Today's warehouses are at great risk

Rick Foster of International Fire and Security Consultants looks at the latest developments in warehouse fire security systems and the various design considerations that should be taken into account.

TECHNOLOGY has caught up with warehousing and important changes are rapidly taking place. Such changes are occurring not only in the machinery used in the warehouse such as sophisticated forklifts and the computerisation and automation of many warehouse functions, but also in the basic architecture of the buildings themselves.

Although most modern warehouses are single story design, for the most part their architecture is inefficient in the use of available land area and can impose a cost penalty in terms of horizontal travel times, because goods are spread over such large areas.

Past attempts at multi-story warehousing were limited in that load limitations were necessary on upper levels, ceilings were low and old lifts were too slow for efficient operation.

Some of these limitations have been overcome in recent years, with the installation of faster lifts and automated loading and unloading.

Now with trends toward greater efficiency we are seeing higher ceilings which permit storage to 10 m or more. With stacker cranes, installations are climbing to storage heights of 40 m.

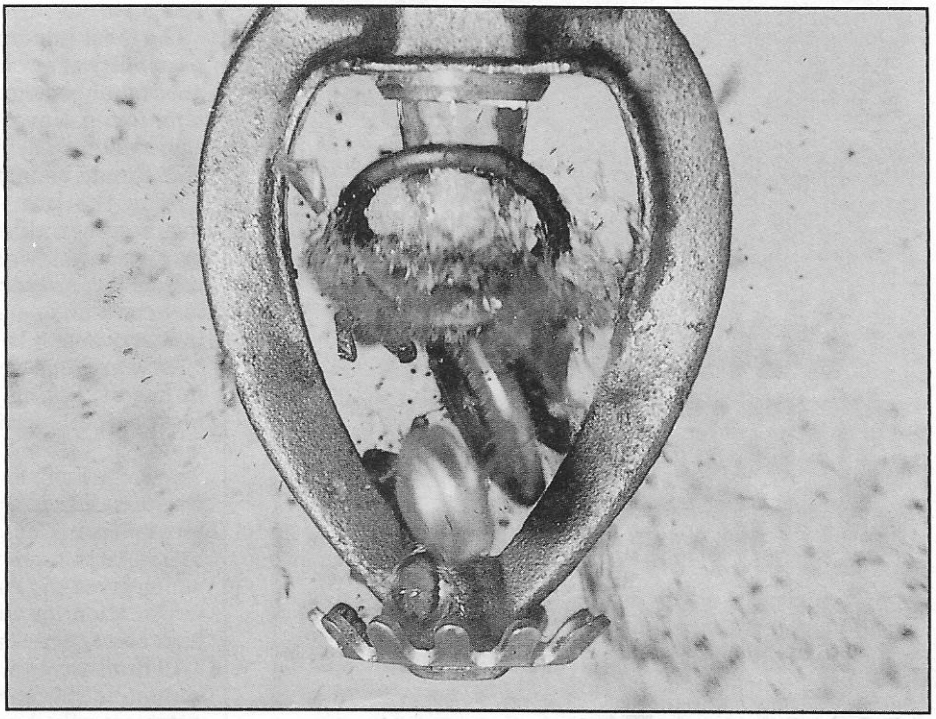
Ever increasing floor sizes and heights unthinkable a few years ago and the increasing concentration of high-value goods, coupled with the trend toward more and more combustible packaging material means that the modern warehouse manager must be on guard as never before.

To reduce the rising trend in insurance losses from warehouse fires, physical underwriting risk assessment of major warehouse facilities has to be stepped up and refined considerably.

One of the most comprehensively reported fires was that of the K-Mart Corporation in the township of Falls in Pennsylvania, USA in 1982, which destroyed a 112,000 m² warehouse divided into four quadrants by fire walls — which it was believed would protect it against total destruction. The loss incurred was more than $US20 million.

The most common cause of fire is supposed to be malicious setting. Figures from the UK indicate that where the cause is known, malicious fire setting accounted for just over half the fires. Another major source of warehouse fires is caused by contractors or maintenance personnel carrying out work which produces sparks and hot metal droplets such as oxy-acetylene cutting and welding.

Most warehouse fires show that the degree of compartmentation provided in such buildings is often inadequate to prevent large and expensive fires. With the notable exception of the K-Mart fire, where adequate compartmentation was provided, very few fires spread beyond the compartment of origin due to failure of a fire resisting-wall, door or floor.



Overseas, most of the large warehouse fires for which a date of construction was reported occurred in buildings built before 1920. Notable exceptions again are the K-Mart fire, and one in the Ford plant in Cologne, West Germany.

On all occasions fire spread was assisted by large quantities of highly combustible or flamable agents such as exploding aerosol cans, containers with paint and thinners and even engine oil.

