# PROACTIVE FIRE TRENDS

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Second Half, 2002


● Giving A New Information Technology Centre An Edge Over Fire

# ProActive Protection For New Cyberport,

## Hong Kong's Flagship Information Technology Project

A glance on the way to the soon-to-be Hong Kong's IT hub.

*CLOCKWISE:*
PFT takes some insights on the installation of PROMATECT®-H boards on partitions and E&M enclosures within the developing complexes in Cyperport.

The short drive from Central up through the Mid-Levels to the western side of Hong Kong island is a ride through high rise, high density usually very expensive cheek-by-jowl housing.

Moving away from the accelerated commercial and administrative downtown heart of this "business first and foremost" territory, it is also brief journey though a microcosm of the Special Administrative Region's unique history, not the least of which is its ability for constant commercial and urban re-invention.

The visitor can be forgiven for thinking the skyline sometimes seems to change faster than the crawling traffic.

It comes as little surprise that Pokfulam, once a neighbourhood of solidly middle class almost upper-crusty establishment credentials, is to become the home site of Hong Kong's ultramodern Cyberport.

### A Flagship Project For Hong Kong's Information Technology Industry

As Hong Kong's notoriously fleet-footed business community continued to evolve at its usual rapid pace, it become increasingly apparent it had to moved to a knowledge-based economy.

Similarly, the need for Silicon Valley-like centres with an East Asian flavour dedicated single-mindedly to specialist business opportunities in the booming Information Technology Age, became equally obvious.

It is a stated aim of the Special Administrative Region's government strategy to make the territory an unquestioned leader in the digital era.

The ability for Hong Kong to maintain unquestioned and profitable leadership as the information technology hub of the thriving and extremely competitive Pearl River Delta area also created added impetus.

If the reasons were ever in doubt, in typical Hong Kong style it was never much more than a question of where and when it would happen. Yesterday!

Located in the Telegraph Bay area of Pokfulam on the southwest side of Hong Kong island, when it is finished Cyberport will be home to a strategic cluster of leading companies and professional talent specialising in IT applications, information services and multimedia content creation.

Cyberport will be supported by a world-class telecommunications infrastructure and a range of hi-tech facilities second to none.

The developers claim that the design of Cyberport promises a relatively low density, campus-style environment which aims to optimise a seafront location with proximity to Hong Kong's central business and financial district.

*Continued on page 2*

## F E A T U R E S

Point of View

# A KISS FOR THE ENTREPRENEURIAL SPIRIT?

We hear a lot these days about the value of intellectual capital and the power of knowledge-based economies. The value and benefits entrepreneurs bring to both business and society are never far behind.

As a matter of interest, the Oxford dictionary defines "entrepreneur" as the "person in effective control of (a) commercial undertaking" or the "contractor acting as an intermediary". It seems to me that neither definition adequately interprets the entrepreneur's modern role.

To employ our well-used KISS (Keep It Short & Simple) principle once again, it seems obvious to me, for any business to be successful it has to act in an entrepreneurial way. By extension this concept also applies to the people who work directly or indirectly for the organisation. Sustained success over a prolonged period therefore implies constant expansion of the role of the entrepreneur.

The continuing performance of Promat in the Asia Pacific market place can be attributed to a number of factors, the spirit of our very own in-house entrepreneurs is just one of many. It seems the corporate mix is just about right – continuing R&D, quality products and services built on solid fundamentals balanced by a blend of personal incentives and team rewards.

The recent launch of our brand new A4 size Promat Asia Pacific Handbook is a case in point. Also known as the "ProActive Fire Protection Systems Application and Technical Manual", this lavish full colour handbook is designed to provide a comprehensive source everything related to Promat's *ProActive Fire Protection*. It therefore generously outlines all Promat products and system solutions in a way which can be easily used advantageously by all. From concept right through to the nuts and bolts. It is the handbook's intention to be the bible for the Promat way to *ProActive Fire Protection*.

Some good examples are highlighted in this issue of ProActive Fire Trends, the 10th in the series of our regional newsletter which, according to some feedback, is proving to be an exceptionally useful marketing tool.

First, we have as our cover story a review of Promat's role in Hong Kong's amazing new Cyberport. This purpose-built state-of-the-art cybercity aims to keep the buzz in Hong Kong's ongoing success by keeping the territory at the cutting edge of the Information Technology industry in the bustling Pearl River Delta area and beyond.

Under Science & Research, PFT takes a look at Smoke Management on page 3. On page 5 we treat readers to a slice of the debate in Australia into alternative solutions based on so-called "tight fitting" solid core doors. Both subjects are sure to find a high level of professional interest.

A subject close to all our hearts in the wake of last year's "911" attacks, an extrapolation of fire protection in high rise office buildings is presented comprehensively on page 4. This covers subjects such as a comparison of national building codes, performance based fire safety design and specific concerns for the Asia Pacific region.

Stories on changes in the Indian Fire and Building Code and in-brief examination of the ventilation and smoke extraction ducts in Manila's MRT new stations round out PFT10.

To return to the central point, we don't expect everyone to suddenly blossom into entrepreneurs overnight but we would like everyone to apply an entrepreneurial spirit, regardless of their position in the organisation, to solve the common problems we all face – making the world a safer and better place to live in.

The contents of PFT10, like all past and future issues aims to provide our clients, customers, associates, friends and most importantly our staff with the shared ideas, quality knowledge and superior product systems to make this happen

Keep up the good work. If there's anything don't hesitate to get in touch directly.

**Erik D. van Diffelen**
*Managing Director*

October 2002

Promat Asia Pacific Organisations
erik@diffelen.com

PROACTIVE FIRE TRENDS

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**The Promat International Asia Pacific Network spans the region with innovative proactive fire protection products, systems and solutions: Australia, China, Hong Kong, India, Malaysia, Philippines and Singapore, with distributors in Brunei, Indonesia, Japan, New Zealand, South Korea, Taiwan and Thailand.**

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# ProActive Protection for New Cyberport, Hong Kong's Flagship Information Technology Project

Continued from cover

## Phase One Partial Completion End 2002

Cyberport is owned by Cyberport Ltd (CPL) of which Pacific Century Cyberworks Ltd (PCCW) is the parent company. In May 2000, the government of Hong Kong signed a Project Century Cyberworks (PCCW) agreement to perform the role of developer. The government is also part owner of certain parts of the Cyberport complex.

When it is completed by the end of 2007, Cyberport will be comprised of 110,000m² of "intelligent" ultramodern office space capable of meeting the all the digital needs of sophisticated multinational and local tenants.

Cyberport will also house a 30,000m² lifestyle complex comprised of retail, entertainment and educational facilities to interface with the public.

A world-class 175 room luxury hotel and a residential complex of 2,800 luxury condominium units will be integrated into Cyberport Hong Kong by the time it fully completed.

Eventually, some 150-200 IT companies are expected to call Cyberport home.

Taken together as an integrated multi-faceted project, Cyberport will not only be more or less a world unto itself – more than able to meet its commercial objectives and social aspirations – but also provide a focal point or standard in Hong Kong's continued drive for excellence.

Not surprisingly, Phase One of Cyberport Hong Kong is scheduled for partial completion by year end 2002.

Defining the times while placing considerable faith in the future of Cyberport strategy is Microsoft. The giant of worldwide software development has already signed a five year tenancy lease for approximately 4,000m² of Cyberport Phase One.

## ProActive Fire Protection for Cyberport

For all tenants, big and small, a high level of *ProActive Fire Protection* is a foundation of Cyberport's aesthetic and pragmatic disciplines.

This is largely due to increasing awareness of the importance of cost effective fire science benefits at virtually all levels and to Hong Kong's ever-evolving and forward thinking fire and building code legislation.

In keeping with the aims, style and quality of Cyberport, PROMATECT®-H calcium silicate boards were specified and employed extensively in the electrical and mechanical enclosures in Phase One's protected corridors.

These also feature PROMATECT®-H on steel stud partitions.

## Defining Quality, Meeting BS 476 Standards

The double-sided partitions in the protected corridors of Cyberport Phase One feature PROMATECT®-H board on each side with mineral wool for insulation and 2-hours integrity to BS 476: Part 22.

A unique feature of these partitions is the height to which they extend, in some cases up to 7.5 metres tall.

On the other hand, the electrical and mechanical enclosures employ a system of PROMATECT®-H board for 2-hours integrity and insulation to BS 476: Part 20.

