Fire Safety & Shelter Bureau Seminar

16th & 17th Apr 2003

HQ SCDF Auditorium

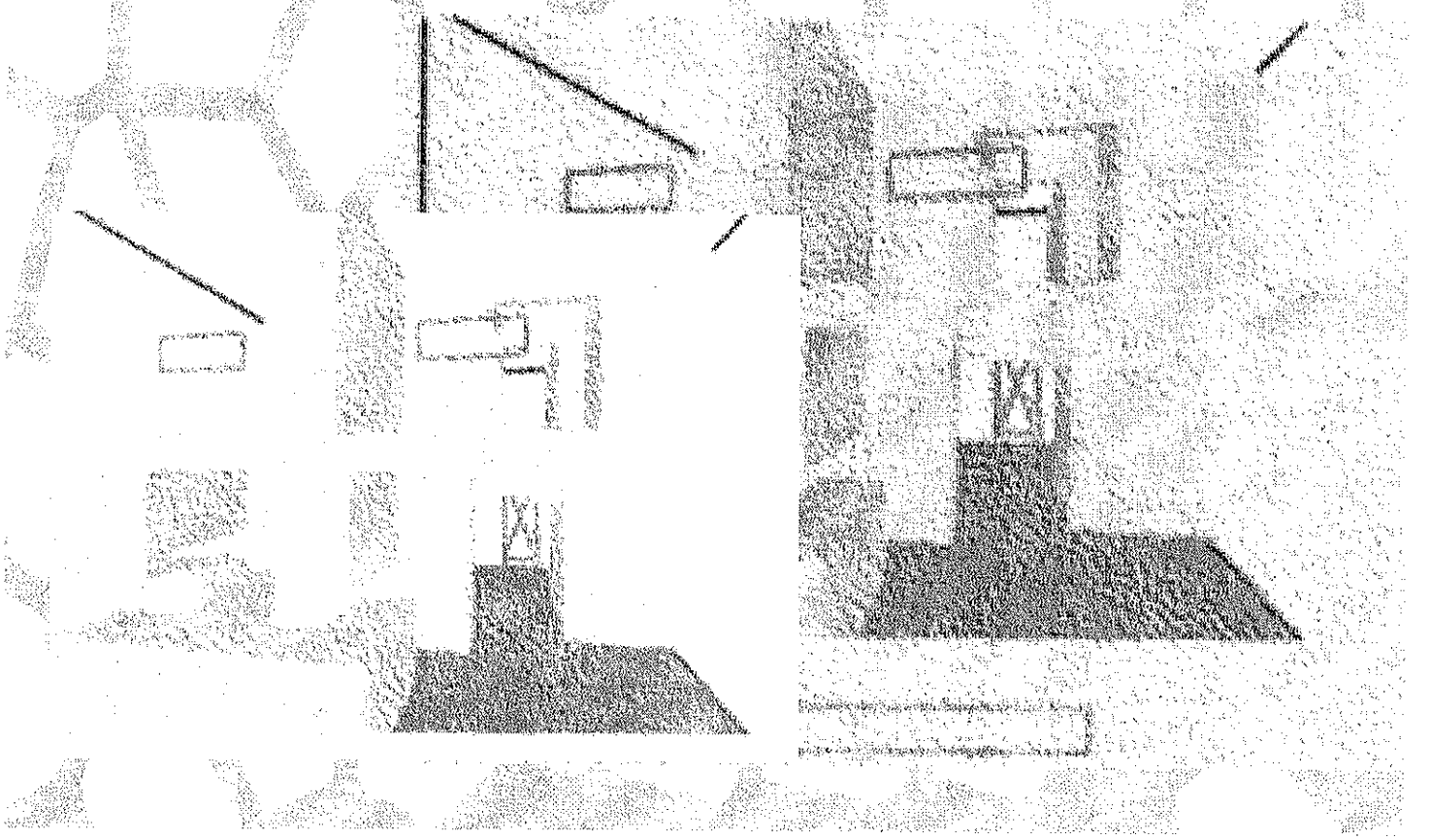


Table of Content

S/No	Topic	Speaker
1.	*The Design and Construction of North East Line Civil Defence MRT Station Shelter*	*Mr Stephen Mok*
2.	*First Cut of the Performance Based Code & Its Related Issues*	*Mr Edmund Choo*
3.	*Fire Code Consultation- What are Your Queries?*	*Mr Chan Hong Meng*
4.	*Audit Checks on Fire Safety Plans- How have you fared?*	*Cpt Yeo Kian Min*
5.	*Pointers for Waivers Application*	*Mr Vijayaratnam*

The Design and Construction of North East Line Civil Defence MRT Station Shelter

By

Mr Stephen Mok
Unit Head
Transit Shelter Engineering
Special Function Division
Building Control Authority

THE DESIGN AND CONSTRUCTION OF NORTH EAST LINE CIVIL DEFENCE MRT STATION SHELTERS

Chin Jen Chyi
Building And Construction Authority

Lee Chee Keong
Building And Construction Authority

Stephen Mok
Building And Construction Authority

Wong Kok Fai
Land And Transport Authority

SYNOPSIS: Most of the underground MRT stations in the North-East Line (NEL) MRT system are designed and constructed as civil defence (CD) shelters. This paper presents some of the main CD design requirements including the construction and testing aspects. It shows how a public transport facility can be designed and constructed to meet both transit and CD operational requirements.

1. INTRODUCTION

The recently completed North-East Line added another 16 MRT stations to the Singapore MRT system (Figure 1). Of the 16 stations, 13 MRT stations are also designed and constructed to incorporate CD shelter provisions.

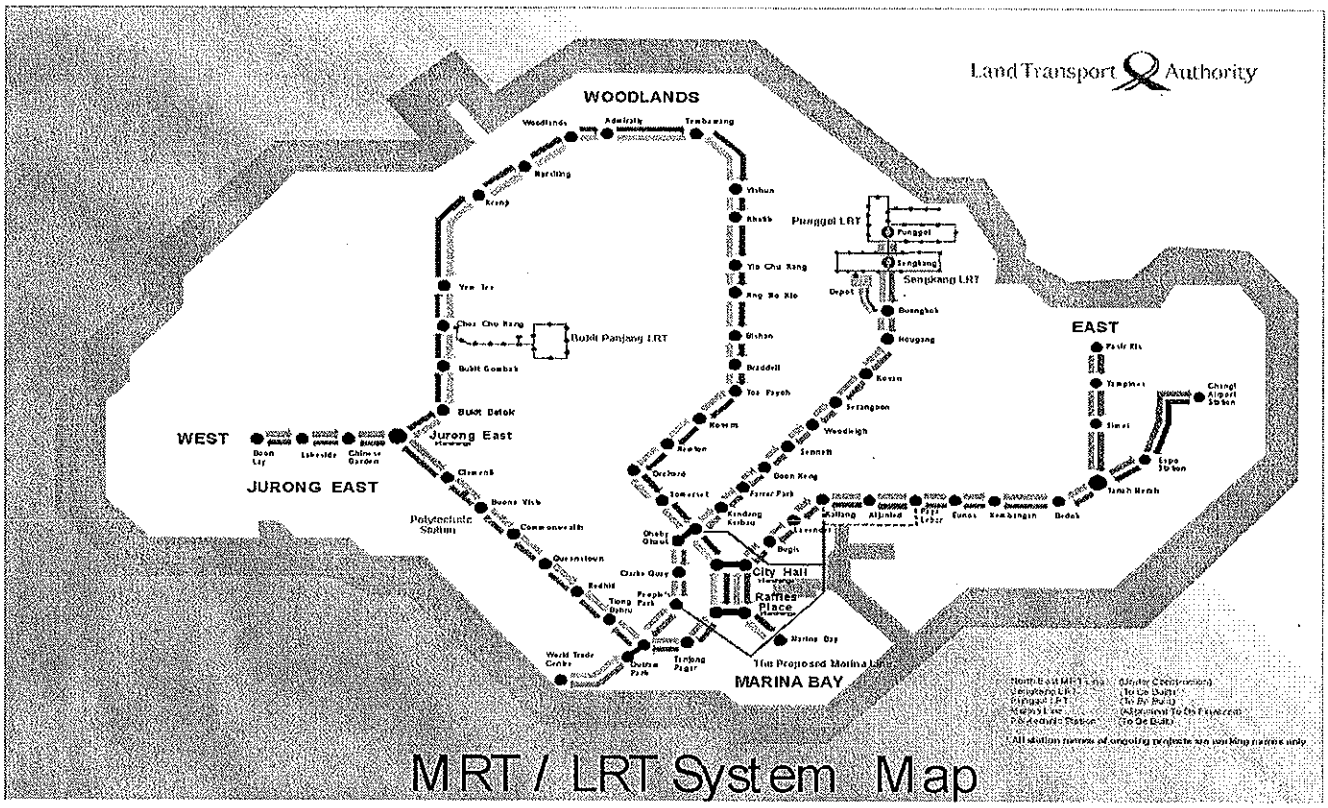


Figure 1: Singapore MRT System.

Underground MRT stations are essentially large underground spaces with thick reinforced concrete floors, walls and roofs. They could therefore be enhanced effectively as CD shelters to give a good level of protection against weapon effects.

Depending on the size of the available sheltering areas, the CD shelter station is designed according to the Technical Requirements for S10-S29 Public Shelters.

2. DESIGN REQUIREMENTS

The Technical Requirements prescribes the architectural, structural, mechanical and electrical design aspects of the station shelter. The following sections present the main CD design requirements and their implications on the respective disciplines.

2.1 ARCHITECTURAL REQUIREMENTS

Architectural CD design requirements refer mainly to layout design such as bounds and zones of protection, access way configurations, additional space requirements and architectural finishes.

2.1.1 Bounds And Zones Of Protection

The CD shelter and its functional areas are protected by a hierarchy of protective boundaries consisting of reinforced concrete walls, slabs, CD doors and CD valves. These boundaries in turn define the zones of protection, the clean and 'dirty' air areas of the shelter.

The thickness of the walls and slabs and the type of CD doors and CD valves must complement the bounds of protection which they are a part of. The characteristics of the various CD bounds of protection can be summarised as follows:

BOUNDS AND ZONES OF PROETCTION	LOCATIONS
Direct Hit Protection	Main shelter hull
Semi-Protection	Access way, stairwells, vent shaft
Blast Protection	Blast lock, plant room
Blast and Gas Protection	Main shelter area

2.1.2 Access Way Configurations

The number of accesses with and without decontamination facilities is largely dependent on the shelter category. As a minimum, two accesses shall be provided with one leading to a decontamination room. The larger shelters would require up to 4 accesses and two decontamination facilities.

In designing access ways to the shelter, one concern is the 'strike point' location i.e. the point where weapons may hit. The strike point is often found before the escalator landing at the concourse level. This means the access way has to be configured in such a way so as to prevent a direct line of sight from the strike point to the entrance sliding door or any CD devices such as blast valves. In addition, the distance between the strike point to the sliding door must be greater than 20 metres. This results in the access way often having to approach the entrance side-on instead of directly (Figure 2).

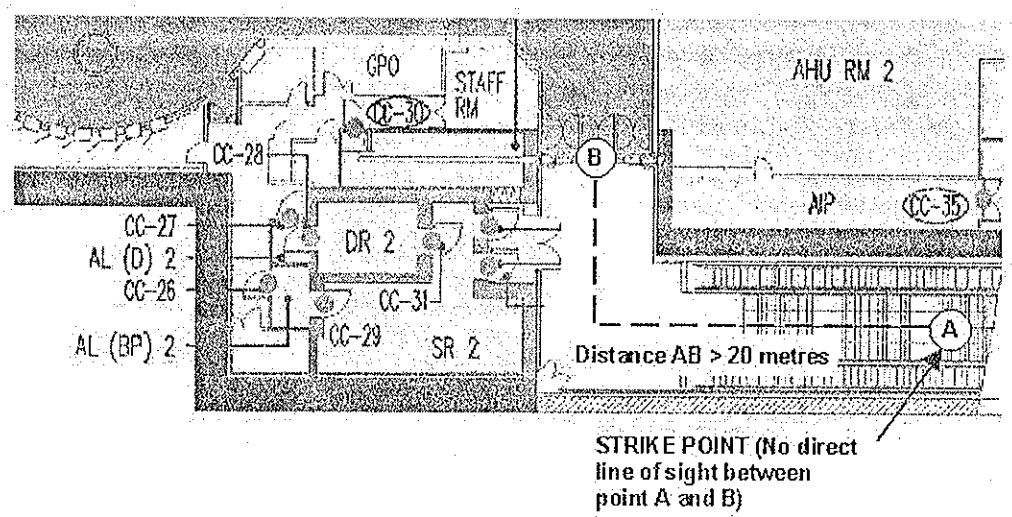


Figure 2: Example of access way layout.

2.1.3 Additional Space Requirements

Additional space is required in the design of the station layout to incorporate the various CD rooms and facilities. This additional area has to be incorporated within the area of the station footprint.

2.1.4 Architectural Finishes

The CD Design Criteria requires the support systems of both ductile and non-ductile architectural finishes to be designed to specified static equivalent shock loads. Additionally, non-ductile materials also have to undergo shock tests. Shock design generally requires an increase in the strength of support members for such items as signage, light fittings, ceiling boards, etc.

Ease of accessibility has to be built into the design of architectural wall, floor and ceiling finishes that are concealing CD services (e.g. water tap point, sprinkler isolation, floor traps etc) and CD devices (e.g. local door status panels, blast valves, pressure gauges, etc). Access panels have to be incorporated and identified with a CD logo (Figure 3).

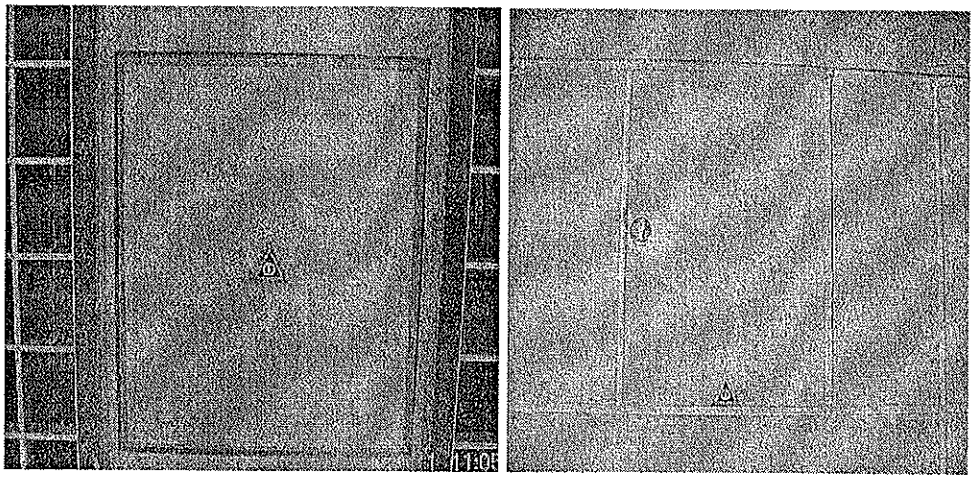


Figure 3: CD Label on Ceiling and Wall Access Panels.

Similarly, the entrances leading to the station shelter shall be provided with appropriate CD logo identifying the station as a shelter station. Appropriate CD messages shall be incorporated into the station signage to facilitate CD operations e.g. designated peacetime door having the message "CD Modes - Open". In addition, doors leading to CD-related facilities shall incorporate the CD pictogram in the door signs for identification. Other forms of marking included the marking of the CD-related services e.g. cable support systems, water pipes, air ducts, volume control dampers, etc.

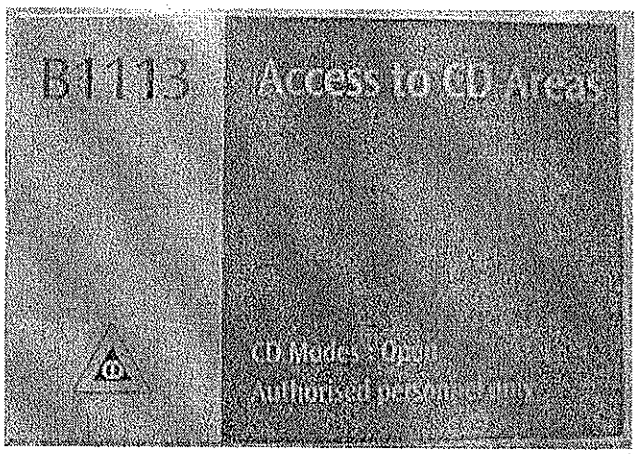


Figure 4: CD Logo and Instruction on Door

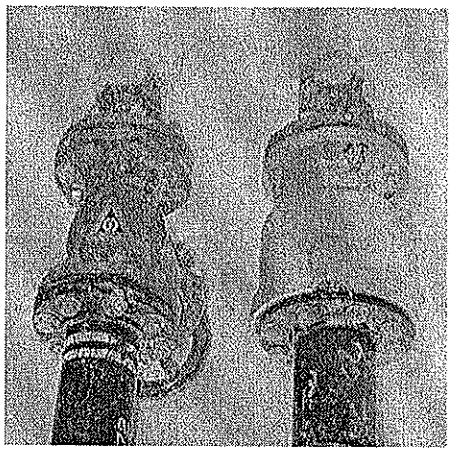


Figure 5: CD Label on Isolation Valve.

2.2 STRUCTURAL REQUIREMENTS

Station shelters have to be designed to meet both peacetime requirements according to various codes of practice and to CD load conditions. Three main areas that impact the structural design of the station shelter are presented here.

2.2.1 Minimum Thickness And Reinforcement

Minimum thickness and reinforcement requirements for various structural members are to be complied with. The amount of reinforcement to be provided for a member depends on the load case. The reinforcement provided has to be checked against minimum requirements prescribed.

2.2.2 Additional Load Cases

In addition to peacetime load cases, the station shelter has to be designed for CD load cases:

a) Debris Loads (CL)

They provide for the debris resulting from damage of nearby buildings above and around the station shelter. Generally, a CL of $20kN/m^2$ is applied vertically onto the station roof slab and horizontally onto the station external wall and is in addition to the peacetime loads. Its application may or may not present a more onerous load case depending on the depth of the station shelter. Generally, the deeper the station, the less critical is the effect of CL.

b) Extra-Ordinary Static Load (EOSL)

EOSL applies to the design of the external shelter hull. The station shelter roof slabs have to be designed such that any one of its supporting columns and walls can be allowed to fail. The EOSL case may or may not be more critical than the peacetime load case depending on the number of and distance between the supporting columns and walls.

c) Dynamic Load Case

Structural members subjected to blast or shock may be designed for their respective dynamic loads by satisfying respective minimum requirements for structural member thickness and steel reinforcement content, and by satisfying stipulated equivalent static load conditions. Blast and shock load design usually prove more onerous than its peacetime design.

2.2.3 CD Doors

The large openings at the station entrances and tunnel portals are 'sealed up' during the CD mode of operation by large entrance sliding doors (Figure 6) and tunnel hinged doors (Figure 7). The reinforced concrete structures framing and supporting these doors have to be designed to satisfy dynamic blast loads that are being transferred from the door leaves onto the structure. These structural design line loads are relatively large.

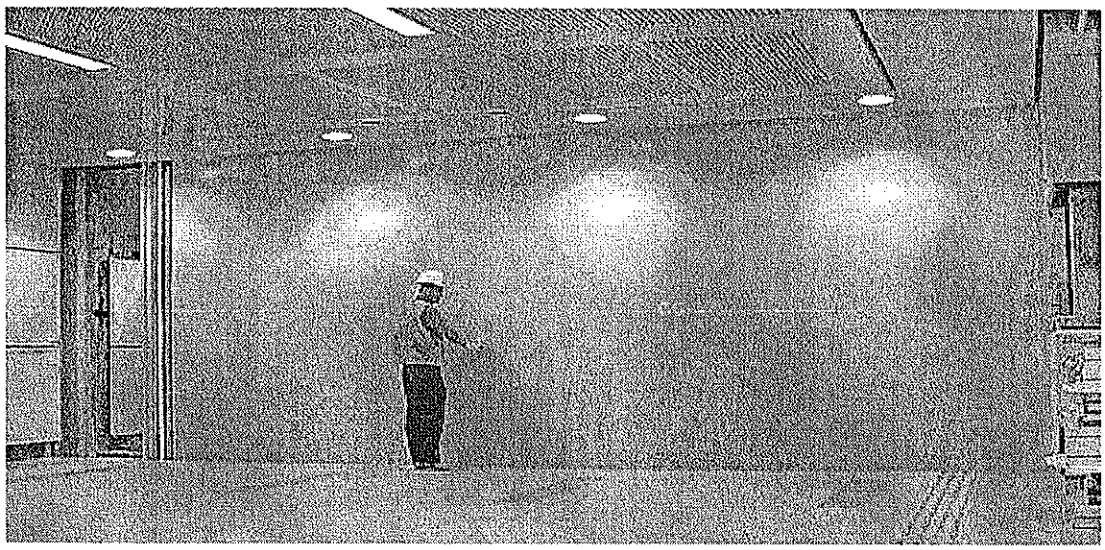


Figure 6: Entrance sliding door.



Figure 7: Tunnel hinged door.

2.3 MECHANICAL REQUIREMENTS

2.3.1 Environmental Control

During the operation of the station shelter, the shelter's CD doors are closed and air from the outside is supplied to the air-filters and air-handling units (AHUs) for distribution to the shelter. The environmental control system provides the shelterees with tolerable physiological conditions measured in terms of effective temperatures. A maximum effective temperature of 28°C is prescribed for both short and longer shelter stays. The effective temperature is a function of the dry bulb (DB) and the wet bulb (WB) temperatures. In general, it is intermediate between the dry bulb and wet bulb temperatures.

The shelter is also overpressured through an air-flow regime to prevent the effects of leaks into the shelter hull. The air-flow regime is discussed in more detail in the next section.

2.3.2 Overpressure Air-Flow Regimes

In a shelter overpressure air-flow regime, generally, the main shelter area has the highest overpressure and the subsequent adjacent rooms leading out of the shelter have decreasing overpressures. The air-flow through the various rooms is regulated by blast valves, overpressure blast valves and overpressure valves. The quantity and layout of these valves have to be designed to achieve the desired overpressures and air-flow. These valves are dedicated CD devices and their functions are explained in the next section.

2.3.3 Blast Valves, Overpressure Blast Valves And Overpressure Valves

Three kinds of CD valves are used in the station shelter. These are blast valves (BV), overpressure blast valves (OBV) and overpressure valves (OV). BVs allow air-flow in both directions and are hence placed in the bounds of blast protection, for example, at the walls of intake air plenums, where they protect plant equipment (such as generators and cooling towers) and air-filters from blast pressure. Similarly, the OBVs (Figure 8) prevent blast but have an added feature

of allowing air-flow in one direction only. They are often used on the walls of access/blast locks to allow air to flow out of the access/blast locks (during air changes) but not inwards.

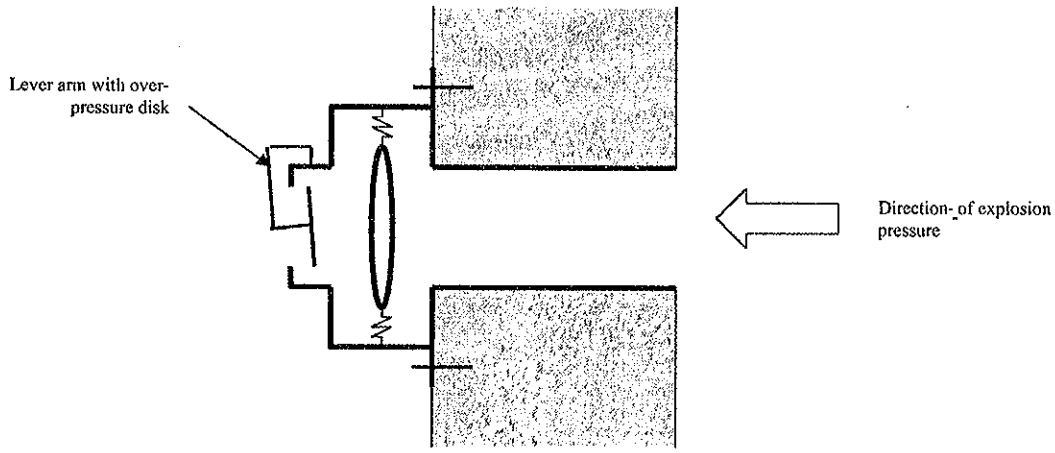


Figure 8: Sectional schematic of OBV.

