SINGAPORE CIVIL DEFENCE FORCE

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Registrar, Board of Architects
Registrar, Professional Engineers Board
President, Singapore Institute of Architects
President, Institution of Engineers, Singapore
President, Association of Consulting Engineers, Singapore

Dear Sir/Mdm

Fire Safety Requirements for Fully Automated Mechanised Car Park (FAMCP) 2015

The fully automated mechanized car park (FAMCP) is a car parking system where the parking and retrieving of vehicles are done by mechanical means without the driver entering the parking area. The FAMCP was introduced into our urban landscape in the late 1990's to optimise land use. In 1999, SCDF has stipulated a set of fire safety requirements specifically for FAMCPs under Appendix 5 of the Fire Code: Fire Safety Requirements for Fully Automated Mechanised Car Park.

2 Since then, FAMCPs have not only increased in numbers, but also in complexity and size. This review takes into account the challenges faced both by the Qualified Persons (QPs) in meeting fire safety requirements and also the fire-fighters in tackling fires in FAMCPs.

3 This revised set of fire safety requirements will supersede the current set and take effect for plans of fire safety works submitted to SCDF 6 months from the date of this circular.

4 Please convey the contents of this circular to members of your Institution/Association/ Board. The circular is also available in CORENET e-Info: http://www.corenet.gov.sg/einfo. For any inquiry or clarification, please contact MAJ Koh Swee Lian at 68481456 or Mr Nicholas Lee at 68481744.

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Yours faithfully,

(transmitted via e-mail)

MAJ Tan Chung Yee
Fire Safety & Shelter Department
for Commissioner
Singapore Civil Defence Force

cc

CEO, BCA
CEO, URA
CEO, HDB
President, IFE
President, SISV
SCDF Fire Safety Standing Committee

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FIRE SAFETY REQUIREMENTS FOR FULLY AUTOMATED MECHANISED CAR PARK (FAMCP)

The fully automated mechanized car park buildings (FAMCP) incorporates the revolutionary concept of parking and retrieving a vehicle by mechanical means without the driver entering the parking area. The building is therefore unmanned and is totally different from the conventional car parks e.g. car park in a multi-storey building, multi-storey car park (MSCP), etc. The main differences between the FAMCP and the conventional car parks are:-

i) close stacking of cars one to another
ii) lack of provision on fire separation to prevent rapid fire spread
iii) non availability of fire fighting access
iv) extensive height and depth involved with highly combustible load

The FAMCP buildings available in the market can be classified into three types, namely, i) small FAMCP, ii) underground FAMCP and iii) above ground FAMCP. Each type of FAMCP has its own specific fire safety requirements.

Please see Annex A for a brief description on the three types of FAMCP. The fire safety requirements are given in Annex B.

Annex A

Fully Automated Mechanised Car Park (FAMCP)

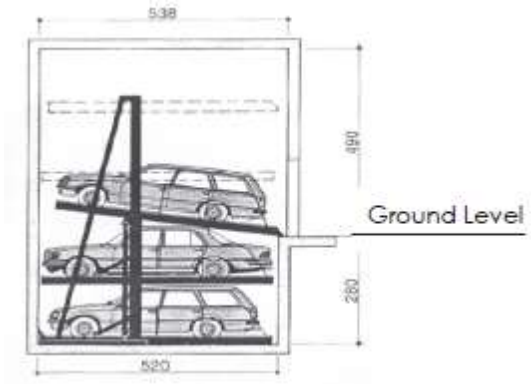
The FAMCP is sub-divided into three categories. They are:

Category 1a: Small above ground with the following sizes:

Maximum floor area	:	200m² (Total area of car parking decks)
Maximum cubical extent	:	1400m³
Maximum parking height	:	10m

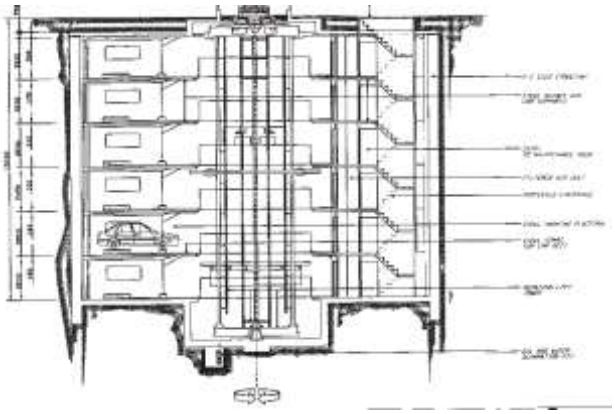
Category 1b: Small above ground with Decks Sunken

