition.

1.6 COLUMN

- (a) Column shall be founded for independent structure.
- (b) Column shall be designed as short column in accordance with SS CP65.
- (c) Unless column is designed to resist high bending moment, the design ultimate axial load of short braced columns supporting an approximately symmetrical arrangement of beams shall be in accordance with SS CP65.
- (d) The column load shall correspondingly be indicated in the reinforcement bar schedule for columns.
- (e) Maximum area of steel reinforcement for columns shall be 4.0% of the gross cross concrete section.
- (f) For column/wall of building structures that is next to driveway shall be checked and designed for vehicular impact load.
- (g) No opening shall be made through column.
- (h) Joints between Steel Column/Stanchion joints shall be pressure grouted using approved Grade 70 High Strength Non Shrink Grout. The grout shall be checked for bearing stress for axial load. For this checking, the design fcu of the grout bearing joint shall be taken as 40 MPa.
- (i) Tie beams shall be provided for columns at ground floor and roof.
- (j) The existing HDB foundation must not used to support new column/stanchions.
- (k) Minimum 4 nos. of anchor bolts shall be provided for the base plate connecting steel stanchions onto the existing slab.

1.7 SLAB DESIGN

- (a) Reinstatement details of slab openings are required for installation of new waste pipes. The reinforcement bars used should be similar or of bigger size than the original. All affected floor slabs are properly reinstated.
- (b) Trimming bars must be provided for existing slab opening due to creation of opening.

1.8 OTHER BUILDING COMPONENTS

- (a) The maximum thickness of the brick/hollow blocks used for the erection of new wall must not exceed 63 mm and 100mm for other storeys and 1st storey respectively.

1.9 STEEL STAIRCASE

- (a) Minimum 2 numbers of anchor bolts shall be provided for base plate connecting stringer beams onto the existing slab.
- (b) Minimum 2 numbers of steel stanchions shall be provided to support the stringer beams at 1st landing of staircase.
- (c) Minimum 2 numbers of anchor bolts shall be provided for column base plate onto the existing slab.
- (d) Minimum ms plate thickness shall be 10 mm thick ms plate at the joint of 2 stringer beams.

1.10 COLD / CHILLER ROOM

- (a) Sufficient air gap (min150 mm) must be provided between the cold/chiller room and the existing RC structures so as to prevent condensation on the surface of the RC structures.
- (b) Topping up of the existing floor slab using extruded polystyrene foam (EPF) is required.
- (c) Provide proper drainage and discharge of the water shall be provided to the existing floor trap.

1.11 CANTILEVER AWNING

(Not applicable for outdoor refreshment area (ORA) awning)

1.11.1 Awning supported directly by RC cantilever beams is not allowed.

1.11.2 LIGHTWEIGHT (eg aluminum/metal) AWNING

- (a) Awning supported directly by RC columns/periphery beams :
 - (i) < or = 2.4m, no propping is required.
 - (ii) > 2.4m, propping is required.

1.11.3 CLAY TILE AWNING

- (a) Awning supported directly by RC columns/periphery beams with length :
 - (i) < or = 1.4m, no propping is required.
 - (ii) > 1.4m, propping is required.

1.12 OUTDOOR REFRESHMENT AREA (ORA)

For ORA adjacent to buildings with height more than 4 storeys (highrise)

1.12.1 ORA setback

- (a) ORA adjacent to parallel parking lots, carpark driveway or service road
 - (i) Total setback from the kerb to ORA outline = 1.1m
 - (ii) Minimum setback from external face of impact guard rail to kerb face = 0.6m

- (b) ORA adjacent to perpendicular parking lots
 - (i) Total setback from the kerb to ORA outline = 1.5m
 - (ii) Minimum setback from external face of impact guard rail to kerb face = 1.0m

1.12.2 ORA Foundation

The ORA structure is to be supported on independent foundation.

1.12.3 Roofing Material

The roofing material must be non-combustible and it shall comply with the following:

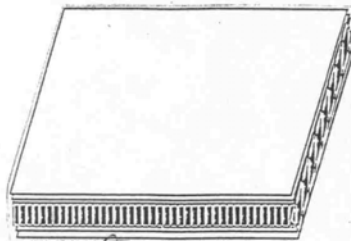
- (a) Reinforced Concrete of 125 mm minimum thickness;
- (b) Sandwiched Panels of 50 mm minimum thickness; or
- (c) Precast Ferrocement Roof of 40 mm minimum thickness.