Finally, the OVs (Figure 9) do not protect against blast pressure but only allow unidirectional air-flow through them. These are used mainly to direct and regulate air-flow between rooms in accordance with the air-flow regime.

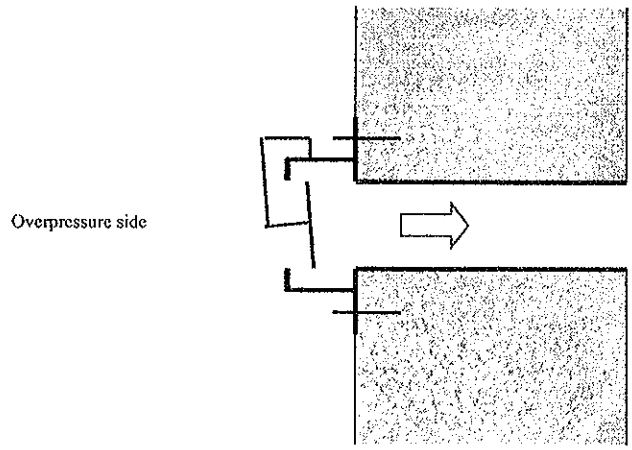


Figure 9: Sectional schematic of OV.

The presence of these CD valves throughout the shelter means that sufficient space on the shelter walls must be provided for their installation. Proper reinforcement around these valves has also to be provided.

2.3.4 Air-Tightness

For the overpressure air-flow regime with its arrangement of CD valves to work, air-tightness at all other locations (through which air-flow is not intended) must be ensured as far as possible. All CD doors are thus designed to be air-tight through the use of rubber seals. Also, all service penetrations through the shelter bounds of protection must be sealed and protected depending on the type of service and the bounds of protection they penetrate. This is achieved by the use of multi-cable transits (Figure 10), various cast-in and fixing details for cables, conduits and pipes.

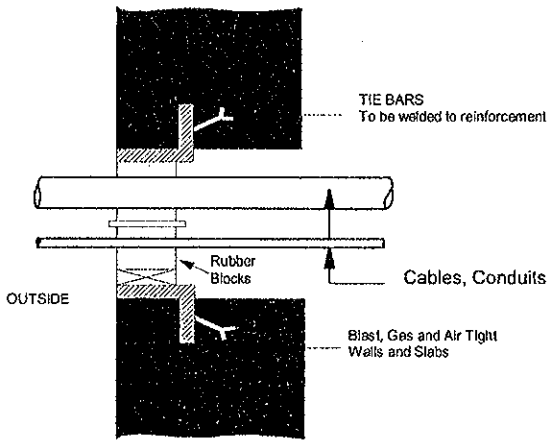


Figure 10: Sectional schematic of multi-cable transit.

2.4 ELECTRICAL REQUIREMENTS

Electrical design concerns mainly the power supply system of the station shelter which is essential for the functioning of the lighting, mechanical ventilation, air-conditioning, water services and communication systems.

2.4.1 Power Supply

Each station is supplied with two 22kV feeders from the local mains. The high-tension feeders are stepped down to 400V through station transformers before supply is distributed throughout the station shelter. An emergency backup power supply system for the shelter is to be provided and the system shall operate automatically in the event when the normal power supply fails.

The emergency back-up power supply system comprises two diesel generators, the associated generator coolers (AHU) and a generator control panel. Each generator is capable of supplying the full emergency power requirements.

2.4.2 Communication Systems

The station shelter is provided with internal as well as external communication facilities for command and control within the shelters.

a) Telephone Lines

The station shelter is serviced by two independent telephone lines.

b) Internal Communications

The internal communication system comprises the local battery telephone system, intercoms and public address system. Voice paging, point-to-point patching terminations and audio-visual source inputs facilities are provided within an integrated communications panel (Figure 11) at the shelter command area. Communication means between adjacent station shelter command areas have to be provided. The infrastructure (telephone points, outlets, etc) necessary for the set-up of this system during emergency has to be provided.

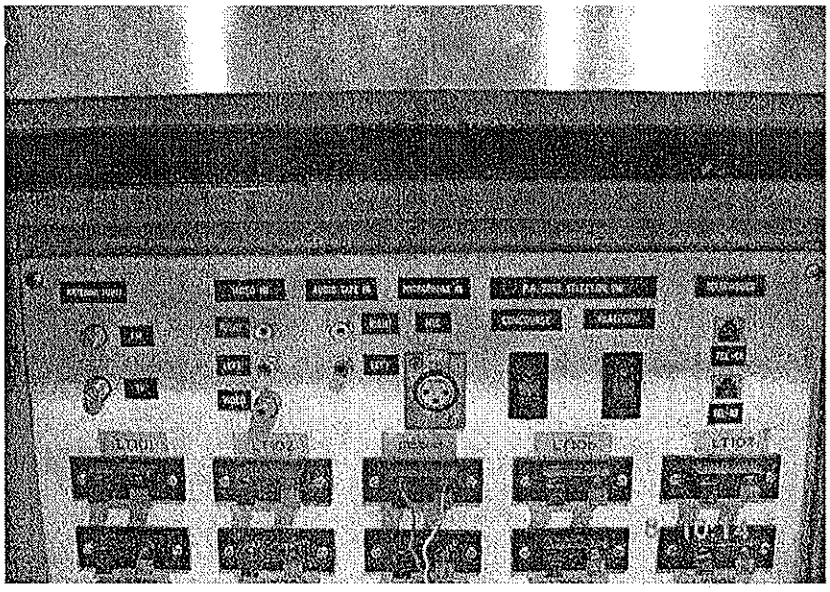


Figure 11: Terminations within the Integrated Communications Panel.

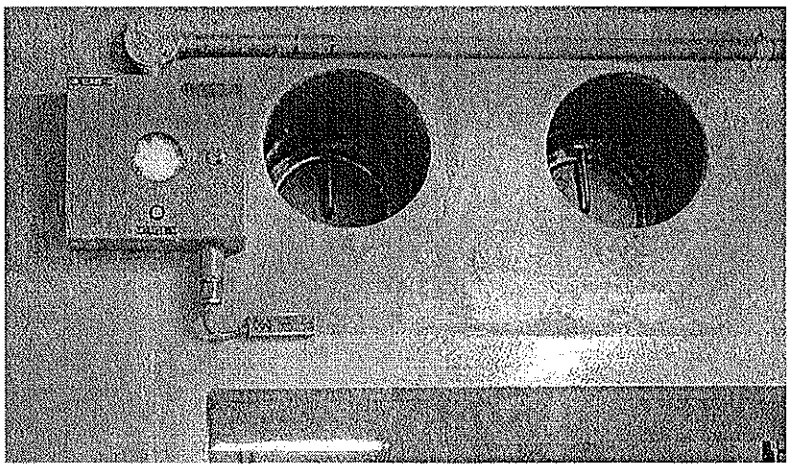
c) Additional Telephone and Antenna

Provisions for connection of temporary telephone lines and antenna (for TV and radio) are made at the entrance area as back-up if the public lines or the building antenna are damaged, .

d) Door Status Monitoring System

This system monitors the status (open/close) of all CD doors in the station shelter via a monitoring panel located in the station master room. When a CD door is opened, the corresponding LED on the panel becomes illuminated together with an alarm.

The system also controls the movement of personnel through the access/blast locks via the local status panels mounted next to the CD doors (Figure 12).



LED COLOUR	DESCRIPTION
RED	DO NOT OPEN
GREEN	CLEAR TO OPEN
FLASHING GREEN	DO NOT OPEN; AIR FLUSHING IN PROGRESS
FLASHING RED	VIOLATION; CLOSE DOOR IMMEDIATELY

Figure 12: DSMS Local Status Panel.

c) CD Equipment Monitoring System

The means to monitor the status of key CD E&M equipment are provided through an equipment monitoring panel located at the station master room (Figure 13). The colours of the illuminated indication modules denote the Run/Stop/Trip status of the equipment.

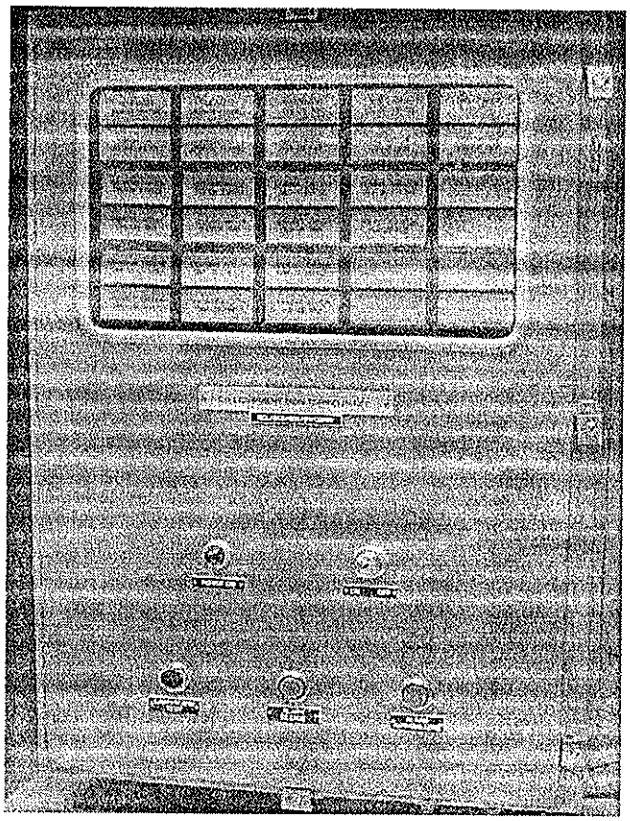


Figure 13: CD Equipment Monitoring Panel.

3. CONSTRUCTION ASPECTS

Some aspects of construction of the station shelters are discussed in the following sections.

3.1 CD REINFORCEMENT

Overcoming the congestion of reinforcement bars can pose a challenge to the contractor, especially where the 'cubic lattice' arrangement of reinforcement bars is required at the external hull (Figure 14) and at areas near CD door frames and other CD devices, such as blast valves and pipe penetrations. Contractor has to be careful in ensuring that the sequence of reinforcement installation and its integration with any CD devices is carefully studied and co-ordinated on site.

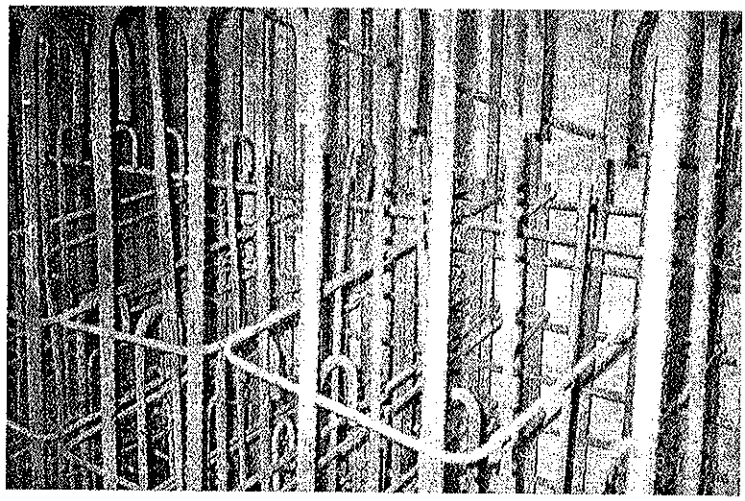


Figure 14: Cubic lattice arrangement (external hull with diaphragm wall).

3.2 CD DOORS

The fabrication and installation of the large CD entrance sliding doors and tunnel hinged doors require experience and skill on the part of both the fabricator and the contractor.

For proper functioning of the doors, the specified design tolerances have to be achieved during fabrication. This demands care when working with very large steel members and thus requires experience and stringent quality control on the part of the fabricator. Mock-ups of the completed sliding doors and tunnel hinged doors are put up at the fabrication yard for testing and inspection before delivery to the site. (Figure 15).

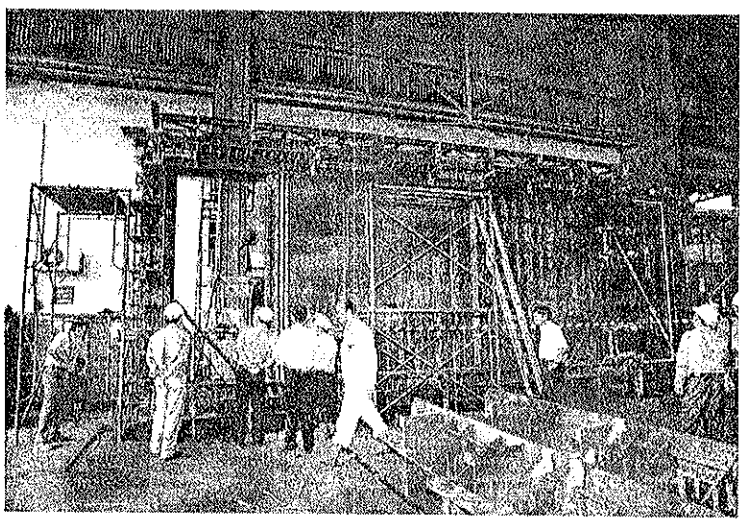


Figure 15: Mock-up of entrance sliding door at the fabrication yard.

During installation of the doors on site, the contractor has to lift, move and place the heavy doors in their required locations (Figure 16). The contractor has to ensure that the door is securely propped and that it meets requirements of correct position and level, verticality, planarity, alignment and seal gap tolerances, etc. Detailed and comprehensive checks must be carried out before finally casting the concrete around the door.

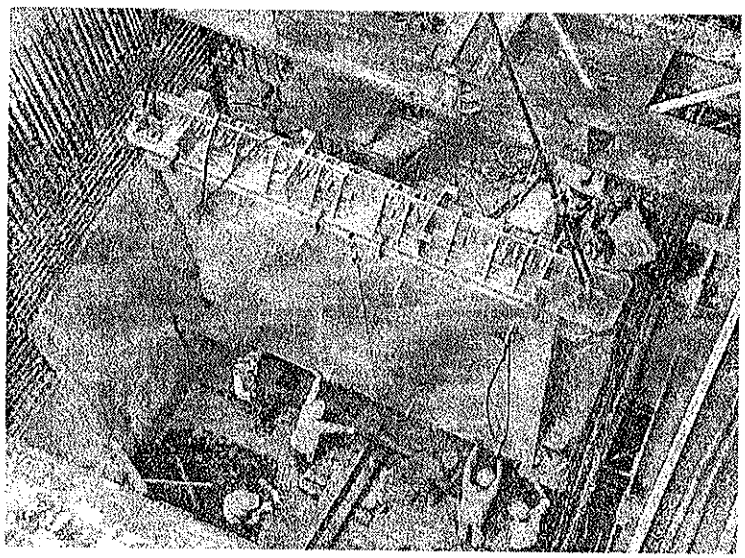


Figure 16: Lowering tunnel hinged door into position.

3.3 CD VALVES

Like any service penetration, the sleeves for the various CD valves have to be installed first within the reinforcement for the walls and cast according to casting schedules at the site. The valve bodies could then be mounted onto the sleeves at a later stage. Since each CD valve has its own type of sleeve, inspections have to be carried out to ensure that the recommended separation distance between the valves is achieved and that the correct quantities and sleeve types have been provided. In the case of blast valves where the number of sleeves to be installed can be numerous and closely spaced (Figure 17), the contractor has to prepare the detailing carefully before fixing the reinforcement bars accordingly.

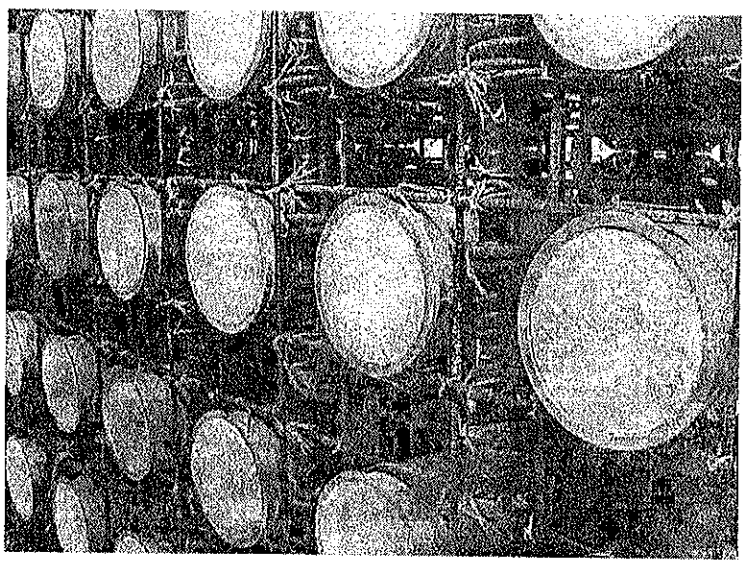


Figure 17: Blast valve sleeves blast end.

3.4 SEALING DEVICES

Numerous services penetrate the station shelter bounds and must be provided with the appropriate sealing details. These include cast-in pipes with and without puddle flanges for pipes, multi-cable transits for cables (Figure 18), conduits and pipes, and flanges with expansion anchor bolts for ducts. To facilitate installation, services routings must be properly co-ordinated to ensure the sealing devices are adequately and correctly provided.

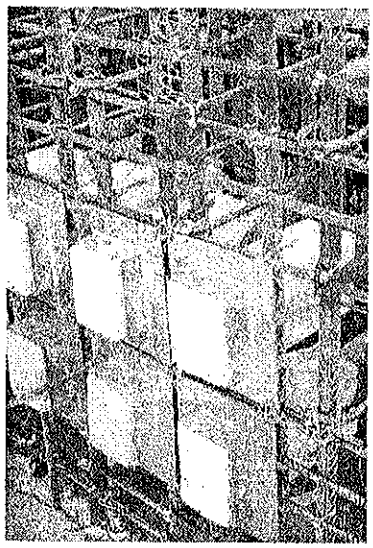


Figure 18: Preparing multi-cable transits frames for casting.

3.5 ANCHOR BOLTS

CD E&M services run within the ceiling spaces of the station shelter and these services rest on approved wall-mounted and ceiling-suspended supports. During the installation, contractors have to ensure that the correct types of anchor bolts and support brackets are used and that the separation distance between anchor supports does not exceed the approved design. Sampling pull-out tests of the anchor for each CD E&M system are conducted to verify that the anchors have been properly installed (Figure 19).

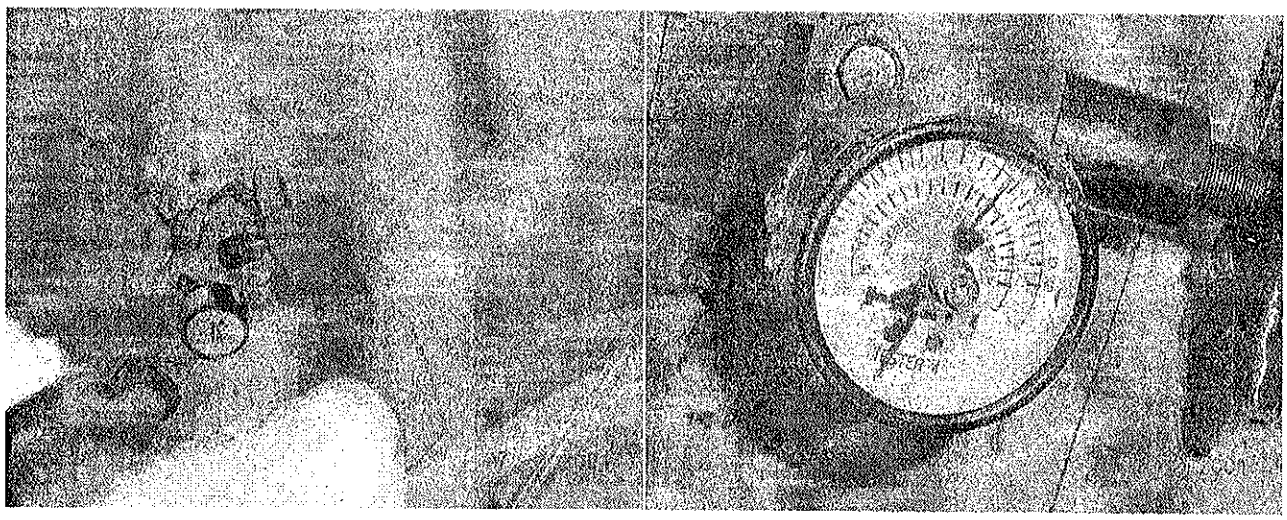


Figure 19: Securing the pull-out test meter on CD anchor and verifying the readings.

3.6 DROP TEST

Architectural finishes and various CD equipment of non-ductile behaviour have to be drop-tested to 15g as required before they are installed e.g. false ceiling, glass balustrade, wall panels, light fitting, local status panels, etc.

The items under test is first mounted onto a test frame and lifted to a height before the test frame is dropped (Figure 20). Accelerometers attached to the test frame would register the 'g' force experienced by the test body when the test frame hit the floor on impact. The test item is visually examined to verify that no part gets dislodged or damaged.

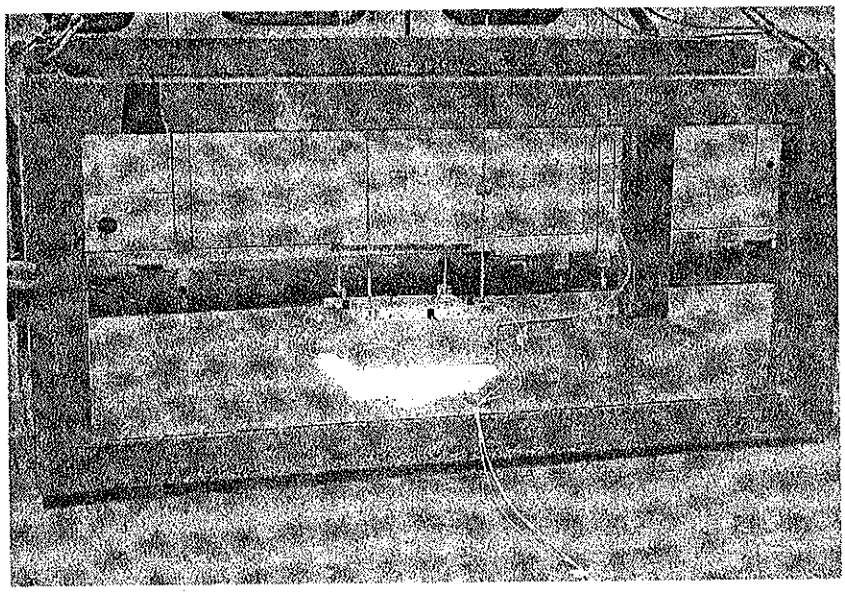


Figure 20: Light fitting mounted on to test frame.

In addition to the drop test, false ceiling systems have to fulfil the 10 m^2 test. This is to ensure that ceiling within a 10 m^2 area does not break-up and collapse as a result of hanger support failure (Figure 21).

