PROACTIVE FIRE TRENDS

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for Asia Pacific Building Industry Professionals

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● Reconciling the different demands of safety

Challenging times for the world's busy airports

Millions of column inches are written about them in newspapers worldwide. They are the subject of novels and the star of television and numerous Hollywood films.

They focus massive amounts of investment funds and the very latest technology. Not surprising, they will likely cause much conversation and, occasionally, some lively conjecture.

Welcome to the world of airports and modern airport design!

There can be little doubt that few would be bold enough to predict the eventual importance of airports when the Wright brothers first propelled manon powered flight a mere 100 years ago.

According to an Airport Council International announcement in 2000, the 20 busiest airports around the world then handled well in excess of 900 million passengers.

With airfares continuing to come down, more seat capacity and generally fewer restrictions, air travel and passenger traffic has grown considerably, despite a few hiccups, in the short time since the beginning of our new millennium. The ACI ranks some 600 airports annually.

Amazing feats of engineering

Airports clearly represent much more than just a vital link in a modern, integrated transportation system. Used by a huge cross-section of travelling humanity, today's airports can be seen as much as political statements as remarkable engineering achievements.

Airports tend to reflect national philosophy, economic strength and health.

Many countries look at their airports, understandably and quite justifiably, as an accurate measure of prosperity or their aspirations or both. A useful achievement indicator.

In many ways, airports are the interface where worlds meet and exchange. In fact, if it is true that a large percentage world does business in an airborne office, that business is therefore, by extension, continued and frequently concluded in the convenient comfort and relative efficiency of an airport.

Good and lasting first impressions

Without a doubt, airports almost invariably make indelible first and frequently lasting impressions.

They are, by nature, purpose-built, for obvious reasons dedicated to the business and safe functionality of aircraft and air travellers, from departure right through to arrival.

With so many people travelling and using airports, it is of little wonder that airports are also subjected to public surveys and opinion polls.

While the busiest airports are usually located in North America and Europe, Asia Pacific airports frequently dominate top survey honours.

For example, in a recent Skytrax Airport of the Year 2004 survey – an annual global barometer of airline passenger opinion – Hong Kong, Singapore, Seoul and Kuala Lumpur claimed first, second, fourth and fifth place honours respectively. As the region's prosperity and global importance continues to increase, this trend is likely to be repeated in the foreseeable future.

Safe transportation hubs for people, technology and business

Airports are magnets for people and, hence, business. To make this interaction as efficient as possible, airports are built to endure and to operate safely at all levels of functionality.

They are therefore built to exceptionally high standards. Not just in terms of aesthetics and design, but also in terms of technology and safety.

Just as they handle the movement of ever increasing numbers of people, airports must also efficiently handle increasing amounts of cargo. Both are predicted to continue generally upward patterns, placing more pressure on all airport facilities.

Indeed, new airports are being built while many existing airports upgrade and extend their facilities just to cope with the routine demands.

As elsewhere, the safety of the built environment is always of paramount importance, particularly as airports have to balance the conflicting expectations of many different users.

In airport structures, safety for every aspect of the user interface

Airports are exceptionally complicated installations to design, build and operate. They require the accumulated knowledge and expertise of many different, professional specialist disciplines.

The top priority is always functional safety – and all safety aspects must be adequately covered – for there is much at risk.

Despite deliberate, planned and strenuous efforts to contain it, fire is just one risk never very far from airport awareness. Sadly, tragic results of fire have been witnessed in airports in the not too distant past.

Fire safety has always been and will continue to be a very real, top-of-the-mind concern for airports everywhere. Stringent measures available from fire technology market leaders such as Promat, are employed in more and more airports worldwide.

Fortunately, fire is the subject of much expertise and an ever-expanding database of empirical wisdom.

Continued on page 2

AIRPORTS SPECIALS

SCIENCE & RESEARCH

Point of View

A Spirit of Excellence

Like everyone else, it was inevitable that I spent some time watching the recent Olympic Games in Athens, Greece. Unable to be there personally but being a wired-up member of our shrinking world meant there were plenty of options to tune in to the extensive coverage of the world¹s biggest sporting event, even as I continued traveling. By and large, a rather pleasant interlude made even better by the remarkable achievements of some countries from our Asia Pacific area.

The Games got me thinking about a number of issues:

First, it is amazing, given the world we live in, that so many people can get together and compete in friendship and peace. Quite an achievement in itself and, in fact, very reassuring. The world of routine geopolitics should take note. Business already has.

Second, without healthy competition, the Games simply wouldn't happen. Nor would much else. Clearly, quality will always play an important role in the competitive equation. At the end of the day, we should always respect our opponents because, without them, we are nowhere.

Third, a level playing field is essential for everyone, no matter how much human nature might try to change it. There will always be cheats looking for a short-cut here, a short-cut there. Fortunately we continue to have faith in the common-sense principles of hard-work and fair play – as well as systems and legislature – to prevent excessive unfairness.

At the end of the day, it is the commonly held belief in the idea that fair competition is as good for business as it is for people. It inspires athletes. It should also inspire us, as a company and as individuals, to continue to produce our best. Always.

This issue's theme is airports, often perceived quite rightly as advertisements for the countries, airlines and passengers they serve. Governments go to extraordinary lengths to present the first glimpse of their national vision to the world while planning for future trends. In this, the 14th issue of PFT, we are proud to present a fairly detailed look at various aspects of fire safety in airports. A page 1 and 2 general overview sets the visual and thematic stage for a detailed analysis in "Fire Safety In Major Airports: A Balanced Approach" by Mr. Paul England of Fire Research Australia Pty. Ltd. on page 3.

In the Science & Research Department on pages 4 and 5, we present "Proactive Fire Protection Principles For Airports" by Mr. Narlin Sharma, the Executive Director (Architecture) of the Airports Authority of India. We extend our collective thanks to Mr. Sharma for his kind assistance.

On page 6, Mr. Jeff Chang of Promat China writes about the PROMATECT® partition systems in use at the Guangzhou Baiyun International Airport. On the same page, Mr. Raymond Man, Area Manager for Promat Hong Kong reviews a Network Report of PROMATECT® and PROMASEAL® at the world famous Hong Kong International Airport at Chep Lap Kok.