The architect for (Phase One of) Cyberport is Wong Tung & Partners, well known for the leading role they played in the development of the Dragon Air Terminal headquarters, the Tsing Yi MTR station and the Pacific Place Phases 1 and 2, amongst other distinctive projects around Hong Kong. PFT

**Identifying the Major Cause of Fatalities in Building Fires**

# ProActive Smoke Management

Smoke rather than heat has been identified as the major cause of fatalities in building fires. However historically Building Regulations in most countries have focussed on the fire resistance of barriers rather than their resistance to smoke. The application of performance based approaches to fire safety design has led to a greater understanding of the importance of ProActive Smoke Management and recent development of test methods provides the tools for the performance of barriers to be measured and specified in quantifiable terms. These developments are important if proactive systems are to be selected and specified with confidence by designers and checked by regulatory authorities.

This paper will provide an overview of the exposure conditions, and new test procedures for assessing the performance of smoke barriers with the intention of encouraging the application of *ProActive Smoke Management* to achieve fire safe and cost-effective building design.

by **Paul England**/Warrington Fire Research, Australia

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*NOTE: The word "passive" in the original article has been replaced with "proactive".*

Smoke leakage rig.

*Figures and picture courtesy of MDM Publishing Ltd.*

## Characterisation of Fires for Design of Barriers

To specify proactive smoke control barriers confidently it is first necessary to characterise fires. A compartment fire can be defined as a four-phase phenomenon comprising:

1. **Establishment phase**
2. **Main growth phase**
3. **Fully developed phase (post flashover)**
4. **Decay phase**

Refer *Figure 1*. For design purposes it is appropriate to adopt a simple approach and define bounding conditions in terms of enclosure/hot layer limiting temperatures.

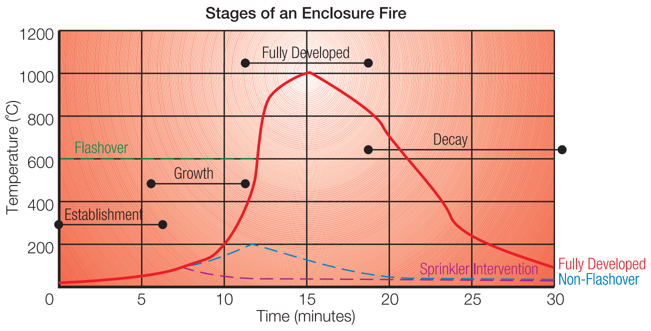


*Figure 1:* **Phases of fire.**

The upper bound adopted for the establishment phase is a hot layer temperature of 200°C. This limiting value has been selected because:

- The radiant heat flux from the hot layer will not significantly increase the burning rate of the fire and heat transfer by convection from the hot layer will not be sufficient to significantly accelerate the production of volatiles throughout typical enclosures. Above 200°C the hot layer may begin to influence fire growth.
- Most automatic suppression systems would activate and maintain enclosure temperatures below 200°C
- First aid fire fighting by occupants has the greatest probability of success at hot layer temperatures below 200°C.
- A limiting value of 200°C is compatible with air leakage test methods such as AS 1530.7[1], UL 1784[2].

The duration of the establishment phase can vary from a few minutes to several hours depending amongst other things on the ignition source, the item first ignited, ventilation conditions and the size of the room. Only a small proportion of fires have the potential to progress beyond the establishment phase. Many fires remain localised until they burn out, are dealt with by the occupants or are automatically suppressed.

The main growth phase relates to the stage of fire development when the radiant heat from the hot layer begins to significantly accelerate the burning rate and the fire is of sufficient size to rapidly spread across the surface of an object or spread to adjacent objects. Usually the growth rate during this period is relatively rapid unless the oxygen supply to the fire is constrained. Successful manual fire suppression by the occupants during this stage would be unlikely. During this phase additional openings may form (e.g. breakage of windows due to the imposed heating).

For simplicity flashover is commonly treated as an event, which occurs at a prescribed heat flux (typically 20kW/m$^2$) at floor level or a hot layer temperature or temperature rise (typically 600°C). Temperatures attained during the fully developed phase typically lie in the range of 800°C to 1200°C depending upon a number of variables including:

1. **Fire load**
2. **Type and configuration of fire load**
3. **Ventilation conditions**
4. **Thermal properties of the boundaries**

The duration of the fully developed phase can vary from as little as two minutes to several hours and is dependent upon the same variables that affect the maximum temperatures attained, which are listed above.

The decay phase can be arbitrarily defined as the period after the average enclosure temperature has decreased to 80% of its peak but temperatures may remain high around some fuel packages (contents) even when the average temperature has dropped considerably.

## Design Exposure / Test Exposures

Exposure to smoke can be defined as a combination of thermal actions, differential pressures, and concentrations of products of combustion.

The thermal actions in relation to proactive barriers can be conveniently split into the following ranges to facilitate establishing their performance as a barrier to fire and smoke.

- Ambient temperature exposure (typically up to 40°C)
- Medium temperature exposure (typically up to 20°C)
- High temperature exposure (a temperature regime representative of the main growth and fully developed phases)

Within the enclosure of fire origin ambient temperature exposure corresponds to a smouldering fire, and for many barrier design applications need not be considered because smouldering fires are generally only a threat to life within the enclosure of fire origin and will not degrade the barrier significantly.

Within the enclosure of fire origin medium temperature exposure (200°C) corresponds to small fires (in comparison to the size of the enclosure), the early stages of a larger fire, or the upper bound enclosure temperature for automatically suppressed/controlled fires. Temperatures of 200°C or less can be sufficient to cause significant degradation of a barrier. Two examples are given below:

- Leakage through a closed door, even if fitted with smoke seals can cause life-threatening conditions in an adjoining space unless the seals are designed to accommodate the differential movement between the leaf and frame.
- UPVC pipes can soften and collapse at temperatures substantially below 200°C allowing the passage of smoke where the pipes penetrate barriers.

For the assessment of elements of construction exposed to high temperature it is common to combine the main growth, fully developed and decay phases and adopt the standard heating regimes specified in ISO 834[3], AS 1530.4[4] and BS 476 Part 20[5]. It has been recognised that more rapid temperature rises can occur and alternative heating regimes such as the hydrocarbon-heating regime are being prescribed more frequently. The traditional and hydrocarbon heating regimes are shown in *Figure 2* with typical enclosure fires obtained from full-scale experiments. It can be seen that the hydrocarbon fire more accurately simulates the main growth phase.

Pressure differentials generated by the buoyancy of hot gases from a fire are a function of the temperature, and the enclosure height above the neutral axis but are generally below 10Pa for medium temperature conditions and 20 Pa for high temperature conditions in small enclosures. However, pressures as high as 50-100Pa can be generated by stack and piston effects for example.

Estimating smoke species concentrations is a complex subject and lies outside the scope of this paper. For many applications close to the enclosure of fire origin it is reasonable to crudely correlate enclosure temperature rises with species concentration. Methods are presented in Klote and Milke[6] and England et al[7]. Temperature rises as little as 10°C-20°C can reduce visibility below design limits.

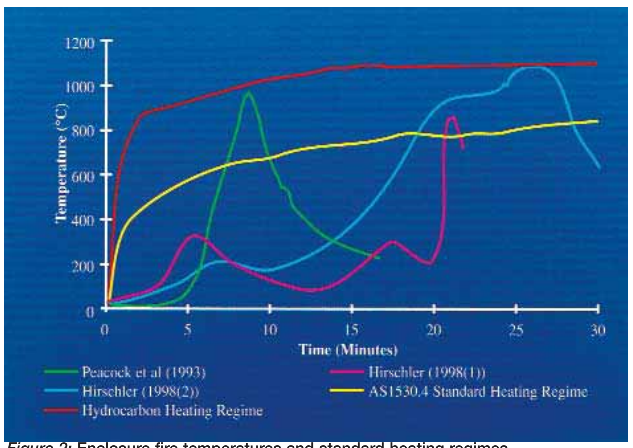


*Figure 2:* Enclosure fire temperatures and standard heating regimes.

## Test Methods

Standard air leakage test methods for doorsets at ambient and more recently medium temperatures have been published (e.g. AS 1530.7: 1998[1]). These test methods can be also applied to wall/floor system and service penetrations such as plastic pipes and air dampers. The test method involves mounting the element of construction in front of an enclosure and measuring air leakage at a range of pressure differentials, at ambient and medium temperature.

Acceptable leakage rates can be calculated for specific applications either by assuming the development of a hot layer and allowing for air entrainment after the smoke passes through leakage paths and/or assuming full mixing of the smoke. Recent research undertaken by Warrington Fire Research has shown that smoke leakage through solid core doors can rapidly cause untenable (life threatening) condition in adjacent enclosures.