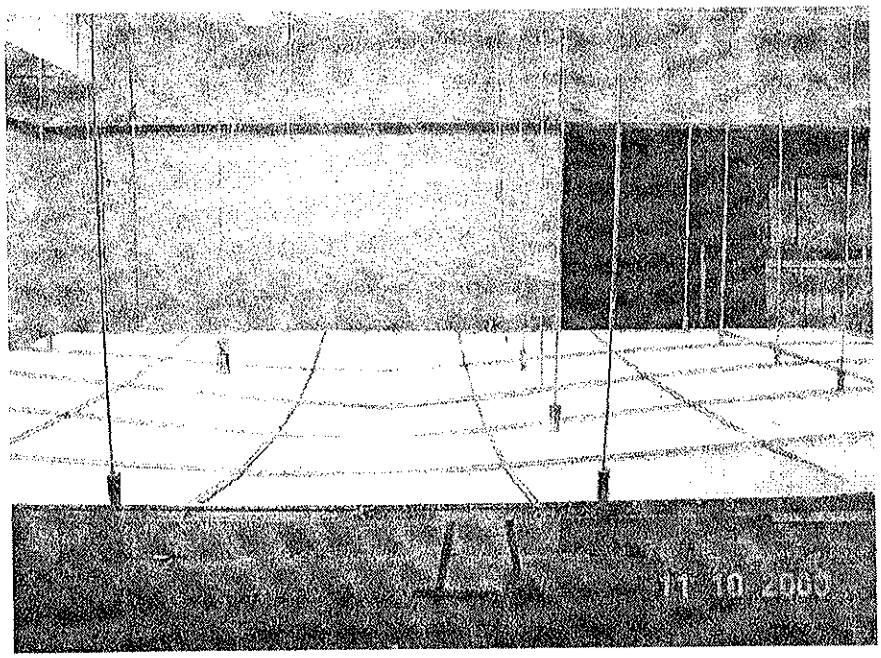


Figure 21: Ceiling system under 10 m^2 test.

3.7 TESTING AND COMMISSIONING

Throughout the construction phase, specific CD testing and commissioning activities have to be carried out to verify that the shelter and the CD equipment will function as per design. The following section described some of the tests to be carried out.

3.7.1 Internal Over-pressure Test (IOPT)

Numerous services penetrate the station shelter bounds, which must be provided with the appropriate sealing devices. The IOPT is an air-tightness test to verify that all envelope components of the station shelter such as RC slabs, walls, CD protective doors and concrete surrounding CD valves and sealing devices are air tight. Prior to the conduct of IOPT, it is essential for the CD doors to have passed the chalk trace and the light penetration tests. During the conduct of IOPT, all CD doors that open out of the shelter are closed and the shelter is pressurised to a minimum overpressure of 1.5 times the design overpressure, which must be maintained throughout the test period of 30 minutes.

3.7.2 Generator Load Test

This test is conducted on site to verify that the generator system including the fuel delivery system function properly over an extended period of time. The performance of the generator coolers (air handling equipment) is also verified. Load banks are used to simulate the power required from CD equipment. The generator is subjected to various step loads, which are increased gradually throughout the test period. The generator is expected to deliver the required power continuously to drive these simulated loads at each specified period.

Measurements such as oil pressure, exhaust temperature, air-flow, currents, supply and return water temperatures, are taken.

3.7.3 Over-pressure Regime and Air-flow Test (ORAT)

The ORAT verifies whether the overpressure measured and maintained in the various CD rooms meet the design values for conventional and filtration mode of operations. It also verifies the functional performance of the air handling equipment, dampers, fans (Figure 22), CD valves and ducts. The airflow and pressure drops through the CD valves in specified CD rooms are checked to ensure that they fall within the designed values. The time needed to ensure adequate air-changes at the air/blast locks is also measured and verified. These timings are then used for calibrating the local door status panels of the DSMS (see Section 2.4.2 d). The effective temperature within the shelter is also measured for verification.

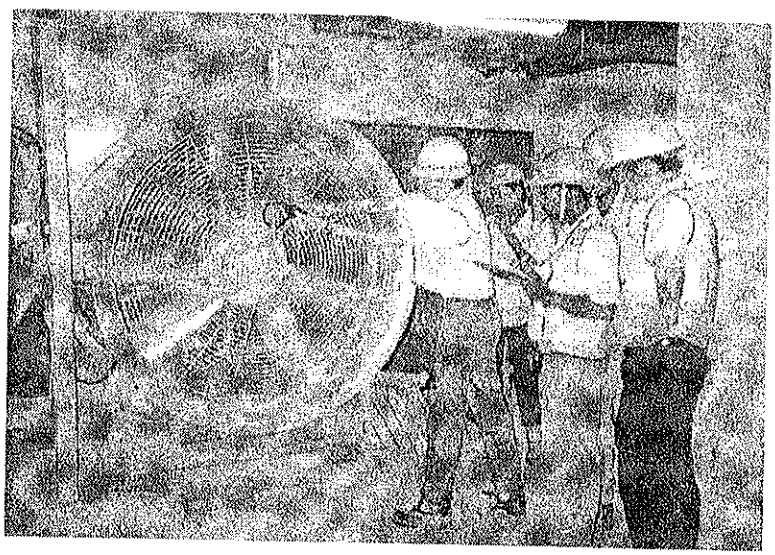


Figure 22: Air-flow measurement during ORAT.

The conduct of ORAT requires the tunnel hinge doors to be closed. As such, these tests can only be carried out when the test running of the trains are not being conducted, and they have to be scheduled and completed early.

3.7.4 Integrated Systems Test (IST)

The purpose of the IST is to test all CD M&E systems in an integral manner to simulate actual CD operations. The systems that are involved in IST include the environment control system, water supply, sanitary and drainage systems, electrical distribution system and CD communication and monitoring systems. All systems are checked functionally and broad measurements are obtained such as air-flow, relative humidity, effective temperature, full-load power and illumination levels.

The conduct of IST serves to ensure that all CD E&M systems within the station shelter are reliable and performing to expectations before the station shelter can be considered operationally ready.

4. CONCLUSION

This paper has presented some of the main CD design requirements, construction and testing aspects of the underground civil defence MRT station shelters along NEL. It shows the specialised CD requirements and the challenges they pose during the design, construction and testing stages. It also demonstrates how a public transport facility can be designed and constructed to meet both transit and CD operational requirements

First Cut of the Performance Based Code & Its Related Issues

By

Mr Edmund Choo
Performance Based Plans Consultants
Fire Safety Consultation Branch
Fire Safety & Shelter Bureau

FIRST CUT OF THE PERFORMANCE BASED CODE & ITS RELATED ISSUES

INTRODUCTION

The performance based code is slated to be introduced in 2003/4. The Performance Based Code Committee has been actively drafting the new code. In this paper, we shall take a look at the format and structure of the new performance based fire code, and the pertinent issues related to the introduction of the code.

2. A point to note is that all proposals mentioned herein in this paper are subject to further changes, and thus may not be taken to be the SCDF's final stand on the matter.

CODE-WRITING - THE FIRST CUT

3. Before we take a look at the first cut of our performance-based code, let us first get an understanding of the process how we arrive at the code itself. A proper understanding of how the code is crystallised will enable its users to be more confident in its application.

4. The Performance Based Code Committee reviewed through the Fire Code clause by clause to sieve out the intentions underlying each clause and subsequently arriving at the root and sub-objectives for the chapter.

We will illustrate the process with an example:-

External exit passageway

Clause 2.3.2(c)(i) (gist)

1. Can be used as a required exit in lieu of internal exit passageway.
2. Ventilation openings above 1.8m from floor level
3. Openings not less than 3m from opening of exit staircase

The underlying intentions are not explicitly stated, and therefore require further delving into to derive them.

Intentions

1. The exit passageway is an extension of the exit staircase (which is why travel distance may be measured up to the exit passageway instead of the exit staircase).
2. The 1.8m clearance from floor to ventilation openings creates a relatively safe passage for occupants to crawl under the openings in the event of a fire in the occupancy unit, in order to reach the exit staircase.

3. The 3m separation of openings from the exit staircase reduces smoke infiltration into the exit staircase.

It can be easily inferred from the above intentions that the ultimate intention for having an external exit passageway is to provide a means of relative safe passage for the occupants to the exit staircase, which is taken to be a transitory safe haven.

Sub-objectives

(i) Reliability of means of escape.

(ii) Adequate protection against heat and smoke migration into means of escape.

Root-objective

Occupants must be able to escape to a safe place, directly or through a protected exit, before untenable conditions are reached during a fire emergency.

5. The same procedure is applied for every clause in the chapter of the Fire Code, so that we can arrive at a set of root and sub-objectives that encapsulates the intentions for the chapter.

6. At this stage, the Performance Based Code Committee has completed arriving at the root and sub-objectives for the entire Fire Code. The final version will be reviewed and refined before being issued for public comment.

PERTINENT ISSUES ON THE DRAWING BOARD

7. Setting up the infrastructure for the performance-based system is critical to the success of the system. There are many issues on the drawing board which will are currently being discussed at the Performance Based Code Committee meetings. These will be highlighted below:-

(a) Fire safety engineering guidelines
(b) Accreditation of fire safety engineers
(c) 3rd party or peer review
(d) Registered inspectors
(e) Performance based submissions on materials/products

(a) Accreditation of fire safety engineers

On this aspect, there ought to be a formal accreditation body administering the registration of fire safety engineers for professional practice.

The role of the appointed accreditation body encompasses the following:-

(i) convene to assess potential candidates for acceptance into fire safety engineering practice
(ii) assess applications of appeal by unsuccessful applicants
(iii) decide on possible disciplinary actions such as de-registration of recalcitrant or negligent fire engineers.

There are two possibilities on the candidates for the accreditation role, ie that the accreditation could either be done by

(a) Singapore Civil Defence Force or
(b) Professional Engineers Board

At the present moment, the 2 options are currently being evaluated.

Regardless of the organisation administering the accreditation of fire safety engineers, one thing is certain : the administering body will have a set of acceptance criteria for the registration of fire safety engineers.

The present proposed acceptance criteria, as discussed during the PBC Committee meetings:-

a. Have at least a degree in fire safety engineering that is recognised and accepted by the accreditation body

b. Have at least 2 years' relevant experience in undertaking fire engineering analysis.

c. Successful clearing of examinations as set by the accreditation body.

d. Successful interview by professional interview panel from accreditation body.

The accreditation status of a fire safety engineer is recommended to be reviewed every 2 years, to ensure the relevancy of the work undertaken in relation to fire safety engineering practice and experience.

It is envisaged that there could be certain exemptions for the initial batches of fire safety engineers in terms of required years of experience because as with the introduction of every new system, the pioneer batches do not have the benefit of garnering the pre-requisite years of experience.

(b) 3rd party or peer review

In the performance based system, there will be a need for peer review for performance based designs. However, it is proposed that such a peer review be imposed for all performance-based submissions, unless otherwise approved by Commissioner SCDF. The owner will pay the 3rd party directly.

The 3rd party checker must be an accreditated fire safety engineer. He/she shall have no professional and financial interest in the project being evaluated.

In the process of checking, the 3rd party checker may require inputs by other specialists. The fire safety engineer, not the 3rd party, will engage such required specialists for which the resulting costs will be borne by the owner.

SCDF retains the prerogative to agree or disagree with 3rd party comments.

The body that administers the accreditation of fire safety engineers will also govern and administer the scheme for 3rd party checkers.

(c) Registered Inspectors (PB)

The requirement for an RI with a fire safety engineering background is warranted by the fact that performance based designs could be more complicated. Such designs could involve the successful interaction of several life safety systems for which having fire safety engineering knowledge will provide the RI a better appreciation of the required deliverables for the proposed system.

At the present, we are exploring the options:-

Proposal I

Owners are required to engage RI(PB)for all plans submitted using the performance based approach, unless otherwise allowed by Commissioner SCDF.

Proposal II

For buildings with major aspects designed using the performance based approach, SCDF may determine that the complexity of the project requires the owner to engage a Registered Inspector (RI) with the requisite fire safety engineering qualifications.

(d) Fire safety engineering guidelines

In order to have a systematic and uniformed approach to fire safety engineered designs, it is the usual practice for fire safety engineers to adhere to

established fire engineering guidelines in the process of preparing for their submission to the authorities.

In the new performance-based system, it is proposed that the fire safety engineer is at liberty to adopt any established fire safety engineering guidelines, eg from Australia, New Zealand, UK.

(e) Performance based submissions on materials/products

The performance-based approach can also be extended to materials and products. In the market, new and innovative fire products have been appearing from time to time. These may have to be evaluated by accreditated test laboratories for their performance before they can be endorsed for use as part of building construction.

However, test standards available may not be appropriate or adequate for the new product. Under such circumstances, the testing laboratory will need to devise specialised test methods and rigs to ascertain the performance of the material/product.

This is the approach adopted by testing labs in countries employing the performance-based approach, and we will be adopting a similar approach for the local context.

CONCLUSION

8. The performance-based code will definitely introduce change to our current system, but this change will in turn allow for innovative designs and products. Let us work together to assimilate these changes that will advance fire safety to the next higher level.

Fire Code Consultation –What are Your Queries?

By

Mr. Chan Hong Meng
O/C Residential & others Section
Fire Safety Consultation Branch
Fire Safety & Shelter Bureau

FIRE CODE CONSULTATION - WHAT ARE YOUR QUERIES

INTRODUCTION

1 The consultation services were formally put in place together with the Self-Regulation System implemented in Sept 1998. Initially, its services were confined to facilitating QPs to clarify with FSSB on fire safety provisions. Over the years, the scope of services then been enlarged to cater to the different needs of the public. It now encompasses the following aspects:

a. Providing consultation service with respect to fire safety provisions of Fire Code and other relevant Code of Practices, i.e. CP 10, CP 13, CP 29, CP 40, CP 52 etc;

b. Technical requirements pertaining to Household Shelters;

c. Submission procedures of all processes, in particular plan approval and TFP/FSC applications;

d. Fire safety requirements relevant to the use of building materials and fire safety products; and

e. Procedures pertaining to retrieving archives of FSSB's documents and approved plans.

PURPOSES

2 This paper aims to cover the following areas:

a. To give an overview of the FSSB's consultation processes.

b. To illustate examples of queries on fire safety provisions in the Fire Codes which are either commonly mis-interpreted by QPs, or may be ambiguous to QPs. With these in mind, we hope QPs have a better understanding of fire safety provisions when preparing plans for FSSB's approval, or applying waiver of fire safety requirements.

FSSB CONSULTATION PROCESSES

3 Currently, QPs and members of public can consult FSSB through either Walk-in Consultation, or Written Consultation.

4 To make a walk-in consultation, QP can visit FSSB during office hours without the need of making appointment, unless he/she wants to consult a particular FSSB consultant for a specific fire safety matter/building project. Before commencement of consultation, QP should complete the prescribed form with questions/queries stated therein. The consultation form can either be obtained at the 1st storey of HQ SCDF, or down-load from SCDF Website: http//:www.scdf.gov.sg.

5 In the case of Written Consultation process, QPs can simply forward the queries with the relevant plans, if applicable, through post or email to FSSB. The queries should be explicitly stated on either the prescribed consultation form, or in any other written format, though the former is preferred.

6 FSSB will officially respond to all consultations within 3 days for walk-in consultation, and 2 weeks for written consultation.

7 To improve consistency and accuracy in its reply to QPs, FSSB has recently deployed only senior officers to handle all consultations on fire matters. These consultants are appointed for their experience and good knowledge of the Fire Code. Whenever any consultant comes across exceptional issues which are not well covered under the Fire Code, such as large chemical plant/hazardous storage, he would arrange a discussion among FSSB consultants for a consensus reply. This may entail recommendation to higher management for decision on complex technical issues before responding to the queries.

CASE STUDY ON QUERIES COMMONLY ASKED

8 Append below are some typical examples of queries from QPs. The findings and comments illustrated for all these cases are not meant to undermine the knowledge of QPs who consulted FSSB in understanding Fire Code. I believe they provide useful information for QPs to better understand and apply the provisions of Fire Code. On the other hand, FSSB views these queries as a form of feedback for reviewing its Fire Code.

a. **Enquiry - "Cl. 2.2A - Two-way travel distance – The two-way escape from Board room through Staff room exceeds travel distance permitted under Table 2.2A. Travel distance of one of the two escape routes is 48m. Is it acceptable?" (see Appendix 1)**

The intent of the provision is to ensure that occupants have alternate route for safe escape, in particular in large floor area. The distance specified under Table 2.2A is to be measured between the equal-distance point of the two-way travel and the exit. With this understanding, it is possible and acceptable to have situation where one escape route is within the specified distance while the other exceeding. Hence, in this case, QP seems to have mis-interpreted the provision. The two-way travel distance at the Board Room would not be an issue if the travel distance, measured between the equal-distance point and exit, meets the requirement (i.e. 45m, or 2/3 x 45m for Direct distance, for non-sprinkler protected buildings). Taking that the two-way travel distance of the floor met with Table 2.2A, the 48m is therefore acceptable since distance of the other escape route is within 45m.

b. **Enquiry - "Cl. 2.2.12 (b) - Direct escape to the required exits at a floor for all tenants – Can rooms of equivalent usage, eg office have escape via another to the required exit? Examples, a) Partitioned Manage's Office within a partitioned open plan office, discharging to escape stairs via corridor; b) Egress via intermediate partitioned space to fire exit" (see Appendix 2)**

The provision of Cl. 2.2.12 (b) ensures that all tenants can gain direct access to the required exit at all times and in the shortest time possible. This is critical especially for large floor space that sub-divided into smaller rooms/spaces. In this respect, FSSB would not consider escape path via a room as a mean of exit even the door is to be installed with device to automatically unlock the door during fire emergency. Based on the layout plan submitted, escape at the manager room is acceptable as the room has no impact to occupants outside even when the door to the manager room is locked. However, escape route through the door in the partition wall, as shown on the other drawing, would not be qualified as a mean of exit for the partition with door is indeed a "separation" thus, the door would likely to be locked.

c. **Enquiry "Cl. 2.3.3 (a)(iii) – 1.5m horizontal separation distance for staircase – Adjacent toilet W1 window opening perpendicular to opening at fire escape stair. What's the separation distance?" (see Appendix 3)**

This is another commonly asked question on how to determine the separation distance between staircase's window and adjacent unprotected opening, which are not aligned along the same plane. The intent of this provision is to prevent infiltration of smoke and spread of flame into escape staircase taking into consideration that both the staircase's opening and the adjacent unprotected openings are aligned on the same plane. In this manner, the effect of radiation from fire to staircase is not so significant, and the 1.5m separation distance is adequate to address the smoke and flame spread problems. However, if the openings are positioned not on a same plane, as shown on the drawing, the separation distance would have to take the heat radiation of fire transmitted through the unprotected opening. In this esse, the separation distance would be

3m, or the 'setback' distance computed based on the area of adjacent unprotected opening, whichever is greater.

d. **Enquiry "Cl. 2.4.5 (f) - Cross-ventilation to smoke-stop lobby – Design of lift lobby as shown on sketch qualify for 2m cross ventilation?" (see Appendix 4)**

The requirement of cross-ventilation to smoke-stop lobby ensures that the single staircase permitted for residential building of habitable height exceeds 24m but below 60m is safe and readily accessible to occupants under all circumstances. To sustain reliability of smoke free approach at all times, only natural mode of ventilation would be allowed and the openings shall be positioned in opposite positions for effective cross-ventilation. It's the common understanding of QP that the smoke free approach must be achieve cross-ventilation as stipulated under the Fire Code. In this case, the smoke free approach is by means of external corridor, as shown on plan. Although ventilation opening is provided only on one side, however, the external corridor would still be acceptable to FSSB (in lieu of cross-ventilation lobby) as the permanent opening along the entire stretch of external corridor is being opened directly to external space. It would have the same effect as cross-ventilated lobby, if not better. However, QP must ensure that height of parapet is kept not more than 1.1m high and no obstruction in any form above the opening.

e. **Enquiry – "Cl. 2.4.6 (b)(ii) – Direct exit from maisonette unit – Is direct exit required for the intermediate level of the 3 level maisonette" (see Appendix 5)**

The provision requires direct exit to upper level of a maisonette unit, if area exceeds 60m^2. It is intended as a cut-off point to relax on the requirement of providing direct exit on the floor. Such requirement is necessarily as occupants at upper storey are vulnerable to fire, if it happened at the lower level. The maisonette units involved in this consultation comprise 3 levels where 1st and 3rd levels are provided with direct exit. Although 2nd level is deemed to have two-way escape (upwards and downwards), however, the requirement of direct exit would still be applicable as its floor area exceeds 60m^2 and escape via upper level cannot be considered as a mean of exit. That's also the reason why Fire Code requires maisonette unit to have exit door located at lower level.

f. **Enquiry "Cl. 3.2.1 (a) and (b) - Provision of compartmentation size – To consult FSSB on the requirement of an automatic sprinkler system." (see Appendix 6)**

The intent of the provision is to minimise the impact of fire and smoke spread within compartment. Size of compartment can be larger than that as permitted

under Table 3.2A provided sprinkler system is installed through the building. In this consultation, the issue is "Can the height of the existing building be taken at 4m for computing its cubicle extent?" Based on the information given by QP, the building height would have to be taken to right up the roof level when computing the cubicle extent of the single-storey warehouse building, as shown on plans. This is because storage space can be piled with goods as high as close to the roof, and fire loads are more intensified. However, if it's used as factory, QP would be allowed to use 4m as the virtual height for purpose of computing the cubicle extent.

g. **Enquiry "Cl. 3.8.9 – Protected shaft containing other services/installations - Gas pipe running in false ceiling void of naturally ventilation fire lift lobby. Can the gas pipe be sleeved and vent to gas riser without fire-rated enclosure" (see Appendix 7)**

The provision prevents spread of smoke and fire from floor to floor through services that run vertically through compartment floor/wall. Hence, fire-rated enclosure would be required for services with combustible content run horizontally at protected lobby. This is to secure the compartmentation of the protected shaft. In addition, the protection enclosure would also contain gas, if leaked from the pipe. In this consultation, FSSB has accepted QP's proposal for the following reasons:

i. Lobby is cross-ventilated; and

ii. API pipe is used with sleeve and vent to external or through a vent source (i.e. riser duct).

That means, gas pipe runs along ceiling void at smoke-stop/fire fighting lobby is not required to be protected if the above requirements are complied with.

h. **Enquiry "Cl. 6.2.3 (a) – Breeching inlet within 18m from accessway, with dry riser diverted. Horizontal pipe run from BI to dry riser is about 40m length, with bends and turns to reach dry riser. Is this acceptable? If not will waiver be considered?" (see Appendix 8)**

The provision ensures that the fire fighting system can be charged up and readily operable in the shortest time possible. Fire Code does not specifically state the distance between the breeching inlet and the vertical stack, but requires it to keep as short as possible. In this respect, the distance proposed by QP may not be practical as it would take sometime to charge water to such prolonged pipe in time of need. In CP 29, it also does not specify the distance. However, it requires the loss of pressure of the riser main to not more than 6 bars. That means, the distance between breeching inlet and riser stack is flexible with numbers of bends so long that the total friction loss through pipe

and hydraulic loss through gravity till the highest landing valve is control to not more than 6 bars. As the specification of CP 29 ensures that pressure and flow rate of the fire fighting system is attainable while allowing longer distance between breeching inlet and riser stack, it thus prevails over Fire Code.

i. **Enquiry "Cl. 6.2.8 - Provision of hosereel – Whether hosereel provision can be exempted for this single-storey child day-care centre with floor area of 270m². (Portable fire extinguisher are to be provided in compliance with current Fire Code)" (see Appendix 9)**

The provision of the first-aid fire fighting system is intended for readily use by ordinary people to tackle incipient fire, where possible, before arrival of fire fighters. The exemption given for small shop (area not exceeding 280m²) at 1st storey of a residential flat is taken into consideration its use and risk posed to the other part of building. Although fire extinguisher serves similar purpose as hosereel, however, each of the fire fighting system has its capacity and limitation in tackling all different kinds of fires. Hence, they are not comparable and inter-changeable. From the Fire Code point of view, the impact on live safety of occupants of childcare centre is being considered much severe as compared with occupants of shop use. Hence, no justification of exemption of hosereel for childcare centre.