In some cases the fire was aided by openings in walls for conveyors and access and openings in floors for a lift shaft or crane-well or open staircases. The fires were helped along still more by oil-soaked timber floors and combustible roof linings.

Minimum requirements for the layout, fire resistance (if any) and system fire protection of warehouse structures are laid down in building regulations of various Australian states. As far as technical matters are concerned, the States try to keep them as uniform as possible, though the regulations are in a constant process of revision.

Building regulations prescribe the maximum size of fire compartments for warehouses for four building types and in high hazard and medium/low hazard with and without sprinkler systems.

There are however, four alternatives to the maximum floor area/compartment limitations contained in the regulations. These are:

- The use of entirely Type 1 construction. This is expensive, though no floor area limitations are imposed unless the local building authority is of the opinion that special provisions should be made to restrict or combat the spread of fire.
- Providing fire separated compartments in accordance with the previous alternative.
- If the warehouse is of single story construction only, space around each building must be kept permanently vacant to prevent the spread of fire.
- For floor areas less than 18,000 m² the vacant perimeters must be at least 18 m wide and the buildings of Type 2 or Type 3 construction used with certain additional fire protection features.

For floor areas exceeding 18,000 m² the vacant perimeter space must be at least 24 m wide or Type 2 or Type 3 construction must be used, again with certain additional fire protection features.

In this area there has been a tendency of warehouse owners to opt for the vacant perimeter space alternative by locating their premises in the outer suburbs of Australian cities, in the mistaken belief that vacant grassland is cheaper than the costs of structural and

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system fire protection.

This mentality produces problems and hazards for the owners of such warehouses and their insurers. For instance, there is no guarantee that the vacant perimeter space will always remain unoccupied.

The idea of vacant perimeter space as a trade-off for the lack of structural and system fire protection is no protection whatever against fire upon the premises of the owner, particularly if the fire starts on premises within the vacant perimeter space.

The most important step in loss prevention is to reduce the possibility of a warehouse fire to the absolute minimum. Only good management will ensure that all obvious causes of fire are eliminated. Nevertheless, some fires will occur and fire protection systems adequate for the requirements of the individual risk should be installed.

From the turn of the century to the mid-1960s, ceiling mounted sprinkler systems were the most widely used fire protection for warehouses and they enjoyed a high level of reliability. As storage heights increased, so did losses. Manufacturers and constructors, governments and the insurance industry began to look for alternative methods of protection.

For warehouses with block storage of less than seven metres in height, ceiling mounted sprinklers are probably still the most suitable form of protection from a cost/benefit point of view.

Both the Factory Mutual System and the Joint Fire Research Organisation in the UK have conducted extensive tests with in-rack sprinkler systems for storage in excess of 7 m in height. These tests have resulted in sprinkler standards and codes which gives the designer a considerable amount of additional information for the design of in-rack sprinkler protection in high storage racks.

An interesting solution for the fire protection of high racked storage is the 'zoned' sprinkler system which is intended to automatically detect and extinguish a fire in the pallet bay or 'cell' in which it started with minimal fire, smoke or water damage, so that the bulk of the warehouse operation can continue unimpaired.

Automatic fire detection systems have been installed either in addition to sprinklers or as the main protective system. For the heights encountered in warehouses, thermal detectors are of limited or no value and more sophisticated detector heads have to be used. These may be photo-optical smoke detectors, air sampling systems or radiation detectors with line-of-sight devices.

An automatic fire alarm system can be used to initiate other actions in addition to giving a local alarm. They can:

- Alert the Fire Brigade.
- Automatically retract stacker cranes to predetermined 'safe' positions.
- Control lighting and power points.
- Operate automatic heat and smoke roof vents.
- Close fire doors.
- Shut down ventilation and air conditioning systems or switch them to the smoke spill mode.
- Start fire water pumps

In non-sprinklered premises, the value of a 'detection only' alarm system is likely to be limited to those cases where the warehouse is continuously manned by highly trained fire fighters, and that is unlikely to be the case in Australia. Thus a 'detection only' warehouse is likely to be a total loss within a short time and might as well have not been fitted with an alarm system at all.

Manual fire fighting systems and applicances essentially consist of fire hydrants, small bore fire hose reels and portable fire extinguishers. Generally, the minimum deployment of fire hydrants, fire hose reels and fire extinguishers for warehouses built after 1974 is covered in the building regulations, Ordinance 70.

The design and installation of hydrant and hose reel fitments and deployment of portable extinguishers should conform to the relevant Australian Standards.

Plan your security requirements

TO PREVENT break-ins and theft effectively, it is necessary that the physical security devices, the organisational measures and electrical monitoring in a security system complement one another.

There are several decisive factors which must be taken into consideration when considering security measures for specific buildings.