Other preliminary results indicate that the selection of smoke seals is critical. For example a seal fitted to a solid core timber door exhibited a high level of resistance to smoke spread when exposed to ambient temperatures, but at medium temperatures the leakage was similar to a doorset without smoke seals. Therefore simple specifications such as solid-core doors with smoke seals do not necessarily achieve the desired outcome.

A more suitable specification for a medium temperature smoke door would be:

The door opening shall be protected by a self closing smoke door with a leakage rate of not more than nn m$^3$/h when exposed to a medium temperature air leakage test in accordance with standard xyz at a pressure differential of nn Pa or greater from both directions.

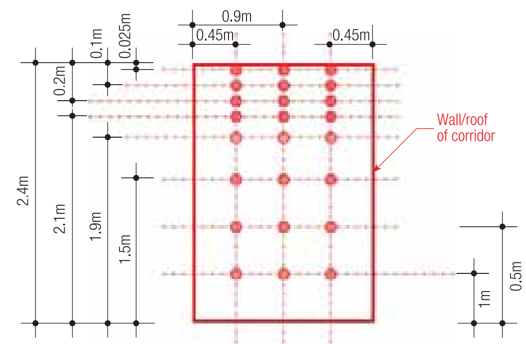


*Figure 3:* **Layout of a typical array of corridor thermocouples.**

Whilst fire resistance tests such as AS 1530.4 and BS 476: Part 20 expose elements of construction to high temperatures they do not provide an indication of smoke leakage and smoke production. A simple addition to the fire resistance test procedures involving the application of an instrumented enclosure provides a practical method for obtaining data suitable for specifying smoke control measures at high temperatures. The method is described in Young & England 1999[8] together with examples of derived data.

A typical array of thermocouples is shown in *Figure 3*.

The method defines a smoke spread parameter as the time for the average enclosure air temperature at a nominated height to exceed a specified temperature rise. The temperature rise can be loosely correlated to visibility and concentrations of toxic species.

A typical specification could require a temperature rise of 15°C, at a height of 1.5m, not to be exceeded within 15 minutes exposure to the standard heating regime of ISO 834.

## Conclusion

This paper has provided a sample overview of available methods for measuring the performance of smoke resistant barriers. The methods cover the range of exposure conditions expected for most fire scenarios and present quantitative results in a form that can be readily used by fire safety engineers, designers/specifiers and regulatory authorities for both performance-based and prescriptive designs. Recent research results have shown that smoke barriers such as solid-core timber doorsets are not as effective as once thought, unless they are fitted with compatible seal combinations.

The range of test methods described is already assisting supplies to provide comprehensive information on their systems in a form that will encourage the application of *ProActive Smoke Management* in order to achieve fire safe and cost-effective building designs. PFT

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[2]**UL 1784** "Air Leakage Tests for Door Assemblies", Underwriters Laboratories.
[3]**International Standards Organisation** "Fire Resistance Tests. Elements of Building Construction. Part 1 General requirements", International Organisation for Standardisation, Geneva, 1999.
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[6]**Klote, J.K. and Milke, J.A.** "Design of Smoke Management Systems", American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Atlanta, GA, 1992.
[7]**England J.P, Young S.A, Hui M.C, Kurban N.** "Guide for the Design of Fire Resistant Barriers and Structures Warrington Fire Research / Building Control Commission", Melbourne Victoria 3000, 2000.
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● The Reflection of WTO Attack on Asia Pacific's

# High Rise Office Building Fire Protection

by **Fang Li** / *Consultant*, Rolf Jensen & Associates

*This article is printed with permission from International Fire Protection (IFP) Magazine Issue 10 May/June 2002.*

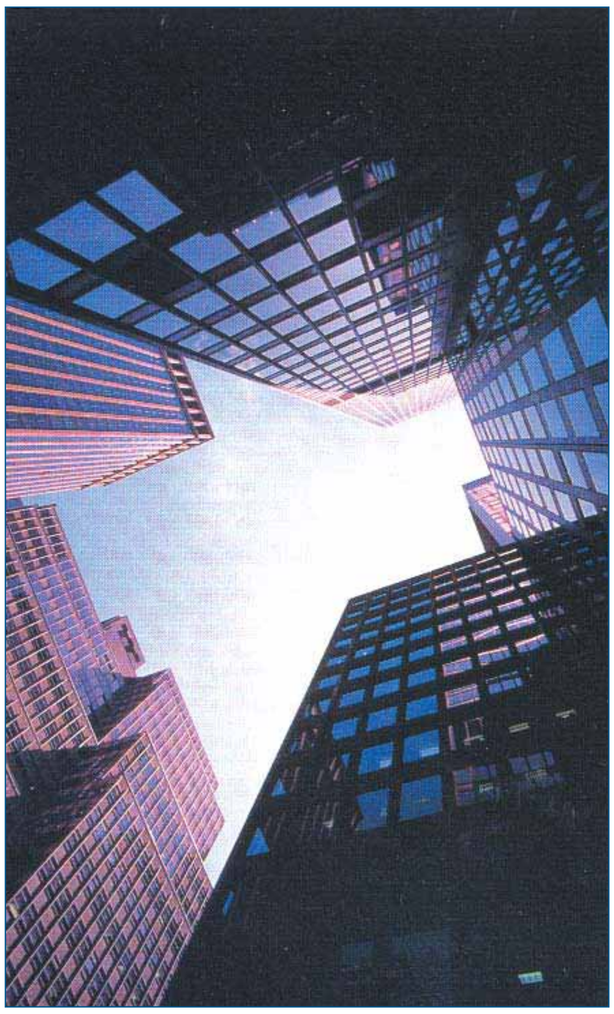

High rise buildings have been one of the most prominent symbols of economic growth for nearly a century. Yet, in the aftermath of the tragedies of September 11, "signature" high rise buildings have become the focus of much debate. Do we still want to build such large buildings? Can we adequately protect these buildings and their occupants? Based on the vast number of proposed high rise projects around the world, especially in Asia, it is clear that the desire to build such monuments is still there. In order for us to protect these buildings and their occupants, fire protection engineers will be facing an increasing challenge to demonstrate that the designs can meet the demands of their inherent fire and life safety risks.

## Introducing National Building Codes

With the fire and life safety concerns these structures represent, most modern building codes around the world have specific prescriptive requirements to address various aspects of their design. These prescriptive requirements address passive fire protection systems (fire resistance ratings of the structural elements), active fire protection systems (fire sprinkler and smoke control systems), communication systems (fire detection and alarm), and egress systems (stairs and refuge areas). The adjacent table presents a comparison of representative prescriptive code requirements for high rise office buildings in different countries.

Although these codes are similar in many requirements, significant differences can be found. One such difference is in compartment size, where the Chinese code is very restrictive while the US codes have no limitation. Reasons for such differences include a country's economic condition, relative emphasis on active versus passive fire protection, climate, maintenance, and historical usage. China's reliance on fire and smoke compartmentation, coupled with natural smoke control, can be attributed to the considerations of cost effectiveness and reliability. But, such prescriptive approaches can often create problems for high rise buildings with mixed used occupancies, large assembly areas, or unique atrium designs. Relying on compartmentation can result in dividing the building into small cubes that limit architectural expression and effective functioning of the building.

The codes today are undergoing a major evolution to address the ability of providing flexibility in the design and use of the building together with cost-effective fire and life safety. Rather than only allow for the application of the restrictive prescriptive code requirements, codes are beginning to accept performance-based design approaches as an equivalency. The use of performance-based design can achieve a level of fire safety equal or better than the prescriptive code while providing the local authority having jurisdiction with an engineered basis for acceptance of the approach. Performance-based design provides the opportunity to overcome the differences between codes of various countries, allows designers to create engineered solutions, and results in cost effective global fire safety.



| | Hong Kong | China | UK | US IBS | NFPA 101 |
|---|---|---|---|---|---|
| Definition of high rise | ≥ 30m in height | > 24m in height | NIL | ≥ 23m in height | > 23m in height |
| Fire resistance | Decided by building construction function | Decided by building construction assembly | Decided by building construction function | Decided by building construction assembly | Not addressed |
| Maximum fire compartment size | 28,000m³ (above ground level) 7,000m³ (below ground level) | 1,000m² | No limit | No limit | No limit |
| Minimum number of exits | 2 | 2 | 2 | 2 | 2 |
| Maximum travel distance | 36m | 40m | 45m | 91m | 91m |
| Area of refuge floors | Maximum every 20 floors | Maximum every 15 floors | No requirement | No requirement | No requirement |
| Number and location of fire elevators | Maximum 60m from most remote area to fire elevator | Decided by floor area, no location requirement | Decided by floor area | No requirement | No requirement |
| Emergency operation of HVAC system | Shut down | Shut down | Shut down | Shut down | Not addressed |

