

Technical Report
FCRC-TR 96-08

Case Studies of Fires in Retail Buildings

FCRC
Fire Safety Systems for
Low-Rise,

Fire Code Reform Research Program
October 1996

Important Notice

This Report has been prepared for work commissioned by Fire Code Reform Centre Limited and has been released for information only.

The statements and conclusions of the Report are those of the author(s) and do not necessarily reflect the views of Fire Code Reform Centre Limited , its Board of Directors or Members.

Neither the authors, Fire Code Reform Centre Limited, nor the organisations and individuals that have contributed, financially or otherwise, to production of this document warrant or make any representation whatsoever regarding its use.

Background

The Fire Code Reform Research Program is funded by voluntary contributions from regulatory authorities, research organisations and industry participants.

Project 6 of the Program involved investigation into factors affecting fire-safety in low-rise, sprinklered shopping centres. As part of this work recorded case studies of fires in retail buildings were examined with particular attention paid to incidents that had resulted in deaths.

This Report summarises this review of case studies that was assembled by Dr Ian Bennetts of BHP Research, Melbourne Laboratories whilst located at 245 Wellington Road, Mulgrave, Victoria 3170. The Report records details of significant fires that have occurred worldwide over a 10 year period..

Acknowledgements

Mr Max Croxford, Commissioner of the Building Control Commission (BCC), Victoria was primarily responsible for the initiation of FCRC's Project 6 relating to "Fire Safety Systems in Low-Rise, Sprinklered Shopping Centres". BCC Victoria additionally provided significant financial support to the execution of this work. BHP Steel Division and BHP Research were further contributors of substantial funds to Project 6. Generous contributions were also received from other donors.

The Board and management of Fire Code Reform Centre Limited acknowledge with sincere thanks receipt of all these financial contributions. The company also acknowledges the kind permission of BHP Research to the re-production and publishing of this document.

Comments

Comments on the content or other aspects of this document are always welcome and should be addressed to:- Fire Code Reform Centre Ltd, Suite 1201, 12th Floor, 66 King St.,
Australia. Tel. Fax. (2) 9262 4255.

FIRE CODE REFORM CENTRE
PROJECT 6

BHPR/SM/R/056

CASE STUDIES OF FIRES IN RETAIL BUILDINGS

by

BHPR-I D Bennetts, K W Poh, I R Thomas;

BCC-A C Lee; VUT-P F Beever

Refereed by: K Watson

October 1996

Circulation: Unrestricted

The Broken Hill Proprietary Company Limited
A.C.N. 004 028 077

EXECUTIVE SUMMARY

The work described in this report was undertaken as part of Fire Code Reform Centre Project 6 “Fire Safety Systems for Sprinklered Low-rise Shopping Centres”. This project is aimed at studying the factors affecting fire safety in shopping centres and will recommend modifications to the existing regulations where this is appropriate.

Over the years, fire incidents in retail buildings have been reported in the fire literature. The extent and quality of reporting is variable but generally such reports provide a fruitful source of information on possible fire scenarios, the performance of fire-safety systems, the behaviour of the occupants and other factors associated with the occurrence of fire in these buildings. The study of such material is important, and in this report, a detailed summary of this information and its apparent significance is presented.

Access to detailed statistical information on fires in retail buildings in the United States over a 10 year period has provided an alternative source of information. In this report a detailed summary and analysis is presented of all reported fires in the United States where deaths have occurred in retail buildings.

The information presented in this report provides a background against which risk-based fire-safety models can be developed.

CONTENTS

	<i>Page No.</i>
1 INTRODUCTION	
2 CASES REPORTED IN THE LITERATURE	2
2.1 Summary of Sources of Information	2
2.2 Review and Analysis	2
2.3 Study of Situations where Deaths Occurred	5
3 LESSONS FROM US STATISTICAL DATA	11
3.1 Summary of Information	11
3.2 Study of Situations where Deaths Occurred	12
4 CONCLUSIONS	15
5 SIGNATURE PAGE	17
6 REFERENCES	18
APPENDIX A SUMMARY OF CASE STUDIES	A1
APPENDIX B CASES WHERE FATALITIES DUE TO FIRE IN RETAIL BUILDINGS IN THE US	B1
APPENDIX C REVIEW OF AUSTRALIAN FIRE STATISTICS — DEATH AND INJURY RATES	C1

1 INTRODUCTION

The Fire Code Reform Centre (FCRC) is undertaking a research project (Project 6) to investigate the fire safety of low-rise sprinklered shopping centres. The project is particularly aimed at large plan area buildings having a rise in storeys of up to four and which may incorporate malls or atriums. As suggested by the title of the project, it is assumed that the buildings will be sprinklered.

To determine the current fire-safety requirements for shopping centres, the Building Code of Australia (1990) has been studied and a detailed summary of these requirements has been published in a report entitled "BCA Fire Safety Requirements for Shopping Centres" (Bennetts, Poh and Lee, 1996). Other aspects of the research project include: conducting fire tests to gain a better understanding of fire development and its effect on a building and its occupants; gaining a detailed understanding of modern shopping centres; reviewing available statistical information on fires in retail buildings; reviewing published accounts of fires in these buildings; and finally, undertaking fire-safety analyses to determine the influence of various fire-safety measures.

Over the years numerous fires in retail buildings have been reported in the literature. The extent and quality of reporting is variable but generally information from such reports can provide a useful source of information on the likely influence of various fire-safety measures in such buildings. It needs to be understood however, that sometimes these buildings bore little resemblance to modern shopping centres. Nevertheless, the study of such material is important as it provides an understanding of the factors that have an influence on fire safety in retail buildings. In this report, a detailed summary of this information and its significance is presented.

Access to detailed statistical information on fires in retail buildings in the United States for a 10 year period has provided an alternative source of information. In this report a detailed summary and analysis is presented of all reported fires in the United States where deaths have occurred in retail buildings. A detailed study of US and Australian fire statistics in relation to matters other than loss of life is to be presented in a future report.