- Location, construction and burglar resistant properties of a building and its openings.
- Existence of physical security systems and burglary and/or electric monitoring devices.
- Presence of occupants or security staff.
- Possibilities of access to the building on foot or by vehicle.
- Escape routes.

These considerations imply that even goods of slight value may be worth stealing if they are within easy reach and can be removed in fairly large quantities without any danger.

It is a well known fact that the exposure of an object to burglary can be estimated particularly well if one puts oneself in the burglar's place. The considerations listed should, as a matter of principle, form the basis of most burglary risk assessments.

- Burglars want to arrive and leave the scene of their activities as quickly as possible. Every measure which prolongs the time needed to reach and remove goods represents a complication for burglars and increases the chances that they will be caught.
- Burglars prefer to go about their work with simple tools.

Good security systems makes special tools and specialised knowledge necessary and thus will act as a deterrent

- Burglars will take advantage of any opportunities which appear favourable. Experience has shown that the likelyhood of a break-in becomes greater the less apparent it is that a building is equipped with security applicances.
- Burglars want to remain unnoticed. Burglar alarms, watchmen and lighting make it possible to discover the burglars at work and catch them in the act.

A chain is only as strong as its weakest link. Thus one of the most important basic rules to be kept in mind when a security concept is being developed is that every exposed spot must be secured separately and in accordance with the degree of exposure it provides so that the most uniform all round protection possible is achieved.

In any brief look at the essentials of burglary prevention, there are decisive factors involved which can only be determined by considering the course, such as the various time phases of a typical burglary.

• Breaking-in time

This is the amount of time a burglar needs to reach the property he is aiming at.

The period required depends on the quality and number of security devices which must be overcome but also on the break-in method chosen.

When ideas on burglary prevention are being discussed, it must be assumed that burglars will adopt the most rapid break-in method possible.

• Collecting time

This period is to be understood as being the time required by the intruder to remove the property and possibly load it into a vehicle.

The time needed is dependent on the weight and volume and thus on the transportability of the goods as well as the difficulty of the removal route.

• Escape time

This begins as soon as the burglar has left the scene of the crime taking his haul with him.

Regarding loss prevention, only the time until the moment the burglar makes his escape is of any significance. Afterwards, in most cases there is only a slight chance that he will be caught — a fact which is proved by the statistics on crimes solved.

The interest in the burglary is strongly influenced by the time the burglar needs to obtain the desired property.

The time necessary to undertake a burglary and the equipment to be used are generally determined by the value of the goods which the burglar hopes to steal and the manner in which they are stored.

A burglar will be prepared to invest more time for the contents of a strongroom than for those of a kiosk. Security devices must therefore be appropriate to the degree of risk.

To repeat; if loss prevention is to be effective, organisational measures and use of security devices must complement one another.

The security of any risk depends almost exclusively on the quality of the security system protecting it. Physical devices can complicate matters for an intruder and increase the total time needed (breaking-in and collecting times), for the burglary.

Burglar alarms should signal an intended entry at the earliest possible moment so that the physical security devices may resist the burglar's efforts and sufficient time is available for counter measures.

Factors of uncertainty can, as a rule be eliminated if particularly those points such as openings in a building and the target spot in these openings are protected both by physical security devices and burglar alarms.

The functional reliability of these systems must be checked regularly.

Burglar alarm installations should conform to Australian Standards AS2630-1983 and AS2201-1978.

Beware of service-related hazards

THERE would be very few modern warehouses that could win a prize for aesthetics — at least on the inside.

They're not intended to be pretty — even without the maze of racking, the walls and ceiling are generally a confusion of cables, ducting and conduits carrying power, lighting, refrigeration, gas, ventilation and computer controls.

Naturally an efficient electrician or plumber will take his ducting or cable, point to point by the shortest possible route and while this may be correct from an engineering standpoint and make for ease of future servicing, from a fire prevention view it could be totally disastrous.

The most efficient and best designed sprinkler system in the world will not extinguish a match if the cable carrying power to the system's pump has been burnt through and is out of action.

There are other services that may be equally affected, such as ventilators, emergency lights and materials handling equipment.

Naturally, overhead lighting requires overhead cabling, but with careful initial planning these cables need not be placed over storage racks.

Cables routed around the walls are less hazardous, provided stock is not packed hard against them, creating an ignition point.

Temperature build-up can be minimised by matching cable to predicted future loads and carrying them in fireproof conduits. Tamper-proof junction boxes should be fitted and all the cabling and fittings inspected at regular intervals.

Wall-mounted power outlets can be another problem source.

The power points may be intended for legitimate warehouse activities such as a shrink wrap machine or recharging batteries in electric forklifts. However if staff are allowed to use these points for little extras, such as bar radiators, electric kettles or radios, then they become a definite hazard.

It does not take much imagination to see the consequence of a tipped over radiator or a boiled dry-electric kettle.

