GUIDELINES

ON

PLAN SUBMISSION

OF

S1 – S5 PUBLIC SHELTERS

Issued By:

Building and Construction Authority

CIVIL DEFENCE SHELTER ENGINEERING DEPARTMENT

BUILDING RESILIENCE GROUP

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APPENDICES

i) List of Annexes

1 INTRODUCTION

1.1 This "*Guidelines on Plan Submission of S1 – S5 Public Shelters*" serves as a useful guide to the qualified persons (QPs) who are responsible for the planning, design and application for approval of public shelter plans.

1.2 The QPs are required to follow the procedures describe herein to obtain the approval of public shelter plans from the Civil Defence Shelter Engineering Department (CDSD) of Building Resilience Group in Building and Construction Authority (BCA) and Fire Safety & Shelter Department (FSSD) of the Singapore Civil Defence Force (SCDF).

2 REFERENCES

2.1 In addition to these Guidelines, the design, application for approval of shelter plans, construction and commissioning of public shelters shall be in compliance with the following documents:

a) "*Technical Requirements for S1 – S5 Public Shelters*"; and
b) "*Guidelines on Construction and Commissioning of S1 – S5 Public Shelters*"

2.2 The QPs applying for approval of shelter building, piling, structural, mechanical and electrical plans shall ensure that their designs also comply with the latest editions of the relevant Codes of Practice, Acts, Regulations and statutory requirements of all other agencies who have jurisdiction over these requirements or systems. The QPs shall also obtain the necessary clearances or approvals from the relevant agencies.

3 ROLES OF FIRE SAFETY & SHELTER DEPARTMENT (FSSD) OF SINGAPORE CIVIL DEFENCE FORCE (SCDF) AND CIVIL DEFENCE SHELTER ENGINEERING DEPARTMENT (CDSD)

3.1 General

3.1.1 Fire Safety & Shelter Department (FSSD) of SCDF is responsible for the overall planning and implementation of the Civil Defence Shelter Program. Civil Defence Shelter Engineering Department (CDSD) of Building Resilience Group in Building and Construction Authority (BCA) undertakes the regulatory functions and provides technical advice and support to FSSD of SCDF.

3.2 Role of FSSD of SCDF

3.2.1 FSSD of SCDF is responsible inter alia for the following:

a) Planning relating to identifying suitable facilities in new buildings to double up as public shelters;
b) Operational requirements relating to the public shelter design; and
c) Commissioning inspections with respect to shelter operation and management requirements.

3.2.2 As the management and operational aspects in the public shelters (e.g. location of CD-dedicated rooms such as command post or shelter management room, CD store room, first-aid room, etc;) are regulated by FSSD of SCDF, QPs are advised to submit preliminary shelter building layout plans to FSSD of SCDF for comments.

3.3 Role of CDSD

3.3.1 CDSD is responsible for the vetting and approval of shelter building, piling, structural, shock design, mechanical and electrical plans. In addition, CDSD provides technical advice on the building, structural, piling, shock, mechanical and electrical requirements of public shelters. It also carries out regulatory and commissioning inspections of public shelters to ensure that they are constructed in accordance with the approved shelter plans.

3.3.2 CDSD performs regulatory and advisory functions which include vetting and approval of the following shelter plan applications:

a) Building, Piling and Structural

i) Overall protection integrity of the public shelter and its ancillary facilities such as accessways, emergency exits and arrangement of M&E rooms and ventilation shafts;
ii) Building, piling and structural plans; and
iii) Shock design for fixtures of all architectural finishes / fixtures and M&E equipment within the public shelter.

b) Mechanical

i) Air-conditioning and mechanical ventilation (ACMV) system / Environmental control system (ECS);
ii) Water supply system;
iii) Sanitary and drainage systems; and
iv) Method statements, test reports and results of commissioning tests.

c) Electrical

i) Electrical distribution system;
ii) Communications and Monitoring systems; and

iii) Generator and Fuel Delivery system.

4 STAGES INVOLVED IN THE DESIGN AND CONSTRUCTION OF A PUBLIC SHELTER

4.1 The design and construction of a public shelter involves the following:

a) Consultation of Public Shelter design requirements and Dedicated CD Equipment;

b) Application for approval of shelter plans;

c) Construction;

d) Commissioning tests.