The Petronas Towers, located in Kuala Lampur, Malaysia, offer a good example of the benefits of performance-based fire safety design. With heights of approximately 1,480 feet, the towers are the two tallest buildings in the world and are the home for the Malaysian government's gas and oil company as well as other multinational corporations that lease space. Rolf Jensen & Associates provided the code consulting and the fire alarm and emergency communications system design for this mixed-use project. A unique egress solution using the elevators and skybridges was developed, where the 750-ton skybridge connecting the towers in the middle serves as an emergency egress route between the towers and the upper and lower floors. The lobbies at each end of the pedestrian bridge were designed as fire compartments, each having its own separate HVAC systems. In order to limit fire and smoke spread, the connecting bridge area was compartmented by use of fire resistance rated assemblies with fire stopping systems (several tragic fires have occurred in other parts of the world where a similar approach was followed, but did not include a suitable fire stopping system). A fire alarm and emergency communications system designed in accordance with the NFPA 72 – "National Fire Alarm" standard together with redundant command centers was provided. The fire suppression system was designed to comply with the NFPA 13 – "Automatic Sprinkler Systems" standard. The combined use of local and international codes on a performance-based approach provided the designer with a more flexible design without sacrificing the level of fire safety.

Each country's codes have their own approach, logic, and advantages. For example, the Chinese code for high rise office buildings over 100 meters in height. It requires an area of refuge every 15 floors with the area providing a minimum size of $0.2m^2$/person. In the Chinese code there is no specific guideline to calculate the occupancy loads, so designers usually use other international codes and standards as the reference. For a 20 story building having 24,000 $ft^2$ per floor with an occupancy load of 100 ft gross area/person, we would have 240 people per floor. Using the code complying stairwell system, timed egress calculations predict that it will take about 51 minutes to evacuate the building. If instead of total evacuation, one moves people to a refuge floor, this time can be significantly reduced (in this case to less than 25 minutes). In China, the total height of 15 floors would be around 50 meters which is just within the range of the fire truck rescue capability in China, giving the options for fire department to rescue the people in the first area of refuge to egress by both fire truck ladder and stairwell. In the US codes, there is no such requirement for refuge areas. Egress design is achieved by the egress zone, which is typically defined as the fire floor, the level below and the level above, which needed to be evacuated simultaneously. All the other floors keep the concept of "defend in place" which in most situations is believed to be the correct approach. Since September 11, however, this concept is being discussed because of the implications that human behaviour may cause the occupants to now evacuate all floors above the fire floor.

In its efforts to reduce barriers to international trade, the World Trade Organisation (WTO) encourages the concept of international codes and standards. WTO compliant international standards development organisations include ISO, IEC and NFPA. Each of these organisations is including performance-based design criteria in their documents.

In support of these code development efforts, performance-based design approaches are being closely studied. There are three major tasks associated with this study:

- behaviour of the building construction during fire exposure
- computer modelling to predict the smoke spread
- computer modelling to predict automatic suppression system actuation and fire control

Computational Fluid Dynamics (CFD) modelling has previously been used in high rise buildings for analysis of the effects of wind on the structure. CFD modelling is now also being used for the study of smoke movement in the building. The traditional method to predict the construction behaviour by the small and large scale tests are not cost-effective and, as a result, much effort is being place of this modelling approach. The model gives us the capability, with real time visualisation output produced from the fire models, to design the emergency smoke control system and evaluate the associated evacuation options. The egress model, Pathfinder, which has been developed by the engineers at Rolf Jensen & Associates is a valuable tool in conducting, verifying and demonstrating the egress analysis.

## Concerns for Asia Pacific High Rise Buildings

Even though the loss from September 11 may bring questions and concerns on the future for high rise buildings, there is no question that for some countries such as China, with the high density of population and the economic boom, high rise buildings will still be dominant in major cities. The collapse of the WTC bring us the question for high-rise office building sprinkler systems and can they help maintain structural integrity in such an incident. The critical failure temperature for steel element is about 500-600°C without any fire retarding treatment, and in most cases for a conventional fire, the sprinkler system would have been sufficient to control the fire size and allow for occupant egress. For office buildings, its fire load is generally defined as 2,000 btu/ft . The fuel load presented by the jet fuel in WTC was considerably greater than what the sprinklers could have been expected to control contributing to the fire growth and its great impact for the whole building construction integrity. Most people agree that it is impractical to attempt to design a sprinkler system for a building to withstand the impact from a fully-fuelled wide body jet. However, with an integrated performance-based approach to fire safety, performance objectives can be developed to meet the exposures the building may be expected to face.

An integrated fire protection system for a building should include the fire resistance rating for the assemblies, the fire stop system in curtain walls and rated assembly penetrations, the fire alarm system along with the emergency voice system, the fire suppression system, and egress systems. All fire safety systems need to be monitored at a fire command center by qualified personnel. A properly managed maintenance program and an emergency evacuation training plan are also necessary. For a good fire protection system, survivability and reliability should be inherent in the design.

We have always learned from fire disasters, such as the New York City Triangle Shirtwaist fire early in the 20th century which led to the creation of their first Bureau of Fire Prevention and the enforcement of fire safety codes for compulsory fire drills and the installation of sprinklers in factories. The MGM Hotel fire in Las Vegas demonstrated the importance of sprinkler systems together with an integrated fire alarm and emergency communications systems working with the emergency smoke control systems. The tragic events of September 11 should be another reason for all of us to think deeply on how to make our buildings stronger and our world safer. PFT

● So-called "Tight Fitting" Solid Core Doors

# Are They An Appropriate Design Solution for Fire Safety Engineered Solutions in High Rise Residential Apartments?

by John Rakic ME(Fire Safety), MBA, BE Mech hons.

*Managing Director*, J-RAK Consulting (Specialists in Passive Fire and Smoke Containment)

*National Technical Convenor*, Technical Committee, TC18, Passive Fire Protection, FPA (Australia)

Australian National delegate to International Standards Organisation, *Technical Committee*, ISO TC92 (Fire Safety)

*Member* of Standards Australia Committees FD18 (Fire Engineering) and FD19 (Passive Fire and Smoke Containment)



*Picture courtesy of Fire Protection Association Australia.*

*ABOVE:* Warrington Fire Research test methodology FSE021 that is used for combined and dynamic fire and smoke leakage measurement. It incorporates a standard fire resistance test furnace and an adjacent full-scale corridor arrangement.

Are our high-rise residential buildings safe? The use of so-called "tight fitting" doors may in fact be a recipe for a disaster, even within buildings incorporating automatic sprinkler systems. There has been a great deal of debate within Australian industry at large relating to the use of alternative solutions and the practice of fire safety engineering. One specific debate, relates to unit entry doors for sole occupancy apartments in high-rise residential apartment buildings. Many alternative solutions are resulting in the replacement of traditional fire rated doors with an alternative door specification, often that of a self closing and so called "tight fitting" solid core door.

These specific alternative solutions are based on the assumption that the automatic sprinkler system and other associated fire safety sub systems, will in fact allow occupant to exit through the adjacent corridor before the onset of unsafe or untenable conditions. But will they? The author believes that there is possibly a serious misunderstanding in terms of the fire resistance and smoke leakage performance of a so called "tight fitting" solid core doors, and that this door solution is not appropriate for life safety consideration, even in a sprinkler controlled fire scenario.

This article has been prepared to give the reader some relevant information relating to the design requirements for unit entry doors for these specific applications. It introduces the concept of a "life safety door" and compares and contrasts this to traditional "fire doors", "smoke doors" and the so called "tight fitting solid core door". It also discusses relevant published research work specifically relating to the performance, or more specifically "lack of performance" of so called "tight fitting solid core doors" in both fully developed fire scenarios and also in simulated sprinkler controlled fire scenarios.

Fire safety practitioners, fire safety engineers, building surveyors, fire brigade personnel and insurance underwriters need to understand the implications of moving outside the "safety net" of the deemed to satisfy requirements of the Building Code of Australia (BCA). In short, they need to specify products with proven performance, remembering that alternative solutions are meant to be performance based designs. They cannot rely on products such as so-called "tight fitting solid core doors" with a perceived performance, especially when there is published information suggesting inadequate performance. The cost for a door with acceptable performance criteria may in fact be comparable to that of the so called "tight fitting solid core doors", especially if the gaps or clearances are in fact defined in the specification and need to be carefully adhered to by the door installation company. It is not a true cost to look only at the cost of the materials. The installation cost also has a significant bearing on the overall cost.