The warehouse ventilation system will not generally contribute to the start of a fire, but it can have a considerable effect on the eventual outcome.

One of the biggest problems facing fire-fighters attending a warehouse or indeed almost all industrial fires is the associated smoke.

Whether toxic or not, it reduces the efficiency of manual fire-fighting efforts and increases the danger for those involved.

It would take a much larger than normal capacity ventilation system to contend with the copious amount of smoke generated by fire in a large warehouse.

"Firemen's efforts were hampered by the vast amount of thick smoke," is a very common phrase by newsreaders reporting on a fire.

Overseas research has shown that roof-mounted vents can take care of most of the smoke problem and 'smoke curtains' suspended from the ceiling can contain it to a restricted area, yet controversy rages between experts as to when venting should take place. Too early and the fire will flare with the fresh supply of oxygen; too late and the smoke is just as big a problem as if there were no ventilation.

Efficient smoke control is still developing and any decision to fit control devices should be based on expert design and consideration of the warehouse construction and the types of goods and its packaging that will be stored there.

If ducting, cables or conduits penetrate a firewall then the breach should be sealed to prevent fire spreading from one compartment to another, remembering that whatever sealant is used, it should be strong enough to withstand the considerable pressure put on cables and piping during a fire.

Refrigerated warehouses have a generally good record since their very nature tends to inhibit fire. However it is some of these same features which work against the fire-fighter once a fire has begun.

Cold stores naturally have limited access and a very basic internal ventilation system, recycling air through the chiller unit, which makes the smoke problem even greater.

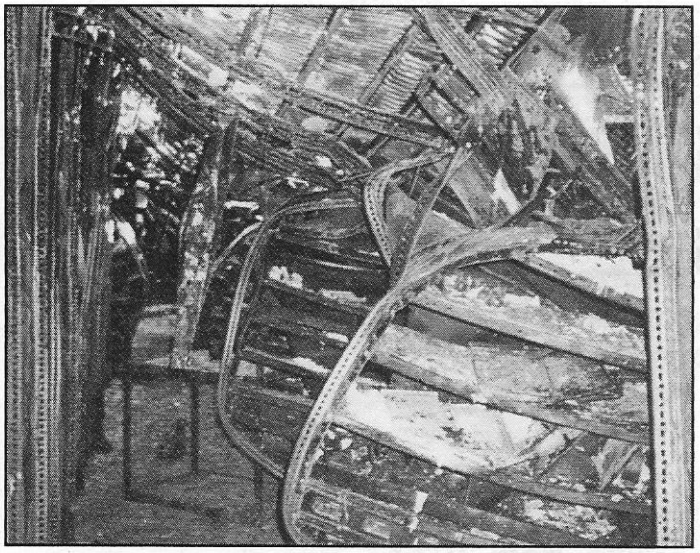
Combustion of ammonia in the chiller and the polyurethane insulation generates highly toxic gases.

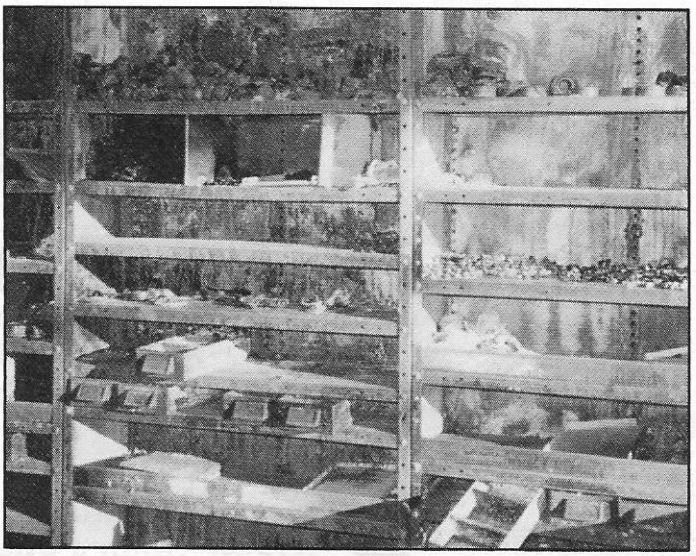
Automated and computer control of warehousing either totally or partially is becoming common and this has lead to special fire protection devices in this area.

Yet these precautions are intended to save the hardware, though it takes very little real heat or smoke to damage or corrupt programs and data.

Hardware can be replaced immediately but lost data could put efficient warehouse operations back 12 months. Perhaps the only sure protection in these circumstances is regular duplication of data.

It's clear then, that fire prevention engineers should be consulted during the initial design stage of a new warehouse and perhaps a retrospective clean up for those already in operation. As mentioned in the opening paragraphs, no prevention system is of any use if it can be put out of action by the very thing it was put in place to prevent.





The results of a fire in a warehouse.