4.2 The detailed procedures for items (a) and (b) can be found in this document while those for items (c) to (d) are given in the "*Guidelines on Construction and Commissioning of S1 – S5 Public Shelters*".

5 CONSULTATION STAGE

5.1 General

5.1.1 Before proceeding with the detailed design of a public shelter, QPs are advised to consult FSSD of SCDF on the management and operational aspects of the public shelter. Subsequently, QPs may seek advice from CDSD on the preliminary design of the public shelter with respect to the building, piling, structural, shock design, mechanical and electrical requirements.

5.1.2 To schedule a date for the consultation with CDSD, QPs shall submit *e-form BCA-CD-PLAN01 (Request for Consultation on Civil Defence Shelter Requirements)* to CDSD. To ensure an effective consultation, QPs are advised to prepare and bring along the information & plans as requested in the respective sections below.

5.2 Consultation on Shelter Building and Structural Requirements

5.2.1 For consultation on the public shelter layout and structural requirements, the following plans shall be made available:

a) Plan showing the location of the site and its surrounding developments;

b) Site plan showing the location of the public shelter in relation to the overall development project. The location of the public shelter shall be highlighted in red;

c) Public shelter layout plan; and

d) Sections and elevations of the public shelter.

5.2.2 The co-ordinating QP shall arrange for the structural, mechanical and electrical QPs to be present at the consultation meeting if necessary. At the consultation meeting, CDSD will advise on the layout and design of the public shelter, the type of protective steelworks to be used and the M&E requirements to be incorporated in the shelter design.

5.2.3 If necessary, the QPs for the mechanical and electrical systems can contact CDSD for separate consultations on the detailed M&E requirements of the public shelter.

5.3 Consultation on Shelter Mechanical Requirements

5.3.1 For consultation on the mechanical requirements in public shelter, the QP (Mechanical) shall include one set of site plan and the public shelter layout plans together with the preliminary plans of the following mechanical systems:

a) Air-conditioning and mechanical ventilation (ACMV) system / Environmental Control System (ECS)
   - The overpressure regime and locations of CD valves & blast louvres shall be indicated on the plan;

b) Water supply system; and

c) Sanitary and drainage systems.

5.4 Consultation on Shelter Electrical Requirements

5.4.1 For consultation on the electrical requirements in public shelter, the QP (Electrical) shall include one set of site plan and the public shelter layout plans together with the preliminary plans of the following electrical systems:

a) Electrical Distribution system;
b) Communications and Monitoring systems; and
c) Generator and Fuel Delivery system.

5.5 Consultation on Dedicated CD Equipment

5.5.1 Dedicated CD equipment (CD valves, gas filters, etc) are important items in public shelter as they ensure that the protection level at openings or services penetrations are adequate and enable the public shelter to function properly according to CD requirements. It is important that suitable types of equipment are provided to ensure that they can withstand the necessary weapons effects.

5.5.2 Prior to confirming the use of the dedicated CD equipment, the QP shall consult CDSD regarding the suitability on the makes and models of these equipment.

5.5.3 To request for a consultation, the QP shall submit *e-Form BCA-CD-PLAN01 (Request for Consultation on Civil Defence Shelter Requirements)* together with a list of dedicated CD equipment (refer to Annex P6) giving the makes, models, quantities and locations of these equipment.

6 APPLICATION FOR APPROVAL OF SHELTER PLAN STAGE

6.1 General

6.1.1 The QPs are required to obtain approval for the following public shelter plans from CDSD of BCA:

a) Shelter Building plans;
b) Shelter Piling plans;
c) Shelter Structural plans (including footing and protective steelworks details, where applicable);
d) Shelter Mechanical plans;
e) Shelter Electrical plans; and
f) Shelter Shock Design plans.

6.1.2 Procedure of Application for Approval of Shelter Plans

6.1.2.1 Every 'new' application, which includes first time application, re-application (i.e. application after Notice of Disapproval has been issued by CDSD) and amendments to approved shelter plans, shall be accompanied by *e-form BCA-CD-PLAN02 (Application for Approval of Civil Defence Shelter Plans)* and one set of the relevant plans.