2.1 SUMMARY OF SOURCES OF INFORMATION

Attempts have been made to obtain technical literature on fires in retail buildings. The majority of these accounts are of overseas fires-particularly in the United States and Europe. Sources of information have been journals such as *Fire Journal*, *Fire Command*, *Fire Prevention Journal* and various others. Ninety-seven accounts of fires in retail buildings have been obtained and these are summarised in detail in Appendix A. A standard format has been used in summarising the data which includes such fields as: *date, time at which fire noted; cause of fire; description of centre (building); type of construction; sprinklers; smoke detectors; death/injuries; area of fire origin; and area affected by fire*. Other aspects of the fire and fire-related activities such as evacuation and the role of the fire brigade are given in *notes* at the bottom of each summary. Unfortunately, many accounts in the literature have insufficient detail to allow all of the above fields to be completed. In such cases, the field entries have been entered as “unknown”. One such example is in relation to injuries where it is suspected that these were rarely reported.

2.2 ANALYSIS

According to Thomas (1996), 77,996 fires over a 10 year period in retail buildings have been recorded by fire-brigade officers in the United States-the majority of them having little impact on property or life. In contrast, a much smaller number of fires have been reviewed in the technical literature. It follows from this, that the fires summarised in Appendix A and which are the subject of this section, are unlikely to be a representative sample from which statistically-based conclusions can be drawn. It is more likely that these fires are those of special “interest” where the loss has been particularly large or where some noteworthy fire-safety issues were demonstrated. Therefore the comments and any generalised conclusions given in this section must be read with caution—taking into account the selective nature of fire incident reporting and that some of the fires described are for incidents that occurred almost 30 years ago.

The cases in Appendix A have been analysed in isolation from one another. Some general trends are apparent and the following observations are made:

- i. The majority of fires appear to have been started by electrical faults or arson-although the “unknown” category is high. In the case of electrical faults, these were often associated with PVC covered wiring and electrical devices within the ceiling space, display case areas or shop facades and faults from appliances. Several fires were caused by welding work during renovation.
- ii. In the majority of situations fires only developed to a significant size if the fire was initiated in a remote area (eg. storage areas or ceiling spaces) or when the building was unoccupied. It appears that very few fires were allowed to develop in areas which were directly observable by the occupants.
- iii. In a few situations, combustible ceiling tiles led to rapid fire spread across the enclosure leading to a serious fire-safety scenario.

- iv. A major mechanism of fire spread to other parts of the building appears to have been through the ceiling space-irrespective of whether there were combustibles in ceiling space.
- v. In some shopping centres, the decision to install sprinklers in a particular shop appears to be a decision made by the owner of the shop or store. Thus, there are some centres where certain shops are sprinklered but others are not. Several of these cases are described in Appendix A and in these situations, where the fire was allowed to develop into a substantial fire in a non-sprinklered part, the fire generally did not spread into the sprinklered parts of the building-although significant water damage occurred in these latter parts of the building due to activation of heads.
- vi. Other cases have been noted where the building was essentially sprinklered throughout but where combustibles or combustible construction within parts of the building (eg. ceiling space construction or combustibles associated with verandahs and awnings) allowed a significant fire to develop such that the sprinklers were overwhelmed and not able to adequately control the fire. Unfortunately no information was given on the design delivery rate of sprinkler systems where this occurred.
- vii. In two cases the sprinkler system had been isolated overnight and fire (which occurred at night) resulted in almost complete destruction of the buildings. One of these buildings incorporated a smoke detection system but this had also been isolated.
- viii. It appears that fires¹ that were able to be extinguished rapidly by the fire brigade tended to be small. For this to be the case the brigade had to have arrived and located the fire in a short period of time or the fire had to be kept small due to the action of the occupants or the sprinkler system. In other cases where there were walls giving fire separation (these may not have been required fire-resistant walls) or partial sprinklering, the brigade was able to confine the fire an area such as the shop of fire origin. Otherwise, for the cases reviewed, the extent of flame spread was very large and significant parts of the centre were destroyed.
- ix. It appears that the fire brigade had little role in the direct evacuation of the occupants-evacuation often taking place before the fire brigade arrived.

The riots in Los Angeles in 1992 resulted in many fires being started in retail and other buildings. During the 5 days of rioting the rate of structure fires went up by a factor of 33. Fires were often started in these buildings on multiple occasions. In the case of non-sprinklered buildings, heavy losses were experienced. Data on the effect of fire on sprinklered retail buildings indicates, that in all cases (40 buildings), fires were extinguished by the action of the sprinklers--despite the fact that some of these buildings were subject to multiple fires". A detailed description of sprinkler performance is given in the literature for 32 of these buildings (Anon, 1992) and is summarised in Table 1. This data illustrates the

¹ It should be noted that detailed statistical analysis shows that the vast majority of fires in retail and other premises, even if not sprinklered, are very small.

² In two cases, sprinklers were shut off after extinguishing a fire and not reinstated before another fire was started in the building by rioters. In these cases the buildings were eventually destroyed.

effectiveness of sprinklers in extinguishing and controlling fires in these buildings.

TABLE 1 AUTOMATIC SPRINKLER PERFORMANCE DURING THE LOS ANGELES RIOT

<i>Occupancy</i>	<i>No. of fires set</i>	<i>No. of sprinklers involved</i>
Department store	9	22
Grocery store	2	7
Department store	2	5
Surplus store	4	11
Appliance store	3	10
Bank	1	
Discount mart	6	6
Grocery store	2	2
Video store	1	5
Laundry	1	2
Department store	1	1
Grocery store	1	1
Automotive parts	2	12
Furniture store	1	5
Grocery store	6	18
Grocery store	3	3
Grocery store	2	2
Grocery store	2	2
Grocery store	2	15
Grocery store	3	3
Grocery store	2	2
Grocery store	1	1
Grocery store	1	3
Grocery store	1	
Grocery store	1	1
Grocery store	1	2
High-rise offices	2	2
High-rise garment store	3	3
Department store	3	3
Electronic store	1	1
Drugstore	4	8
Drugstore	1	1
Grocery store	exposure	10
Drugstore	exposure	1

2.3 STUDY OF SITUATIONS WHERE DEATHS OCCURRED

As one of the main objectives of the building regulations is to provide an adequate level of life safety in the event of a fire, it is important to particularly consider retail fires where deaths have occurred. A useful summary of the more

notable fires where fatalities occurred in department stores up to early 1967 has been given by Meyer (1967). The following fatalities were noted:

<i>Year</i>	<i>Location</i>	<i>Deaths</i>
1932	Tokyo, Japan	14
1938	Marseille, France	50
1947	Christchurch, New Zealand	41
1948	Mexico	12
1955	Andover, USA	22
1956	Monticello, USA	15
1957	Villa Rica, USA	12
1958	Bogota, Sth America	83
1960	Liverpool (Hendersons Ltd)	11
1962	Nurnberg (Kaufhof AG)	21
1963	London, Richmond	1
1963	Tokyo, Japan	7
1963	Glasgow, United Kingdom	1
1964	Tokvo, Japan	19

Meyer noted the following factors associated with the above situations:

- Inadequate alarm system to the fire brigade.
- Little or no compartmentation within buildings, which in some cases, allowed for rapid fire spread both vertically and horizontally.
- Inadequate training in the use of portable extinguishers

Other details are not given and no mention was made of sprinklers.