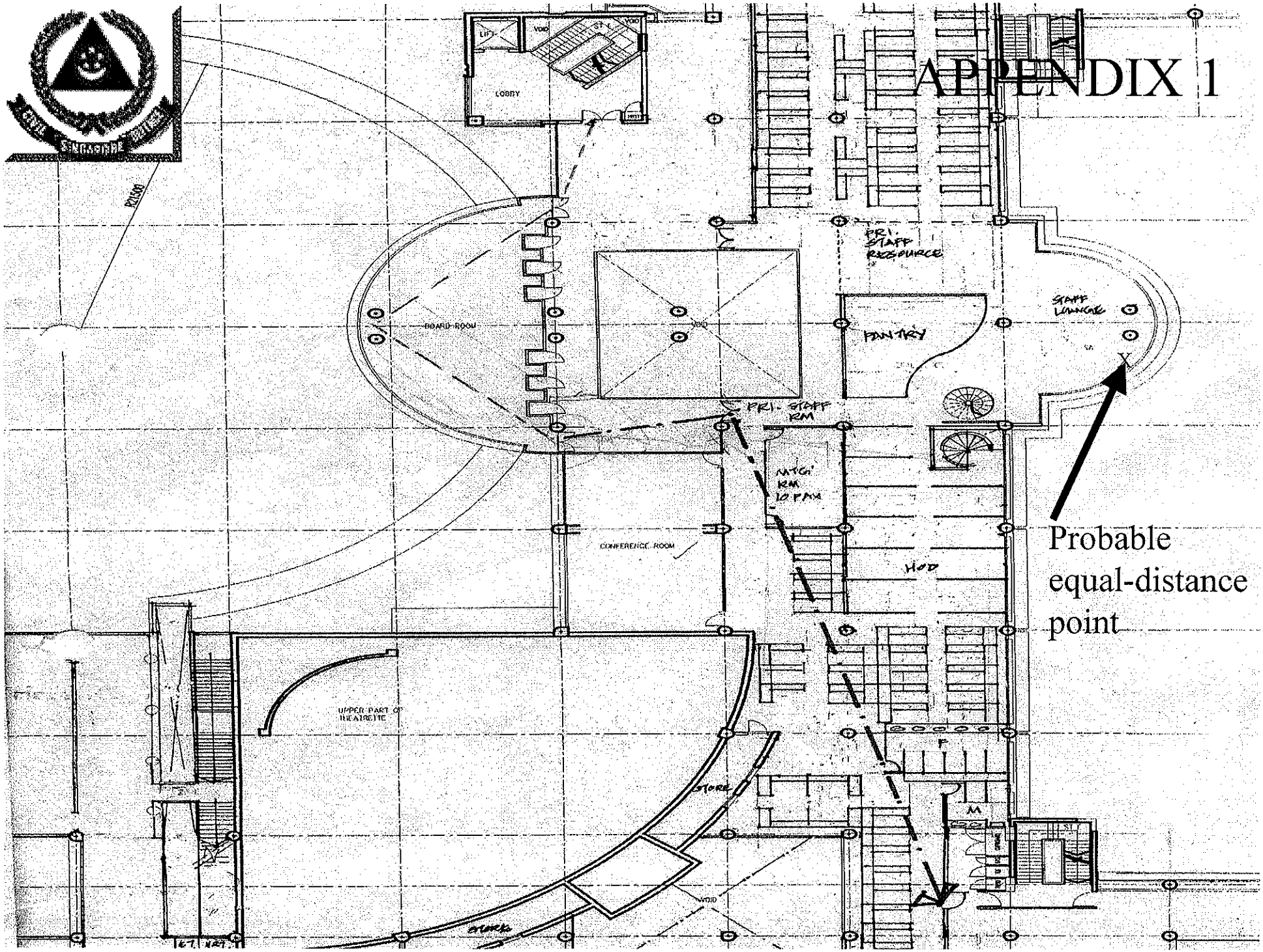
l. **Enquiry "BP submission for conventional house – BCA directed us to clarify whether FSSB approval is required for the proposed A & A to the existing 2-storey with a lower ground floor semi-detached house with a new attic" (see Appendix 10)**

In this case, BP submission to FSSB is certainly required as the building comprises 4 storeys. This includes subsequent RI inspection in connection to TFP/FSC application. In fact, conventional houses not more than 3 storeys, including basement and attic would still have to comply with the relevant fire safety requirements, i.e. elements of structure, boundary setback, etc, though these buildings are exempted from plan submission to FSSB. QP should take note that conservation residential buildings that built of timber construction would still have to be approved by FSSB. That means, the exemption order is not applicable to buildings under conservation scheme.

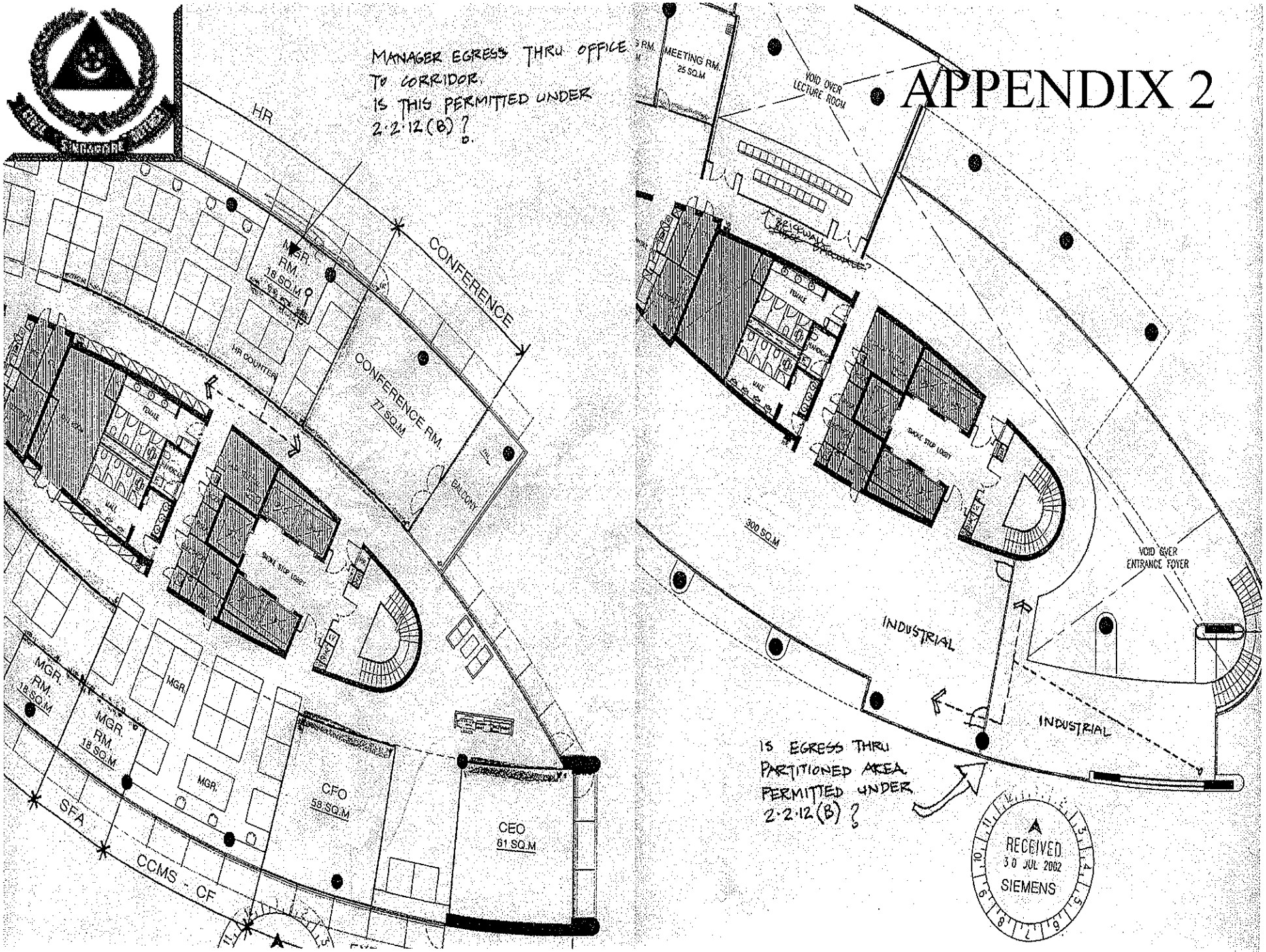
CONCLUSION

9 FSSB welcomes QPs and members of public to consult FSSB on both technical and administrative issues. FSSB will do its best in this endeavour to quality consultation services to the public.

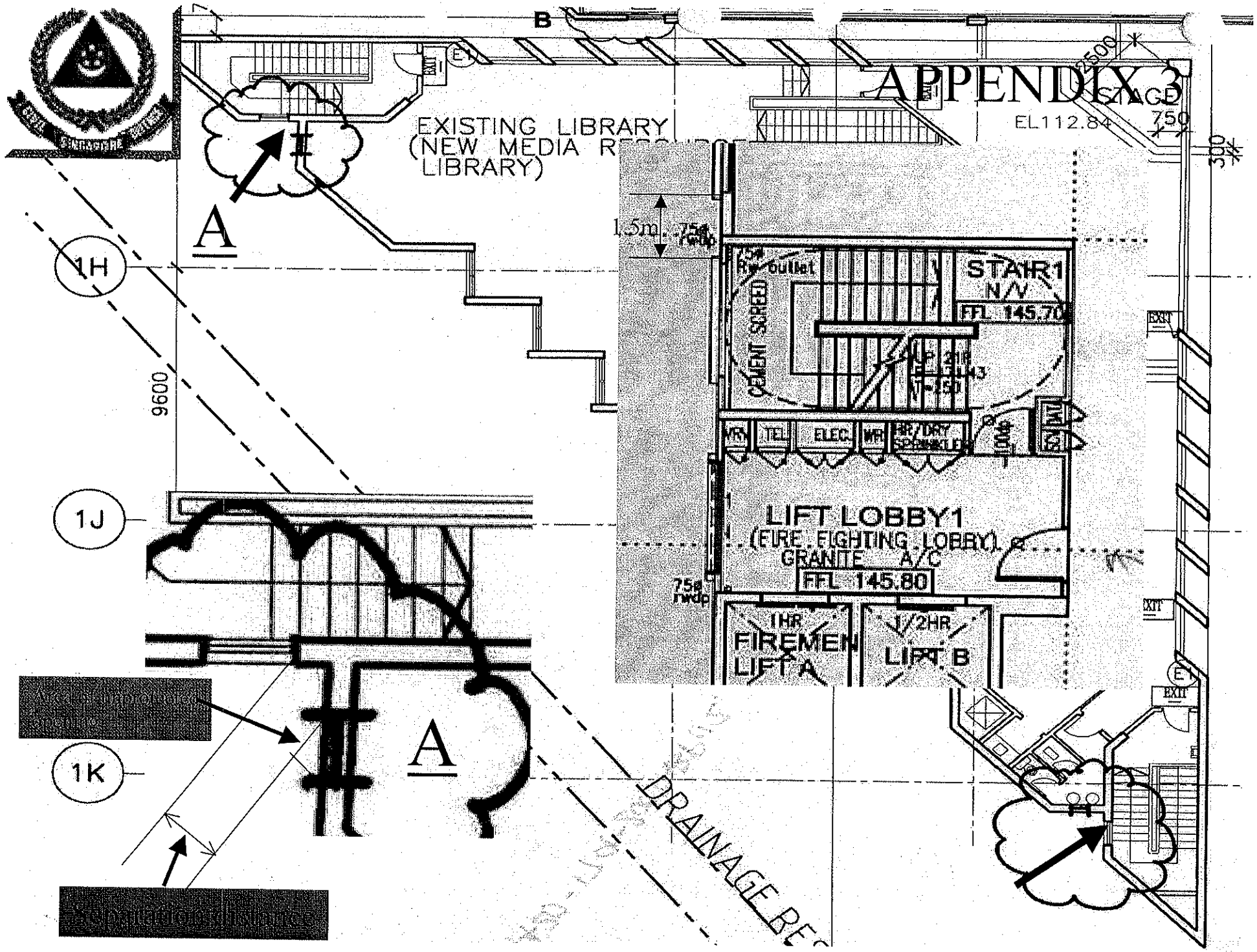
APPENDIX 1


LOBBY
VOID
LIFT
ST.
BOARD ROOM
VOID
PANTRY
FRI. STAFF RESOURCE
STAFF LOUNGE
X
FRI. STAFF RM
MTG. RM 10 PAX
CONFERENCE ROOM
HOD
UPPER PART OF THEATRETTE
STORE
VOID
STORE
F
M
Probable equal-distance point

APPENDIX 2

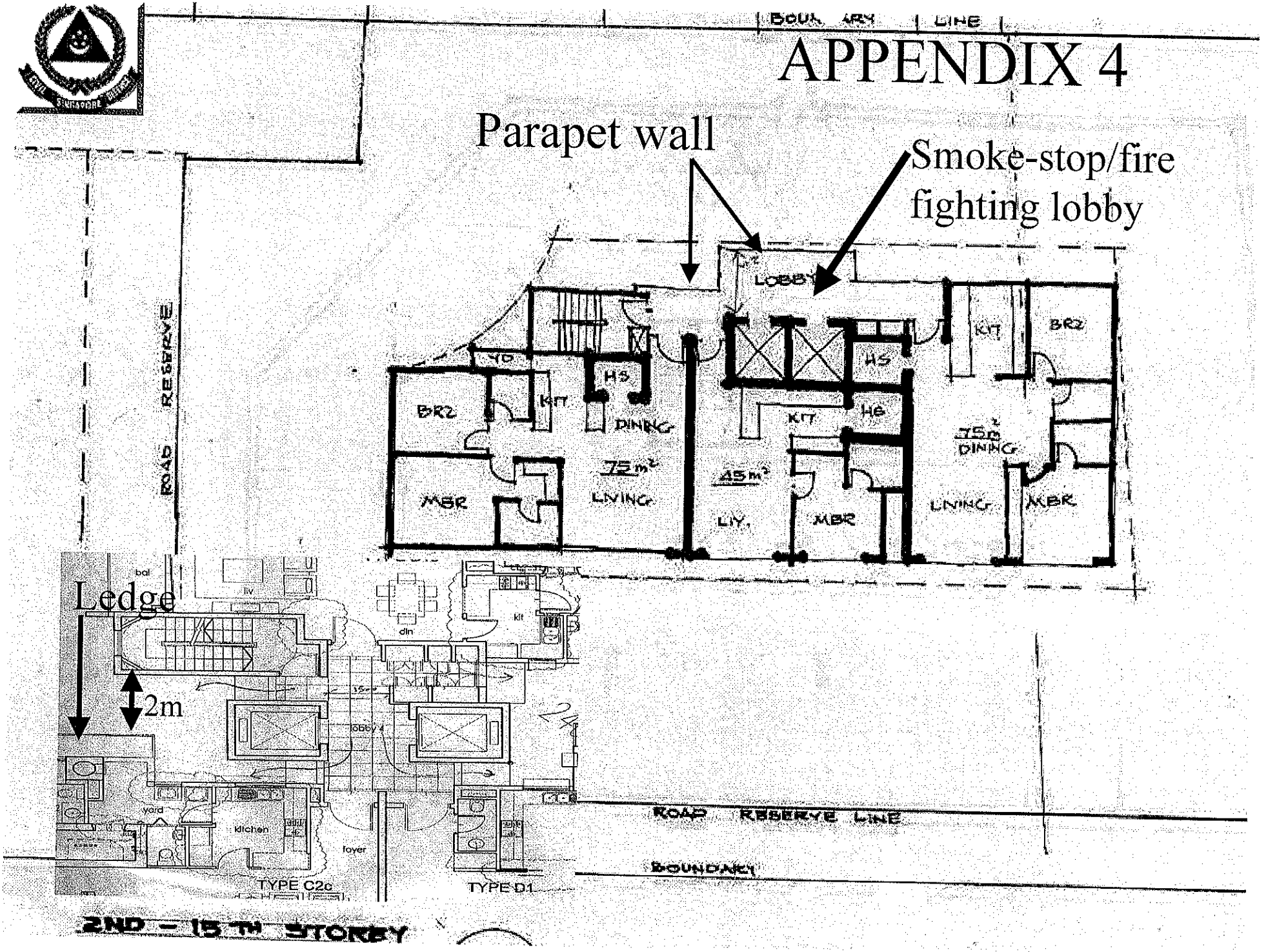

MANAGER EGRESS THRU OFFICE TO CORRIDOR. IS THIS PERMITTED UNDER 2·2·12(B) ?
HR
CONFERENCE
MGR. RM. 18 SQ.M
HR COUNTER
CONFERENCE RM. 77 SQ.M
BALCONY
MEETING RM. 25 SQ.M
VOID OVER LECTURE ROOM
MGR. RM. 18 SQ.M
MGR. RM. 18 SQ.M
MGR.
MGR.
CFO 58 SQ.M
CEO 61 SQ.M
SFA
CCMS - CF
300 SQ.M
INDUSTRIAL
INDUSTRIAL
VOID OVER ENTRANCE FOYER
IS EGRESS THRU PARTITIONED AREA PERMITTED UNDER 2·2·12(B) ?
RECEIVED
30 JUL 2002
SIEMENS

APPENDIX 3



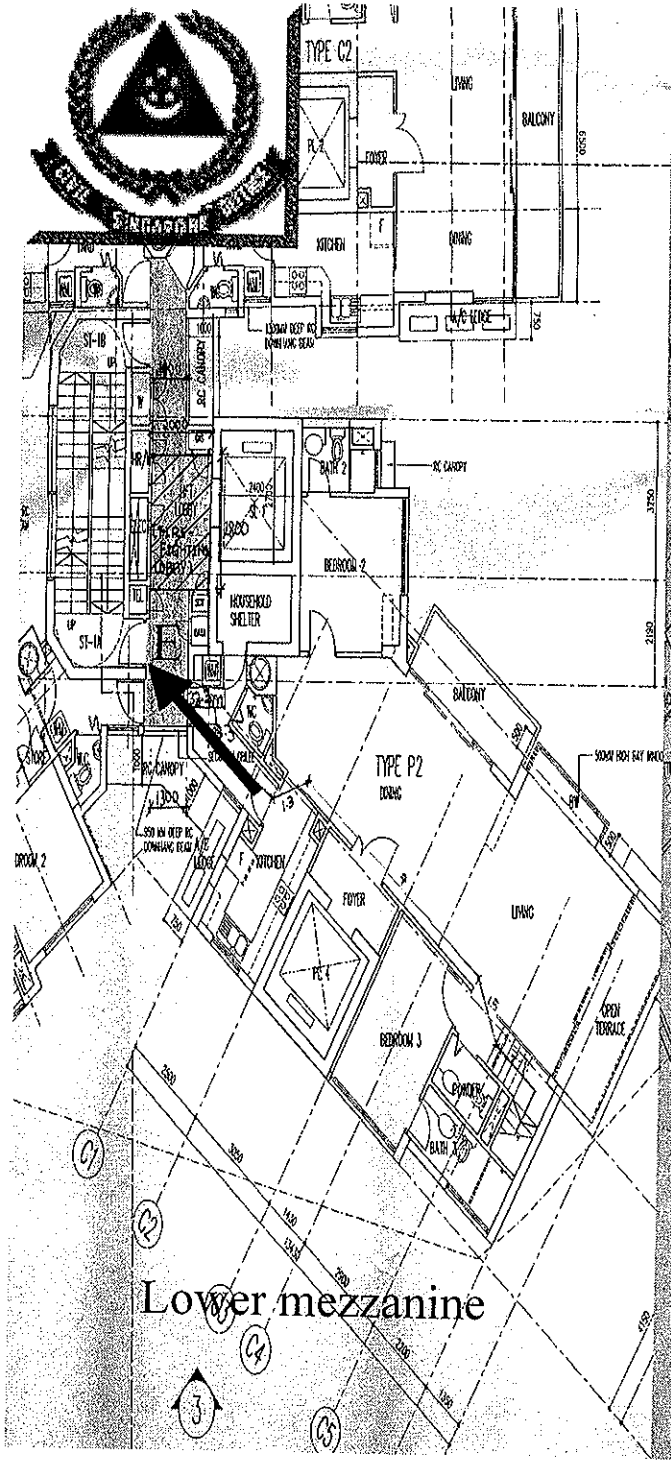
EXISTING LIBRARY
(NEW MEDIA RESOURCE LIBRARY)
STAGE
EL112.84
750
300
2500
1.5m
75ø rwdp
75ø Rw outlet
CEMENT SCREED
STAIR1
N/V
FFL 145.70
UP 21R
T=250
WR
TEL
ELEC
WR
HR/DRY SPRINKLER
LIFT LOBBY1
(FIRE FIGHTING LOBBY)
GRANITE A/C
FFL 145.80
1HR
FIREMEN LIFT A
1/2HR
LIFT B
EXIT
A
1H
1J
1K
9600
DRAINAGE RES
Area of unprotected opening
Separation distance