If your current project has "tight fitting solid core doors", you may have to revisit the design in light of this paper.

## BCA Deemed to Satisfy Provisions for Unit Entry Doors

For Class 2, 3 and 4 buildings, the Building Code of Australia (BCA) includes deemed to satisfy (dts) provisions relating to unit entry doors for sole occupancy units or apartments. The requirements for Type A construction (high rise), typically require a self closing fire door with an Fire Resistance Level (FRL) of one hour (-/60/30) and needing to complying with AS/NZS1905/1 (fire door code).

There are some concessions in the current BCA that apply only to specific buildings that incorporate an automatic sprinkler system. These concessions apply only to Type B and C construction (low rise building with rise in storeys of 3 or 4), where a so-called self closing, "tight fitting, solid core door" is allowed in place of the one hour fire door.

The relevant clauses that relate to these concessions are given in Clause C3.11 and Specification 1.1 - Clause C3.4.

*The author has not been able to ascertain what the "perceived" performance a self-closing and so-called "tight fitting, solid core" door was believed to have had when regulators first allowed this concession. In light of recent published research work and practices in other countries, the author seriously challenges the validity of this concession. It should be noted that this particular concession does date back to early Ordinance 70 days.*

## Fire Doors (BCA Compliant)

The self closing -/60/30 fire door, (FRL of -/60/30), as required by the dts provisions of the BCA, is required to comply with Specification C3.4 which requires compliance with AS/NZS1905/1 and fire testing to AS1530/4. These requirements result in a self closing fire door, where installation clearances restrict perimeter gaps to 3mm maximum, and door bottom/threshold gaps to 10mm maximum.

It should be noted, that the requirement for a so-called "tight fitting" door is not considered in other national building codes and associated national standards. In other countries, unit entry doors to Class 2, 3 and 4 buildings, are required to have both a fire rating and smoke leakage rating and therefore in most cases will require the use intumescent fire seals and/or smoke seals.

The combined fire and smoke door will require both a proven fire resistance rating/performance level demonstrated by a standard fire resistance test (analogous to our AS1530/4) and a maximum smoke leakage rating (at a nominated temperature of exposure and pressure differential), to a standard air/smoke leakage test standard (analogous to our AS/NZS1530/7).

The designation for a combined fire and smoke door is by incorporating a suffix "S" with the fire resistance level / fire rating, so a unit entry door for our scenario in Australia could possibly designated as -/60/30 "S".

There is serious technical merit to an argument that our current BCA deemed to satisfy provisions for fire doors for unit entry door applications, require an additional requirement for smoke leakage and therefore require smoke seals. This requirement will require smoke seals and not rely on the so called, "tight fitting" nature of doors, to provide smoke separation to adjoining escape corridors (refer to the following discussion regarding performance of tight fitting doors).

## Solid Core Doors – Tight Fitting (BCA Compliant)

The BCA deemed to satisfy requirements for a so-called "tight fitting" and "solid core" door do not provide any associated definitions and this in itself is a problem for industry.

### Solid Core

Firstly what is a "solid core" door? There is no definition in the BCA and there is no appropriate Australian Standard either. The author has heard on many occasions that the timber door standards, AS2688, AS2689 and AS1909 have definitions for "solid core doors", but they do not.

It is the authors view, that the term "solid core" door has evolved to differentiate against a "hollow core" door, which is a door filled with a cellular, honeycomb type cardboard core. Doors typically available here locally in Australia and referred to as "solid core" doors are doors constructed of "solid" core substrates that may include for example blockboard, particle board or solid MDF. Some laminated cores incorporating MDF with a polystyrene infill to keep their weight down are being termed as "semi solid" doors.

Without an adequate BCA definition, the use "solid core" as you can see, can or may mean different things to different people, and in terms of their relative performance in terms of fire resistance and resistance to smoke leakage in fire conditions (including sprinkler controlled scenarios), will vary considerably.

The above argument does not even touch on the frame type, the dimension of the frame's doorstop, and the installation of the frame to the surrounding wall, which in itself opens up another "can of worms" and many more variants.

### Tight Fitting

Secondly, what is the definition of "tight fitting"? Again, there is no definition in the BCA for this term also.

There are a number of areas of the door, where clearances or door gaps can be and should be measured, and these include the clearance around the door, (both the perimeter clearance and the clearance at the door bottom/threshold) and the gap or clearance between the frame's doorstop and the door leaf itself.

One must be practical about the concept of installing and maintaining the so-called "tight fitting" door, even if the definitions are given in a subsequent amendment of the BCA. Tight fitting installation practices are hard to control in the first place, and in practice, doors will settle on their hinges after commissioning, and the perimeter and frame doorstop clearances will change with general "wear and tear" of the door in service, and with thermal conditions in the building (Heating, Ventilation and Air Conditioning), not to mention issues with changes in floor finishes.

Even with a so called "tight fitting" door and with improved definition, and assuming clearances can be maintained, credible published research suggest that the performance of this type of door in relation to smoke spread should be of serious concern to industry.

Should a so-called "tight fitting" solid core door be in the BCA in the first place and how and why did it get there?

## Performance of "Tight Fitting" Solid Core Doors

There has been some local Australian research published relating to the performance of so-called "tight fitting" solid core doors, both to fully developed fires and to simulated sprinkler controlled fires.

### Fully Developed Fire Scenarios

An industry sponsored research project, involving Lorient Australia and Tyco Building Products, was conducted by Warrington Fire Research Australia, (WFRA). Some of the findings of this industry sponsored research work have been published by the Victorian Building Control Commission[1]. This research work developed a documented a test methodology, WFRA FSE 021[2], that utilised a standard AS1530/4 fire test furnace and a full-scale corridor. This test methodology has since been put forward to International Standards Organisation, (ISO), as a possible International Standard as a test methodology for combined fire and hot smoke leakage of unit entry doors leading onto adjacent escape corridors.

The results of this work clearly showed that the conditions in an escape corridor adjacent to a unit entry door incorporating a so called "tight fitting" solid core door would become untenable in only a matter of minutes for a fully developed fire scenario.

After completion and publication of this work, the author believed that the use of so-called "tight fitting" solid core doors would cease, especially for alternative solutions for high rise residential apartments where protection from the "safety blanket" of the BCA dts provisions were not available.

Most surprisingly, this was not the case. As many of these high rise residential apartment buildings incorporate automatic sprinkler systems, some designers were comfortable that sprinkler activation and the performance of so-called "tight fitting" solid core doors would result in acceptable conditions in adjacent escape corridors. But will they?

*Continued on page 6*

*References*

[1]**England, J.P & Young, S.A.** "Report on the Performance of Solid Core Timber Door in a Fire Test using a Standard Heating Regime", Warrington Fire Research (Aust), Building Control Commission (Victoria), 1999 as part of FREE CD inclusive of test video footage.

[2]**Warrington Fire Research (Aust) Pty Ltd Standard FSE 021** Fire Safety Engineering Test Method for Doorsets Subject to Simulated Fully Developed Fires, Revision 1; April 2000, Warrington Fire Research (Aust).

[3]**Rakic, J.** "The performance of unit entry doors when exposed to simulated sprinkler controlled fires"; Fire Australia, February 2000, pp 24 to 28.

*Australian Standards*

**AS/NZS1905/1** Components for the protection of openings in fire-resistant walls – Fire-resistant doorsets.

**AS1530/4** Methods for fire tests on building materials, components and structures – Fire resistance tests of elements of building construction.

**AS/NZS1530/7** Methods for fire tests on building materials, components and structures – Smoke control door and shutter assemblies – ambient and medium temperature smoke leakage test procedure.

**AS1851/7** Maintenance of fire-protection equipment, Part 7: Fire-resistant doorsets.

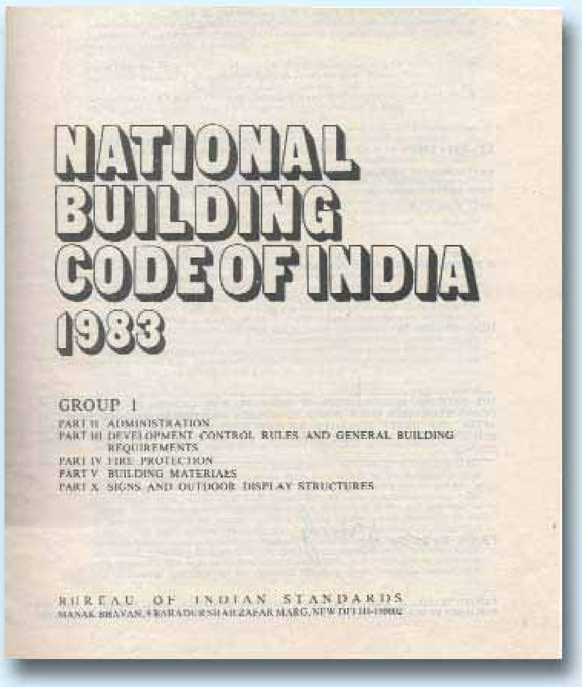
**AS2688** Timber doors.