The cases summarised in Appendix A took place after the above fires and those where deaths occurred are now considered in detail.

i. A L 'Innovation-Brussels, Belgium (1967)

Figure 1 shows the layout of the building which was totally destroyed with more than 400 persons perishing in the fire. As noted in the summary given in Appendix A, the building was five levels and a combination of reinforced concrete and unprotected structural steel. The building occupied an entire city block.

The fire occurred during the lunch break and was said to have spread rapidly, both vertically and horizontally, through voids which connected the various levels and across the ceilings. Decorative combustible ceilings were used below the normal ceilings and these assisted horizontal fire spread. The fire brigade arrived 5 minutes after receiving a call but noted that upon arrival "the building was engulfed in flames". At this point survival within the building was an impossibility.

It should be noted, that in many countries in Europe, it is common for stores to be closed at lunchtime. Thus there were relatively few shoppers in the building at the time of the fire. On the other hand, shopping staff were present-many of whom were dining in the restaurant on the third level.

The 200 or more people in the restaurant perished from smoke inhalation. The large quantities of thick smoke made it very difficult for the occupants to find their way to safety as smoke spread throughout the building as the various levels were connected by open staircases and two enclosed stairways for fire emergency purposes. The former stairs assisted the upwards spread of flames and smoke. The latter stairways were noted to have inadequate doors, and in one case, were blocked with combustibles.

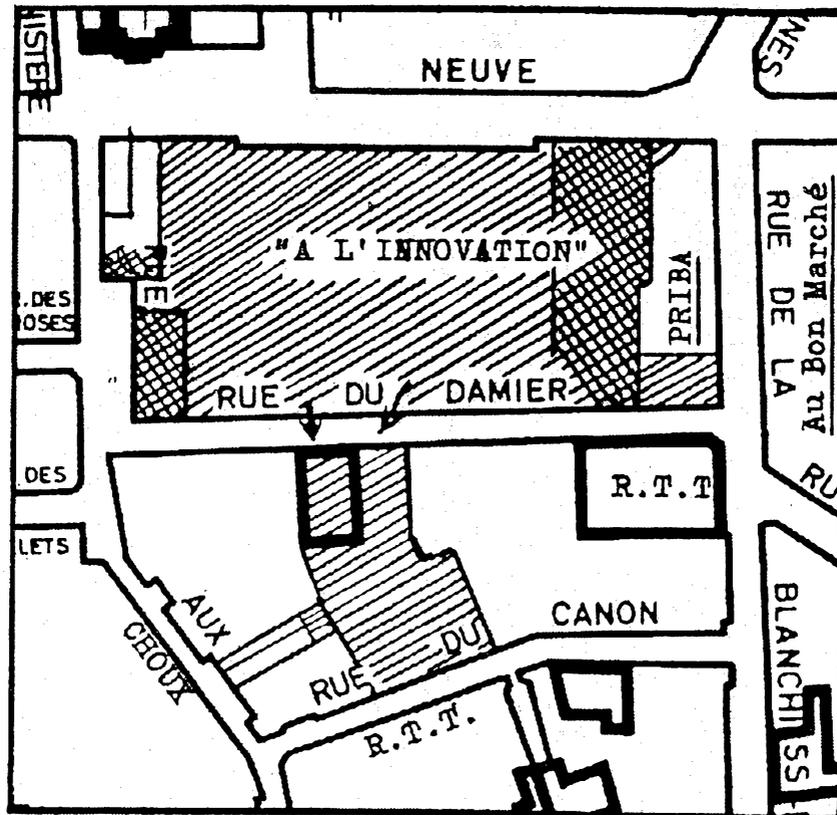


FIGURE 1 A L' INNOVATION—BRUSSELS, BELGIUM

The building did not have a sprinkler system.

The building was not designed to have a specific fire resistance level-in fact the two levels below the restaurant level were constructed of unprotected structural steel. These levels collapsed well after the people in the restaurant had perished from smoke inhalation and well after evacuation from any part of the building was possible. The brigade could do little to evacuate people from the building.

ii. *Single Storey Supermarket, Europe (1976)*

The fire in this building was noted to have spread rapidly. The fatality occurred when a shop assistant went back into the building to get some personal possessions and was overwhelmed by the smoke. Fire appears to have started in a storage area which is unlikely to have been occupied. As the walls between the storage and non-storage areas did not extend to the roof, the fire was able to spread rapidly into the rest of the building. The building was not sprinklered.

iii. *Younkers Department Store, Merle Hay Mall-Iowa, USA (1978)*

The Younkers Department Store was a two-storey building of reinforced concrete. The building was essentially occupied by staff at the time of the fire which, it is thought, was initiated by an explosion of substances in the ceiling spaces on both levels of the department store. The heating and air conditioning system was being refurbished at the time. The building was only occupied by staff (22 in total) at the time of the fire and it is therefore reasonable to assume that all of the occupants were familiar with the location of fire exits-although it appears that some of the exits were poorly sign posted. The resulting fire spread rapidly through the horizontal ceiling spaces and from the lower to the upper level by means of openings in the floor (including two banks of escalators). It is not known whether there were combustibles in the ceiling spaces. The brigade arrived a few minutes after the explosion to find heavy smoke coming from the building and flames external to the store. Ten people died from smoke inhalation on level 2. None of them made it to an exit.

The building was not sprinklered and had no form of electronic fire detection.

iv. *Woolworths-Manchester, UK (1979)*

This building was six levels above ground with two basements. The lower basement was a services area whilst the other basement was a sales area. The top level was used for storage and plant equipment. The fire initiated on the 3rd level above ground (ie. second storey) in a furniture display area and grew rapidly once stacked furniture and polyurethane mattresses became involved. This resulted in heavy smoke throughout the building such that even the first storey became smoke logged. The smoke travelled via the escalators which provided a link between the basement and the second storey but were not enclosed in any way. Three enclosed fire stairs were provided within the building (enclosure construction being between 2 and 4 hours and doors of 1 and 2 hours) and these all provided access to open air at street level. At the fire floor all three exit staircases (fire-isolated) were available but only one was accessible due to the effects of the fire. The remaining staircase became smoke logged due to the door being continually opened although a large number of people escaped using this exit.