6.1.2.2 If the submitted plans are found to be in order, CDSD will issue a *Notice of Approval.* For manual submission with hardcopy plans, the QP shall bring the original copy of ***Notice of Approval*** to the BCA Service Centre to collect the set of approved shelter plans within 14 days from the date of receipt of *the Notice of Approval*.

6.1.2.3 If there are design non-conformances, CDSD will issue a Written Direction (WD) to the QP. The QP shall amend and re-submit their amended plans together with a covering letter to CDSD within 2 weeks from the date of the

WD. For re-submission through the CORENET e-submission system, the QP shall adopt the same **ES No**. as the submission for which the WD had been issued and submit using **CR submission**.

6.1.2.4 If the QP fails to re-submit or respond to a WD within the stipulated timeframe, a *Notice of Disapproval (NOD)* would be issued. After a NOD had been issued, the QP is required to submit a re-application using *e-Form BCA-CD-PLAN02*.

6.1.3 Project Reference Number and Plan Type

6.1.3.1 All applications of public shelters plans shall have a project reference number issued by the co-ordinating QP, who would normally be the QP for the building works. The QPs for the other disciplines shall use the same project reference with the appropriate Plan Type suffix and number to denote the different types of submissions, e.g., A1234-00001-1999-**CS01** to denote a public shelter structural plan application and A1234-00001-1999-**CD01** to denote a public shelter building plan application. The following characters are used to denote the different Plan Types of a public shelter plans applications:

a)	CD	-	Building
b)	CS	-	Structural and Piling
c)	CK	-	Shock Design
d)	CM	-	Mechanical
e)	CE	-	Electrical
f)	CT	-	Method Statement and Test Report for commissioning test

6.1.3.2 For ‘New’ applications, which include first time applications, re-applications (i.e. application after Notice of Disapproval has been issued by CDSD) and amendments to approved shelter plans, QPs shall use the respective Plan Type suffix and unique numbers in their applications. For example, if CS01 had been used for an earlier shelter structural plan application, then this

number shall not be used again for the subsequent 'New' shelter structural plan applications for the same project.

6.1.3.3 For a re-submission submitted within the stipulated time frame, the QP shall indicate the ***same*** ES No. (for e-submission) and Plan Type No. as the Written Direction.

6.1.4 Standard Approval Stamp

6.1.4.1 All shelter plans (except shock design plans where section 6.7 shall apply) shall be prepared in A1 size drawings and shall bear the QP's professional stamp & signature in the title block (see Annex P1) on the right hand column of every plan.

6.1.4.2 The first and last sheet of the plans shall also bear the standard certification by the QP (see Annex P1).

6.2 Application for Approval of Shelter Building Plans

6.2.1 All shelter building plans shall be endorsed by the QP for building works before they are submitted to CDSD for approval.

6.2.2 QP shall include the following plans when applying to BCA for approval of shelter building plans:

a) Plan showing the location of the site in relation to the surrounding locality;

b) Site plan showing the location of the public shelter in relation to the overall development project. The bounds of protection (blast, gas and blast & gas walls and slabs) of the public shelter shall be outlined separately in different distinct colours;

c) Layout of the shelter showing the following details:

i) M&E plant rooms, generator room and air locks, etc;
ii) Entrances to and exits from the public shelter;
iii) Locations and overall dimensions of protective blast doors, hatches, louvres and gas-tight doors;
iv) Locations and provisions of blast valves, overpressure blast valves, overpressure valves, sealing devices and other cast-in items;
v) Sizes and locations of the intake and exhaust air shafts, expansion chambers of the M&E plant room and generator room;
vi) Thicknesses of the external and internal structural members of the public shelter such as the external protective walls, roof and floor slabs of the public shelter, etc.; and
vii) General information of public shelter (Annex P2) (To be included on the first sheet of plan)

d) Appropriate elevations and sections of the public shelter.

6.3 Application for Approval of Shelter Piling Plans

6.3.1 For public shelters supported on piles, the QP for structural works shall submit the shelter piling plans to CDSD for approval. Shelter piling plans shall be endorsed by a QP for structural works before they are submitted to CDSD for approval.