Maximum floor area	:	200m² (Total area of car parking decks)
Maximum cubical extent	:	1400m³
Maximum parking height	:	14m (subject to maximum parking height of 10m above the ground level)



Category 2: Any FAMCP that is above ground level and do not fall under Category 1

Category 3: Any FAMCP that is below ground level and do not fall under Category 1



Sectional view of an underground fully automated mechanised car park (FAMCP)

Annex B

FIRE SAFETY REQUIREMENTS FOR FULLY AUTOMATED MECHANISED CAR PARK

INTRODUCTION

1 The purpose of this circular is to stipulate the fire safety requirements for the Fully Automated Mechanised Car Park (FAMCP). These requirements will assist the Qualified Person when making plans submission pertaining to the design, construction, protection, location and arrangement of the various fire safety provisions.

DEFINITION

Fully Automated Mechanised Car Park (FAMCP)

2 The FAMCP is defined as a building or part of a building that is intended for the storage/parking of vehicles (passenger car) employing fully automated mechanical facilities to move the vehicle from the point of entry to the parking deck and vice-versa. The parking area would be accessible by trained staff when carrying out maintenance works only. The parking system is to cease during the maintenance operations.

Parking Height

3 The height shall be measured from the average level of the ground adjoining the outside of the external walls of the building to the highest/lowest car parking level. In situations where mixed usage involving above ground and underground car parking, the height shall be measured between the highest and the lowest car parking levels.

Calculation of Cubical Extent

4 The building height as defined in the Fire Code shall be used to calculate the cubical extent for all the car park types and in the event where there is no roof over, the highest/lowest car park level shall be used.

STANDARDS AND CODES

5 The following standards and codes shall be complied with:-

a.	SS EN 3	:	Portable Fire Extinguishers.
b.	SS 550	:	Code of Practice for Installation, operation and maintenance of electrical passenger and goods lifts.
c.	SC CP 5	:	Code of Practice for Electrical Installations.
d.	SS CP 10	:	Code of Practice for The Installation and Servicing of Electrical Fire Alarm Systems.

e.	SS 553	:	Code of Practice for Air-conditioning and mechanical ventilation in buildings.
f.	SS 563	:	Code of Practice for The design, installation and maintenance of emergency lighting and power supply systems in buildings.
g.	SS 546	:	Emergency Voice Communication System in Buildings.
h.	SS 575	:	Code of Practice for Fire hydrant systems and hose reels.
i.	SS CP 52	:	Code of Practice for Automatic Fire Sprinkler System.
j.	SS 578	:	Code of Practice for Use and maintenance of portable fire extinguishers.

6 All clauses and tables mentioned in this circular are extracts from the current "Code of Practice for Fire Precautions in Building".

CLASSIFICATION OF FAMCP

7 The FAMCP shall be sub-divided into three categories as follows: -

Category 1a: Small Above ground

This type of FAMCP refers to those small sizes, above ground structure and having the following sizes:

Maximum floor area	:	200m² (Total area of car parking decks)
Maximum cubical extent	:	1,400m³
Maximum parking height	:	10m
Minimum side openings	:	At least one side of the FAMCP shall be fully open and facing the access road.

Category 1b: Small Above ground with Decks Sunken

This type of FAMCP refers to those small sizes, above ground structure without more than 2 car parking level sunken below the ground level and having the following sizes:

Maximum floor area	:	200m² (Total area of car parking decks)
Maximum cubical extent	:	1,400m³
Maximum parking height	:	14m (Subject to maximum parking height of 10m above ground level)
Minimum side openings	:	At least one side of the FAMCP shall be fully open and facing the access road.

Category 2 — Above Ground
Any FAMCP that is above ground level and do not fall under Category 1.

Category 3 — Underground
Any FAMCP that is below ground level and do not fall under Category 1.

Includes FAMCP that combines above ground (Category 2) and underground (Category 3) parking.

FIRE SAFETY REQUIREMENTS THAT ARE APPLICABLE TO ALL THREE CATEGORIES OF FAMCP

8 The fire safety requirements that are applicable to all three categories of car parks are as follows:-

a. Accessibility
Areas within the car park building shall not be accessible to the public.

b. Designation of Purpose Group
The car park building shall be classified as Purpose Group VIII (storage) as per Table 1.2B.

c. Means of Escape
Means of escape shall be provided where there are areas that are accessible by the public and these shall be in accordance with the requirements as for Purpose Group VIII.

d. Separation from Other Usage
Where a separation wall or floor is required, a minimum 2-hour fire resistance rating wall or floor subject to compliance with the requirements of the elements of structure for Purpose Group VIII shall be provided to separate the car park from other usage.