As there was no automatic detection system, the alarm had to be given by the receptionist or by means of one of the "break-glass" alarms which were installed throughout the building. Due to confusion in interpreting the "fire" message from the store manager, the building alarm was not activated nor was the fire brigade called for some time. The building alarm was finally activated by a member of staff using a break-glass alarm, while the fire brigade was called by a passing taxi. By the time the building alarm had been activated, the majority of people had left the first and second storeys by means of one of the staircases and the escalators.

The escalators were used by the occupants until the severity of the smoke prevented further use. There were 500 people in the building at the time of the fire although it appears that most of them were located below the 3rd

storey with mainly staff occupying the floors above the second storey. These staff managed to escape via the lifts, one of the staircases to ground level, and from the roof of the building.

The fire developed rapidly due to the polyurethane associated with furniture and rapidly became too large to be extinguished by the occupants using hose reels. The breaking of external windows resulted in an influx of oxygen and corresponding rapid fire growth. In fact, it took 2:30 hours from the time of arrival for the fire brigade to bring the fire under control. The alarm to the fire brigade was considerably delayed.

10 people died due to smoke inhalation. They were in the restaurant on the second storey. Some of the deceased had attempted to leave the restaurant to find the fire stairs (see Figure 2) and despite their close proximity to the stairs were unable to find them before being overcome by the smoke. A 1.7 m high partition separated the restaurant from the sales area.

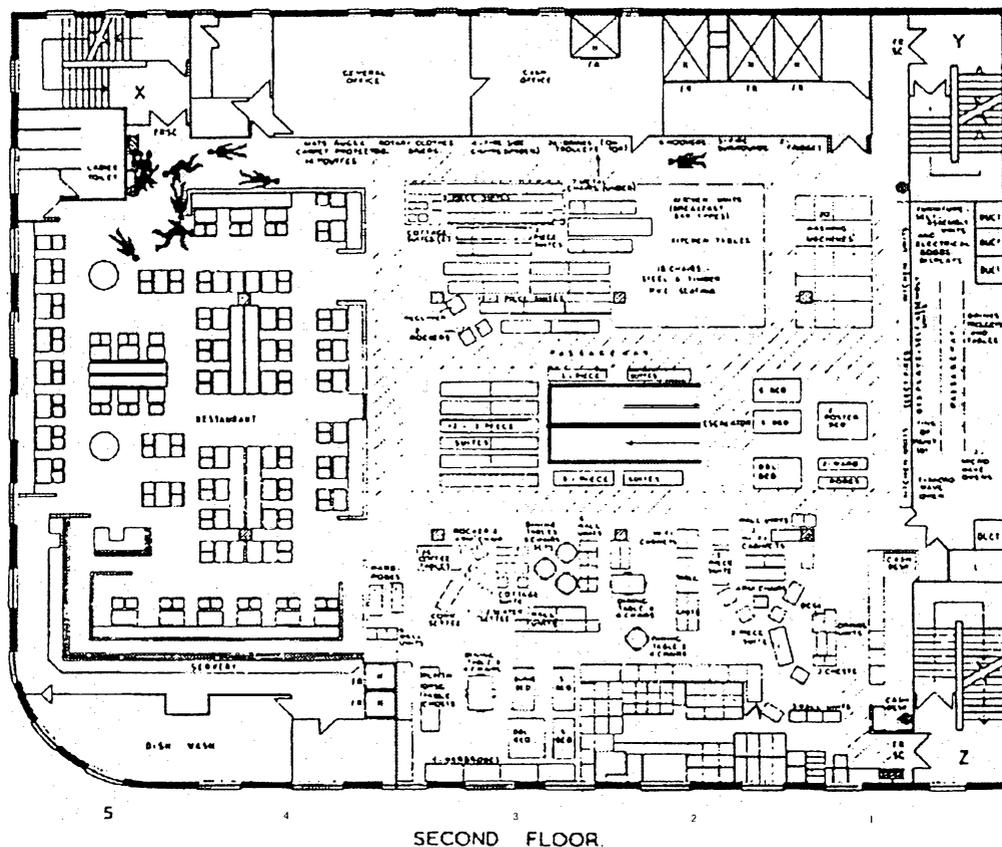


FIGURE 2 WOOLWORTHS-MANCHESTER, UK

There were no sprinklers in the building and no automatic detection. Portable extinguishers and some hose reels were provided throughout the building.

Multiple Retail Store-London, UK (1981)

This building was a 3 storey building with part timber and concrete floors supported by protected and unprotected steel columns. The fire was initiated

in a stockroom on the second storey which was not likely to have been occupied (except by the arsonist) at the time of the fire. The fire spread to the rest of the second level and then both upwards to the roof and downwards to the other storeys. The roof was covered with bituminous felt. The building was unoccupied at the time of the fire but a fireman lost his life when he entered the building and was unable to retreat when the fire grew in intensity.

The building was not sprinklered.

vi. *Shopping Arcade-North Devon, UK (1983)*

This fire occurred in the early morning in a building constructed during the last century. It is likely that many of the people in the building were asleep at the time of the fire. The building consisted of 4 levels of shops with residential flats above on one side of an arcade with a 5 storey hotel on the other side. The fire appears to have started in a ground level shop and spread horizontally and vertically. Fire also spread to parts of the hotel. An LPG explosion on the first storey resulted in a fatality. 200 people were successfully evacuated. Partial collapse of the building structure occurred about 20 minutes after arrival of the fire brigade.

vii. *Department Store-East London, Republic of South Africa (1984)*

This building in which 5 people died had no sprinklers, minimal compartmentation and much of the internal construction was combustible. There was no detection or alarm system. The building consisted of a lower ground storey (basement), a ground storey and a mezzanine level (timber). It appears that the fire originated in a video and television storage area on the ground floor. This immediate area was not occupied at the time of the fire although two store attendants smelled smoke and went to investigate. Their fire fighting efforts proved futile due to non-functional equipment and poor training. The fire spread rapidly and was assisted by a stack of cardboard boxes. The stairway between the lower ground floor and the ground floor (where the fire initiated) was noted as being alight. Most of the occupants escaped out of the front door or one of the other exits. Those that died were overcome with smoke and unable to find their way. It appears that the deceased were mainly staff.