1.12.4 Sandwiched Panel Roofing Material

(a) The detailed composition of the panel is as shown below:

Sandwiched panels

Sandwiched panels comprising of 2 pieces of 9mm cement boards bonded to a 32mm polyurethane foam core with additional outside facing of 0.65mm ceramic steel and inside facing of 0.7mm aluminium sheet.



Roofing facing : 0.65mm ceramic steel
Outer layer : 9mm cement board
Core : 32mm polyurethane foam
Inner layer : 9mm cement board
Ceiling facing : 0.7mm aluminium

(b) If the composition of the proposed sandwiched panel is deviated from the above reference or other roofing material (non-combustible) is to be used, the QP for structural work is required to conduct a test on the proposed panel based on the following criteria. The report of the test (conducted by an accredited laboratory) shall be submitted for our evaluation:

- (i) A test report (impact load test) is to be submitted to justify that the material must be able to withstand the impact load of 6kg flower pot falling from the height of 45m.
- (ii) Assumed impact contact time = 0.1 sec

(c) For the simulated test, the QP shall submit the calculations to show the equivalent weight / force used in the simulation for our evaluation. All test result shall be accompanied by photographs of the test conducted and catalogue of the material.

1.12.5 Precast Ferrocement Roof

- (a) Minimum strength shall be 40 N/mm².
- (b) A layer of square wire mesh 6mm (minimum) at 100mm spacing sandwiched between four layers of square wire mesh 1.5mm (minimum) at 25mm spacing.
- (c) The wires shall be galvanised with a zinc coating weight of 65g per m² minimum with minimum proof stress of 300 N per mm².
- (d) Minimum thickness of precast ferrocement roof shall be 40mm.

For ORA adjacent to buildings with height 4 storeys and below

1.12.6 Umbrella Type ORA (greater than 4x4=16m²)

- (a) Engagement of QP is required to provide the structural design and supervision
- (b) The umbrella type ORA shall be supported on independent foundation

1.13 ROBUSTNESS

The QP (ST) shall ensure that his design satisfies the robustness requirement in SS CP 65. In particular, all the ground floor columns and walls are to be tied in two directions by ground beams.

In the case of a two-column framing system, the QP (ST) shall design to allow for the notional removal of one column or catenary action against progressive collapse.

1.14 SERVICES COORDINATION

- (a) The QP (ST) shall ensure that the services layout including the size and position of all services openings to be formed in floor slabs and beams are indicated on the services coordination drawings. The services coordination drawings shall be prepared in conjunction with the architectural, structural, mechanical and electrical drawings. These drawings shall include all services required in a building block such as electrical, telephone, water, gas, TV, sanitary and air-conditioning.

- (b) The services coordination drawings shall be prepared for each floor and shall show all details necessary for fabrication works.
- (c) No sanitary piping shall be cast inside the slab, beam, column and reinforced concrete wall.
- (d) The UPVC pipe sockets in toilet/kitchen must cast into the slab for joining the vertical stack.
- (e) The reinforced concrete structure and piles shall not be used as lightning conductors or earth electrodes. Lightning conductors shall not be embedded in the reinforced concrete components of the building structure.

1.15 STEEL STRUCTURES AND CLADDINGS

- (a) Metal roofing sheets shall not be used for highrise blocks more than 4-storey.
- (b) Grade 43 steel sections shall be used for general structural steel members and the design of steel members shall be in accordance with BS 5950.
- (c) The design of deflection for steel structures shall consider the total service imposed loads inclusive of dead and live loads and shall satisfy the allowable deflection limit for imposed load as recommended in the code of practice.
- (d) Steel hollow section, if used, shall not be drilled for securing cladding or metal roofing sheets. The steel plate, angel or cleats shall be used and welded to steel hollow sections for connection of roofing or cladding panels.
- (e) Self-drilling Australian standard 3566 or approved equivalent. There shall be minimum 3 threads protrusion beyond the plate surface.
- (f) The technical specification of the self-drilling screw or self tapping screw that are used for conformity in the design shall be included as part of design calculations.
- (g) Self-drilling screw or self-tapping screws shall not be used for connection of structural members.

- (h) Where roofing sheets or claddings are designed by a specialist, the QP (ST) shall check and ensure that the design satisfy safety, stability and durability requirements.
- (i) Appropriate separator shall be used at the contact between two different metal materials to prevent galvanic corrosion.
- (j) The bolt connection for the base plate of the steel column shall be on or above the ground floor slab level.