e. External Wall
Where an external wall is required as in Cl.3.5, a minimum 1-hour fire resistance rating floor subject to compliance with the requirements of the elements of structure for Purpose Group VIII shall be provided

f. Unprotected Areas in any side of a building
For unprotected openings, "TABLE 2 TO PART II OF APPENDIX 'B' TO Cl. 3.5" shall be complied with.

g. Portable Fire Extinguisher
Extinguishers having a minimum rating of 70B shall be provided at every entrance and exit of the car park.

h. Hose reels

Hose reel coverage shall be provided for every entrance and exit of the car park.

i. Electrical Power Supplies

Where any such installation is required, its primary and secondary source of power supplies shall be in accordance with Chapter 5.

j. Fire Engine Access Road

Fire engine access roads to be provided to gain access to the Fire fighting staircases.

CATEGORY 1
FIRE SAFETY REQUIREMENTS FOR SMALL ABOVE GROUND FULLY AUTOMATED MECHANISED CAR PARK (SA-FAMCP)

9 The specific fire safety requirements for the SA-FAMCP shall be as follows: -

a. Compartmentation
The SA-FAMCP shall not exceed the following compartment limits as indicated in the table below.

Compartment	Maximum Floor Area	Maximum Cubicle Extent
Compartment between average ground level and a height of 10m.	200 m^2 (Total area of car parking decks)	1,400 m^3

b. Structural Design
The SA-FAMCP shall be constructed of structural steel construction. Fire resistance to element of structure shall be provided according to Cl 3.3.

c. Vertical Deck Separation
For SA-FAMCP having multi-car parking level, vertical fire separation between the upper and lower decks by using non-perforated and non-combustible materials (structural steel plate) shall be provided. This is to minimise direct impingement of flame to the car in the upper deck and also to prevent dripping of any possible leaking fuel to the lower deck.

d. Fire Engine Access Road
Fire engine access roads to be provided to gain access to the Fire fighting staircases.

e. Private Fire Hydrant
Private fire hydrants if required shall be provided in accordance with Cl.4.4.

f. Natural Ventilation
At least one side of the FAMCP shall be fully open and facing the access road. The maximum distance measured from the opening(s) to the most remote part of the car parking deck shall not exceed 8m.

CATEGORY 2

FIRE SAFETY REQUIREMENTS FOR ABOVE GROUND FULLY AUTOMATED MECHANISED CAR PARK (A-FAMCP)

10 All A-FAMCPs will be subjected to the Fire Certificate scheme. The specific fire safety requirements for the A-FAMCP shall be as follows: -

a. Element of Structure
The A-FAMCP shall be constructed of structural steel construction. Fire resistance to element of structure shall be provided according to Cl 3.3.

b. Vertical Deck Separation
The vertical fire separation between the upper and lower decks by using non-perforated and non-combustible materials (structural steel plate) shall be provided. This is to minimise direct impingement of flame to the car in the upper deck and also to prevent dripping of any possible leaking fuel to the lower deck.

c. Fire Fighting Provisions

(i) All fire fighting staircases shall conform to the requirements of Cl.2.3.3;
(ii) Smoke free approach as stated in Clauses 2.2.13 and 2.2.14;
(iii) Fire doors of 1-hour fire resistance rating for the access of fire fighters via the staircase into the car park. The fire door shall be of at least 850mm wide by 1000mm high with a visual glass panel. Wordings of "For smoke venting, do not enter" shall be posted on the external side of the door. The wordings shall be of at least 25mm in height.
(iv) The number of staircases provided shall depend on the number of rising mains. Each rising main serving every car parking level shall provide the following coverage:

(a) Where internal access to every car parking deck is provided:

(1) An access platform of minimum width of 0.9m shall be provided and shall be constructed with minimum 1-hour fire resistance. Handrails shall be provided on both sides to prevent fall.
(2) No part of any car parking deck shall exceed 28m.

(b) Where no internal access to every car parking deck is provided:

(1) The maximum distance measured from the staircase door to the most remote part of the car parking deck shall not exceed 8m.

(v) Breeching inlet serving rising main shall be located within 18m of the Access road.

(vi) Dry rising main shall be provided for height exceeding 10m and up to 60m. When the height exceeds 60m, wet rising main shall be provided. The breeching inlet shall be located at the foot of the riser stack. One standby fire hose shall be provided at the ground level of each staircase.

(vii) Fire lift shall be provided for height exceeding 24m.

(viii) Where fire lift is required, a two way voice communication system shall be provided between the Fire Command Centre and the following areas:

(a) Every fire-fighting lobby, including 1st storey.