The fire brigade was notified by outsiders and arrived in time to rescue 3 people who were trapped behind a blocked-up window in the lower ground floor.

viii. *Furniture Store-Maryland, USA (1984)*

This building was a three storey building with a two storey extension. Large openings were provided between storeys and unprotected stairways linked each storey. The building incorporated timber stud walls, timber floors and a timber roof covered with tar. There were no sprinklers and no smoke detection. Fire was ignited by workers using oxyacetylene equipment. It appears that the building was occupied by mainly staff at the time of the fire as there is no record of shoppers having to be evacuated. Three fire fighters were caught in the building during flashover. There was rapid fire spread

around the building and particularly across the roof space due to the extensive use of combustible materials in the building.

ix. *Shopping Ma&--Tennessee, USA (1988)*

This was a two-storey building of combustible construction having timber frames, masonry walls and a tar and gravel roof. There were no sprinklers but a smoke detection system was incorporated in the building. The fire originated on the second floor of the building. All of the occupants were evacuated with the exception of a person in a tanning salon who stopped to get dressed but then found that he could not exit due to the smoke. He perished due to smoke inhalation.

x. *Department Store-Osaka, Japan (1996)*

The building was a 5 storey building and had no detection and no sprinklers. This fire was the result of arson on the 4th floor, The fire spread rapidly (particularly the smoke) to the 5th floor. Employees and customers were evacuated from the 4th floor and below. All 15 occupants who died were located on the 5th floor. The cause of death in every case was smoke inhalation.

xi. *Clothing Store-New Jersey, USA (1991)*

This building was a 3 storey building with openings in external walls which apparently should have been protected (by drenchers etc) due to the vicinity to other buildings. A fire fighter was killed but details are not given as to the activities being undertaken by fire brigade at that time. An external wall collapsed and fire spread to 8 other buildings. There were no sprinklers in this building. At the time of the fire, the building was not occupied.

xii. *Civil Disturbance Fire-Nevada, USA (1993)*

This fire was started by rioters in a single storey mall. The building appears to have incorporated a combustible roof. One part of the mall was sprinkler protected. The rest was not. The sprinklered part of the building sustained only moderate damage while the non-sprinklered part was destroyed. One of the rioters perished in the fire.

xiii. *Dusseldorf Airport—Dusseldorf, Germany (1996)*

This building did not incorporate either smoke detection or sprinklers—except that sprinklers were incorporated in a kitchen and restaurant area. The building was of substantial fire-resistant construction being of reinforced concrete. The fire was initiated by maintenance work on a road way above part of the terminal building. Sparks from this work ignited PVC cabling within the ceiling of a flower shop in the terminal building. This fire spread along the cables and also due to the polystyrene insulating slabs throughout the ceiling space. The air handling system distributed smoke around the building—despite the fact that thermally activated fire dampers were present in the air-handling system. These latter dampers did not operate. 8 people died in a VIP lounge when the single exit from the lounge was blocked by smoke. Other people died when a lift arrived at an area which was saturated with smoke and the lift doors would not close due to the interference of smoke with the infrared door sensors. All 16 people died

from smoke inhalation. Over 60 people were injured and about 2500 were evacuated from the building. Figure 3 illustrates the spread of fire within the building. Descriptions of the fire have been given by Wolf (1996), Anon (1996), Favre (1996).

Refurbishment of the building has required virtual demolition of the terminal building due to the enormous cost of adequately cleaning the effects of the smoke (HCl, dioxins) from the building.