1.16 COMPUTER ENGINEERING SOFTWARE

The QP (ST) shall ensure that the computer engineering software programmes used by the Accredited Checker are different from that used in his structural analysis and design.

1.17 SLOPE AND EARTH RETAINING STRUCTURES

The QP (ST) shall ensure that all proposed slopes and earth retaining structures where required, be designed to the relevant Codes of Practice (eg. SS CP18 for Earthworks, CP No. 2 for Earth Retaining Structures, SS CP 65 for Structural Use of Concrete etc) and comply with the Specifications and the requirements of the relevant authorities.

1.17.1 Slope

- (a) For proposed slopes greater than 2.5m in height, the QP (ST) shall submit slope stability and design calculations to show the stability of the slope. Slope protection measures must be taken to stabilise any slopes that fail to satisfy the required factor of safety.
- (b) For slope stability, a minimum factor of safety of 1.5 times.

1.17.2 Earth Retaining Wall

- (a) For earth retaining structures over 1.0m in height, design calculations and structural plans shall be submitted.

- (b) The design shall comply with factor of safety recommended in the code of practice or the following, whichever is greater,
 - (i) Factor of safety of 2 times for overturning and sliding stability;
 - (ii) Factor of safety of 3 times for allowable bearing pressures;
 - (iii) Factor of safety of 1.5 times for overall stability or slip circle failure;
- (c) The design of earth retaining structures shall take into consideration of the following requirements.
 - (i) Adopt full water table height at ground level when considering water pressure acting on the wall.
 - (ii) Cater for a surcharge of at least 10KN/m² or other construction or incidental loads, whichever is higher.
 - (iii) Cater for a minimum unplanned excavation depth of 0.5m or 10% of the total height of the earth retained, whichever is deeper.
 - (iv) Do not use net pressure method in stability analysis of wall.

1.18 GREASE TRAP, INSPECTION CHAMBER AND SCREEN CHAMBER

All grease trap, inspection chamber (IC) and screen chamber shall be in reinforcement concrete. Brick wall is not allowed.

The new I.C. should not be supported by existing structure. It must be independently supported.

The design imposed load should be 5KN/m² for the Grease Trap, Inspection Chamber and Screen Chamber.

All grease trap, inspection chamber (IC) and screen chamber shall not be subjected to vehicular load.

Total operating weight (self weight and the content weight when full) must be considered in the design.

1.19 SEWER WORKS

1.19.1 For minor sewers, the requirements laid down in the current Standard Specifications for Sewerage Works published by the Sewerage Department, PUB, shall be complied with.

1.19.2 The Drawings shall show the layout of sewers to serve the proposed building developments. It shall include positions of sewer manholes, size and gradient of sewer lines, sanitary connections, foundation of manholes/sewer lines, etc.

1.20 DRIVEWAY/SERVICE ROADS/DRAINS

1.20.1 Driveway and Service Road

(a) The design of driveway and service road shall comply with road Note No.4 of British standard.

(b) For fire engine access and parking, the affected driveway and service road shall be designed to comply with FSSD requirements.

(c) The minimum width of one way service road shall be 4.5m.

(d) The minimum width of two ways service road shall be 5.4m .

(e) The minimum width of driveway shall be 6m.

(f) The minimum turning radius of services road shall be 6m.

(g) The setback of the column/wall of building structures from the edge of service road shall be minimum of 600mm.

1.20.2 Catchment for drainage system

The catchment design calculations shall comply with surface run-off requirements of PUB. The discharge point must be provided according to the PUB's approved catchment plan.

1.21 DRAWINGS

It is the QP (ST)'s duty and responsibility to ensure adequacy of design and details necessary for the strength, stability, integrity, safety and serviceability of building foundation and structures in compliance with the code of practice and regulatory requirement.

1.22 SPECIFICATIONS FOR CIVIL AND STRUCTURAL WORKS

The QP (ST) shall ensure that the specifications prepared by him/her comply with the minimum requirements on the performance standard of materials, construction quality control on the supply, manufacturing, production, installation, procurement of materials and suppliers from HDB approved list and necessary testing as stipulated these HDB Standard Specifications. This shall not relieve the QP (ST) from his/her responsibility to satisfy himself/herself that the specifications are appropriate and adequate to ensure safety, integrity and quality of building structures.