**AS2689** Timber doorsets.

**AS1909** Installation of timber doorsets.

● Revising Part IV of India's National Building Code

# Creating A New Millennium Fire Safety Document




India is home to considerably more than a billion citizens, one sixth of all humanity, second only to China in terms of human density. It is an ancient civilisation where the need for standardised, modern fire and building codes is sometimes obvious.

But India is also a big country, by any measure. Many fragmented dimensions of geography, language, religion, social custom and culture – some fundamentally different – all jostle for attention in what is frequently described as a "colourful but typically balanced Indian" mosaic.

It is all too convenient to think of India as a single demographic, political unit.

## Past Tragedies Accelerate Awareness

India's built environment, perhaps not surprisingly, reflects a similar story.

In the past, disastrous fires made all too frequent and tragic headline news.

Annualised losses caused by fire to India's national economy are estimated by some to be approximately in the vicinity of Rs1,600 crore, about US$300 million.

Increased awareness – particularly at government authority level – for the need of workable fire protection measures has been on the national agenda for quite some time.

Sadly, the low level of knowledge fire science technologies, particularly amongst architectural designers and building developers in the past, did little to convert awareness into reality.

However, the first version of India's National Building Code was legislated, along with appropriate guidelines, into the bureaucratic and governmental landscape as early as 1970.

Additions came 13 years later and Part IV of the NBC – dealing specifically with fire protection measures – was revised in 1997.

The overall knowledge of fire sciences and fire protection has also increased significantly over intervening years of progress. However, recent fires in the country have revealed loopholes in the code and in various building methods.

The government feels the time is right to revise existing standards and update them to international levels. The National Building Committee – comprised of experts from fire fighting organisations, fire science consultants, insurance companies, fire test institutes, chief fire officers from Delhi and Mumbai – have worked closely with parliament to ensure smooth legislation.

The process started in March 2002 and is expected to be finalised by late October 2003 when local fire and building code bodies have the choice of taking NBC guidelines and converting them into to effective by-laws at state level.

## Progress Creates Change For The Better

Just as progress creates the need for change, particularly among interconnected disciplines, the government of India has long recognised the need for a major overhaul to the National Building Code.

The general trend of thinking now between government and industry will create a full rewrite of the entire NBC. It is therefore necessary to re-examine critical provisions and likely revise a number of areas in Part IV.

The book of regulations of the National Building Code consists of approximately 800 pages. Part 4 of the code is alone comprised of 150 pages but this is expected to expand to 175 pages.

According to Mr. S.K. Dheri, a former Chief Fire Office of Delhi and currently Chairman of the National Building Committee, the proposed NBC revision is due for completion in the first quarter of 2003.

Its secondary aim is to create generally increased awareness for fire protection, the need for clear, wide ranging code descriptions and strict application of *ProActive Fire Protection* measures as prescribed in the NBC.

## Creating A New Millennium Fire Safety Document

The National Building Committee therefore intends to create a thoroughly professional "New Millennium Fire Safety Document".

Unlike in the past, it will be presented in a new and hopefully more relevant format:

- Part 1 – Preventive Care (passive fire protection provisions)
- Part 2 – Protection/Fire Protection (updating a number of clauses)
- Part 3 – Life Safety (an overview of what needs to be done to ensure the safety of the occupants in different buildings, the built environment in general and various potentially life and environment threatening situations).

At the end of the day, the expected revisions to the NBC strive to convert any potential fire causing accident into a small and manageable accident while preventing its conversion into a possibly bigger disaster.

In adopting a revised National Building Code it is generally considered that its recommendations will make their conversion to state level by-laws a relatively straightforward and hopefully standardised process.

However, sounding an advisory note, Mr. Dheri points out "general fire prevention steps taken during construction should not be taken as life safety provisions". PFT

## So-called "Tight fitting" Solid Core Doors

Continued from page 5

### Sprinkler Controlled Fire Scenarios

The author published the findings of his own research work, which was based on full-scale air/smoke leakage testing of doors in the USA[3]. This work measured the air/smoke leakage around so called "tight fitting" solid core doors at different exposure conditions (different temperatures and pressure differentials), which were argued to be typical of sprinkler controlled fire scenarios.

The leakage rates for a typical and so-called "tight fitting" solid core door at both ambient and medium temperature (200°C after 30 minute exposure) and at modest pressure differentials were very significant. Some quick calculations show that an adjacent corridor would in fact be filled with smoke relatively quickly, even in most sprinkler controlled fire scenarios, but especially if the sprinkler system do not operate, which is a fire scenario which should be considered for most credible fire safety engineering designs.

The author is somewhat bemused by the number of high rise residential apartments whereby so called "tight fitting" solid core doors are being specified as an acceptable design solution by way of alternative designs.

A closer look at the rationale being applied (or misapplied as the case may be) by some fire safety engineering practitioners, is that there may be an incorrect or "perceived" performance for a so called "tight fitting" solid core doors. They will NOT provide 20 or 30 minutes FRL and they will most certainly NOT provide tenable conditions in an adjacent corridor for the same period of time due to their so called "tight fitting" nature. I strongly suggest the published research work be obtained and read carefully.

*ABOVE:* An AS1530/4 type standard fire resistance test incorporating two proprietary fire doors under fire test.

Another interesting and concerning rationale is the literal interpretation of BCA performance requirement CP2(b). To save you rushing to your BCA, CP2(b) relates to building elements and in this case the walls, doors and other penetrations, restricting the spread of fire to a degree necessary from adjoining sole-occupancy units and public corridors in Class 2 or 3 building or Class 4 part.

Some "creative" fire safety engineering practitioners will argue that spread of fire does not include spread of smoke and therefore will consider omission of fire stopping products on penetration seals between adjacent sole-occupancy apartments and also allow the use of the so-called "tight fitting" solid core unit entry door leading onto adjacent public corridors.

The authors view is quite simply that the literal interpretation, whereby only spread of flames from a fire, and ignoring smoke spread is a convenient and dangerous loop hole which is being exploited. The net result is clearly building which are NOT as safe as the current BCA dts requirements, irrespective of the ambiguous reports that are being created by some fire safety engineering organisations.

Sure, the fire safety engineering practitioners can hide behind the "degree necessary" part of the BCA requirements when challenged by peer review, but it will be interesting to see how effective this defence mechanism is if ever challenged in our infamous coronial courts.

### Life Safety Doors

I think it is important to the introduce a new term, that of a "life safety door" which will differentiate doors utilised in alternative solutions from conventional fire doors, smoke doors or combination fire & smoke doors.

The life safety door is one that has demonstrated or proven performance for fire resistance and smoke leakage, which can be applied to the relevant design fire(s) being considered by the fire safety engineer. Such a doorset, which includes the wall type, door frame, door leaf and associated hardware (inclusive of door seals), will most probably have fire test performance data to AS1530/4 (or equivalent) and separate air/ smoke data to AS/NZS1530/7 (or equivalent), or have some combined or dynamic fire and smoke leakage to a test methodology such as WFRA FSE021 (or equivalent).

These life safety doors, should also be labelled (tagged), certified and maintained in the same manner as conventional fire doors. The absence of any labelling on these doors and smoke doors for this matter causes confusion in the market place especially when essential services maintenance is subsequently conducted, especially when fire door maintenance companies are looking for one hour labelled dts AS/NZS1905/1 compliant fire doors.

It has been bought to the author's attention that in some instances, where alternative solutions have resulted in the installation of life safety doors in place of prescriptive fire doors, these life safety doors, during subsequent essential service inspections, have subsequently been recommended for and even replaced with conventional fire doors. These instances reflect the need for appropriate labelling and record keeping to avoid these unfortunate circumstances.

### Acoustic Requirements

There are other performance requirements that need to be considered, other than fire and smoke, and one important one is sound containment or acoustics.

The ABCB is proposing some changes to the sound containment provisions in the current BCA dts provisions which will if it is implemented, result in an airborne sound insulation requirement for unit entry doors of 25db, which loosely converts to an STC or Rw value of 28-30dB, in our old terminology.