Page 7 features are usual bilingual news while another thoughtful Science & Research feature – Loadbearing PROMATECT®-H Panels For MRT At Changi Airport from Promat Singapore's Mr. Lai Boon Keong – complete this special airport issue.

By the way, a new marketing brochure for everyone's use – Proactive Fire Protection For International Standard Airport Application – is listed in the Enquiries Form on page 7. If you¹re involved in the upgrading of fire protection systems in an old airport or the installation of a new terminal, I encourage you to use this marketing tool.

In conclusion, I am sure you will all agree that we should take the spirit of excellence, honest effort and much perseverance of the Olympic Games and continue to apply it in the world of business. It's obvious to me that the planners and builders of most international standard airports understand the concept extremely well. Fortunately, there is already much in common as we strive for the best, making today's built environment safer for tomorrow.

Erik D. van Diffelen
Managing Director

Promat Asia Pacific Organisations

October 2004

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 and Singapore, with distributors in Brunei, Indonesia, Japan, New Zealand, Philippines, South Korea, Taiwan and Thailand.

ProActive Fire Trends is published by Promat (Malaysia) Sdn. Bhd. (PMSB) and Promat Building System Pte. Ltd. (PBS) for professional organisations and/or individuals interested in the fire sciences industry in the Asia Pacific region.

Challenging times for the world's busy airports

Continued from the cover

Virtually every aspect of modern fire science knowledge can be focussed on and employed in airport applications.

Adequate protection for structural steel work is a global benchmark for all modern structures, including international standard airports. It is an area to which Promat provides much accumulated expertise.

Similarly, proven solutions for glazing can be of enormous reassurance as most modern airport designs these days feature large areas of aesthetically-pleasing glass surfaces.

PROMAGLAS® and SYSTEMGLAS® are two such high performance materials, which continue to find increasing acceptance throughout the world.

Ceilings in airport buildings and airport administrative offices should also receive the safety seal of approval with fire-rated architectural boards. Proprietary Promat protection in the shape of PROMATECT® is a market leader wherever architects and engineers appreciate the value of a strong , durable public interface.

Airports cover huge areas and many different demands

Nearly all modern airports are made up of many different integrated functions. Travellers and public alike usually see and use only the areas dedicated to passengers and their specific demands.

Behind that façade is a wide-spread infrastructure devoted to management, electronics, catering, security and cargo handling, among others.

For example, adequate protection is essential for cables linking sophisticated electronic communication and security facilities without which most modern airports would not be able to function effectively. Promat is also a recognised fire safety leader in this specialist field.

Back-of-the-house operations in any airport feature the vital departments of round-the-clock aircraft maintenance, catering and cargo handling. The ventilation, heating and air-conditioning ductwork indirectly essential for producing nourishing meals for many an airport visitor and weary travellers is vital to many airport kitchens.

Here again, airports employ a number of different Promat systems to reduce fire risk to a bare minimum.

The huge areas of most cargo handling facilities in many airports require robust and durable fire protection systems. Specific Promat products and systems, recognised worldwide, also come into their own in airport cargo terminals.

At the end of the day, companies like Promat make significant contributions to the demands for increased safety at all airports. Faced with the challenge of today's ever-changing world, it is reassuring to know that a market-leader is working quietly to protect the built environment, even at airports.

Promat Asia Pacific has published an overall airport fire protection catalogue with project reference. It can be obtained simply by writing in via the Enquiries Form on page 7. PFT

A special study from the professional

Fire Safety In Major Airports – A Balanced Approach

The article on this page is researched and written by **Mr. Paul England** and **Mr. Nabeel Kurban**
Warrington Fire Research (Australia) Pty. Ltd.
and is used with permission.

Major airports and in particular airport terminals have changed considerably in the last two decades and will in all likelihood continue to change in the future. Passenger volumes have increased substantially and airport terminals have been transformed from simple buildings where passengers checked in their luggage and got on an aircraft, to the multi-function complex structures we see today.

This presents a major challenge to building designers and airport terminal operators to design/re-develop and maintain functional buildings that satisfy appropriate fire risk management requirements whilst allowing sufficient flexibility for expansion and future changes.

Melbourne airport is a typical example. In 1996, approximately 2 million passengers used the international terminal, increasing to approximately 3.75 million by June 2004.

Melbourne airport now comprises an international and two domestic terminals. These terminals contain significant and growing retail components and offices in addition to the normal airport functions. There is also an adjoining multistory short-term carpark with a hotel above.

At the time of writing, the short-term carpark is being extended, retail outlets are being added/refurbished and plans are being developed for the introduction of larger wide bodied jets which will require substantial redevelopment to address potential occupant congestion and to facilitate efficient boarding of the aircraft. Such changes are typical of the dynamic situation at many airports.

Like many major airports, Melbourne, has adopted a performance-based fire safety engineering approach because traditional prescriptive building solutions are not suited to airport terminals. The Building Code of Australia permits such an approach. This article will provide an overview of some of the issues that have to be considered when deriving fire safety strategies.

Establishing design objectives

The design objectives of the Building Code of Australia and many other National Codes relate primarily to life safety with minimal requirements to specifically address property protection and business continuity (except for controls relating to fire spread between buildings).

Closure of a major airport can have a very large impact on a local economy as well as the income of the owners/operators and the objectives for a fire safety strategy for airport terminals are commonly extended to include the minimisation of business interruption if a major fire incident occurs in addition to providing an acceptable level of life safety for occupants and emergency services personnel.

The above objectives generally lead to a requirement for a robust fire risk management strategy incorporating multiple fire safety measures such as:

- Fire prevention
- Early detection and suppression
- Smoke control
- Structural fire protection
- Control of furnishings and lining materials
- Fire and smoke compartmentation
- Evacuation
- Fire brigade intervention
- Proactive emergency planning by airport operator

The combination and detailed design of these systems may vary considerably from one part of the terminal to the next.

In addition, the fire risk management strategy needs to be compatible with the building function. For example there are advantages in having, fire compartments, smoke compartments and evacuation zones coincident with various security areas and to arrange for evacuation to open space without the need to cross security barriers etc.