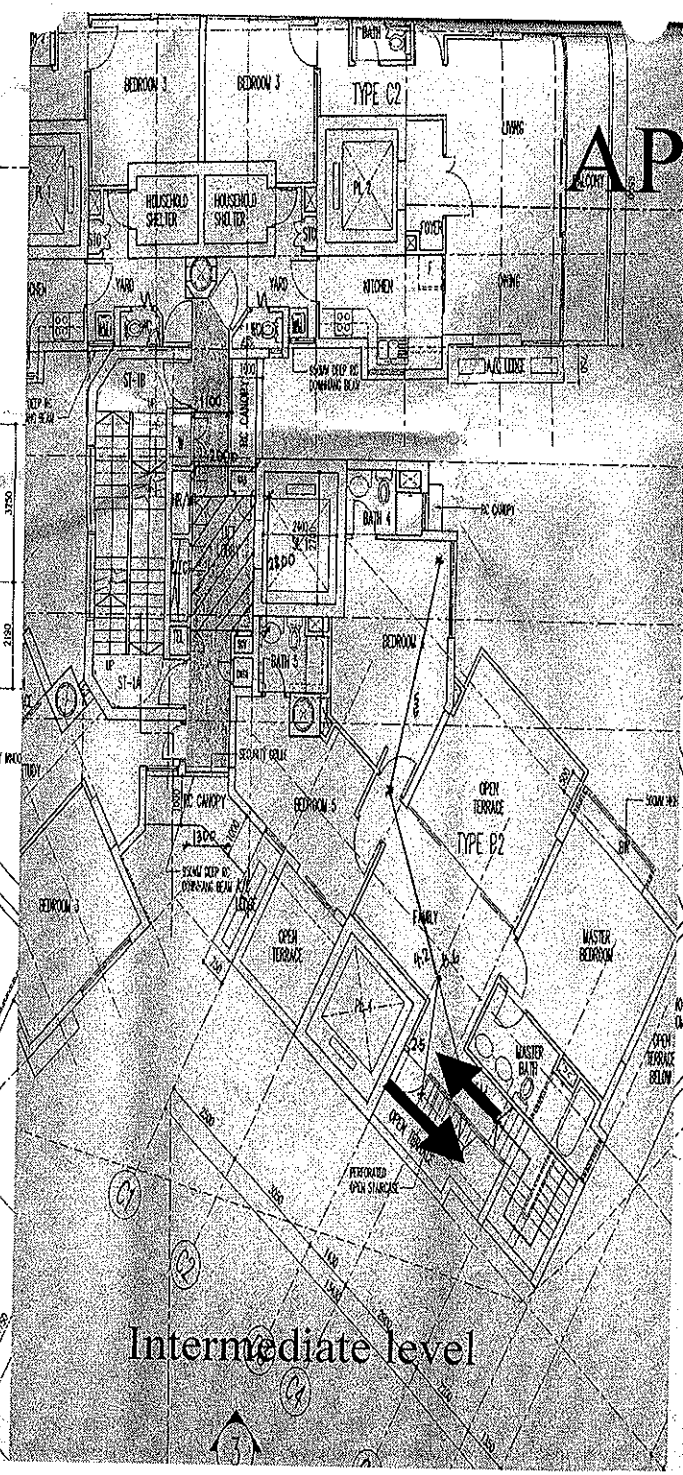
APPENDIX 4

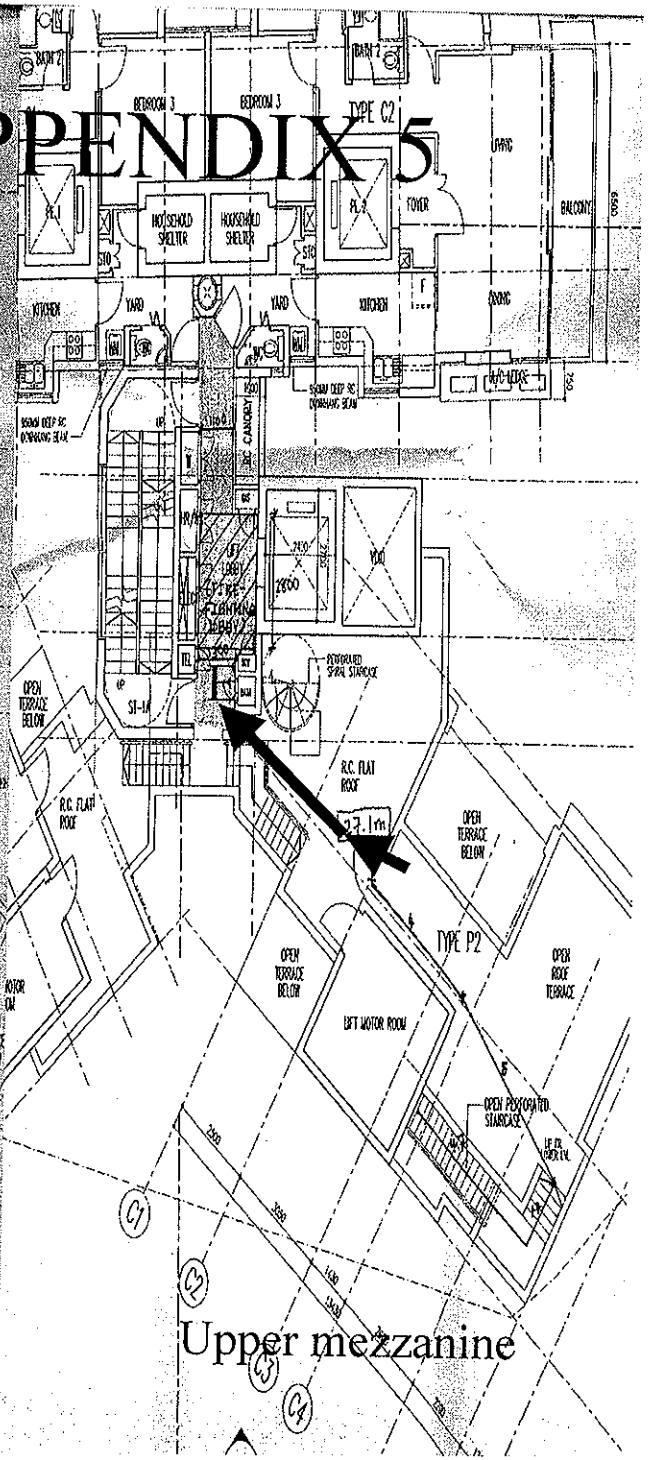


Parapet wall
Smoke-stop/fire fighting lobby
LOBBY
BR2
KIT
HS
DINING
75m²
LIVING
MBR
45m²
LIV.
ROAD RESERVE
Ledge
2m
bal
liv
din
kit
yard
kitchen
foyer
TYPE C2c
TYPE D1
ROAD RESERVE LINE
BOUNDARY
2ND - 15TH STOREY

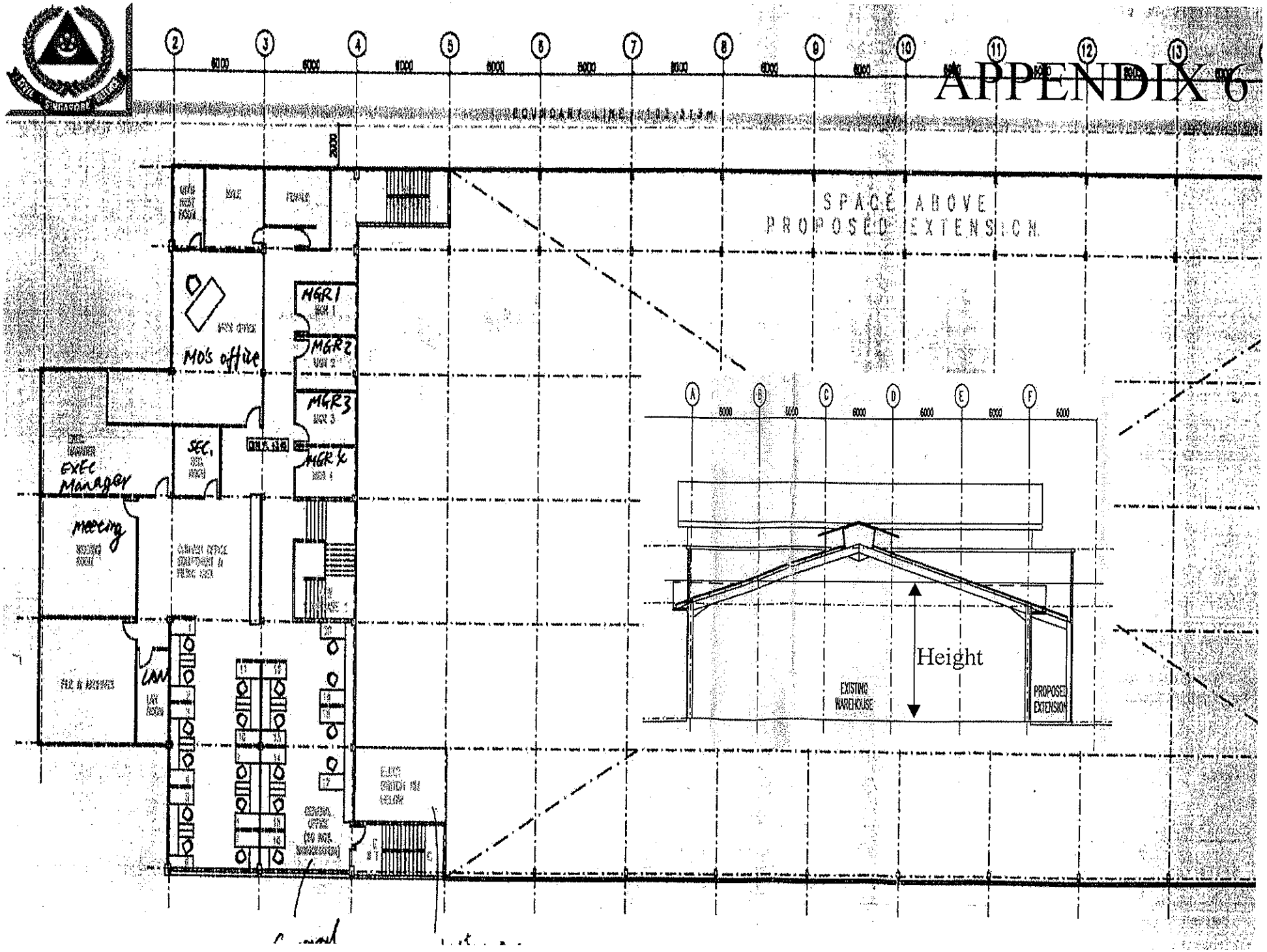
APPENDIX 5


TYPE C2
LIVING
BALCONY
FOYER
KITCHEN
DINING
A/C LEDGE
BEDROOM 2
HOUSEHOLD SHELTER
BATH 2
R/C CANOPY
TYPE P2
BEDROOM 3
OPEN TERRACE
Lower mezzanine


BEDROOM 3
TYPE C2
HOUSEHOLD SHELTER
YARD
KITCHEN
A/C LEDGE
BATH 4
R/C CANOPY
BEDROOM 4
BATH 3
TYPE B2
OPEN TERRACE
FAMILY
MASTER BEDROOM
MASTER BATH
PERFORATED OPEN STAIRCASE
Intermediate level


TYPE C2
LIVING
BALCONY
FOYER
HOUSEHOLD SHELTER
YARD
KITCHEN
DINING
A/C LEDGE
R/C CANOPY
SPIRAL STAIRCASE
OPEN TERRACE BELOW
R.C. FLAT ROOF
TYPE P2
LIFT MOTOR ROOM
OPEN PERFORATED STAIRCASE
Upper mezzanine

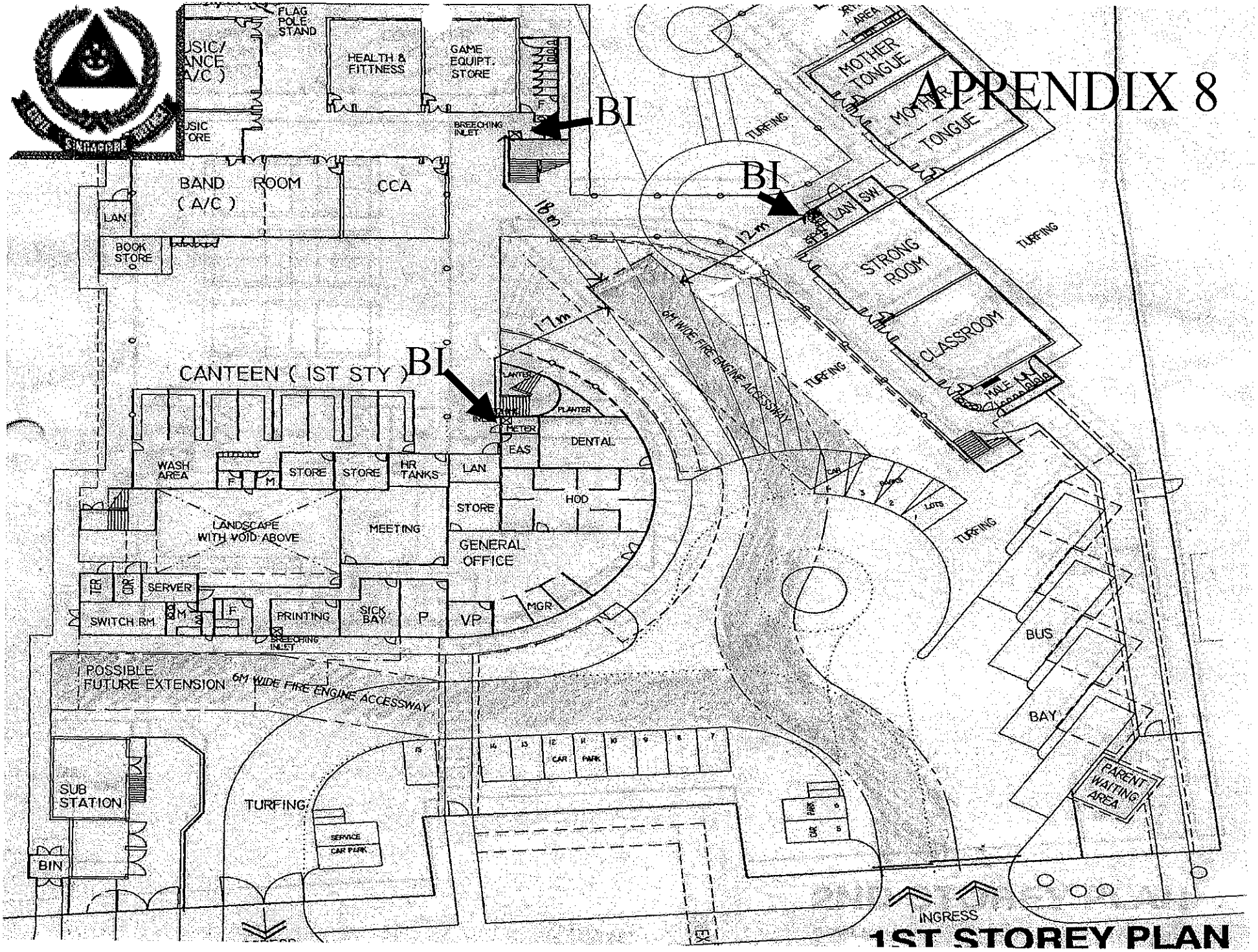
APPENDIX 6


SPACE ABOVE
PROPOSED EXTENSION
MGR1
MGR2
MGR3
MGR 4
MO's office
SEC.
Exec Manager
meeting
Height
EXISTING WAREHOUSE
PROPOSED EXTENSION

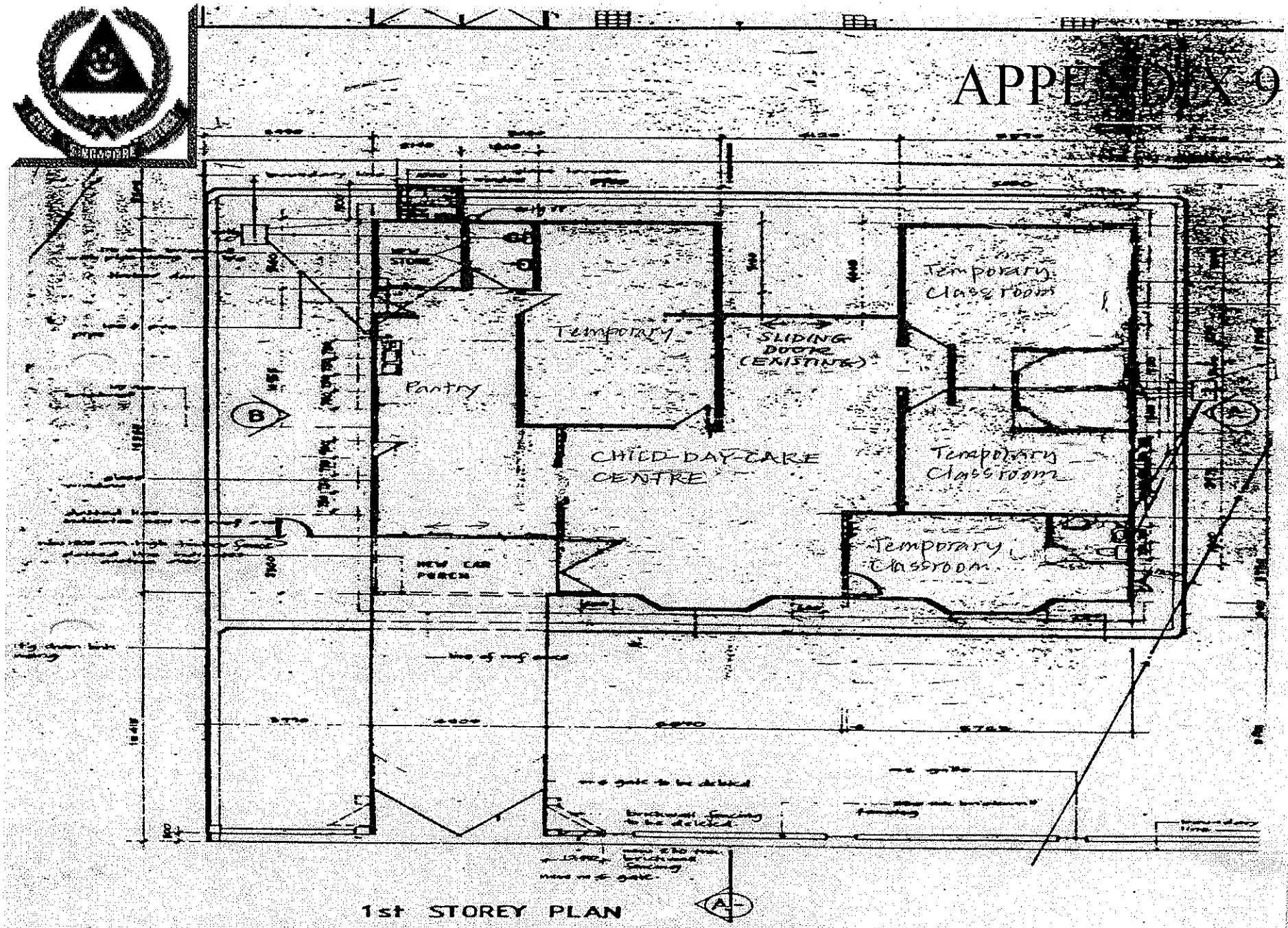
APPENDIX 7

Opening
Opening
TYPE A
TYPE B
TYPE C
ST-1
ST-2
FIRE RATED BOX-UP
ø20 API PIPE
ø20 API PIPE
ø20 API PIPE

APPENDIX 8

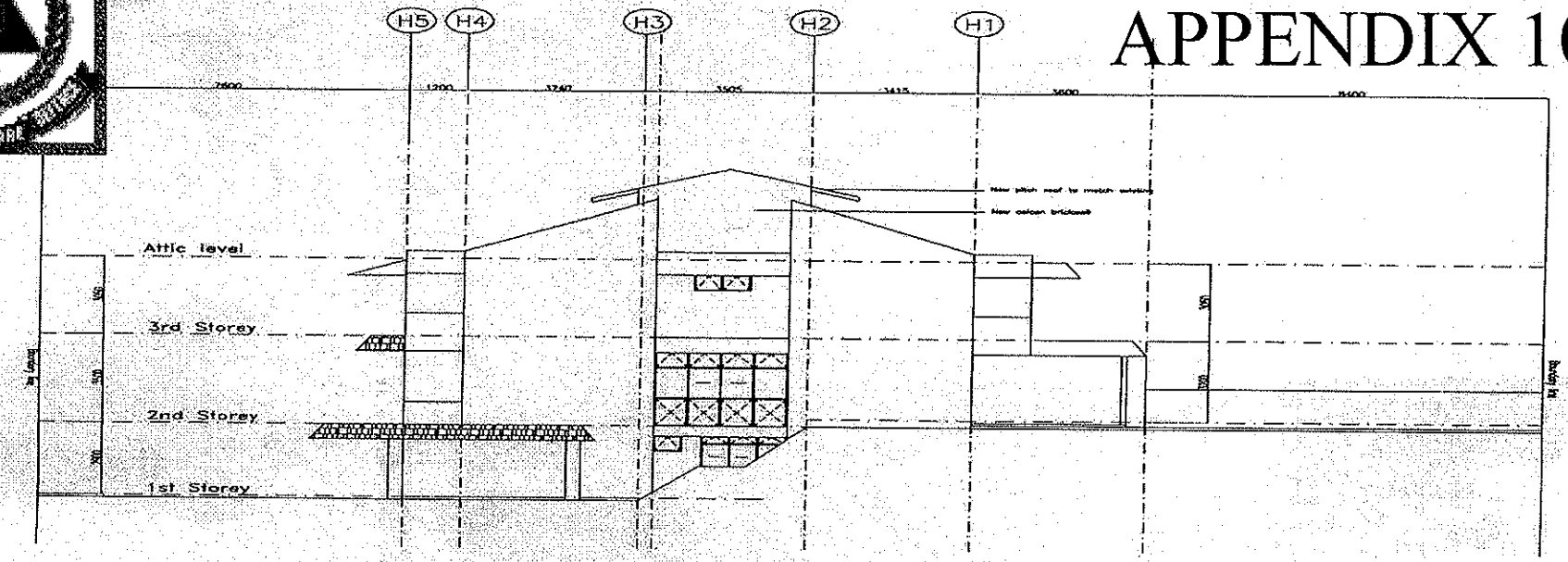

FLAG POLE STAND
HEALTH & FITNESS
GAME EQUIPT. STORE
BREECHING INLET
BI
BAND ROOM (A/C)
CCA
LAN
BOOK STORE
MOTHER TONGUE
TURFING
LAN
SW
STRONG ROOM
CLASSROOM
6M WIDE FIRE ENGINE ACCESSWAY
CANTEEN (IST STY)
WASH AREA
STORE
STORE
HR TANKS
LAN
DENTAL
HOD
STORE
LANDSCAPE WITH VOID ABOVE
MEETING
GENERAL OFFICE
SERVER
SWITCH RM
PRINTING
SICK BAY
P
VP
MGR
POSSIBLE FUTURE EXTENSION
SUB STATION
BIN
SERVICE CAR PARK
CAR PARK
BUS BAY
PARENT WAITING AREA
INGRESS
EGRESS
1ST STOREY PLAN

APPENDIX 9

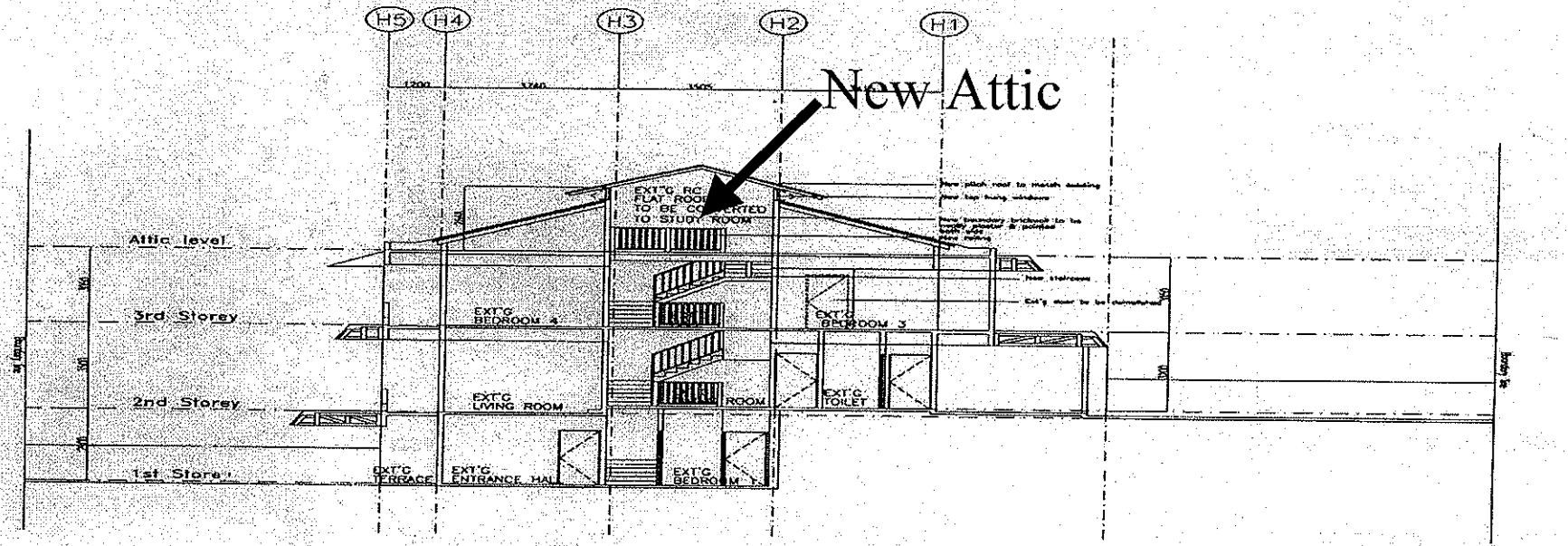


1st STOREY PLAN
(approx 270 m²)

APPENDIX 10



SIDE ELEVATION



SECTION A—A

Audit Checks on Fire Safety Plans - How have you fared?