This will require the addition of acoustic seals or gaskets to unit entry doors and will result in the deletion of so called "tight fitting" solid core doors based on sound containment principles.

Suppliers of doors and door seals will need to ensure their systems or doorsets have the required fire, smoke and acoustic performance requirements.

- The cost of a fully installed and maintained so called "tight fitting" solid core door does perhaps not result in any appreciable cost savings to the developer.
- Published research work relating to the performance of so-called "tight fitting" solid core doors, is available in the public domain, and it suggests that these doors should not be used on high rise residential apartments.
- The BCA requires definitions for both "tight fitting" and "solid core" as without these definitions there are all sorts of doors being utilised which are claimed to meet the intent of the BCA.
- The existing BCA dts concession for Type B and Type C constructions, where automatic sprinkler systems are employed may not meet the performance criteria of the BCA.
- BCA performance clause CP2(b) requires clarification regarding its overall intent, specifically in relation to whether "spread of fire" in fact means "spread of fire and its effect, namely smoke".
- All "life safety" doors, (those with necessary performance criteria for fire and smoke resistance capabilities), require labelling/tagging and certification in a similar manner to those requirements outlined in AS/NZS1905/1 and AS1851/7.
- Proposed acoustic provisions will require acoustic door seals on doorsets and the design for fire and smoke cannot be conducted in isolation. PFT

*Picture courtesy of Fire Protection Association Australia.*

封面内容

# 香港 IT 产业旗舰建筑——新资讯港的防火措施

香港是一个以商业著称的社会，为了保证经济的持续、高速发展，政府逐渐在将重心转移到知识型经济上。

并且，在当今汹涌的 IT 大潮中，东亚地区强烈需要一个能够全力发展高科技商业和办公的硅谷型的 IT 中心。基于此考虑，并结合香港自身的条件，香港特别行政区的战略文件中明确指出，要将资讯港（Cyberport）区域建成领导这个新时代的先锋。
如果香港保持 IT 行业的稳步发展，就有如"集线器"的功能一样，也将为蓬勃发展且具有很强竞争力的珠江三角洲地区注入新的动力。
如果说上述理由尚还是个疑问的话，那么依照香港的工作方式，那都不过是发生地点和发生时间的问题。在今天，一切已经解决。
坐落于薄扶林的钢线湾区域位于香港岛的西南位置，当资讯港项目建成后，它将成为 IT 技术应用，信息服务和多媒体设计等类型顶尖公司和技术精英的中心。
资讯港项目的物业将拥有世界一流的通信设施和许多首屈一指的高科技设施。
项目发展商声称资讯港的设计将是相对低容积率，具有校园风格的工作环境，同时临近太平洋并邻近香港的中央商务区和金融区。

## 资讯港项目一期工程将在 2002 年末完成

资讯港项目由资讯港有限公司（CPL）投资开发，它是盈科数码动力有限公司（PCCW）的子公司。早在 2000 年 5 月，香港特区政府就签署了一个创造资讯工程协议来赋予相关发展项目的权利。同时，香港政府也是资讯港部分项目的业主。
预计到 2007 年该项目完全建成时，资讯港将具有 11 万平方米的超现代办公面积，能够满足所有跨国和本土公司的高端电信、资讯需求。
资讯港项目同时还有 3 万平米的建筑面积，包括零售、娱乐、教育等设施，能够满足社会公众生活的各种需求。
在资讯港建成的同时，一座拥有 175 套豪华客房的世界一流酒店和一所包括 2800 套单元的豪华公寓也将随之投入使用。
最终，将有 150 至 200 间 IT 公司将入驻资讯港，作为自己事业发展的平台。身为一个集于一体的巨大综合项目，资讯港不会只是成为一个孤立的世界，它还完成其商业功能和社会职能，成为香港地区的一个焦点所在，并推动香港走向完美。
依照计划，香港资讯港的一期工程预计将于 2002 年年底完成。
对资讯港前程充满信心的一个重要租赁业主就是微软公司（Microsoft），这家世界级的 IT 软件巨人已经和资讯港签订了一期工程中约 4000 平方米的办公面积，而且租赁期长达 5 年。

## 资讯港采用的预防式防火措施

对于资讯港大厦中的租赁业主来讲，无论其公司规模大小，他们都认为大厦应该具备高性能的预防火灾的设计考虑和相关系统功能，它将是该项目美观和实用的必要前提和保障。
资讯港所采用的严格的防火设计规划，正是完全基于公众对长远的安全，经济的综合考虑，并充分满足香港消防和建设法令的规定而制订的。
为了达到上述高标准和经济的防火要求，同时保证资讯港的整体建筑风格和质量，在一期工程的消防通道中的电力、通信系统防火保护中人们使用了保全 PROMATECT®-H 硅酸钙防火板。
另外在轻质防火隔墙也同样采用了这种性能优秀的防火板。

## 品质卓越，严格符合英国标准 BS 476 的要求

在消防通道使用的防火隔墙构造是：双面各 9mm 的 PROMATECT®-H 防火板，中间填充岩棉，并且通过 BS 476 第 22 部分的耐火测试，达到 2 小时的完整性和绝热性。此防火隔墙具有轻质，高强度的特点，在有些部位可达到 7.5m 的高度。
同时，数码港电力、电信系统的防火保护系统通过使用 15mm 厚的 PROMATECT®-H 防火板，可以达到 BS 476 第 20 部分中所要求的 2 小时的完整性和绝热性。PFT

# 高层建筑的防火保护设计

原作 Liang Li, Consultant, Rolf Jensen & Associates
摘自 International Fire Protection (IFP) Magazine 2002 年 5/6 月刊

在近一个世纪以来，高层建筑已经被视作经济增长的显著象征。然而，在经历"九一一"这个惨剧之后，高层建筑受到了前所未有和来自各方面的指责。尽管如此，高楼建设计划尤其在亚洲的需求仍然存在。防火工程师目前为此更加必须证明严格满足安全的设计需求。

但是我们可以在这些规范要求上找到一些明显的差别，第一就是防火分区的大小，在中国的规范中对分区（面积）要求非常严格，而在美国的规范中却没有限制。原因有关国家的经济发展状况，被动防火和主动防火的侧重点、气候条件，维护状况和传统习惯。
为了经济地达到建筑消防和人员安全的目的，现代的规范应当具有建筑设计和建设використ上的灵活性，而非与以前只可以按照规范条文限定的内容去执行。现在的规范将开始接受"性能目标设计"的方式，后者可以消除不同国家规范差异，为设计师高效率地进行实际消防安全设计提供了有效的解决办法。
位于马来西亚吉隆坡高达 1480 英尺的双峰大厦（Petronas Twin Towers），就是一个"性能目标"消防设计的很好例子。其消防规范咨询和报警，紧急通讯系统设计的专业服务都具备完全。独特的电梯和天桥进行人员疏散的方法，也另外需要在两楼的中部架设的 750 吨重的天桥成为两楼上部和下部人员紧急疏散的通道。天桥两端的避难区均被设置为独立的防火分区，均设有独立的 HVAC 系统。为了减少火灾和烟气扩散，天桥两端的避难区均设置耐火构件和防火封堵系统。"性能目标设计"使得我们可以灵活，有机结合地方和国际规范进行高效防火设计，而不至于一些局限因素而造成人身危险和财产损失。
每个国家的规范都有自己的独特方法，逻辑和优点。中国的规范对超过 100m 高度的办公建筑要求每隔 15 层设置避难区，面积不小于 0.2m²/人。在中国的规范中对人员密度计算没有特别的规定，于是设计师通常引用一些国际标准和规范来进行参考。在中国，15 层的建筑高度大约在 50m 左右，正好处在消防车的营救能力范围以内，消防队员可以选择是用消防车云梯还是从消防楼梯对第一避难层人员进行营救。而在美国的规范中却依靠疏散设计通道，这些观念在大多数情况下都是有效的，但自从"九一一"事件以后，这种思路开始被重新讨论，因为通过此事件中人们的潜意识将使着火层以上所有楼层人都同时疏散。
为了消除国际贸易上的技术壁垒，世界贸易组织（WTO）开始鼓励应用国际标准和规范。承认的国际组织包括 ISO（国际标准化组织），IEC（国际电工协会）和 NFPA（美国消防协会），上述组织的规范标准中都包括"性能目标设计"的概念。人们对此概念的研究可以归纳为三项主要任务：1）建筑物在火灾中的表现；2）对烟气传播的计算机模型设计；3）自动灭火系统动作和火灾控制的计算机模型设计。
尽管因为"九一一"事件使得人们重新审视认识高层建筑，它们仍然在中国这样人口密度大及经济增长快的国家占主导需求的地位。世贸大楼的倒塌给我们提出一个问题：高层办公大楼中的自动喷水装置能否在此种紧急情况下保证结构的稳定？没有任何防火措施的钢构件在 500℃ 和 600℃ 之间开始失稳。在通常火灾中，自动喷水系统足以控制火灾并使人员有时间疏散。但是大多数人都认为设计一个巨大的喷水系统来承受装满汽油飞机撞击火灾荷载，是不切实际的。然而，通过一个完整的"性能目标设计"的消防安全解决方案，建筑是可以达到能控制任何可能突发的火灾危险。
一个完整的建筑防火系统应当包括构件的耐火性能要求，楼层和耐火构件穿越处的防火封堵，火警和紧急通讯系统，灭火系统和疏散系统。拥有一个合理的消防管理维护程序和紧急疏散训练计划也非常必要。