6.3.2 For formal application, the QP shall submit the shelter piling layout plan together with the shelter pilecaps details.

6.3.3 Except for the areas within the public shelter, piling works for other parts of the development may proceed after the necessary approval and *Permit to Carry Out Structural Works* have been obtained from the Building

Engineering Group (BE). Piling works for the public shelter shall not commence unless a *Notice of Approval for Public Shelter Piling Plans* has been issued by CDSD.

6.3.4 For public shelters supported on footing, the QP for structural works shall submit his/her plans for the footing, together with the shelter structural plans as a single application to CDSD for approval.

6.4 Application for Approval of Shelter Structural Plans

6.4.1 Shelter structural plans shall be endorsed by a QP for structural works before they are submitted to CDSD for approval.

6.4.2 For formal application, the following details shall be submitted:

a) Shelter structural layout plan (including footing plan if applicable);
b) Details of structural members (and footing if applicable); and
c) Details showing the openings for services penetrations through walls and floor slabs.

6.4.3 The QP for shelter structural works shall note that structural works for the public shelter shall not commence unless a *Notice of Approval for Public Shelter Structural Plans* has been issued by CDSD.

6.5 Application for Approval of Shelter Mechanical Plans

6.5.1 Plans of shelter mechanical systems shall be endorsed by a QP for mechanical works before they are submitted to CDSD for approval.

6.5.2 The following shelter mechanical plans shall be submitted to CDSD for approval:

a) Air-conditioning & mechanical ventilation (ACMV) System / Environmental Control System (ECS);
b) Water supply system; and
c) Sanitary and drainage system.

6.5.3 Air-Conditioning and Mechanical Ventilation (ACMV) System / Environmental Control System (ECS)

6.5.3.1 For ACMV system / ECS, the formal application shall include plans showing the following:

a) Layout of plant room showing the locations of blast louvres, CD valves, expansion chambers, ductwork, air-conditioning units such as chillers, air handling / fan coil units, ventilation fans, manometers, silencers, special gas filters, dampers, test holes on ductwork, etc.;

b) Airflow and overpressure regime in the public shelter;

c) Design Summary for ACMV system / ECS (refer to Annex P3); (To be included on the first sheet of plan)

d) Sections and elevations showing details of blast louvres (BL) and CD valves such as overpressure blast valves (OBV), overpressure valves (OV), and blast valves (BV) with / without filters; and

e) Locations and fascia of the associated electrical distribution board, main control panel (MCP), remote control panel (RCP), equipment status panel and the routing of associated electrical trunking and conduits.

6.5.4 Water Supply System

6.5.4.1 For water supply system, the formal application shall include plans showing the following:

a) Layouts and locations of the potable and decontamination water tanks in the public shelter and the associated booster pump system, where applicable;

b) Details of all accessories associated with the water tanks such as manhole cover, water level indicator, vent pipe, discharge pipe, etc;

c) Incoming water supply pipes routing from an approved water bulkmeter, roof top tank (if any) and emergency infill point to the public shelter's storage water tanks;

d) Outgoing water supply pipes routing from public shelter's storage water tanks to drinking points and decontamination shower points. Height of drinking and shower points from floor level;

e) Detailed schematic layout of the booster pumps system for potable and decontamination water, where applicable;

f) Locations of MCP, RCP and the associated electrical distribution boards including the routing of associated electrical trunking and conduits;

g) Design Summary for Water Supply System (refer to Annex P4) (To be included on the first sheet of plan);

h) Sectional plans of the water tanks showing internal clear dimensions, thicknesses of walls, clearance between top of the water tanks and the ceiling slab, clearance between bottom of the water tanks and the floor slab, height of water tanks, effective

storage capacity, etc; and

i) Details of water supply pipe penetrations into public shelter structural envelope and the locations of isolating valves and flexible connections.

6.5.5 Sanitary and Drainage System

6.5.5.1 For the sanitary and drainage system, the formal application shall include plans showing the following:

a) The sanitary and drainage piping layout in the public shelter as well as pipes connecting to nearest external inspection chambers (IC), manholes (MH) or open drains;

b) Detailed schematic layout of sanitary and drainage system (including ejector system if applicable) indicating the venting system, floor traps, floor wastes, blast valves, etc.;

c) Details of sanitary and drainage pipe penetrations out of the public shelter structural envelope; and

d) Locations of MCP, RCP and the associated electrical distribution board including the routing of associated electrical trunking and conduits (where ejector system is applicable).