(b) All fire-fighting related mechanical equipment rooms inclusive of sprinkler pump room, wet riser pump room etc.

(ix) Fire Command Centre shall be provided in accordance with Cl.8.2.3.

d. Private Fire Hydrant

Private fire hydrant where required shall be provided in accordance with Cl.4.4.

e. Fire Engine Access Road

Fire engine access roads to be provided to gain access to the Fire fighting staircases.

f. Active Fire Fighting Systems

The FAMCP shall be protected by sprinklers or clean agent systems.

(i) Where sprinkler protection is installed, it shall be in accordance with SS CP 52. Quick response sprinklers shall be provided. Each parking deck shall be protected by at least 1 sprinkler head.

(ii) Where clean agent systems are installed, they shall comply to NFPA 2001. The amount of agent required to achieve the design concentration shall be based on total flooding method.

(a) Standby cylinders (100%) shall be provided on site.

(b) All doors, shutters, dampers and/or openings shall be closed throughout the duration of gas deployment.

(c) Bypass door shall be provided in the event there are occupants inside FAMCP during gas deployment.

(d) Fire fighters shall be able to activate the clean agent manually if the system was not activated during fire.

g. Provision of Sump Pit

(i) Sump pit shall be provided to contain water discharge from sprinkler system. The capacity of the sump pit shall be based on simultaneous operation of sprinklers for 4 carpark decks for duration of 20 minutes.

(ii) Foam inlet in accordance to Cl 6.2.7 shall be provided adjacent to the sump pit to address liquid fire (burning fuel on water).

h. Smoke Management

(i) For FAMCPs protected by sprinkler systems.

Ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated automatically by activation of sprinklers or heat detector, if such openings are not naturally ventilated.

(ii) For FAMCPs protected by clean agent systems.

Ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated manually by fire fighters.

i. Detection systems

(i) Addressable heat detectors shall be installed according to SS CP 10 and provided to every parking deck to assist fire fighters in identifying the exact location of the car on fire.

Each addressable heat detector shall be represented by its own LED indicator and shall be displayed at the sub-alarm panel in according to their locations/levels.

Sub-alarm panel shall be provided at the entrance of FAMCP.

(ii) Thermocouple reading for every parking level shall be provided as a means for fire fighters to identify if the fire has been effectively extinguished. No point in the FAMCP shall exceed 10m from a thermocouple.

A panel to display temperature readings shall be installed adjacent to sub-alarm panel.

j. Deck to deck height

The deck to deck height shall be at least 2.2m.

k. Self-contained breathing apparatus (SCBA) for maintenance personnel

SCBA shall be provided and maintained in a clearly marked cabinet for maintenance personnel. Maintenance personnel must be equipped with SCBA while working in FAMCPs. Signages with words minimum 50mm shall be clearly visible and state : "Personnel must be equipped with SCBA during maintenance"

l. FAMCP shall be maintained and inspected yearly or at intervals specified by the individual system suppliers, whichever is shorter.

CATEGORY 3

FIRE SAFETY REQUIREMENTS FOR UNDERGROUND FULLY AUTOMATED MECHANISED CAR PARK (U-FAMCP)

11 All U-FAMCPs will be subjected to the Fire Certificate scheme. The specific fire safety requirements for the U-FAMCP shall be as follows: -

a. Compartmentation

The U-FAMP shall not exceed the following sizes:-

Maximum Parking Depth Maximum	Floor Area Maximum	Cubical Extent
28m	$2000m^2$ (Total area of car parking decks)	$7000m^3$

b. Element of Structure

The U-FAMCP shall be constructed of structural steel construction. Fire resistance to element of structure shall be provided according to Cl 3.3.

c. Vertical Deck Separation

The vertical fire separation between the upper and lower decks by using non-perforated and non-combustible materials (structural steel plate) shall be provided. This is to minimise direct impingement of flame to the car in the upper deck and also to prevent dripping of any possible leaking fuel to the lower deck.

d. Fire Fighting Provisions

The U-FAMCP shall be provided with the following:-

(i) All fire-fighting staircases shall conform to the requirements of Cl.2.3.3;
(ii) Smoke free approach as stated in Clauses 2.2.13 and 2.2.14;
(iii) Fire doors of 1-hour fire resistance rating for the access of fire fighters via the staircase into the car park; and
(iv) The number of staircases provided shall depend on the number of rising mains. Each rising main serving every car parking level shall provide the following coverage:

(a) Where internal access to every car parking deck is provided:
(1) An access platform of minimum width of 0.9m shall be provided and shall be constructed with minimum 1-hour fire resistance. Handrails shall be provided on both sides to prevent fall.