请即以下表格传真到您最近的保全普美亚太建筑材料组织
以获取一本最新的 **Promat Asia Pacific Handbook 2002**
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VENTILATION DUCTS
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**New Rail System Promises Safety As It Eases Congestion**

# New Manila LRT Stations Built With Fire Protection Ductwork & Sound Barrier Design

While about 7.5 million Filipinos work abroad in some 150 countries around the globe, the sprawling capitol of the Republic of the Philippines never seems to sleep, much less stop growing.

Perhaps it has something to do with the high level of remittances, estimated to be in excess of US$4 billion in the first half of 2002, sent back to the archipelago nation of 7,100 islands some 74 million citizens call home.

Since it was founded by a Spanish conquistador in 1571, Manila's long and colourful history has been punctuated by numerous notable events. Its population growth, now reckoned to be 8.5 million and climbing steadily, has rarely been matched by similar, long-lasting economic gains.

## Mighty Metro Manila

As with some other aspects of Manila life, congestion in both human and vehicular terms can take at times almost legendary dimensions.

It surprised no-one when the government eventually bit the bullet to ease the low-lying, flood-prone city's traffic and transportation woes with the construction of a Light Rail System.

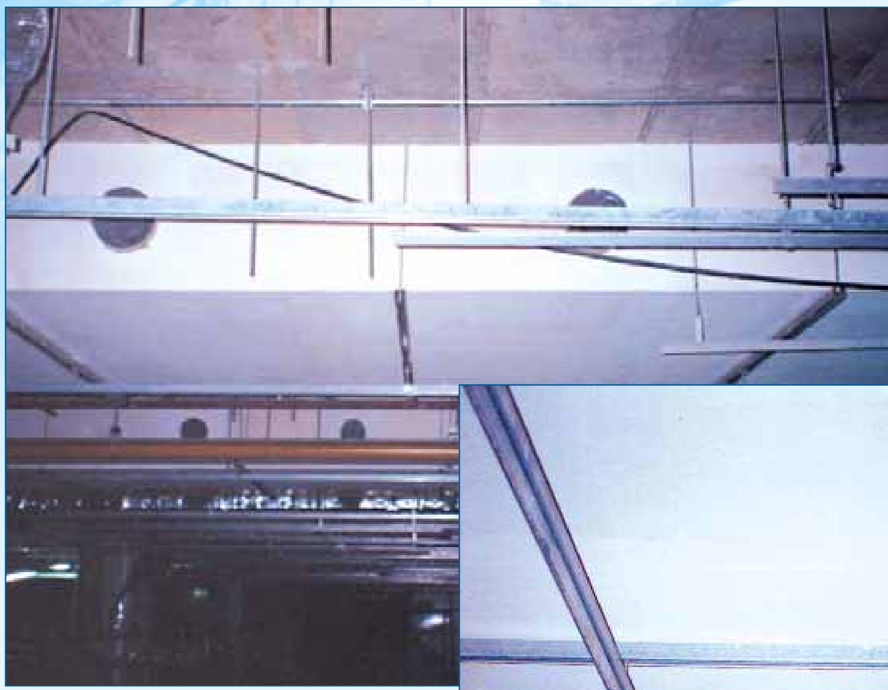
The eleven stations of Phase 1 of Line 2 of the new Metro Manila Light Railway Transit project are designed to link three of the larger urban concentrations in the greater Metro Manila area. These are the main cities of Marikina, Quezon and downtown Manila.

The idea of the project was first proposed in 1990. Line 2 is an integral part of a metropolitan-wide mass rail transit development project which aims to provide Metro Manila with a much needed circumference route (a ring road system) within the foreseeable future. Construction began in 1994.

Phase One of Line 2 of the MMLRT – connecting Recto, Legarda, Pureza, Araneta, J. Ruiz, Gilmore, Boston, Cubao, Anonas and Santolan – is scheduled to be operational by April 2003. Phase 2 – from Boston to Recto Station – will be completed by the following year.

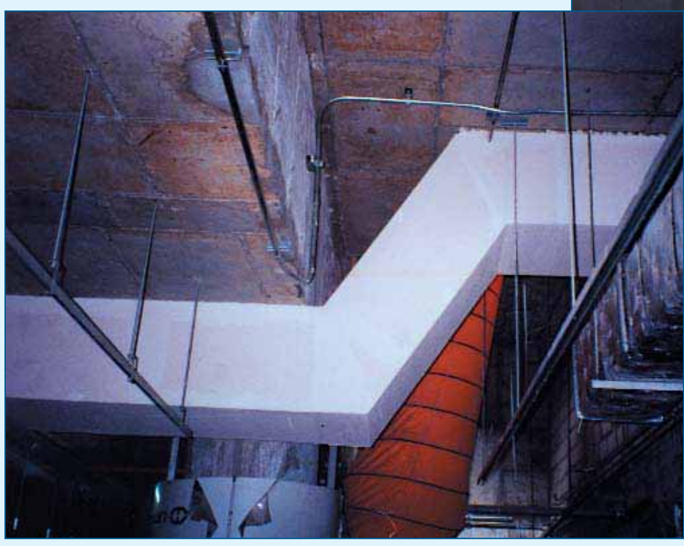
Not surprising in a crowded metropolitan conditions, Line 2 of MMLRT is designed as a high capacity system with wide body metro-type vehicles operating in four-car consists capable of carrying 1,600 passengers per train.

Line 2 is a linear system, in which the last station intersects with Line 1 at Claro M. Recto for effective passenger transfer.



**"When were designing the MMLRT Line 2 Project for Manila, knowing that we would require a fire-rated HVAC system, I immediately got in touch with Promat because I know their products and am convinced of Promat quality and reliability."**

**Mr. Gene Gesilva** / *Consultant Engineer*



The system will meet the passenger demands of 38,000 and 58,000 passengers per hour per direction (pphpd) projected for the 2010 and 2025 respectively, provided a capacity expansion programme is carried out after the year 2010.

Future expansion to about 90,000 passengers (pphpd) will be attainable by utilising six-car consists.

## Promat Fire Protection For MMLRT Stations

Line 2 of the MMLRT project used 9mm PROMATECT®-H calcium silicate boards for fire-rated ventilation and smoke extraction ductwork and sound barrier applications in their Katipunan Station, the only underground station in the mostly elevated Phase 1 Line 2 project.

Katiputan Station is the second station from the system's depot located in Santolan, Pasig.

According to MMLRT consultant engineer, Mr. Gene Gesilva, the system/project/station design, PROMATECT®-H was used for a number of reasons.

"When were designing the MMLRT Line 2 Project for Manila, knowing that we would require a fire-rated HVAC system, I immediately got in touch with Promat because I know their products and am convinced of Promat quality and reliability," Mr. Gesilva said.

According to Mr. Gesilva, Promat's "fast and superb service helped" him and his team get their work done easier and faster.

*RIGHT:*
Pureza Station, one of the many Metro Manila Light Railway Transit stations built with fire safety installation.

Approximately 1,390 sheets of 9mm x 1220mm x 2440 PROMATECT®-H were utilised. Fabrication and installation were carried out on-site.

PROMATECT®-H was also used as a sound barrier under the platform floors of the other 10 elevated stations in Phase 1 Line 2 of the MMLRT project. The system's elevated stations are on average about 15 metres above road/ground level.

PROMATECT®-H was used because it clearly met Line 2 project specifications. The project's subcontractor for the station's fire-rated HVAC system is Glazone Building Components Inc., Promat's distributor in the Philippines.

Check out next issue of PFT for more information of Ventilation & Smoke Extraction Ducts. PFT