6.6 Application for Approval of Shelter Electrical Plans

6.6.1 Plans of electrical systems shall be endorsed by a QP (Electrical) before they are submitted to CDSD for approval.

6.6.2 For a public shelter, plans for the following electrical systems are to be

submitted to CDSD for approval:

a) Electrical Distribution system;
b) Communications and Monitoring systems; and
c) Generator and Fuel Delivery system;

6.6.3 Electrical Distribution System

6.6.3.1 For Electrical Distribution System, the formal application shall include layout plans showing the following:

a) Electrical switchboards and distribution boards;
b) Switches, power outlets and isolators;
c) Light fittings, emergency battery pack light fittings, EXIT light fittings, etc;
d) Legends and descriptions of all electrical fixtures used in the public shelter;
e) Single line diagrams of the electrical installation in the public shelter; and
f) Calculations for the average lighting levels in the public shelter using both the normal and emergency battery pack light fittings.

6.6.4 Communications and Monitoring Systems

6.6.4.1 For Communications and Monitoring systems, the formal application shall include layout plans showing the following:

a) Communications systems panels;
b) Telephone sockets;
c) TV/FM sockets;
d) Bells and bell push buttons;
e) Intercom stations;

f) Public address speakers;
g) Door monitoring equipment;
h) Legends and descriptions of all communication systems fixtures used in the public shelter; and
i) Schematic diagrams of the communications systems, e.g, intercom, public address, MATV, door monitoring, etc.

6.6.5 Generator and Fuel Delivery System

6.6.5.1 For Generator and Fuel Delivery System, the formal application shall include layout plans showing the following:

a) Generator room layout and dimensions;
b) Air intake and exhaust blast louvres, openings and expansion chambers;
c) Generator set, batteries and control panel;
d) Fuel day tank, bulk fuel storage tank, fuel pipes, fuel pumps, vent pipes, fuel top-up point, etc;
e) Generator exhaust pipe and penetration details;
f) Sound reduction attenuators;
g) Tool box; and
h) Calculations for generator sizing, fuel tank sizing and airflow requirements of the generator system.

6.6.6 In addition to the plans for the above systems, the following plans shall also be included:

a) Site plan showing the following information:

i) Incoming electrical cable route to the public shelter;
ii) Incoming telecoms cable route to the public shelter;
iii) Incoming communications systems (e.g. MATV) cable route to the public shelter; and

iv) Access route to the generator room.

b) Cable sealing devices layout plan showing the following information:

i) Main cable support systems;
ii) Cable sealing devices for cable crossings at bounds of protection and across different pressure regime areas; and
iii) Openings and penetrations for cables and pipes, etc.

6.7 Application for Approval of Shelter Shock Design Plans

6.7.1 Shelter shock design plans shall be endorsed by a QP(Civil/Structure) or QP(Mechanical).

6.7.2 All plans shall be prepared in A3 size drawings and bear the endorsements as stated in Section 6.1.4.

6.7.3 Shelter shock design plans shall be prepared for the shock mounting of every equipment, services and fixture in the public shelter. Each set of shelter shock design plans shall consist of the following information and details:

a) Design Summary for Shock Calculations (Annex P5)
(To be included on the front page of each set of shock calculations)

b) Shock load calculations for mounting brackets (including sizes of components and welds), expansion anchor bolts, shock isolators, etc., on the 3 major axes (X, Y and Z directions) for the supports of M&E equipment, ductwork, pipework, and architectural fixtures, etc;

c) Layout plan of the public shelter showing location of the shock design item;