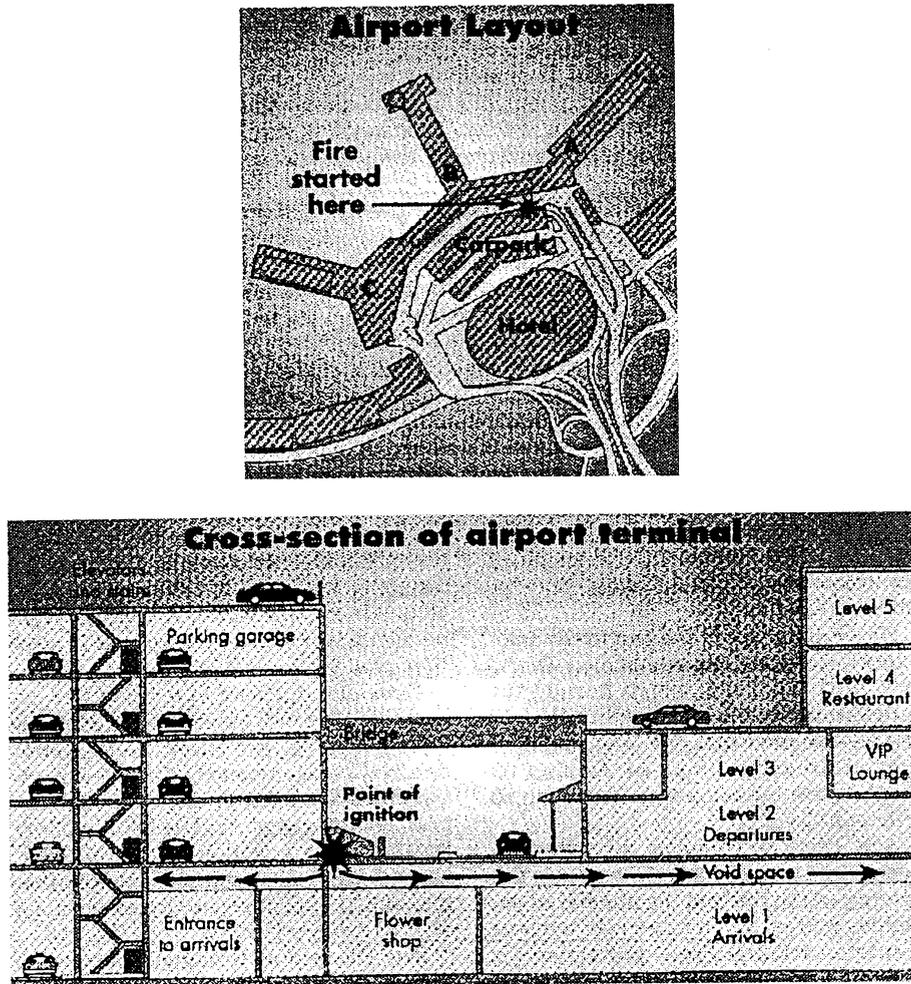


FIGURE 3 DUSSELDORF AIRPORT-DUSSELDORF, GERMANY

3.1 SUMMARY OF INFORMATION

As explained in the introduction to this report, another part of Project 6 is aimed at evaluating fire statistics for retail buildings in the US and Australia. There have been no fatalities in such buildings in Australia and it is therefore necessary to use the wider US data to understand the key factors associated with fatalities. It is apparent from these data that there are numerous situations in the United States where deaths have occurred but where no account of these fires can be found in the published literature. Nevertheless, these additional cases have been constructed based on the *National Fire Incident Reporting System* (NFIRS) in the US and are summarised in Appendix B for fires in retail premises during the period 1983 to 1993 (except 1986). It was recognised that data for 1986 contains a number of errors and its correction is a difficult exercise. The data for that year has therefore been ignored. The cases presented in Appendix B utilise the NFIRS wording which will appear to be somewhat stilted - it is nevertheless an accurate presentation of the data.

It is not unreasonable to consider that fire statistics for retail buildings will be similar in the United States and Australia. The use of US statistics is helpful as the number of fires recorded in the US data is very much higher than the number recorded in the Australian data.

It should be noted however, that the descriptions given in the NFIRS database are limited in that, while they generally give enough detail to give some idea of the course of the fire and the reasons why fatalities (and sometimes injuries) occurred, they do not give specific detail of the fires-merely the description of the classification in the NFIRS coding guide that was chosen to represent the specific situation. Thus some of them might be misleading. However, the impression from reading through them is that generally a coherent picture emerges that can be assumed to reasonably represent the incident.

In some cases the description obtained from the NFIRS data was inconsistent or confusing. This could result from several causes including errors in coding the incident forms or in data entry, but it could also result from trying to represent complex situations in a relatively limited format. In such cases the data as a whole for that incident has been reviewed and rationalised into what appears to be the most likely consistent description. This is how the summary data given in Appendix B has been derived. The presentation format adopted is the same as for Appendix A.

The retail buildings covered by the NFIRS statistics appear to include buildings where the primary function is retail, but where there is some sleeping facility-eg. sleeping accommodation at the rear of a shop. It is difficult to otherwise make sense of some of the deaths noted in Appendix B and discussed below.

3.2 STUDY OF SITUATIONS WHERE DEATHS OCCURRED

There have been 86 deaths in 77,996 retail fires over 10 years in the United States giving a death rate of about 1.1 per 1000 fires. This may be contrasted with a rate of deaths in residential buildings in Australia of 7.08 per

thousand fires (see Appendix C). The nature of these deaths in retail fires is now considered, There have been no deaths in retail buildings in Australia.

The descriptions, as given in Appendix B, have been reviewed and an assessment made of the likely scenarios leading to fatalities. For example, for some fires it is recorded in the field condition before injury that the victim was asleep. In other fires this field was blank or unknown or had some other entry, but another field indicated that falling asleep was the cause of the fire. In other cases the time of alarm and other circumstances discernible from the description make it probable that the victim was indeed asleep at the time of the alarm. Thus for many fires it has been assessed whether the victim was asleep at the time of alarm or was likely to have been asleep at that time or could have been asleep at the time of alarm.

This assessment indicates that about ten of the victims were asleep at the time of alarm, about twenty were likely to have been asleep and about six more could have been asleep at that time. Of the remainder about seven appear likely to have been involved in incendiary fires, another seven in suspicious fires-in some cases possibly involved in starting the fires or possibly subject to the attack themselves. It appears that fires in or from cars might have resulted in a further two of the fatalities and that a further twelve of the victims were bedridden, too young to act or too old to act, this contributing to their death. It appears that a further sixteen of the victims might have been intimately involved in the ignition (but not in an incendiary or suspicious manner).

Thus in these retail buildings it appears that well over one third of the fatalities might have been asleep at the time of ignition, a further one sixth "impaired" in some way (bedridden, too young, too old) resulting in over half of the victims likely to have been unable to respond to the fire. A further one third might have died as a result of having been intimately involved in the ignition (not necessarily in an incendiary or suspicious manner). Thus it appears that over two thirds of the fatalities might have resulted from circumstances and involvement such that the behaviour, age or condition of the person was a significant contributing factor in their death in the fire.

Flammable liquids and to a lesser extent gases seem to have been involved in many of the fires that resulted in civilian fatalities. They were identified as having been involved in fires resulting in 37 of the fatalities, including several with multiple fatalities, and were possibly involved in fires causing a further seventeen fatalities. Included in the latter category are fires in buildings identified as motor vehicle or boat sales or service and where no other cause of fire was identified (that is, if wood, plastic, etc was identified as involved in the ignition, the fires have been excluded from the seventeen mentioned) or other occupancies where incendiary or suspicious was flagged but no other material involvement specified.

The rationale behind the assumed "possible" involvement is that flammable liquids (usually petrol) is often flagged as being involved in the ignition of fires in these buildings. Thus flammable liquid or gas was involved with 43% of the fatalities and possibly involved in a further 19%-a possible total involvement of 62%.

There was one fire involving 5 fatalities in a sprinklered building. In this case the sprinklers operated and limited the spread of fire to the area of fire origin. It appears that flammable liquids were involved with this fire. Additional details are

being sought. There were no other recorded fatalities in known sprinklered buildings.

4 CONCLUSIONS

4.1 CASES REPORTED IN

The study of fire incidents reported in the literature indicated that:

- Fires only developed to a significant size if the fire was initiated in a remote area (eg. storage areas or ceiling spaces) or when the building or substantial part of the building was unoccupied.
- Key mechanisms of fire spread to other parts of the building appears to have been via a combustible ceiling or through the ceiling space—the latter mechanism being exacerbated by the presence of combustible construction or materials within the ceiling space.
- Sprinklering of only sections of a shopping centre is generally not a sound practice as substantial damage (including water damage) may occur to the sprinklered sections if the fire is initiated in a non-sprinklered part.
- The fire-brigade was most effective in controlling and extinguishing a fire when it was small. Sprinklers are an effective way of keeping a fire sufficiently small.
- There was no case where structural collapse of part of a building led to a loss of life.