Most countries apply a classification system for buildings. Typically the main functional areas of an airport terminal comprise:

- A departure hall/check-in
- Arrivals
- Concourse and gate lounges
- Baggage collection
- Baggage handling
- Passenger/VIP lounges
- Conference/Meeting facilities

In Australia these would fall into the broad Assembly Building Class which also applies to buildings such as sports stadia and concert halls. Therefore it is not surprising that the prescribed solutions are often inappropriate.

Commonly the following building classifications uses are also integrated into airport terminal designs:

- Retail outlets
- Offices
- Carparks
- Entertainment complexes
- Hotels

The apron areas adjacent to airport terminals can be considered to be more closely aligned to industrial processes or the petrochemical industries (except for the close proximity of large members of the public). Issues such as the impact of fuel spills and pool fires are significant considerations.

Fire prevention and control of the rate of fire growth

The adage that prevention is better than the cure holds true to fire safety, but there are practical limits that apply to a functional airport.

Generally it is practical to control lining materials and the combustibility of some building materials and to a limited extent furnishings. High levels of maintenance (e.g. maintenance of electrical and other heat sources), management systems (e.g. hot works permits), security measures and staff training will all reduce the rate of fire starts considerably and are practical to implement.

Early detection and suppression

With large numbers of people within the building early detection of a fire is important to facilitate prompt evacuation and manual intervention. It is also important to accurately identify the location of an alarm/fire and therefore addressable detection systems can offer significant benefits.

Automatic suppression forms a critical component of fire safety strategies for airport terminals by limiting the extent of fire spread, which in turn minimises the impact on the structure and limits smoke production to manageable levels.

Whilst sprinkler systems are expected to have high levels of reliability, that reliability is significantly reduced due to the need to isolate the system whilst building works are being undertaken. This can be addressed in a practical manner by providing monitored isolation valves capable of isolating relatively small areas so that the unprotected areas are as small as practical during building works and that the risk of inadvertently leaving a valve closed is significantly reduced.

Since the airport contains a large variety of different functional areas it is to be expected that different levels of sprinkler protection will be provided depending on the fire hazard within a particular area.

Smoke control

The methods of smoke control will vary depending upon the area being considered. Smoke exhaust will be the preferred method for large open spaces such as baggage claim and arrivals/departure halls and large circulating spaces.

For areas where fire and smoke barriers can be used to assist with minimising smoke migration, air pressurisation systems may be employed in conjunction with the physical barriers to restrict the movement and spread of smoke and other products of combustion.

Structural fire protection and fire compartmentation

Even if it can be shown that safe evacuation is likely to occur prior to collapse and sprinkler systems are provided it is still prudent in a robust design to maintain structural adequacy of major structural elements to allow for fire brigade intervention to minimise the subsequent disruption should a major fire occur coincident with the fire sprinkler system being unavailable.

The required periods of fire resistance will depend upon variables such as the fire load and characteristics of combustibles within a functional area, the enclosure and opening dimensions, lining materials, expected time to fire brigade intervention and importance of the structural member.

Similarly fire resistant barriers can be used to limit fire spread. The extent to which these can be used will be largely controlled by functional constraints. For example subdivision of arrivals/departures and baggage claim halls and other circulation spaces would be generally impractical whereas substantial compartmentation would be adopted in a hotel area, around plant rooms etc.

Evacuation

Due to the large volumes of people from a range of countries in international terminals emergency messages may need to be provided in addition to alarm tones and the use of pictograms may be preferable. In addition the evacuation of people with disabilities is also an important consideration.

Intercommunication during emergencies for both evacuation purposes and fire brigade intervention is necessary and should be designed in conjunction with emergency procedures and evacuation plans. The evacuation plans also need to be cognisant of the security measures and as far as practical occupants should be able to evacuate without moving through security levels.

Many airports have their own fire brigade but also have the facility to call in assistance from local brigades. Initial fire brigade intervention would tend to be prompt and the fire brigade would be expected to have a thorough knowledge of the terminal. Drills with other fire brigades could be used to provide other fire brigades with a knowledge of the terminal.

Conclusions

Major modern airport terminals have been shown to be complex multiple occupancy structures which require fire safety strategies to be tailored to the specific application rather than utilising prescriptive solutions. Such an approach is permitted in the Building Code of Australia and has been applied to Melbourne Airport to derive and maintain an effective fire risk management strategy.

Robust fire safety strategies requiring significant levels of redundancy are generally adopted to address issues such as business continuity as well as live safety. Typical elements of a robust design have been discussed to provide an insight of some of the major considerations. PFT

- An insightful, interpretative view from India

Proactive Fire Protection Principles For

Structural steelwork protection using PROMAPAINT® systems, air conditioning and smoke extraction ductwork systems in airport terminals

Fire, a four letter word, revered but feared.

Fire provides light, energy and heat.

Fire cooks our food, helps us to survive.

So what do we fear of fire?

With millions of passengers and corresponding amounts of cargo moving through airport terminals each year, airport rescue teams respond to thousands of calls. To stay prepared, the Airport Fire Division trains its staff constantly not just to meet emergencies but also to ensure that all equipment is ready for operational use at a moment's notice.

When fire occurs under controlled conditions, it is helpful to man. When it is uncontrolled, it is usually to be feared. A good servant but a notoriously bad master.

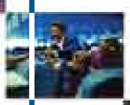
In undeveloped rural areas or in the built environment, fire needs to be controlled. Indeed, the control and mastering of fire is always an dominant influence, particularly in urban planning.

When linked directly or indirectly to airports, fire is an issue of huge significance.

Airports cover very large areas and inter-related, inter-dependent resources under their control. Buildings and facilities range from passenger terminals, cargo terminals, service buildings, hotels, vehicular parking areas for trains, coaches and cars as well as VIP complexes, important security systems and super-sensitive fuel farms.