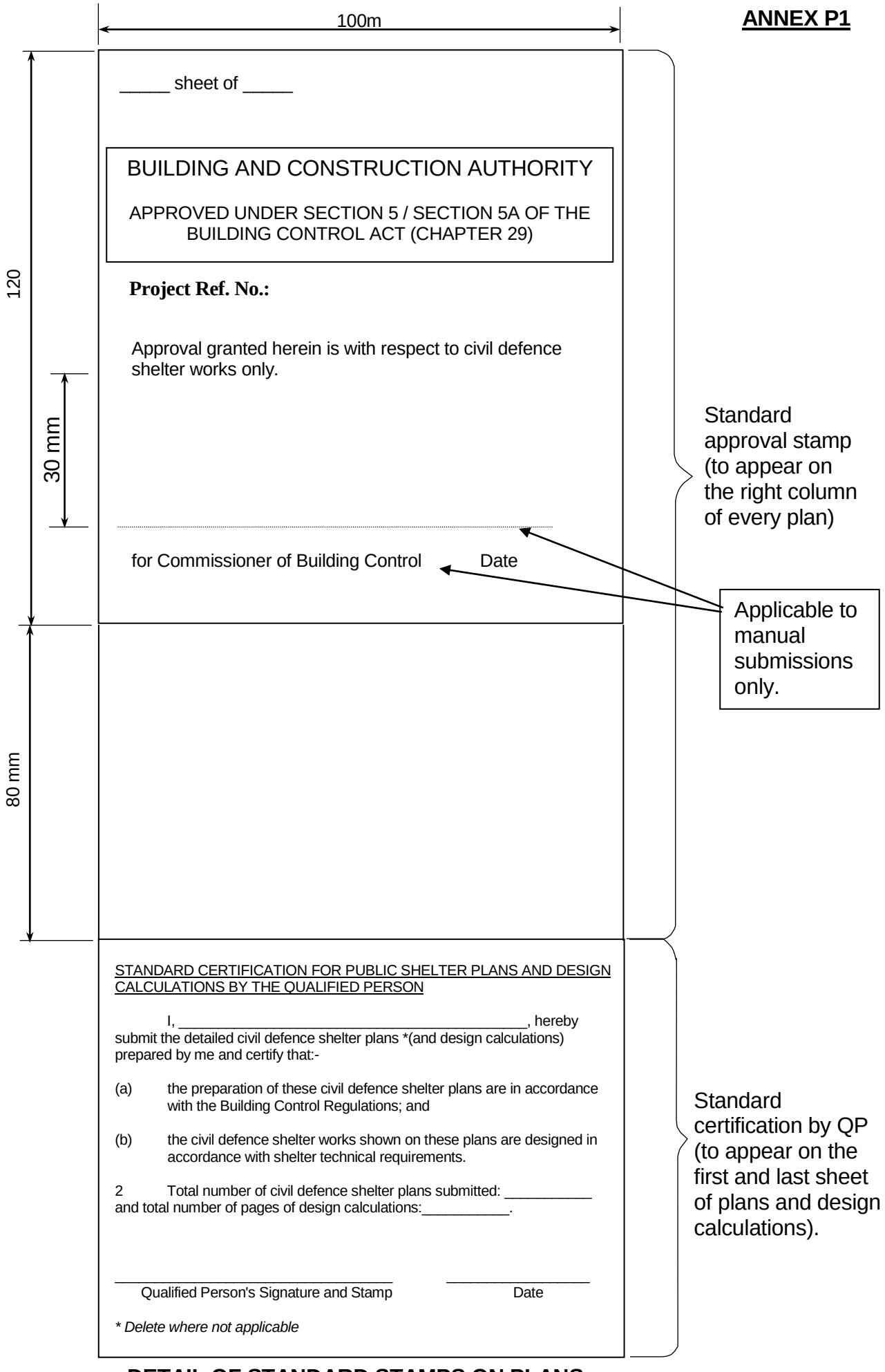
d) Details of mounting brackets (including sizes of components and welds), expansion anchor bolts and shock isolators, etc. and

e) Catalogues and technical data sheets showing details of mounting brackets, expansion anchor bolts, shock isolators, etc.