By

Cpt Yeo Kian Min
Fire Safety Consultant
Fire Safety Consultation Branch
Fire Safety & Shelter Bureau

AUDIT CHECKS ON FIRE SAFETY PLANS - HOW HAVE YOU FARED?

INTRODUCTION

The SCDF embarked on the Self-Regulation System in September 1998. This system superceded the Self-Declaration System in 1996. The Fire Safety and Shelter Bureau (FSSB) has been monitoring this system through studying the various data it obtained. The findings are constantly analysed to determine problem areas in the following processes:

- Plans submission & approval
- Plans Audit
- Minor Additions/Alterations (MAA)
- Consultation
- Waiver

2 Review and updates are regularly being made to the Fire Code of Practice to meet the ever-changing demands of the building industry particularly on the problems faced at the design, planning and construction stages. This paper will focus mainly on the findings from the Plans Audit and MAA processes.

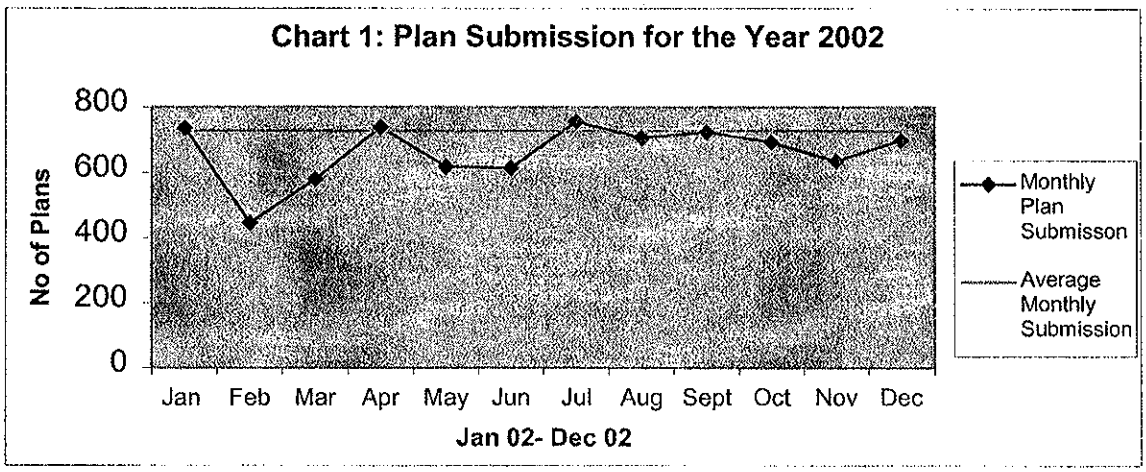
AIM

3 The objective of this paper is to present the results of the Plans and MAA audit checks carried out during the period Jan 2002 to Dec 2002 as well as highlight the findings of the study.

PLANS APPROVAL PROCESS

4 We shall first look at the plan approval process. With the implementation of the Self-Regulation System, all major and minor plans are approved within 2 working days. This fast plan approval process benefits the building industry as construction works can be carried out without any delay.

5 In the year 2002, an average of 661 plans per month was submitted for approval. Chart 1 shows the breakdown of both building and fire protection plan submissions through a 1-year period.



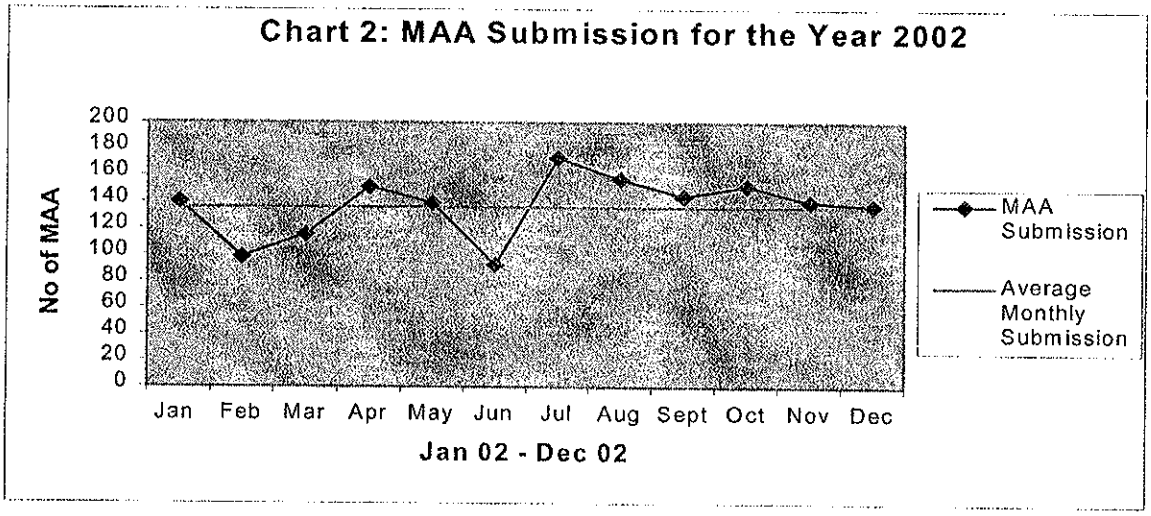
AUDIT CHECKS ON APPROVED PLANS

6 In order to achieve the desired goal of fast plan approval without compromising the fire safety standards, audit checks are conducted randomly on plans submitted and approved under the Self-Regulation System. The Fire Safety Online Processing System (FISOPS) selects ten percent of all major and minor plans monthly for audit by FSSB officers.

7 On completion of the auditing, the findings would be presented to the Audit Check Committee. The Committee would decide on the severity of the deviations from fire safety requirements and ascertain if the QP would need to provide a written clarification or whether the QP would need to attend a hearing before the committee to explain the non-complaint items either in person or through a representative. For all hearing cases the Audit Check Committee would review each case and determine if there is a need to refer the case to the Audit Disciplinary Committee for disciplinary action either in the form of a warning letter, a fine or court action.

AUDIT CHECKS ON MINOR ADDITIONS & ALTERATIONS

8 Minor Additions/Alterations (MAA) to fire safety works refers to the erection or deletion of internal partitions involving materials of lightweight non-combustible construction and must not affect the various aspects of fire safety such as compartmentation, means of escape and fire protection systems. Chart 2 shows the monthly breakdown of MAA submission through a 1-year period from January to December 2002. There was an average of 136 MAA submitted a month through that period.



9 This is only applicable to a shop or an office for which a Temporary Fire Permit (TFP) or a Fire Safety Certificate (FSC) has already been obtained. Under the MAA scheme, a QP would undertake the responsibility to ensure that the fire safety works are in compliance with the Fire Code and lodge the plans with FSSB. The QP will receive an acknowledgement letter from FSSB. No approval is required.

10 The audit procedure for MAA is similar to that for the building plan submission. Ten percent of plans are randomly selected and any deviation found would be presented to the Audit Check Committee.

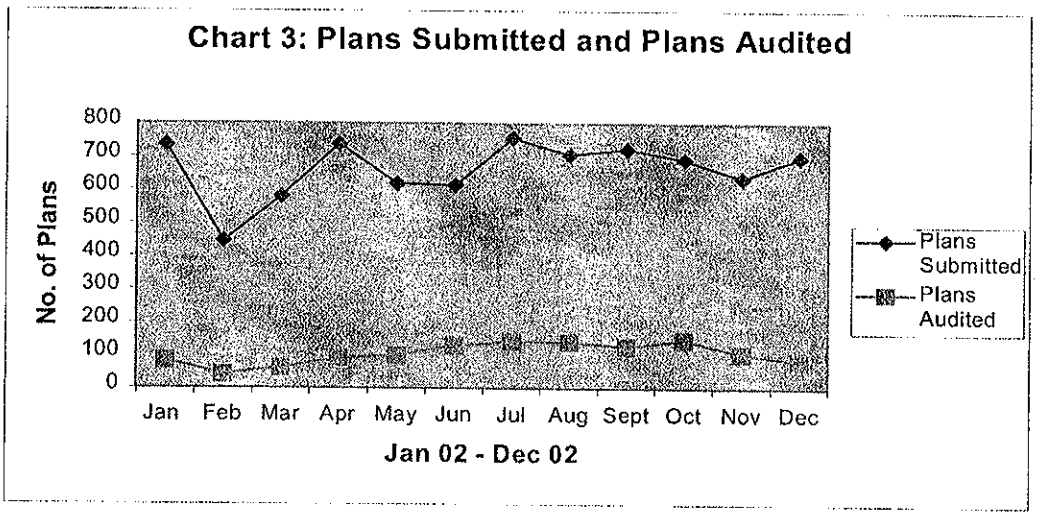
AUDIT CHECK FINDINGS

11 Audit check findings on both the Plans and MAA audits are highlighted below:

a) Auditing of Approved Plans

In the year 2002, a total of 7943 plans were submitted for approval out of which 1242 plans were audited. This makes up sixteen percent of the plans submitted which exceeded the ten-percent quota proposed for the Self-Regulation System. The increase in the number of plans was due to the additional cases being referred to by officers conducting TFP/FSC inspections and those received through public complaints.

Chart 3 shows the plans approval cases and cases picked up for audit



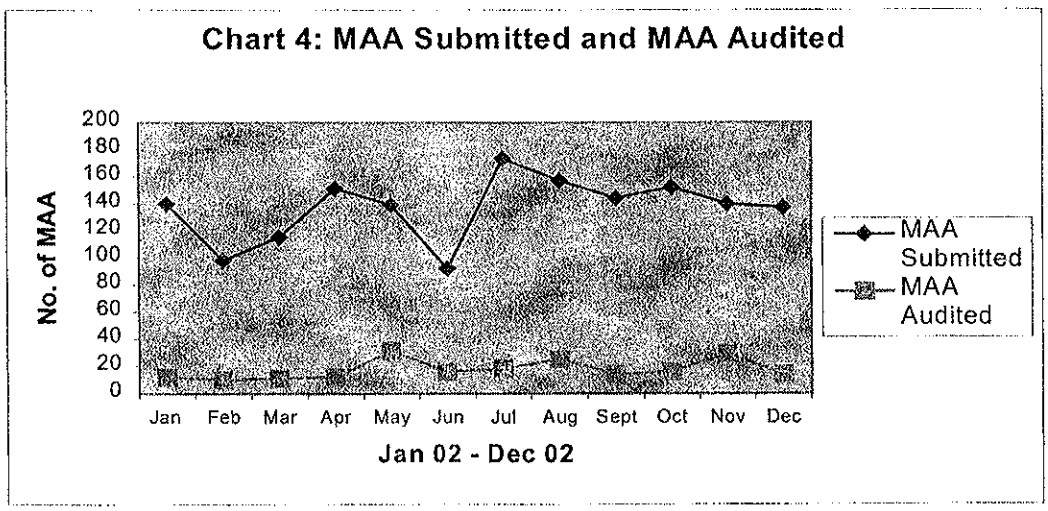
From the audit check findings, the common non-compliant items have been identified and tabulated in the table below

S/No	Non-Compliant Item
1	No provision of fire hose reels and call points
2	Positioning of the fire hose reels and fire extinguishers are not in order.
3	Exit doors do not swing in the direction of escape
4	Exit staircases do not discharge directly into a safe exterior space.
5	Escape through another occupied space.
6	No smoke stop lobby is provided for buildings exceeding 4 storeys above ground.

7	Incorrectly computed set-back distances, occupant load and exit capacity.
8	Non-provision of fixed openings for natural ventilated corridors.
9	Non-protection of exit staircases.
10	Fire door rating for compartmentation is insufficient.
11	The type of material and fire protection system for the raised floors is not indicated on the plan.
12	No indication of fire protection system on building plans.
13	The location of the affected sprinkler control valve is not indicated on the plan.
14	Hydraulic calculation is not given for sprinkler piping works that affect the design point.
15	No provision of fire damper for compartmentation.
16	Sprinkler design data is not provided in the submission.
17	Ineffective cross ventilation to lift lobby for buildings with a single exit staircase provision.

b) Audit to MAA Cases

In the year 2002, a total of 1638 MAA cases were lodged out of which 208 plans were audited. This made up twelve percent of the plans submitted which exceeded the ten- percent quota proposed for the Self-Regulation System. Chart 4 show the total MAA lodged vs the MAA lodgements audited.



The reasons that the quota was exceeded were due to the following non-compliant items shown in the table below.

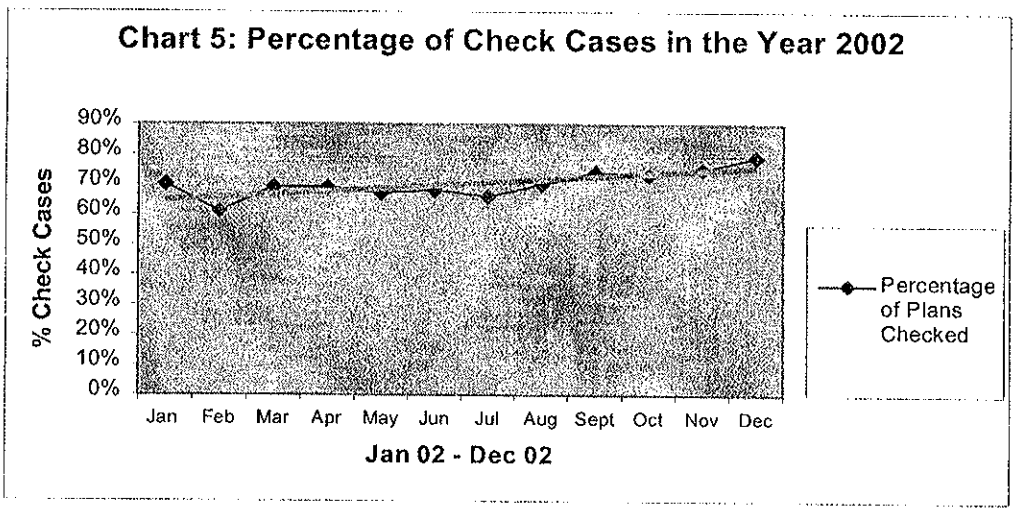
S/No	Non Compliant Item
1	Premises other than shop and office submitted as MAA.
2	Works affecting means of escape such as exit staircases and exit doors
3	New fire extinguishers and exit signs in MAA submissions.

ANALYSIS OF AUDIT RESULTS

12 The results of the plans audit and MAA audit are shown below:

a) Plans Audit

Chart 5 shows the percentage of "checked" cases over a one-year period. "Checked" cases refer to audit cases cleared in the first round of audit.

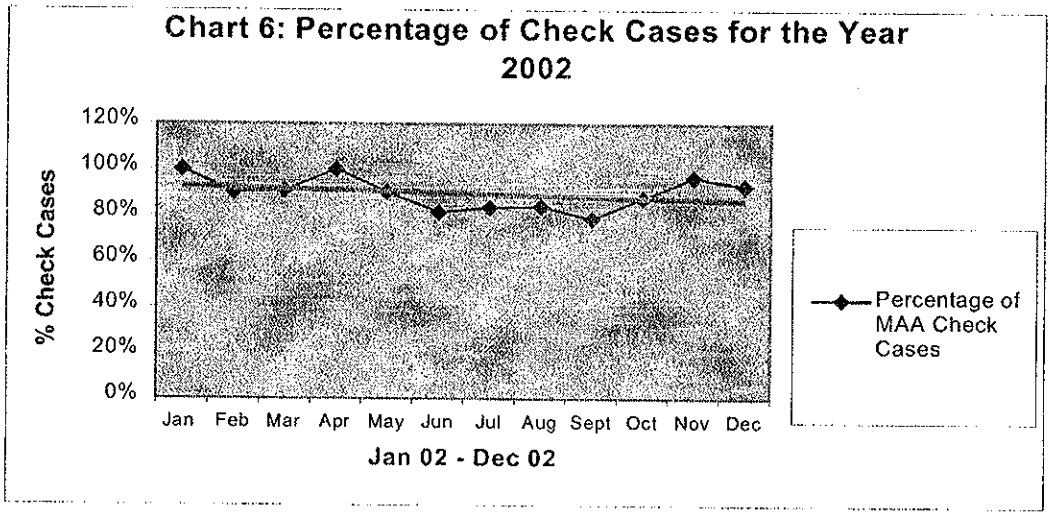


There is an upward trend in the number of checked cases done during the plan audit process. This shows that QPs have made a conscientious effort to pay attention to constant non-compliant items highlighted by FSSB. This results in fewer mistakes in their plans submission.

In the year 2002, of the plans audited, there was a decrease in the number of cases found to be not in order. Similarly, there was only a small number of QPs referred to the Audit Disciplinary Committee and issued with warning letters/fines. In 2001, 20 QPs were subjected to such disciplinary action and in 2002, there were only 11 QPs.

b) MAA Audit

Chart 6 shows the percentage of MAA checked cases over a one-year period. Check cases refer to MAA audit cases cleared in the first round of audit.



There was a downward trend in the number of MAA check cases. However, the percentage of "checked" cases for MAA cases is still higher than those in the plans submission, ranging from 81% -100% as compared those of plans submission, whose range is between 61% - 79%.

Comparing the MAA submissions for the year 2001 and 2002, there was also an improvement in the audit check results. In the year 2001, out of the total number of plans audited, 36 of MAA lodgements were found to have deviations from the Fire Code. There was a decrease in non-compliant cases in 2002, where only 22 of cases were reported.

REASONS FOR IMPROVEMENT

13 The reasons for the improved results are:

a) There were more Qualified Persons seeking consultations with FSSB officers to clarify doubts that they had with the Fire Code and other relevant codes of practice. This resulted in a higher standard of Plan/MAA submissions.

b) There were many cases where waiver applications were made before commencement of the construction. This contributed to a better standard of plan submission. It also showed that the building industry is better educated and informed in its understanding of the fire safety requirements.

c) Most importantly, the building professionals themselves deserve credit for having done careful checking of the plans for compliance before submitting them to FSSB. This shows the professionalism of the Qualified Persons and also leads to faster processing time for audit cases by FSSB officers.

CONCLUSION

14 The Self-Regulation System has benefited the building industry with regards to building plans approval. It resulted in QPs paying better attention to the fire safety requirements. This has resulted in better quality building plan submission.

15 However, the audit check process must still carry on. FSSB will continue to monitor the data gathered and continue to work closely with QPs for resolving issues affecting the building works. QPs are also encouraged to continually give feedback to FSSB regarding any fire safety matter. Through this feedback, FSSB can regularly review and update its practices in the area of fire safety. This updates and further developments would then be shared with the QPs in the future FSSB seminars and dialogue sessions.

Pointers for Waiver Application

By

Mr. Vijayaratnam
Senior Consultant
Fire Safety Consultation Branch
Fire Safety & Shelter Bureau

POINTERS FOR WAIVER APPLICATIONS

INTRODUCTION

Waiver applications are necessary, as not all building designs can be tailored to suit the provisions in the Fire Code. It is a means of communication for those who design and construct buildings and those who enforce codes to work closer to make appropriate changes in building fire safety designs. It provides an avenue for the QP to propose alternative solutions to FSSB for consideration. While proposing alternate solutions, it must be borne in mind that fire safety standards should not be compromised.

2. It has been noted that not all waiver applications were made with suitable alternative to the fire safety measure or allows for improvement to the Fire Code. Worst still, there are some Qualified Persons who appear to apply only to appease the Owner. As such, we have received waiver requests that lack sound supporting reasons for doing away with of compliance to fire safety requirements.

3. The aim of this paper is to highlight some important points for the applicants to note when making a waiver request it is important for applicants to provide technically accurate information in waiver applications. This will help facilitate processing of waivers by our staff and aid in decision making by the Waiver Committee. In this regard, we seek Qualified Persons co-operation to explain to your clients the rationale for the fire code requirements.

AREAS FOR ATTENTION

Timing of Waiver Applications

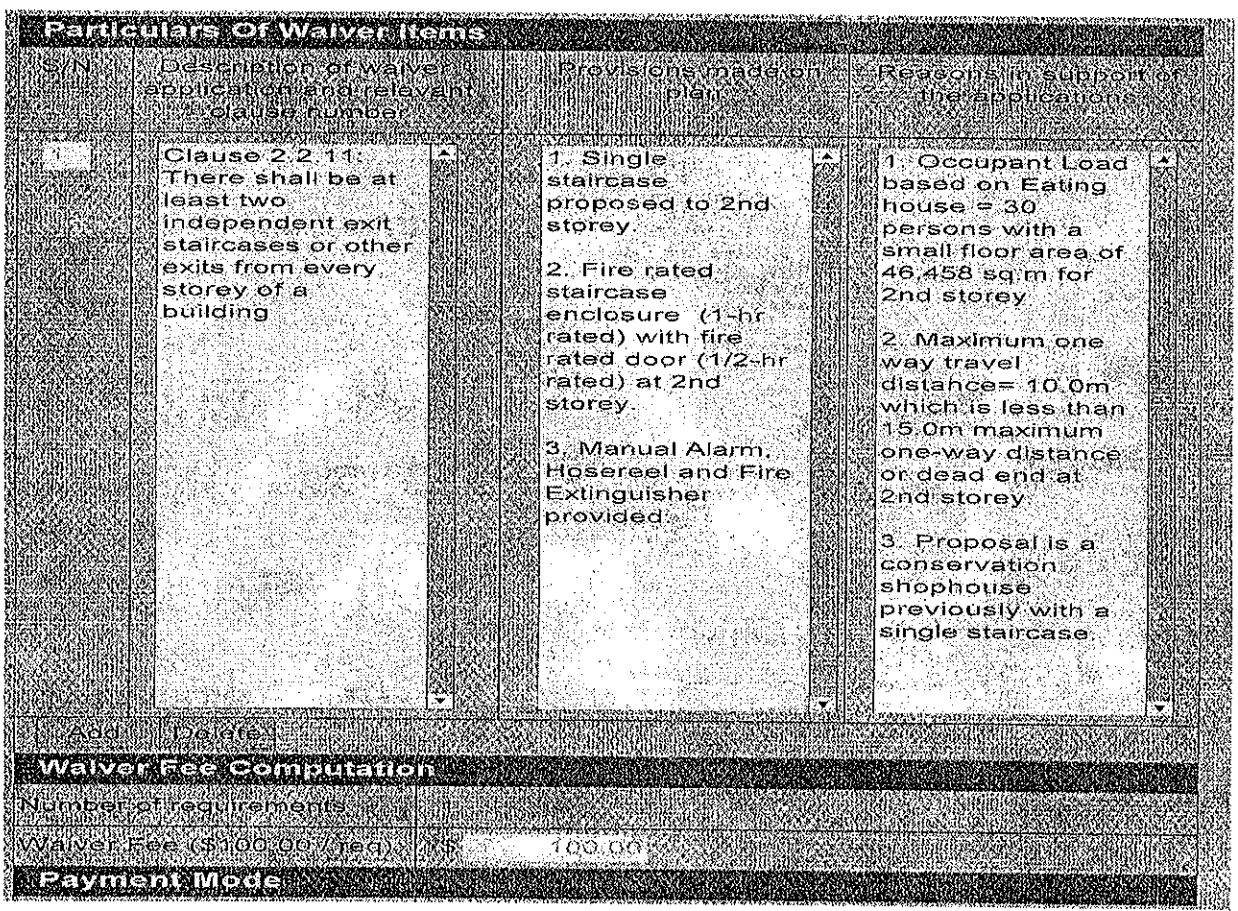
4. Ideally, waiver applications should precede plan submission under the Self-Regulation system. Otherwise, the submitted plans which are approved outright by FSSB based on Qualified Person's declaration are deemed non-compliant during audit checks. In some cases, the Qualified Persons were ignorant of the non-compliance till they were notified by FSSB. We strongly advise Qualified Persons against waiting till the audit findings or when Registered Inspector point out the non-compliance to them and thereafter seek waiver. In most of these late applications, works have already been completed on site and any rectification works would be costly. These are not

considered reasonable justification for the authorities to grant the waivers and are therefore rejected outright.