The fire services required at airports need to provide not only proactive fire protection measures but also fire fighting and rescue services. They have to respond to any type of emergency that threatens the safety of life, loss of property or environmental protection. Thus, a typical Airport Fire Fighting Department provides fire fighting and rescue services for humans, aircraft, built structures and other equipment. As such, it mitigates fires, conducts rescues, handles hazardous materials and incidents and responds to a multiplicity of emergencies. Its responsibilities include:

- Fire fighting operations
- Aircraft rescue and fire
- Structural fires
- Hazardous materials operations
- Fire code and life safety inspections
- Fire suppression and detection
- Inspections
- Public fire life safety
- Investigations
- Emergency medical services



The equipment that helps fire crews sustain their effectiveness has to be modern, technologically and task capable. The fire crews operate the quick response vehicles, crash fire trucks, heavy rescue tenders, structural crash pumpers and aerial platform vehicles, among others.

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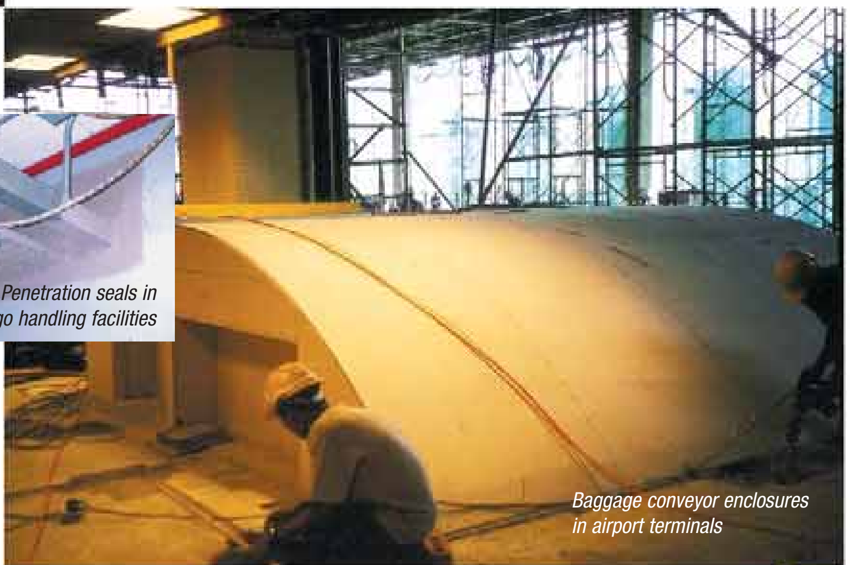

Baggage conveyor enclosures in airport terminals

Penetration seals in cargo handling facilities

Despite all wise precautions, fires continue to occur

A few examples will help illustrate the situation, at least for India.

One late night in October 1996, fire was noticed in the Passenger Terminal at Delhi. Structured entirely on a system of interconnected steel columns and trusses, the building was fortunately unoccupied at the time. Despite strenuous efforts to contain the fire, flames apparently kept raging above the false ceiling and eventually softened the steel structure at its column and truss joints. One significant movement and the entire structure collapsed, other joints had obviously been affected by the heat. There was no loss of life but it could have been tragically different. The terminal had to be urgently rebuilt to minimise inconvenience to passenger traffic, aircraft movement and loss of revenue at a major transportation hub.

1) Fire in an occupied passenger terminal at Mumbai created panic one February morning not so long ago. The fire began at about 9.30 a.m. and soon filled the entire terminal with dense, dangerous black smoke. The Authorities quickly evacuated the terminal. Unfortunately, a few odd passengers remained inside the building, probably unaware in the wash-rooms at the time announcements were made to evacuate the buildings. When they emerged from the washroom they could see only opaque smoke. The electricity had also been switched off. On one side, fearful darkness. On the other, reassuring sunlight could be seen. Naturally, the passengers then rushed to where life giving light penetrated the double glazing of toughened glass two floors above the air-side apron, only to find that this was not the way out. The battery-operated emergency signs indicating exit from the building were by then rendered invisible by smoke and soot. The passengers were lost. Fortuitously, an Airport Authority employee, shouting to people to get out of the building, noticed silhouettes in the distance and guided the lost passengers to safety.

   Apparently, the fire had initiated in one of the textile and garment shops on the mezzanine floor of the passenger transit lounge and concourse. Fire did not spread because the architectural materials in use had fire resistant ratings. However, some of the materials continued to simmer, emitting dense black smoke due to their high carbon content. This dense black smoke spread and covered everything with heavy soot, including emergency lights and signage.

   The terminal was closed but thankfully not the airport. The passengers were checked-in and custom-cleared on the apron. The remaining, unaffected terminal was made operational by late night only after Herculean effort cleaned dark carbon soot from every affected surface.

2) Another example of airport fire occurred, innocuously at first, in a corporate office one morning. The cleaning staff in one of the office cubicles possibly placed a burning cigarette on the chair while dusting the furniture. He went on to clean other cubicles, leaving the smouldering cigarette behind. The upholstered chair and then the table caught fire. Papers, computer and fax machine fanned the flames. Fire staff were called when the fire was noticed in windows from other offices. The fire did not spread to the adjoining room, nor did the carpet or venetian blinds fully burn. The entire room was made up of fire resistant constructions and what could have been major damage was restricted to just one room. In fact, the laminate on other side of the door did not even blister.

   Unwanted and uncontrolled fires will always occur. The best way to ensure fire safety therefore is to prevent fires. The same is patently true at airports where preventing problems, saving lives and loss of property are all part of a routine day for most Airport Fire Divisions.

   The risk of fire increases with the building size, use, occupants, design and construction. An airport is an example of a vast area with a mass gathering, large span construction, use of many combustibles and large volumes of air-conditioned air being served from different air handling units.

These are just a few of many instances of planned measures and instinctive human reaction leading to failure. There may well be other incidents in which entire airport facilities are closed thanks to interconnected fire and accelerated fire spread through larger terminal spaces. Obviously, there is much at stake for airport planners and users alike. Proactive fire protection principles play extremely important and significant roles. In-depth knowledge of the fundamentals involved is essential.

The need to get back to basics

To understand the issues related to fire, we first need to understand the nature of fire itself. Fire is a process of oxidation, which can be accomplished only in the presence of oxygen and heat – and where an element that can burn – exists.

Items or elements that can burn are numerous and will always form a part of human lives and building construction. Since these elements can sustain fire only in the presence of oxygen and heat, it is these two aspects that need to be controlled.

When we control these then we must also remember the necessities of human life. It is the uncontrolled aspect of oxygen and heat that therefore need attention.