The cases where deaths occurred are very limited but a number of observations are made:

- all deaths appeared to result from smoke inhalation. The possible exception to this is in the case of several firemen who may have died due to exposure to radiation and flames. There was no case where structural failure of the building resulted in death.
- In several cases, the occupant's path to safety was cut off due to the effects of the fire (which originated in an area remote from the victims) and a lack of knowledge of the location of the exit. The lack of an alternative exit path was a factor in several cases and in one case, exit construction which was incapable of providing adequate protection against the effects of the fire was also a factor.
- all deaths occurred in non-sprinklered buildings with no smoke detection system.

These conclusions are of interest but because of the selective nature of the data sources are not necessarily statistically valid.

4.2 US STATISTICAL DATA

According to the NFIRS fire statistics in the United States the death rate per thousand fires in retail buildings is 1.1. However a detailed consideration of these deaths indicates that the majority of victims were:

- impaired or asleep, or
- involved with flammable liquids-particularly petrol.

These conclusions were drawn from data on all fatal fires in retail premises recorded in the NFIRS database for a 10 year period. They therefore may be seen as statistically significant. It is reasonable to assume that the incidence of occupants being asleep or involved with flammable liquids will be much less in a modern shopping centre and therefore that the death rate will be significantly less than 1 per 1000 fires.

With the exception of one fire involving 5 fatalities there were no recorded deaths in sprinklered buildings. In the latter case it appears that flammable liquids were involved with this fire but that the sprinklers confined the fire to the area of fire origin.

Report written by:



P F Beever
Associate Professor
(Victoria University of Technology)

Approved by:



K R Slattery
Manager Research-Steel Market Programs



I D Bennetts
Research Associate



A C Lee
Liaison Officer
(Building Control Commission)



K W Poh
Senior Research Engineer



I R Thomas
Senior Research Associate

6 REFERENCES

- Anon (1992), *Sprinklers Provide the Edge in L.A. Riot*, Record, Sept/Oct.
- Anon (1996), *Mittens ins Inferno*, Der Spiegel, No. 16, pp 22-25
- AS 2577 (1983), *Collection of Data on Fire Incidents*, Standards Australia.
- Building Code of Australia* (1990), Australian Building Codes Board.
- Bennetts, I. D., Poh, K. W. and Lee, A. C. (1996), *BCA Fire Safety Requirements for Shopping Centres*, BHP Research Report BHPR/SM/R/045, June.
- Favre, J. P. (1996), *Comments on the Dusseldorf Airport Fire*, private communication
- Meyer, J. (1967), *Fires in Department Stores Over the Last Few Decades*, Journal des Sapeurs-Pompiers, No 10, pp 255-259.
- National Fire Incident Reporting System*, Federal Emergency Management Agency, USA.
- Thomas, I. R. (1996), *Fire Safety Design in Design of Steel Buildings for Fire Safety-European Perspective*, Australian Institute of Steel Construction.
- Wolf, A. (1996), *Seventeen Die in Dusseldorf Airport Terminal Fire*, NFPA Journal, July August, pp 43-46.

APPENDIX A
Summary of Case Studies
(as reported in fire literature)

area affected by fire: 8 stores involved. Fire did not enter sprinkler protected department store.

notes: Police attended burglar alarm at the jewellers store and encountered smoke coming from ceiling level. It was recognised that the fire had been burning vigorously before being observed and reported to the fire brigade. It is suspected that the fire entered the ceiling space and spread rapidly to other occupancies. In one case, the fire had spread above the deluge systems and therefore spreading to that occupancy. The late discovery of the fire and the continuous ceiling void space contributed to the rapid spread of fire. It was undetermined if a gas pipe in the ceiling space contributed to the spread of fire. Within 30 minutes after notification of the fire, the roof over the origin of fire collapsed aiding the brigades efforts to vent the fire.

Supermarket—Europe (Schaden Spiegel No 14—December 1971)

date: 1970
time at which fire noted: Unknown but building occupied.
cause of fire: Unknown
description of centre: Floor area 2500m²
type of construction: Non-combustible construction. Partition walls between storage and sales areas did not extend up to the roof.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 1 death
area of fire origin: Storage area
area affected by fire: Building destroyed.

notes: Fire was noted to spread rapidly within a few minutes. A shop girl went back into the building to get her coat and could not find her way out due to the smoke.

Supermarket—Europe (Schaden Spiegel No 14—December 1971)

date: 1970
time at which fire noted: Unknown but building occupied.
cause of fire: Fire in a “hot dog” stand but cause is not known.
description of centre: Primarily single storey but with one level of galleries (mezzanines) having a total floor area of 11000m².
type of construction: Fire-resistant construction in part.
sprinklers: Yes
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: A “hot dog” stand at the front of the main building.
area affected by fire: Large part of the building, including the roof was destroyed.

notes: The canopy to the “hot dog” stand was covered with grease and was not sprinklered. Also it appears that the sprinklers were under designed for the fire load and were overwhelmed on the gallery level. The fire spread from the stand canopy through a ventilation shaft and up into the gallery level. The sprinkler system was activated early but was unable to limit the fire. The smoke venting system did not work. Over 1000 people successfully evacuated.

Shopping Centre—Europe (Schaden Spiegel No 14—December 1971)

date: 1970 or 1971
time at which fire noted: Not known but building unoccupied at time of fire.
cause of fire: Electrical-smouldering fire above ceiling.
description of centre: One or two storey having a total floor area of 10000 m².
type of construction: Unprotected steel building. Storage areas were fire separated from the rest of the store. Combustible ceiling tiles were used.
sprinklers: Two storage areas sprinklered but sales area not sprinklered
smoke detectors: Unknown

A L'Innovation—Brussels, Belgium
(Journal des Sapeurs-Pompier Suisses—Octobre XCIII 10 / 1967)

date: Friday 22 May 1967

time at which fire noted: 1:34 pm

cause of fire: Unknown

description of centre: Building occupied a city block and was a combination of several older buildings that were building around each side of the block-see Figure 1 on p 5.

type of construction: Various types of construction-steel and reinforced concrete. Main building consisted of five levels of galleries surrounding a central void with a glazed roof. These levels had no compartmentation above ceiling or below it, an in the ceiling space, had services and air-handling facilities. Below normal ceilings in these levels were combustible ceiling which were provided for decorative purposes. Only two "fire-isolated" exits---one of which was full of combustibles and the other had doors at each level of timber and glass. No exit signs. Also open stairway connected the various levels. Distance from furthest point to an enclosed stairway was 60m. Main parts of the building were noted as being of unprotected steel-the two storeys below a restaurant on the third level and a larger part associated with another part of the building.

sprinklers: Not present

smoke detectors: Not present

deaths/irjuries: 400 civilian deaths-not clear how many people were in the building at the time of the fire as fire occurred during lunch break. Number of injuries unknown.

area of fire origin: Fire appeared to start in a clothing area on the second storey and was noted to spread very rapidly up an open stairway and up the atrium as well as horizontally.

area affected by fire: Whole building destroyed.

notes: Fire brigade arrived within 5 minutes of receiving call at which point it was noted that the whole building was ablaze. Large quantities of dense smoke made it almost impossible to see as people made tried to make their way out of the building. Collapse of parts of the building were noted. The construction supporting the restaurant and the levels above the restaurant collapsed about two hours after arrival of the fire brigade-well after the 200 people in the restaurant had died from smoke inhalation.