Need for accuracy, clarity and good presentation

5. The application form is an essential element in processing and presenting the waivers. FSSB officers rely heavily on the information provided therein. The waiver application form must thus be properly completed. Any inconsistency may result in the waiver application being rejected. The Qualified Person must have a clear understanding of the Fire Code and other technical requirements before seeking waiver. The Qualified Person must lay out the case for the waiver in an orderly and systematic manner as required in Section II of the waiver application form. This section is basically divided into 3 parts:

- Column "A" calls for the description of the waiver sought and it should state whether it is a request for a partial or complete exemption of the requirement.
- Column "B" captures information on the actual provision made, with shortfalls clearly stated. Also, the alternative measures provided to address any shortfalls should be given.
- Column "C" reflects the reasons in support of the waiver and these shall be provided in detail.



6. The reasons should show the alternative measures taken to make-up for the shortfall in compliance of code requirements. In addition, drawings of the proposed solutions and snapshots of actual conditions on site serve as useful visual recognition of the site to process the waiver application.

INEFFECTIVE WAIVER APPLICATIONS

7. Some examples of waiver applications that were rejected are given in this paper. Each waiver case is closely evaluated with the reasons for rejection appended against them. 10 actual case studies highlighting details of the waiver applications received, the particular requirement in the Fire Code and materials submitted in support of the waivers are given. The cases cut across all categories of fire safety requirements, ranging from Means of Escape to Fire Alarm systems.

Case 1

The first case involves a waiver to permit escape path to pass through another occupied space before reaching the staircase exit. However, the code requires all occupants to have direct access to exits. The reasons given to support the case was that the door across the exit access would be linked to the building's fire alarm system and provided with door release device on both sides. It is assumed that this would enable occupants to escape without difficulty. However the doors can still be locked by the occupiers to prevent unauthorised access and for security reasons. The locking of the door would deny occupant access to exits during fires.

Case 2

The next case seeks to exempt provision of protected exit staircases for a place of public resort. Being a conservation building, the staircase has to be accommodated in a protected shaft of at least 1- hour fire rating and the nature of occupancy requires 2 exit staircases. The crux of this waiver request was that the Owner wants to maximise use of restaurant space and save cost. It appears that Qualified Person may be applying for a waiver to appease the Owner. What he should do, firstly protect the existing staircase and offer a solution like providing auto fire alarm system to address the shortfall. Staircases are vital for the egress of the patrons of the restaurant and shall be protected.

Case 3

In this case there is a change of use from office to training school where the existing exit capacity of the staircases cannot accommodate the additional occupant load. Owner undertakes to limit the number of students based on a posted figure for the student population at any given time. Such undertakings are not acceptable as it is not enforceable simply because the market forces will determine the student enrolment. If this allowed, the school will operate to meet market needs ; and the operators will soon forget about any undertaking to limit the number of students. Qualified Person should advice their clients not to take up the premises in the building, as it is not designed for their need.

Case 4

The next case seeks to permit the use of glass as an element of structure for the construction of part of the floor. Their reason was that the glazed areas are relatively small and are not part of the means of escape. A conditional waiver was previously granted based on openings in one level of the 4-storey building being protected with fire rated glass. Qualified Person still persist in using non-rated glass floor throughout and thus permitting 4 storeys are in a single compartment. This clearly shows the Qualified Person is trying his luck to do away with fire safety requirements without providing sound reasons in support.

Case 5

To exempt the provision of private hydrant for residential building is the next case. Qualified Person claimed that the shortfall of the roadside hydrant's coverage could be mitigated by the provision of dry riser and hosereel. Though the building is equipped with two rising mains only one of the breeching inlets is within 18m from the fire engine access. It is clear that the fire engine access has to be extended and in order to serve the dry riser.

Case 6

The next waiver seeks to retain the inadequate existing hosereel coverage. The reasons given are the low occupant load and dried foodstuff storage that is assumed to pose low hazard. However dried foodstuff is combustible and

especially in a warehouse, as such adequate hosereel coverage is critical for incipient fire fighting by occupants.

Case 7

This waiver seeks to exempt the provision of dry riser system to a 5-storey commercial cum residential building. The Qualified Person's reasoning was that the plan was submitted on 7 March 2002 and as such the dry riser is not required. However, this is not a new requirement as the 1997 version of Fire Code already required residential building under PG 2, with habitable height exceeding 10m, to be equipped with dry riser.

Case 8

The next case is on not providing sprinkler protection to carpark floors. Reason cited : "BCA has waived mechanical fume extraction and had deemed the 5 to 7 % ventilation openings to be adequate for natural ventilation". However, 50% openings evenly distributed throughout the open sided carpark floors are required for omission of sprinkler protection. It is a clear-cut case and there is no basis for consideration as the openings provided were extremely small.

Case 9

To waive the provision of auto fire alarm to shophouses formed through amalgamation of more than 2 units. In this case, the premises are provided with manual fire alarm system and comprise 5 shopunits connected together. A fire shutter complete with fusible link would be fitted to the opening in separating wall. Both are required provision for amalgamated old shophouse, as the auto fire system is expected to initiate immediate closing of the fire shutters.

Case 10

The next waiver case is a repeat case. It is a requirement under current Fire Code to provide 1-way comms and FCC for premises with gross floor area exceeding 5000 sq.m. Qualified Person had put up the same reasons in the previous application and it was turned down. It is a waste of money as there was no new supporting reasons.

8. By highlighting the above case studies, we hope to impart useful pointers that would help Qualified Persons avoid making waiver applications that do not carry good grounds for consideration.

SUGGESTIONS FOR AN EFFECTIVE WAIVER APPLICATION

9. In preparing a waiver application, one must first consider the underlying intent of the specific clause in the Fire Code. It will be useful to frame a waiver application in three steps to communicate clearly the intent to the Waiver Committee. The first step is to provide the relevant information such as when the existing condition was approved; the problem faced in trying to comply; the operational needs of the premises concerned; all these would be useful for the waiver committee's consideration. The second step is to provide all necessary illustrations, plans, photos and calculations. This is to ensure that your case is well presented to give the committee a convincing case. The last step to ask yourself if you have given adequate alternative solutions. After you have given your reasons for the waiver, it is necessary to check that the alternative measures are appropriate and do not compromise the fire safety standard intended.

CONCLUSION

10. The waiver application process must not be misused. It is not for the purpose of bypassing requirements but a channel to overcome constraints while implementing building fire safety. The fire code requirements exist for good reasons, as these are needed to ensure high standards of public safety. Don't hesitate to consult FSSB when in doubt of fire safety requirements while implementing your projects. FSSB officers would study every waiver meticulously and present it to the Waiver Committee for deliberation. On our part we will endeavour to deliver the outcome within 10 working days. We may allow the Qualified Person to present the waiver case to the Waiver Committee in person if there is an appeal on the waiver decision. However, a sound decision depends on how well Qualified Persons put up their case and whether the circumstances deserve due consideration. The next time you submit a waiver application please bear in mind the pointers and suggestions that I have delivered in this paper.

CASE STUDY 1

Issue 1

Description of the Requirements

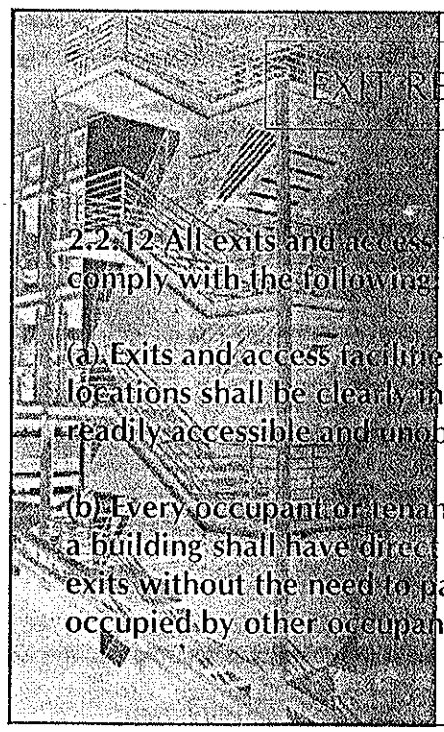
To waive the requirement for occupant escape path to exit pass through another occupied space via network room

Provision made on plan

-02 nos of 'break glass' press button on both sides of the door 'A' which allow the door to be opened during emergency

Reasons in support of the application

-Under taking letter by owner -Only computer equipments and racks are stored -The space is unman operated -Door are provided with 'Break Glass' to release door in time of emergency -Door is connected to FIB panel and it is a 'fail saye type" -Entry for the personal is required for maintenance only

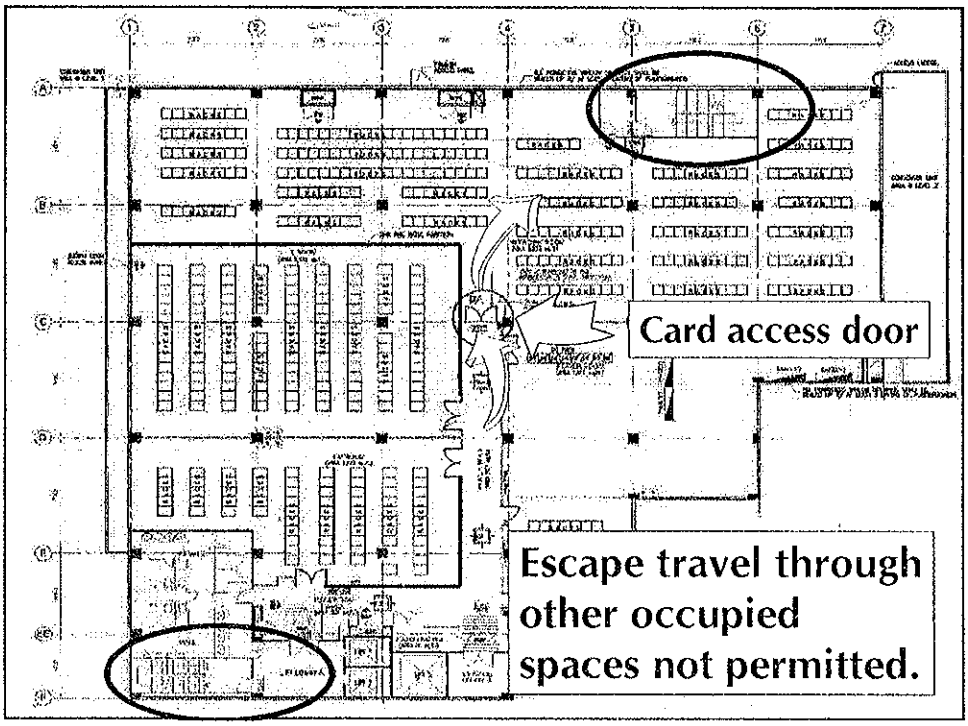


EXIT REQUIREMENT

2.2.12 All exits and access facilities shall be required to comply with the following:

(a) Exits and access facilities shall be clearly visible or their locations shall be clearly indicated and shall be kept readily accessible and unobstructed at all times, and

(b) Every occupant or tenant within a building or storey of a building shall have direct access to the required exit or exits without the need to pass through the spaces or rooms occupied by other occupants or tenants.



CASE STUDY 2

Issue 1

Description of the Requirements

THE ENCLOSURE OF AN INTERNAL EXIT STAIRCASE.

Provision made on plan

INTERNAL EXIT STAIRCASE IN 1ST, 2ND AND 3RD STOREY IS NOT COMPARTMENTED.

Reasons in support of the application

1) THE AREA OF EACH FLOOR IS ONLY 90M2. 2)THIS IS A CONSERVATION BUILDING. THE STAIRCASE IS ORIGINALLY NOT COMPARTMENT. 3) THIS BUILDING IS PROVIDED WITH MANUAL ALARM SYSTEM, HOSEREEL AND FIRE EXTINGUISHERS. 4) COMPARTMENTATION OF THE EXISTING STAIRCASE WILL REDUCE THE RESTAURANT ARA DRASTICALLY. 5) THE OPERATOR OF THE RESTAURANT WISHES TO UTILIZE THE RESTAURANT FULLY AS THE MONTHLY RENTAL IS EXTREMELY HIGH. 6)3 SIDES OF THE BUILDING WITH WINDOW OPENINGS ARE FACING THE ROAD.

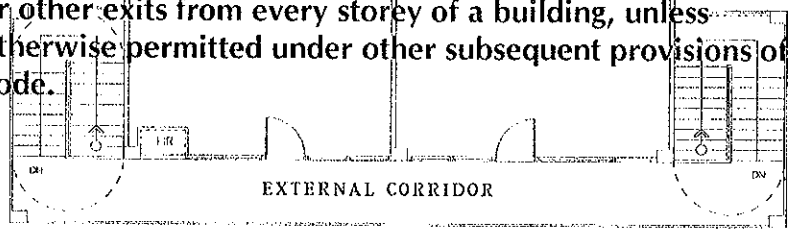
EXIT REQUIREMENT

FIRE SAFETY REQUIREMENTS AFFECTING SHOPHOUSES UNDER CONSERVATION

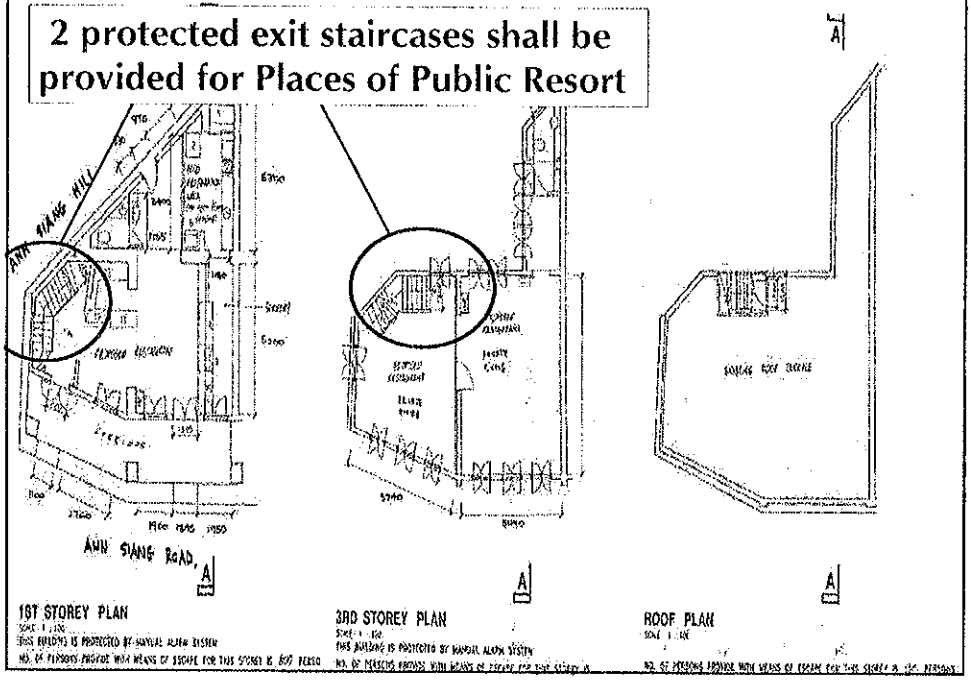
3-STOREY SHOPHOUSE (PROTECTION OF STAIRCASES)

Timber staircases, which serve as means of escape, shall be protected and comply with compartmentation requirements of minimum 1 hour rating.

2.2.11 There shall be at least two independent exit staircases or other exits from every storey of a building, unless otherwise permitted under other subsequent provisions of the code.



2 protected exit staircases shall be provided for Places of Public Resort



CASE STUDY 3

Issue 1

Description of the Requirements

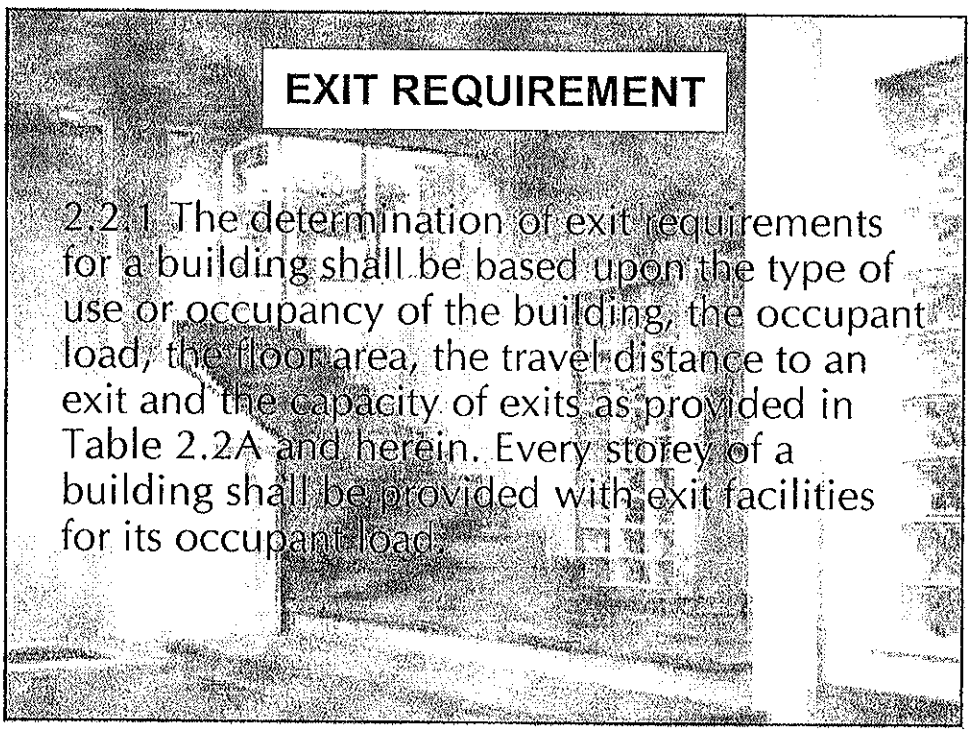
To permit Existing staircases with regards to the occupant load based on part of the existing office change to training facilities.

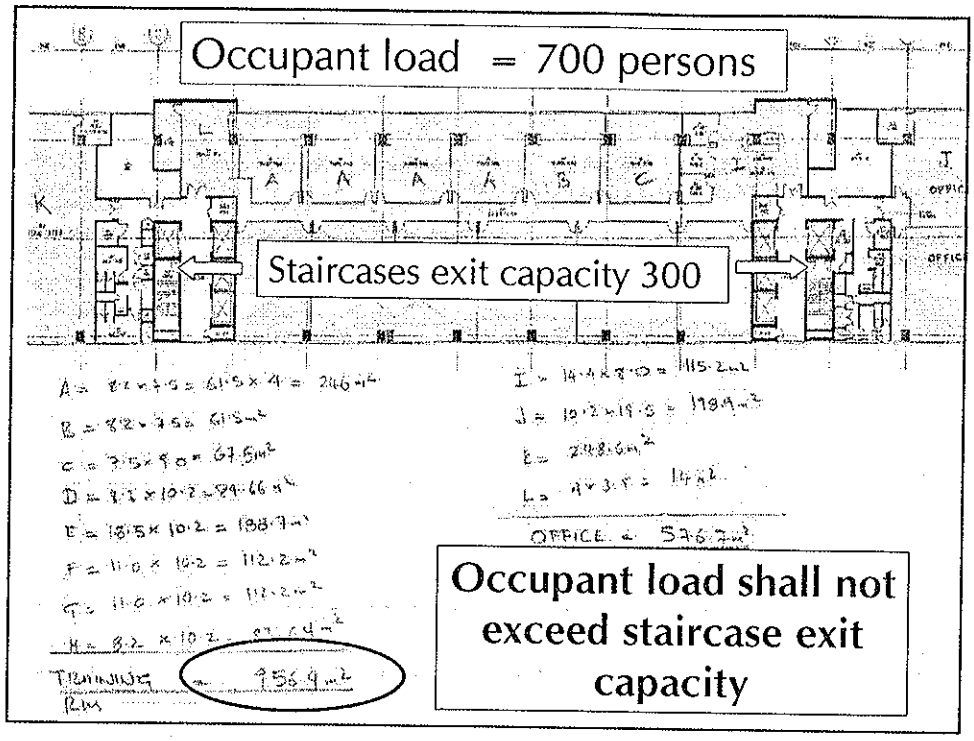
Provision made on plan

1. Automatic sprinkler system provided. 2. Fireman lift provided. 3., Hose reels provided at every level. 4. Fire extinguishers are provided in every room.

Reasons in support of the application

* Building is sprinkler protected *[OWNER] undertakes to ensure that at any one time the occupancy load will not exceed 450 people(Please refer to the letter from Corporation). *[OWNER] informed that the courses occupancy varies from 300 to 450 which are conducted to staggered times and it is under utilized during the day. * The evening classes are occupied with approximately 10% absenteeism. *[OWNER] ensures that there will be 1 of their staff in charge of the premises during





CASE STUDY 4

Issue 1:

Description of the Requirements

Fire resistance of element of structure: To permit to use glass as part of flooring material

Provision made on plan

We will install 10+10 thk non-fire rated tempered laminated glass as flooring material complete with steel support for the following areas: a Bridges at 2nd and 3rd storey lift lobby b. Glass floor at 3rd storey airwell

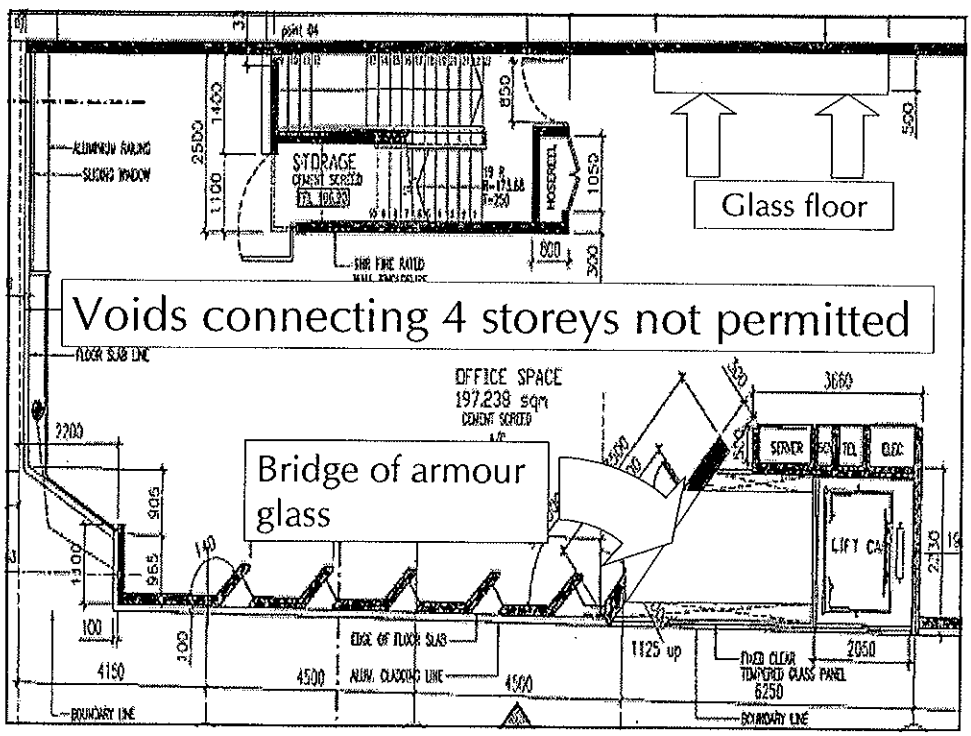
Reasons in support of the application

- All 4 storey is within 1 compartment Please refer to our waiver attahced -We have provided a continuous fire-escape staircase compartment from mezzanine to 1st storey external area -During fire, those areas where we have glass as flooring material are not being used as an escape route to the fire staircase. Please see floor plan sketches attached -During fire no access allowed to lift. It is not a fire escaoe lift and is equipped with auto-homing device -Glass floor areas are relativelt small: 4.