Analysing fire further, it is noteworthy that the National Fire Protection Association categorises fire into four classes:

Class A Fire involving ordinary combustible materials.
Class B Fire involving flammable or combustible liquids or flammable gasses.
Class C Fire involving energised electrical equipment.
Class D Fire involving combustible metals and other reactive metals.

For each class of fire, there are various options for suppression, to suit the characteristics of each class of material:

Class A Fire requires a coolant as a fire suppressant, e.g. water.
Class B Fire requires excluding air (oxygen) from the burning materials.
Class C Fire requires a non-conductive extinguishing agents such as gaseous systems.
Class D Fire requires a heat absorbing extinguishing medium which does not react with the burning metals.

The major products of any fire are heat and smoke. We also know that smoke can be very harmful, just as it undermines all procedures and processes of fire control and rescue.

Working against the products of fire

Smoke is often considered the most harmful and dangerous aspect of fire. Inhalation of smoke and toxic gases is responsible for most fatalities in uncontrolled fire. It also obscures emergency lights and fluorescent directive signs for safe exit from the buildings. Dense black smoke can also prevent fire crew from reaching the source of fire, as was the case in the Mumbai terminal fire.

(Continued on the right)

Cable protection systems

Fire resistant kitchen smoke extraction ducts

Fire resistant glazing systems and security doors for custom facilities

Air conditioning and smoke extraction ductwork systems

ection
r Airports

Industrial strength security door and warehouse pallet racking protection systems for cargo handling facilities

Industrial strength fire and security hatches for cargo handling facilities

The article on this centrespread is researched and written by

Mr. Nalin Sharma
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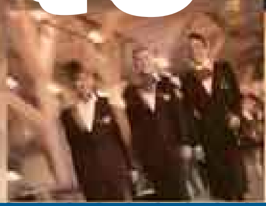


Passenger bridge protection in airport terminals

Smoke needs special attention when planning fire preventive measures.

The other product of fire is heat. It can cause drastic loss of structural integrity, as noted in the collapse of the terminal at Delhi and the World Trade Centre in New York.

When heated beyond a point, steel softens and losses it physical properties, reducing to rubble all structural calculations.Although the hijacked planes damaged the World Trade Towers on 9/11, the buildings withstood the initial impact. The eventual and tragic collapse likely occurred when structural steel, probably softened by excessive heat caused by fire in the building, lost its structural integrity.

When we analyse fire and the products of fire, another aspect to consider is the spread of fire.

Fire can spread from one compartment to another by conduction, convection or radiation. Whatever the method, fire can ultimately involve the entire building and in some case even other buildings. The previous illustration of fire in the corporate office indicates how fire spread can be contained through the application of fire resistant constructions.

A typical route for spread of fire is in the areas above false ceilings. To prevent such occurrences, the fire code in India now compels provision of a separate return air duct for air-conditioning. The open space above the false ceiling is also not to be used for return air for air conditioning.

The most common method of fire spread can be blamed on poor quality partitions and building materials together with a lack of awareness concerning the need to seal around penetrations through floors and walls etc. Another important aspect of airport passenger terminals is their use of very large column-free high ceiling spaces and a large number of concessionaires and cubicles/compartments usually scattered throughout the terminal. If fire occurs in one of these counters or concessionaires, drop-down fire rated curtains need to be used to prevent fire spread. On balance, fire control measures other than sprinkler systems etc. should be strongly emphasised.

Structural steelwork protection and ceiling systems in airport terminals

The behaviour of certain systems and materials

Resistance to fire is equally important, referring to the behaviour of a material in the event of fire. A material can be combustible or heat resistant or prevent surface spread of flame, i.e. it only simmers. A material can also be ignitable or non ignitable and the burning material can produce toxic smoke.

In any case all the above references are limited to materials and control of fire when fire has occurred. We may refer to these as the passive control of proactive fire protection.

The active part of proactive fire protection lies in the systems to detect the fire heat or smoke, principally intended to alert people in a building and even suppress the fire with the help of sprinkler systems or similar controlling methods.

Smoke is detected through smoke detectors fixed to the ceilings or heat sensors also fixed to the ceilings. In all these cases the systems have to be regularly inspected and maintained for functional operation.

One of the fire codes in India now states that if the false ceiling is above a metre deep, fire protection systems have to be placed above the false ceiling also. There have been instances when the false ceiling material is sufficiently guarded against fire and has a fire rating of over two hours but the material for suspending the false ceiling may not be sufficiently protected.

In such cases the fire does not spread but it may not be able to stop the entire false ceiling falling due to inadequate fire resistant suspension systems.

Industrial strength fire door for maintenance hangars

A sensible idea for alternative exit routes

The routes of escape for people when fire occurs, is another frequently misunderstood issue. The travel distances of exit staircases and other passages, the knowledge of the route, the adequacy of space in the exit routes to accommodate panicked people are all important considerations.

Exit routes must have adequate signage systems that will not only be visible and noticed during normal movements of passengers in the building but also during periods when dense smoke and panic are present. Though the nearest staircase or the exit route may be indicated and adequately marked by signs, it may also be likely that the exit route is on fire or covered with smoke.

Structural steelwork protection, boards, and paints in airport terminals

There is a natural tendency for passengers to turn back from such exit routes. It is therefore wise to use different colour coding system to mark the routing and the location of an alternate exit route. These proposals may seem redundant but it is always better to err on the side of safety. If it saves only one life, the expense of an additional signage system is worth it.

One other aspect is the location and opening of doors leading to fire exits. The doors must be wide enough to cope with an increased crush of passengers. Doors must open outwards. Obviously, such doors and even their handles must be of material that does not get too hot to touch.

There must be also sufficient space prior to the exit opening or the exit staircase for the panic rush of passengers to exit in an orderly manner.

Last but not least, a note on building materials.

It is vital to study fire protection products and the material they are made of. Materials that are easily combustible should clearly not be used, particularly if other materials are available.

Materials that provide adequate fire resistance but have variable physical properties when heated, e.g. steel, aluminium etc., need to be protected by cladding or encasement solutions.