(2) No part of any car parking deck shall exceed 28m.

(b) Where no internal access to every car parking deck is provided:
(1) The maximum distance measured from the staircase door to the most remote part of the car parking deck shall not exceed 8m.

(v) Breeching inlet serving rising main shall be located within 18m of the access road.
(vi) Dry rising main shall be provided for height exceeding 10m and up to 60m. When the height exceeds 60m, wet rising main shall be provided. The breeching inlet shall be located at the foot of the riser stack. One standby fire hose shall be provided at the ground level of each staircase.
(vii) Fire lift shall be provided for basement depth exceeding 9m.
(viii) Where fire lift is required, a two-way voice communication system shall be provided between the Fire Command Centre and the following areas:
(a) Every fire-fighting lobby, including 1st storey.
(b) All fire-fighting related mechanical equipment rooms inclusive of sprinkler pump room, wet riser pump room etc
(ix) Fire Command Centre shall be provided in accordance with Cl.8.2.3.
(x) Basement levels shall be provided with two-way voice communication system in accordance with Cl.8.2.4

e. Private Fire Hydrant
Private fire hydrant where required shall be provided in accordance with Cl.4.4.

f. Fire Engine Access Road
Fire engine access roads to be provided to gain access to the Fire fighting staircases.

g. Active Fire Fighting Systems

The FAMCP shall be protected by sprinklers or clean agent systems.

(i) Where sprinkler protection is installed, it shall be in accordance with SS CP 52. Quick response sprinklers shall be provided. Each parking deck shall be protected by at least 1 sprinkler head.

(ii) Where clean agent systems are installed, they shall comply to NFPA 2001. The amount of agent required to achieve the design concentration shall be based on total flooding method.

(a) Standby cylinders (100%) shall be provided on site.

(b) All doors, shutters, dampers and/or openings shall be closed throughout the duration of gas deployment.

(c) Bypass door shall be provided in the event there are occupants inside FAMCP during gas deployment.

(d) Fire fighters shall be able to activate the clean agent manually if the system was not activated during fire.

(iii) Foam inlet in accordance to Cl 6.2.7 shall be provided to address liquid fire (burning fuel on water).

h. Provision of Sump Pit

(i) Sump pit shall be provided to contain water discharge from the sprinkler system. The capacity of the sump pit shall be based on simultaneous operation of sprinklers for 4 carpark decks.

(ii) Foam inlet in accordance to Cl 6.2.7 shall be provided adjacent to the sump pit to address liquid fire (burning fuel on water).

i. Smoke Management

(i) Smoke Vents. This requirement shall apply to basement not exceeding 1,000m^2 in floor area and maximum 5m in depth measured from the ground level area to the lowest floor level.

(a) For FAMCPs protected by sprinkler systems.

Ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated automatically by activation of sprinklers or heat detector, if such openings are not naturally ventilated

(b) For FAMCPs protected by clean agent systems.

Ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated manually by fire fighters.

(ii) Smoke purging systems of 9 air changes per hour shall be provided if the basement exceeds 1,000 m2 in floor area or 5m in depth measured from the ground level area to the lowest floor level.

(a) For FAMCPs protected by sprinkler systems.

The smoke purging systems shall be operated automatically by activation of heat detector.

(b) For FAMCPs protected by clean agent systems.

Smoke purging systems shall be operated manually by fire fighters.

j. Detection systems

(i) Addressable heat detectors shall be installed according to SS CP 10 and provided to every parking deck to assist fire fighters in identifying the exact location of the car on fire.

Each addressable heat detector shall be represented by its own LED indicator and shall be displayed at the sub-alarm panel in according to their locations/levels.

Sub-alarm panel shall be provided at the entrance of FAMCP.

(ii) Thermocouple reading for every parking level shall be provided as a means for fire fighters to identify if the fire has been effectively extinguished. No point in the FAMCP shall exceed 10m from a thermocouple.

A panel to display temperature readings shall be installed adjacent to sub-alarm panel.

k. Deck to deck height

The deck to deck height shall be at least 2.2m.

l. Self-contained breathing apparatus (SCBA) for maintenance personnel

SCBA shall be provided and maintained in a clearly marked cabinet for maintenance personnel. Maintenance personnel must be equipped with SCBA while working in FAMCPs. Signages with words minimum 50mm shall be clearly visible and state : "Personnel must be equipped with SCBA during maintenance"

m. FAMCP shall be maintained and inspected yearly or at intervals specified by the individual system suppliers, whichever is shorter.