7 CONCLUSION

7.1 After the QPs have obtained the necessary approvals for all the public shelter plans, they may proceed to the construction stage. The requirements and procedures for the construction and commissioning stages of a public shelter are given in the "*Guidelines on Construction and Commissioning of S1 – S5 Public Shelters*"

ANNEXES



DETAIL OF STANDARD STAMPS ON PLANS

ANNEX P2

GENERAL INFORMATION OF PUBLIC SHELTER

1. Shelter Category : _____

2. Area of MSA : _____

3. No of Shelterees : _____

4. Type of Shelter : _____
(Please state Aboveground, underground or semi-buried)

ANNEX P3

DESIGN SUMMARY FOR ACMV SYSTEM / ECS

1. Shelter Category : _____

2. Type of A/C system : _____
(State type of A/C system and whether air cooled or water cooled)

3. Air-Conditioning Heat Load
   a) Shelter Heat Load = _____ kW
   b) Design Heat Load = _____ kW

4. Fresh Air Requirement
   a) Required Air Flow Rate for Overpressure Regime (see table below)

Room Name	Floor Area (m^2)	Shelter Height (m)	Required Air Change	Required Air Flow (CMH)	Design Air Flow (CMH)	Remark
AHU Room						
Plant Room						
Separation Room			30			
Decontamination Room			30			
Toilet			12			
Air Lock 1			30			
Air Lock 2			30			
	Total Required Airflow rate (**Item a**)					

   b) Required Fresh Air Rate for Shelteree (**Item b**) = _____ persons x 6 CMH
   = _____ CMH

   c) Design fresh airflow rate = _____ CMH (Item **a** or **b**, whichever is higher)

5. Air Exhaust Through Blast Louvres (BL)

	Design Air Flow (CMH)	Size of BFL or BL (m^2)	Effective Area of BFL or BL (m^2)	Velocity Across Blast Louvre (m/s)
Chiller Plant Room (Supply Air)				
Chiller Plant Room (Exhaust Air)				
Generator Plant Room (Supply Air)				
Generator Plant Room (Exhaust Air)				
Air Intake Chamber (Fresh Air)				

ANNEX P4

DESIGN SUMMARY FOR WATER SUPPLY SYSTEM

1. Shelter Category : _____

2. Water Storage Requirement

Usage	No. of Shelterees	Storage Requirement per shelteree (l/person)	Design Storage (m^3)	Size of Tank (LxWxH)	Effective Capacity (m^3)	Remark
Decontamination		2.5				
Drinking		5				

3. Number of water points : _____

4. Dimension of Pump Sump : _____ mm (L) x _____ mm (W) x _____ mm (D)

ANNEX P5

DESIGN SUMMARY FOR SHOCK CALCULATION

(*EQUIVALENT STATIC ANALYSIS / DYNAMIC ANALYSIS)

(*Delete where not applicable)

Details of *Equipment / Services / Fixtures :

Name _____

Description : _____

Weight : _____ (to provide weight per support for services)

Design Parameters:

i) Shock acceleration : 15*g* in *x*-, *y*- and *z*-axes.

ii) Shock velocity : 0.60m/s in *x*-, *y*- and *z*-axes.

iii) Shock displacement : 0.05m in *x*-, *y*- and *z*-axes.

Item	Make	Model	Permissible Load	Calculated Load
Shock Isolator				
Anchor bolt				
Fastening bolt				

Item	Dimensions
Supporting frame (e.g. base skid, lug, etc)	
C-channel	
Hanger rod	
Fastening strap	

Results of Dynamics Analysis (For Dynamic Analysis Only)

a) Max. C.G. acceleration : _____ (≤ 3*g*)

b) Max. vertical relative displacement of isolator : _____ (max. allowable deflection: _____)

c) Max. transverse relative displacement of isolator : _____ (max. allowable deflection: _____)

d) Max. longitudinal relative displacement of isolator : _____ (max. allowable deflection: _____)

e) Max. relative displacement of auxiliary point : _____ (within ±100mm)

Result : The shock isolators selected are acceptable.

LIST OF DEDICATED CD EQUIPMENT IN PUBLIC SHELTER

S/N	Dedicated CD Equipment	Make	Model	Location	Qty	Remarks
1.	Blast valves					
2.	Blast valves with pre-filters					
3.	Overpressure blast valves					
4.	Overpressure valves					
5.	Gas-tight shut-off valves					
6.	Gas filters					
7.	Multi-cable transits (MCTs)					
8.	Anchor bolts					
9.	Equipment shock isolators					