Services that run through areas above the false ceilings also require regular preventive maintenance as they can be a likely route for the spread of fire. High fire load services passing through means of escape or fire spread need to be enclosed by fire rated membranes. Ducts in particular need to be clad with non-combustible board linings. Electrically operated systems should be well protected and at least one lift should be a dedicated fire-rated lift. PFT

Fire resistant glazing systems in airport terminals (this picture and the backdrop)

Fire safety installation in new Guangzhou Baiyun International Airport

PROMATECT® Partition Systems

Mr. Jeff Tang
Technical Support Engineer,
Promat China Ltd.

The new Guangzhou Baiyun International Airport, designed by Parsons Corp. and URS Greiner Corp, both of the United States, and the Guangdong Provincial Architectural Design Institute, can accommodate the world's largest planes, such as the Boeing 747. It is said to be the largest and the most advanced airport in the nation, and it is also the first one in China that had been designed and constructed in accordance with the pivot airport idea.

The initial phase covers an area of some 15 square kilometres and is capable of handling 25 million passengers and 1 million tons of cargo annually. In a vast area more than 7000m long and 3000m wide, the new airport is divided into three zones – administration, terminal and aircraft maintenance and cargo facilities.

The terminal building covers an area of 350,000 square meters. The exterior of the terminal building features a natural smooth arc anchored by a massive steel superstructure and gleaming glass walls. This magnificent glass and steel terminal "palace" spans 220m from east to west and has a ceiling height of more than 55m. In such a huge airspace, considering emergency fire hazards, some important functional areas had to be designed as isolated fire-proof compartmentation. In one such area is a passenger check-in island.

(Continued on the right)

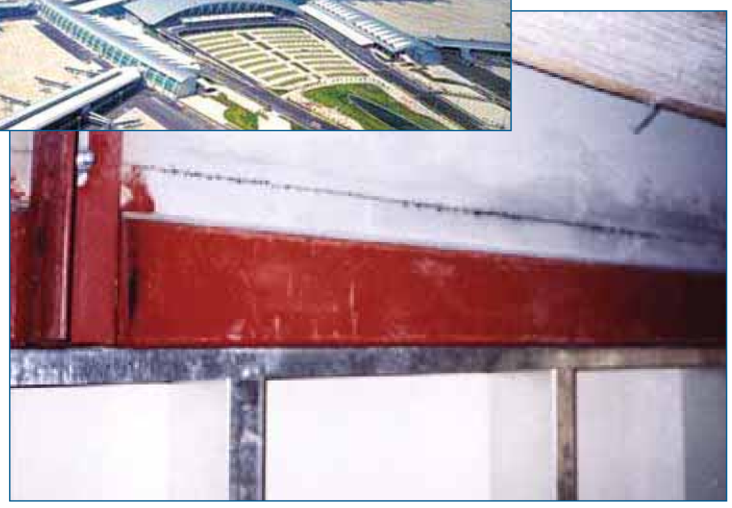
Thanks to its excellent fire resistance properties, and light weight and easy workability, PROMATECT® board was widely used to construct the check-in island building. The system includes 2-hour steel column cladding and 2-hour non-load bearing floor.

Other than the grand terminal building, the airport also boasts the largest cargo station as well as the largest hangar in the Chinese mainland. The cargo station covers more than 10,000 square metres and the hangar takes up 96,000 square metres, large enough to park four Boeing 777 aircraft.

In the cargo station, an isolated fire-proof compartmentation was designed to contain cargo handling equipment. To accommodate the maintenance and exchange work of the equipment, one side of the partition wall required removable construction. To meet this requirement, 4-hour PROMATECT® partition systems were divided into many isolated element sized 4m x 4m and sited in the existing concrete frame. Every partition element can be easily lifted out through the steel channel frame around it.

Both in the cargo station and in the hangar, the bottom part of the fire-proof partition is constructed with concrete. But the part from the top of the concrete partition to the undersurface of the roof, a net height of 3m, many pipe elements of the roof steel network pass through, making it very difficult to built concrete wall. As a reasonable solution, lightweight 4-hour PROMATECT® partition systems were adopted here. PFT

Top: The aerial view of new Guangzhou Baiyun International Airport.



A recap of the world famous Hong Kong International Airport

PROMATECT® & PROMASEAL® Protect First Class Airport

Mr. Raymond Man
Area Manager, Promat
International (Asia Pacific) Ltd.

A prestigious design of landmark

The Hong Kong International Airport is located outside the core island city, measuring a landscape up to 6,000m long x 3,000m wide. The airport covers an area of 1248 ha made from 25% existing island and 75% reclaimation from the sea. The 1200m airport terminal is capable of handling 35 million passengers a year, estimating 5,500 passengers per hour and 19,000 bags per hour at peak times.

This terminal, equivalent to 35 football pitches and a floor plan area of about 515,000 square meters, is one of the world's largest construction projects. It is a mammoth undertaking, both in the size of the project itself and the financial risk involved.

Therefore, a joint venture was formed between the following companies:

- AMEC International Construction
- Balfour Beatty International
- China State Construction Engineering Corporation
- Kumgai Gumi (HK)
- Maeda Corporation.

Foster and Partner, a UK-based firm, is the architect for the design and project management of this prestigious mega project.

Fire rated applications in the airport at Chek Lap Kok

Promat is honoured to be one of the providers for fire protection materials, i.e. PROMATECT®-H and PROMATECT®-S boards and PROMASEAL® fire stopping feature in the airport's fire-rated smoke extraction ductwork, ceiling, steel structure protection and partitions of the core building and its related buildings.

Amongst them the cargo handling unit in Superterminal, maintenance of aircraft in Asia Air Terminal, and supporting services around Cathay Pacific Headquarter and Dragon Air Terminal.