COMPARTMENTATION

3.2.4 Compartmentation by Height

(1) In any compartment except those mentioned under sub-clause 3.2.4(d), up to a habitable height of 24 m, no compartment shall comprise more than three storeys.



CASE STUDY 5

Issue:

Description of the Requirements

To waive provision of fire hydrant

Provision made on plan

Coverage of hydrant within 50 metres (Existing fire hydrant) Provision of hosereel & dry riser

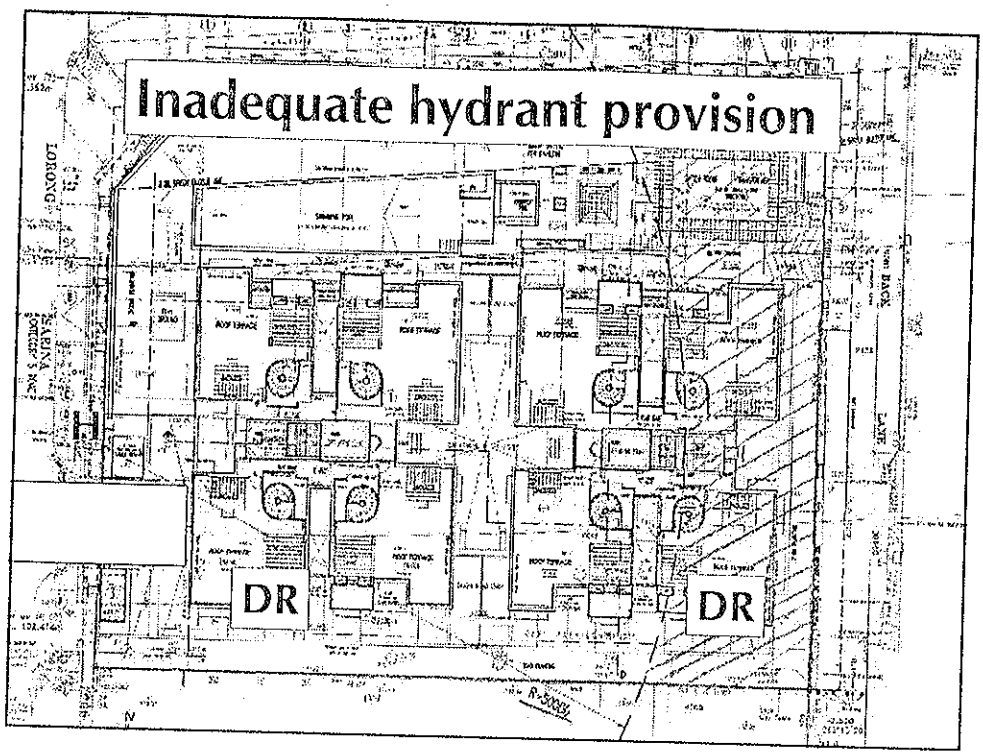
Reasons in support of the application

Portion of the apartment unit between (Grid line 9 to 11) is not within hydrant coverage Areas not covered: See areas hatched (blue)

HYDRANT

4.4.1 (b) In situations where more than one private hydrants are required, the hydrants shall be located along the fire engine access road and/or an accessway such that every part of the access road and/or accessway is within an unobstructed distance of 50m from any hydrant .

6.2.3 (a) All buildings fitted with rising mains shall have accessways or fire engine access road (applicable to buildings under purpose group II) for pumping appliances within 18 m of the breeching inlet.



CASE STUDY 6

Issue 7

Description of the Requirements

CL 6.2.8 (A) Hose-reels to be provided in compliance with CP 29 ie all parts of the floor to be within 30m + 6m throw of the hose-reels

Provision made on plan

1. Only 2 nos existing hose-reels provided

Reasons in support of the application

1. For single tenancy per floor, only a small portion of the floor is outside the 6m throw. Almost all parts of the floor are within the 8m throw. 2. For multiple tenancies per floor, the area that is outside the throw of the hose-reels shall be provided with more fire extinguishers. 3. The warehouse is intended to be used as an air-conditioned warehouse for dried foodstuffs and as such, they are of a low fire hazard. 4. In addition, the occupancy load is likely to be rather low. Based on the

HOSEREEL

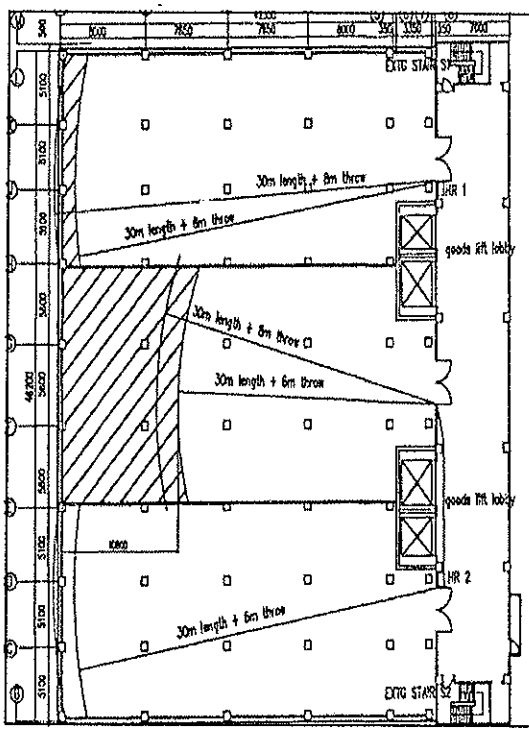
6.2.8 Hose Reels

(a) Hydraulic hosereel conforming to the requirements in SS CP29 Code of Practice for Fire Hydrant Systems and Hose Reels shall be provided in every storey of every building regardless of building height, except the following:-

(i) Purpose group I buildings;

(ii) A shop on the first storey of a shop- cum-residential building provided the shop does not exceed 280 m 2 in floor area and is properly separated from the residential floors or parts of the building by compartment walls and floors;

(iii) Any other small building such as guardhouse/post, bin centre, open-sided shed, etc.



EXISTING TYPICAL STOREY PLAN (2ND TO 5TH STOREYS)

WAIVER ISSUE: TO MAINTAIN 2 NOS HOSE REEL AS PER EXISTING PROVISION

LAYOUT 2: 3 TENANCY UNITS/FLR

-- ONLY THE HATCHED AREA IS OUTSIDE THE 36M REACH OF THE HOSE REEL

-- MORE FIRE EXTINGUISHERS TO BE PROVIDED IN THE AREA OUTSIDE THE REACH OF THE HOSE REEL

CASE STUDY 7

Issue 1

Description of the Requirements

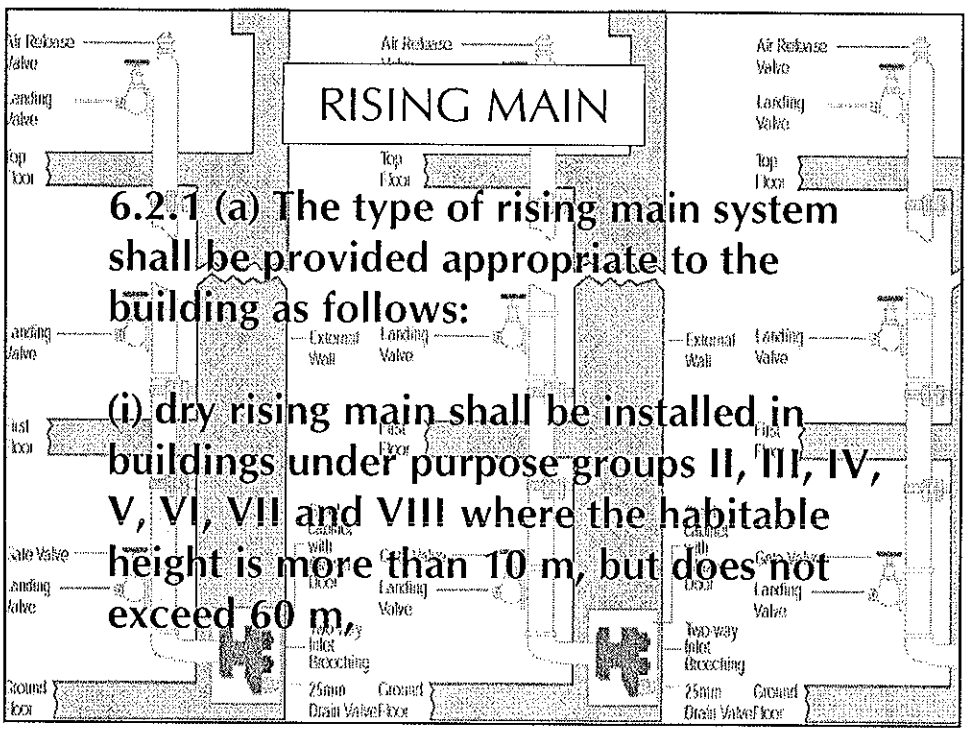
To waive the dry riser main system for the 5 storey commercial cum residential building.

Provision made on plan

1) Automatic Fire Alarm system has been provided for the 5-storey building. 2) Fire hosereel system has been provided for from 1st to 5th storey.

Reasons in support of the application

- Please has been submitted and approved on 7 March 2002. - 1st and 2nd storeys are food and beverage and entertainment usage. - 3rd to 5th storeys are residential usage. - The Fire Engine Access driveway are located at the front, side and rear of the building. (Attached a copy of the site plan for your reference).. - The GFA per floor is only 170 sq.m.



6.2.1 (a) The type of rising main system shall be provided appropriate to the building as follows:

(i) dry rising main shall be installed in buildings under purpose groups II, III, IV, V, VI, VII and VIII where the habitable height is more than 10 m, but does not exceed 60 m,

CASE STUDY 7

Issue 1

Description of the Requirements

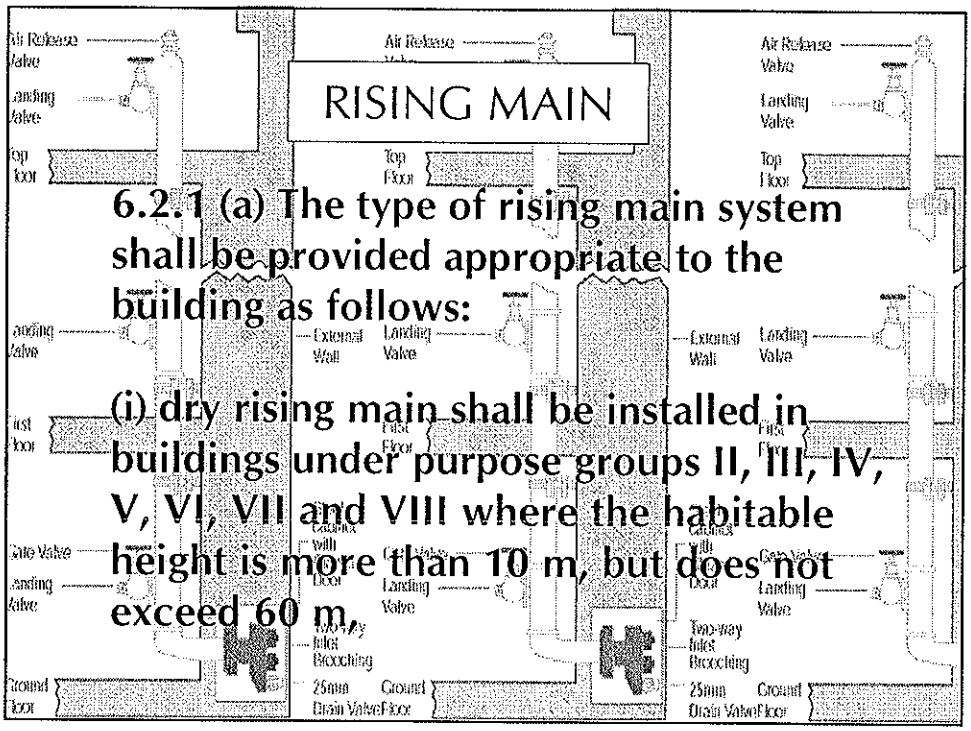
To waive the dry riser main system for the 5 storey commercial cum residential building.

Provision made on plan

1) Automatic Fire Alarm system has been provided for the 5-storey building. 2) Fire hosereel system has been provided for from 1st to 5th storey.

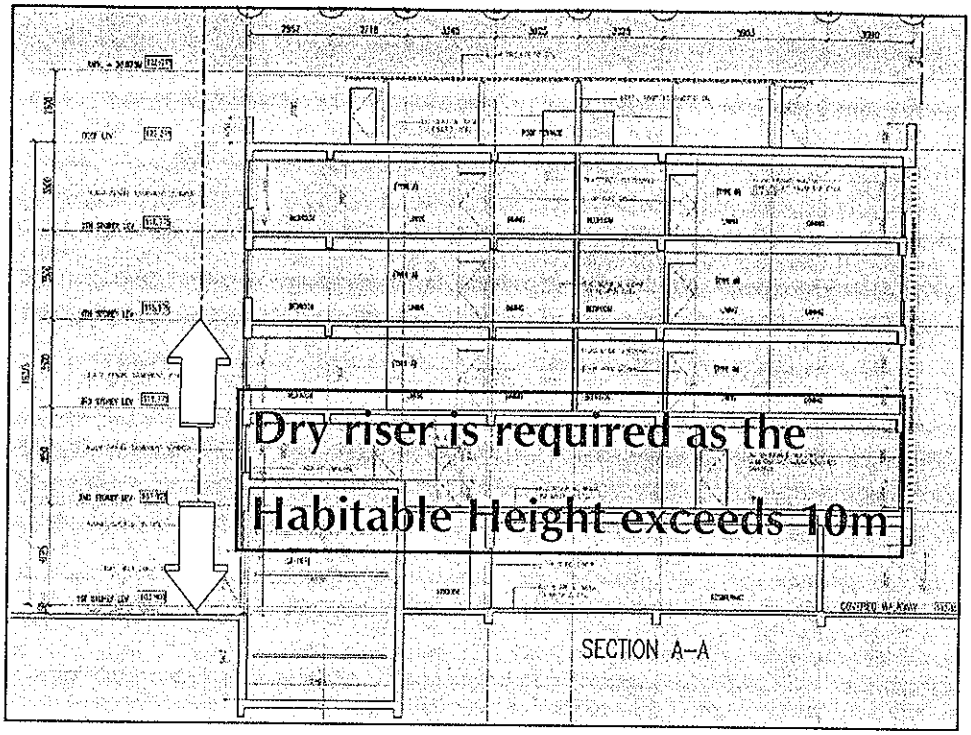
Reasons in support of the application

- Please has been submitted and approved on 7 March 2002. - 1st and 2nd storeys are food and beverage and entertainment usage. - 3rd to 5th storeys are residential usage. - The Fire Engine Access driveway are located at the front, side and rear of the building. (Attached a copy of the site plan for your reference).. - The GFA per floor is only 170 sq.m.



6.2.1 (a) The type of rising main system shall be provided appropriate to the building as follows:

(i) dry rising main shall be installed in buildings under purpose groups II, III, IV, V, VI, VII and VIII where the habitable height is more than 10 m, but does not exceed 60 m,



CASE STUDY 8

Issue 1

Description of the Requirements

To permit Carpark floors at 4th to 8th storey of existing World Trade Centre to be considered as natural ventilated carparks though the definition of ventilation openings in DPA calculation differs from FSSB fire Code Clause 3.2.8 (c)

Provision made on plan

Please refer to attached list for Carpark Ventilation Calculation (Existing Building) The ventilation openings range from 3.56 to 7.91%

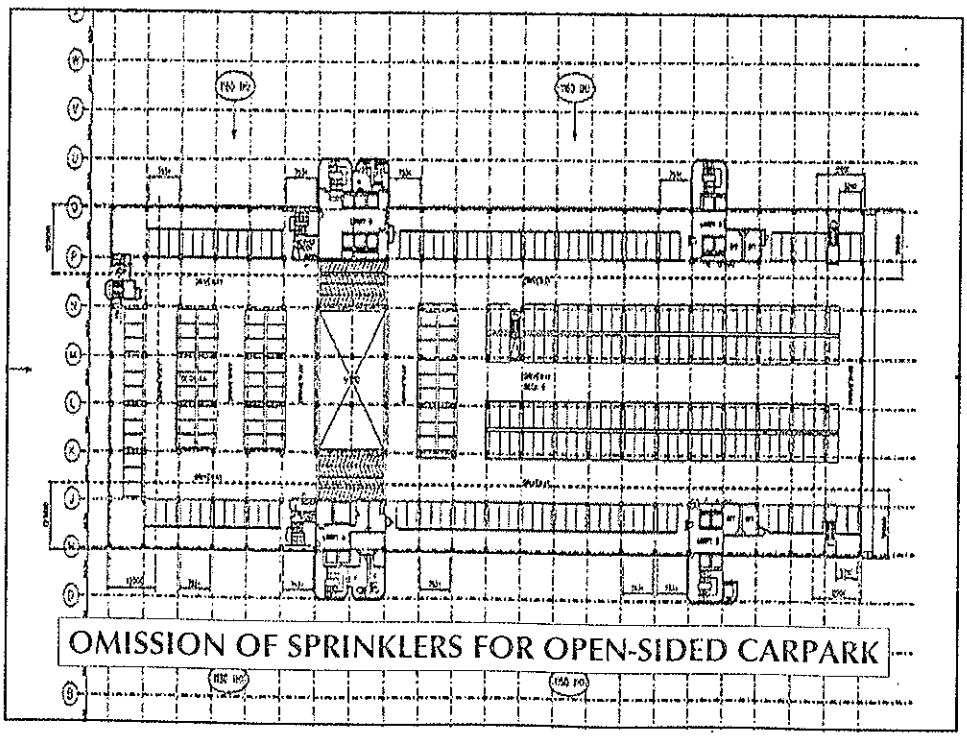
Reasons in support of the application

BCA considers the carpark floors as naturally ventilated as per earlier CSC issued on 27.01.88. (BCA letter dated 25.11.02 and CSC dated 27.01.88 attached) The carpark floors are well ventilated due to its present locaton by the sea. The carbon monoxice content during peak hours as measured on 1.11.02 is well below the minimum requirement. (refer to SPECS letter dated 12.11.02 attached). The sprinklers can be omitted because the carpark is naturally ventilated.

SPRINKLER

6.4.6 In multi-storey buildings under Purpose groups IV, V & VII, where any car parking floor above ground is provided with natural ventilation in accordance with cl.3.2.8(c), the provision of automatic sprinkler to the car parking floor is not required. In lieu of sprinkler system, an automatic smoke detection system shall be provided to the car parking floor.

3.2.8(c) Open sided car parking decks having not less than 50% of the sides permanently open and such openings being evenly distributed as to provide cross ventilation to all parts of the car parking areas.



OMISSION OF SPRINKLERS FOR OPEN-SIDED CARPARK

CASE STUDY 9

ISSUE 1

Description of the Requirements

Fire Safety Requirement for addirions/alterations of conservation and non-conservation shophouse building: Para 7(2)- To waive the provision of Automatic Fire Alarm System for shophouses amalgamating more than 2 units

Provision made on plan

1. The premises are protected by existing Manual Fire Alarm Systems. 2. A 1 hr fire rated shutter complete with fusible link shall be provided to the new opening (1.2m X 1m high) in the party wall.In addition to the fusible link,2 nos of new smoke det

Reasons in support of the application

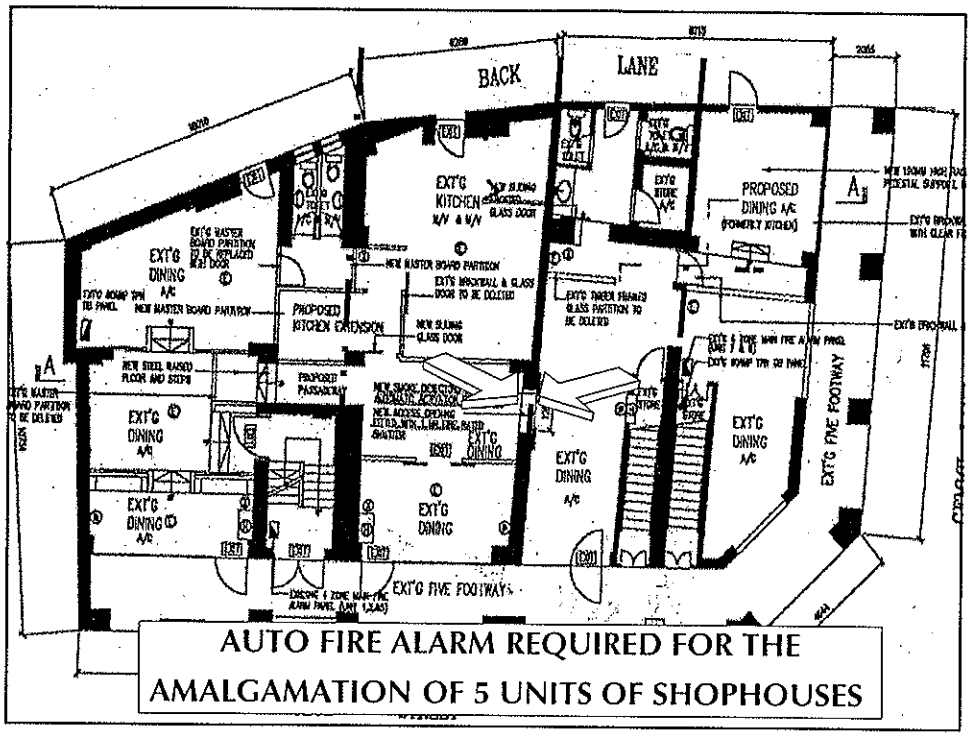
1. The proposal is for alterantion and addition works carried out to only 1st storey of 2 adjacent upgraded conservation shophouses projects.The project at no 1/3/5 Club Streetb amalgarnated two 3 storey shophouses,where the project at no. 7/9 Club Street involved 2 units of 2 storey shophouses.The 1st storey of both shophouses were approved for restaurant usage. Breaking up an opening (1.2m X 2.1m high) in existing party wall between these two projects is to combine the operation of two restaurant under

FIRE ALARM SYSTEM

AMALGAMATION OF SHOPHOUSE UNITS

If the amalgamation of shophouses is more than 2 units, to provide fire shutters or fire doors to the openings at the party wall between every 2 units

For shophouses exceeding 3 storeys or having an amalgamation of more than 2 units, automatic alarm system must be provided.



CASE STUDY 10

Issue 1

Description of the Requirements

To modify Clause 8.2 (a) - One way emergy communication system and Fire Command Centre

Provision made on plan

i) Voice communication system to be installed at reception counter ii) No Fire Command Centre provided

Reasons in support of the application

Building is sprinkler H abitable height is 24m Industrial activities in the building is not fire harzardous. Occupancy level is low

FCC & VOICE COMMS SYSTEM

8.2.1(a) One way emergency communication system and a fire command centre shall be provided as follows:

(i) For all large buildings under Purpose groups III (excluding educational buildings such as schools, colleges), IV, V & VII (gross floor area greater than 5000 sq m or having a total occupant load exceeding 1000 persons) and large industrial buildings under Purpose group VI & VIII, including mega warehouses, (gross floor area greater than 5000 sq m).

Non provision of FCC & voice comms