The airport is linked by the MTR airexpress train to Kowloon and Hong Kong island MTR systems. Kowloon Station and Hong Kong Station also serve as the urban check-in centre for airport passengers. In Kowloon station, PROMATECT®-S smoke extraction duct system is installed over the station, some up to 10m wide. In Tsing Yi station, one of the airport express train station, PROMATECT®-H board is also employed for the smoke extraction ductwork . PFT

封面内容

● 如何满足不同的安全需求

当今世界各大繁忙机场的严峻挑战

总能发现世界各大报刊以数不尽的篇幅来描绘一个机场建筑，机场甚至会成为一本小说的主题或电视和好莱坞电影的耀眼明星。机场建筑代表着巨额投资和最新科技，所以机场项目总能成为人们的谈资有时甚至是传说也就不足为奇了。

欢迎来到现代机场设计世界！

无庸质疑，当100年前莱特兄弟发明飞机的时候，没人会预料到机场的重要性。根据国际机场协会2001年的一份报告，世界最繁忙的前30座机场，当年旅客吞吐量已超过9亿人次。跨下年伊始，随着机票价格的下降、客运能力的提升和乘机限制的减少，航空运输业迎来了前所未有的发展。国际机场协会每年评估的机场约600个。

工程实力的完美体现

机场代表的远不止是交通系统中的一个重要环节，它可以被看作是一种政治声明和工程学成就。机场建筑往往反映了一个国家的哲学态度和经济实力。机场就是一个指示器，许多国家都会把机场视作该国繁荣昌盛的象征。机场也是一个国家与世界交流的平台。在大部分世界贸易通过航空业来实现的今天，没有一个方便、舒适和高效的机场服务是无法想象的。

永远美好的第一印象

无庸质疑，机场总会给人留下持久的第一印象。机场的建设，使用功能和安全性始终是第一位的，但旅客的评价也不容忽视。虽然最繁忙的机场总出现在北美和欧洲，但旅客评价得分最高的却是亚太地区的机场。例如，最近公布的一项关于2004年机场旅客评价的调查报告显示，香港、新加坡、汉城和吉隆坡机场的得分分别名列第一位、第二位、第四位和第五位。这一结果与该地区的经济增长和国际地位的提高有直接关系，而且这一趋势在不远的将来还会出现。

人员、科技和商务的安全交流枢纽

机场是人员和商务的基石，为使机场高效运作，安全性就尤为重要。所以机场设计必须遵照最严格的标准，不光在建筑美学方面，而且在技术和安全方面。当今，机场不但面临客流量的增加，而且也面临着货运量的增加，这给机场设施带来了前所未有的压力。实际上，在现有机场进行扩建的同时，新机场也在不断的建设，所有这一切都是为了满足这一不断增长的需求。

旅客安全的保障

机场建筑无论在设计、建造和运营方面都是极为复杂的，它是不同专业学科的汇总和集中表现。当然安全性是第一位需要考虑的，任何安全疏漏都是不允许存在的。尽管已经做了最大努力，但火灾的隐患却无时不在，不久前发生的机场火灾悲剧已经说明了这种危险的存在。无论何时何地，防火安全在机场建筑中都是重中之重。防火安全业界的先驱，如Promat，建议的严格防火安全措施已经在越来越多的机场建筑中得到推广和应用。

幸运的是，防火安全在专业知识和经验数据下是可以解决的。实际上现代消防学已经涵盖了机场建筑中防火安全的各个方面。

在现代建筑中，包括机场建筑，钢结构都需要充分的防火保护。在这方面，Promat积累了丰富的经验。同样，在现代机场建筑中，为了达到美学的目的，大面积的玻璃隔断也被广泛采用，在这种情况下，玻璃的防火性能就显得极为重要。PROMAGLAS®就是一种可以满足该要求的防火玻璃，并在世界范围内得到了广泛采用。在机场建筑中，防火吊顶在防火安全评估中也是一项重要内容，PROMATECT®防火板凭借其高强度和耐久性而被设计师和工程师所推崇。

机场建筑占地面积巨大，功能多样

几乎所有的机场都划分为多个不同的功能分区，平时旅客看到和使用到的只是一些表面设施。在这些表面设施背后，隐藏着大量的用于管理、供电、配餐及货物处理设施。其中，为通信及安全设施供电的电缆就需要完善的防火保护。Promat被公认为是该领域的领导者。

在机场繁忙的表面运营背后，飞机维修保养、配餐和货物处理等部门也同样在全天候运转。在您享受机场美食的同时，通风和空调系统的管道正在为您提供着周到的服务。在这里，PROMAT防火系统同样被广泛采用，以使火灾的危险性降到最低。货运中心的货物处理设备同样需要防火保护系统，公认的Promat防火保护系统在这里更是找到了用武之地。

最后不得不说，Promat在当今防火安全要求越来越高的机场建筑项目中做出了突出的贡献。面对世界的飞速变化，Promat正蓄势待发，为每一件建筑，尤其是机场建筑，营造安全的使用环境。

Promat最近出版了一套完整的机场防火安全手册，并附有工程实例。您可以通过填写以下的联络表Enquiries Form，索取这项新手册。PFT

● 广州新白云国际机场的防火安全设备

PROMATECT®防火墙

[illegible]/技术支援工程部 Promat China Ltd

广州新白云国际机场由美国Parsons公司、URS Greiner公司和广东省建筑设计院设计，可以供世界上最大的飞机波音747进行起降。广州新白云国际机场是目前中国大陆最大和最先进的机场，同时也是中国大陆第一个按中枢机场理念设计的机场。

广州新白云国际机场一期工程占地面积约15平方公里，年旅客吞吐量2500万，货物吞吐量100万吨。在长超过7公里，宽超过3公里的区域内，该机场共划分为3个功能区：飞行管理区，航站区和飞机维修及货物处理区。

航站楼占地面积35万平方米，由巨大的钢结构和玻璃幕墙体系构成平滑的流线造型，由东向西跨度达320米，吊顶标高达33米。在如此巨大的空间内，考虑到防火安全，某些重要的功能区必须设计成独立的防火分区，如旅客办票岛。

保全防火板PROMATECT®凭借其卓越的防火性能、轻质及易加工性，在航站楼的很多分项工程中被广泛采用，主要系统包括2小时钢柱包覆和2小时防火屋面系统。

除了宏伟的航站楼，广州新白云国际机场同时拥有中国大陆规模最大的货运中心和飞机维修库。货运中心占地面积[illegible]平方米，而飞机维修库占地面积[illegible]平方米，可以同时容纳4架波音747飞机。

在货运中心主体建筑中，设计了一个独立的防火分区以安放昂贵的货物分拣设备，但由于货物分拣设备需要定期维修或更换，所以要求该防火分区的一侧防火墙应设计成活动式。为了满足以上要求，保全板4小时防火墙被划分为多个4m×4m的独立防火单元，分别安装在已有的混凝土框架中。每个防火单元都可以通过其[illegible]

在货运中心和飞机维修库工程中，防火墙的下面主要部分都采用了混凝土构造，但在屋面以下约2米距离屋面的空间内，由于屋面钢结构构件的存在，给混凝土防火墙的施工带来了极大的难度。在这种情况下，轻质的保全防火墙成了最合理的选择。PFT

Enquiries Form

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(1 = Excellent; 2 = Very good; 3 = Useful; 4 = Okay ; 5 = Not useful.)

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This Enquiries Form refers to ProActive Fire Trends Newsletter Volume 7, Number 2 - Second Half, 2004

● Further study on steelwork fire testing method and Hp/A calculation

Loadbearing PROMATECT®-H panels for MRT at Changi Airport

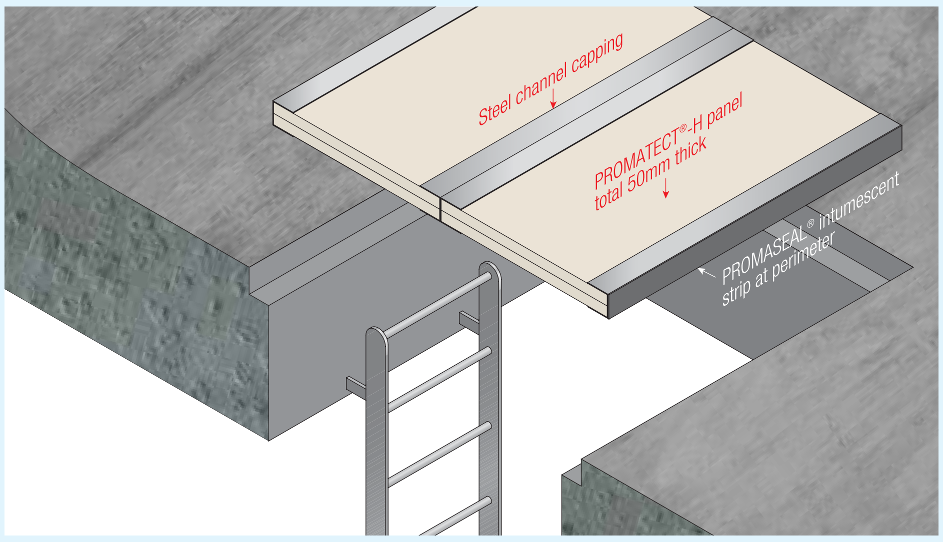
Mr. Lai Boon Keong
Technical Advisor,
Promat Building System Pte. Ltd.

Changi International Airport is one of the largest aviation facilities in Asia. It is located on the eastern edge of Singapore, about 20km from the city centre. Traveling to the city is convenient with the new Singapore Mass Rapid Transit, or MRT, station located at Changi. The Changi Airport MRT was completed in February 2002 as part of the expansion of the East-West Line system.

To ensure that the station and the trains are operate undisrupted, it is essential that the maintenance of the technical systems is carried out regularly. There are several floor access openings for maintenance purposes in certain portions of the MRT station. It is therefore required to have access panels to cover the openings. The main issue is now that the function of the floor as a fire compartmentation element has to be maintained.

As part of the fire safety requirement, the access panels for the floor must have fire resistance equal to that of the floor construction, i.e. two hours in terms of integrity and insulation criteria of BS 476: Part 20: 1987. Due to the existing situation where there were recesses in the concrete around the openings, the thickness of the access panels must not exceed 60mm including the top finishing. There will be either chequered-plates or tiles as top finishing. Also the access panels have to be lightweight to facilitate removal. In addition to the above, the access panels which were installed in the control rooms and along the corridor that leads to a baggage check-in room, have to withstand a point load of up to 5kN. The designer anticipated that there would be heavy carts transporting baggage, maintenance tools and equipment going over the fire rated access panels.

PROMATECT®-H which is robust and highly resistant to impact and abrasion has been used in this project. The fire rated panels, consist of two layers of 25mm thick PROMATECT®-H boards, were used to cover these openings. The openings sizes were up to 800mm x 800mm, minus the width of the recess in the concrete floor. The overall panel size is 850mm x 850mm considering the recess. The panels were each divided into two halves of 850mm x 425mm with the long edges capped with steel channels of 50mm x 50mm x 1.5mm thick. Then, the two halves were joined together by welding at the steel channels capping.

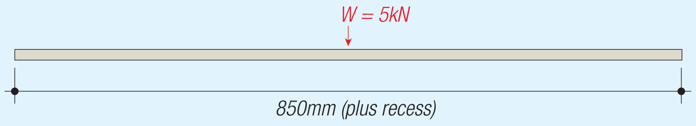


Close-up of barrier grating services (left) and view from top (below).

Types of panel for requirement of barrier (downwards from right).

It is therefore imperative that the PROMATECT®-H will not fracture under the following loading conditions:

- Assuming the proposed panel to be simple laterally supported at its two ends.
- The imposed point load, W = 5kN.
- The loading diagram is therefore as below:



- Flexural strength of PROMATECT®-H is 10N/mm² (longitudinal) and 5.5N/mm² (transverse). Therefore, it is important to ensure that the longer side of the PROMATECT®-H panel is cut along the original supplied length of the board. PROMATECT®-H is normally supplied in a sheet of 2440mm x 1220mm. For this case the 850mm side of the panel was cut along the 2440mm long side of the sheet.
- Factor of safety, F.O.S, taken as 1.50.
- Hence the maximum permissible stress, σ_{perm} = 6.66N/mm^2
- Maximum bending moment, BM_{max} = WL/4 = 1062.50Nm
- Sectional modulus of panel, Z_x = 42.5 x 52/6 = 177.08cm^3
- Maximum bending stress, σ_{max} = 1062.50/177.08 = 6N/mm^2

Since the maximum bending stress, σ_{perm}, is within the maximum permissible stress, σ_{perm}, the PROMATECT®-H panel as proposed will provide satisfactory performance under the point loading of 5kN. PFT