Winter Park Mall—Florida, USA (Fire Journal—November 1969)

date: Sunday 6 April 1969

time at which fire noted: 5:00 am

cause of fire: Unknown

description of centre: Approximately 31 shops contained with two, two-storey department stores at each end of the centre. Shop are generally single storey.

type of construction: External walls consist of wire lath panels covered with stucco on steel studs. Concrete floors and wall and steel roof framing. Lowest 10 feet of columns encased in concrete. Roof consists of composition covering over a gypsum deck. Internal walls of timber stud covered with gypsum plaster board.

sprinklers: Partial protection-only department stores protected but ceiling space sprinklers not provided. Deluge system also provided at glass entrance door to mall. A storage area of another store contained sprinkler heads tapped off the domestic water supply.

smoke detectors: Unknown

deaths/irjuries: 0 deaths. Number of injuries unknown

area of fire origin: Ceiling space of jewellers stores

Shopping Centre—North Hampton, UK (Fire Prevention No 160—June 1983)

date: Wednesday 19 March 1975
time at which fire noted: 1:40 am
cause of fire: Arson
description of centre: Eight storey centre. Carpark on top
type of construction: Concrete construction
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: Unknown
area of fire origin: Wooden workman's hut above shopping levels
area affected by fire: Four workman hut involved

notes: The hut's contained building material and LPG cylinders. The fire spread to four huts. LPG cylinders exploded. The hydrants were obstructed by building materials. The fire caused concrete spalling.

Multiple Store—Bognor Regis, UK (Fire Prevention No. 129—March 1979)

date: Thursday 26 August 1976
time at which fire noted: 2:00 pm
cause of fire: Unknown
description of centre: 3 storeys (1350 m² per storey)
type of construction: Timber floors
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: 1st storey stock room
area affected by fire: All 3 storeys severely damaged

notes: Stock room contained highly combustibles-paints, motor oils, plastics. The goods were stored in metal racks and in bins. Fire burnt through timber floor to ground level. All levels severely damaged. Ventilation at 1st storey aided fire spread and spread of toxic smoke and fumes.

Department Store—South Glamorgan—UK (Fire Prevention No. 121)

date: Friday 3 December 1976
time at which fire noted: 7:30 am
cause of fire: Unknown
description of centre: 3 storey department store with semi basements. Store contained textiles, clothing, footwear and household goods. (222 m² per storey)
type of construction: Walls of brick and stone, corrugated sheet metal wall extension. Semi-basement floor of concrete, upper floors of timber. Roof of part slates on timber, part concrete, part corrugated metal
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Assumed upper storey
area affected by fire: Ground, first and second levels

notes: Fire detected by large volume of smoke from upper storey. The fire was slow burning which eventually built enough to result in windows being broken. Rapid flashover occurred immediately after, and totally involved the ground, first and second storey. The roof, first, second, and some of ground floor collapsed. Adjoining occupancies received slight smoke and fire damage. Extent of fire brigade involvement not reported.

deaf/w/injuries: 0 deaths. Number of injuries unknown
 area of fire origin: Ceiling space within sales area.
 area affected by fire: Sales area destroyed
 notes: Sprinklers in storage areas did not activate due to power lines for sprinkler pumps being destroyed (they passed through the sales area). Everything was destroyed except for the two storage areas.

Furniture Store—Europe (Schaden Spiegel No 14—December 1971)

date: 1970 or 1971
 time at which fire noted: Building not occupied at the time of the fire.
 cause of fire: Electrical fire associated electrical sign.
 description of centre: Four storey furniture store, roof area 8000m'
 type of construction: Fire-resistant construction with numerous fire-resistant walls.
 sprinklers: Yes, except in the ceiling space.
 smoke detectors: Unknown
 deaths/injuries: 0 deaths. Number of injuries unknown
 area of fire origin: electrical sign
 area affected by fire: Fire spread rapidly throughout the entire complex.
 notes: By the time that the fire brigade arrived, large flames were coming from the roof and passed through the whole complex via the ceiling space and through unstopped openings in fire-resistant walls. Flames were fanned by high winds. Sprinklers were overwhelmed

Plymouth Meeting Mall—Pennsylvania, USA (Fire Journal—1970)

date: Saturday 10 Jan 1970
 time at which fire noted: 10:00 am
 cause of fire: Electrical fault in show case
 description of centre: Constructed 1966. 2 storey mall containing 110 shops. Large department stores located at each end of mall.
 type of construction: Unprotected steel framework, exterior walls of masonry, concrete floors and part concrete and metal deck roof.
 sprinklers: Partial protection-3 of the larger stores protected. Two of these stories had an additional deluge sprinkler system located at entrance to mall. Fire affected store not protected.
 smoke detectors: Unknown
 deaths/injuries: 0 deaths. Number of injuries unknown
 area of fire origin: Show case within clothing store-ground level
 area affected by fire: Ground and 1st level. 11 stores destroyed. 32 stores damaged from roof collapse and smoke and heat effects. Floor also collapsed.

notes: Fire spread within a show case containing many combustible decorations. Fire then spread within the store and vertically above a balcony to a shop above. 23 minutes lapsed before brigade was notified as spectators at the fire assumed someone else had alerted the brigade. An attempt to use a hose reel failed, but a deluge system that was manually activated at an adjoining store was successful in stopping fire spread to that occupancy. There was not all that many people in the mall as the fire just occurred after opening.

It took 1:30 hours for roof over fire origin to collapse. The ventilation system was still supplying fresh air and recycling smoke to other areas. The access to the air handling system controls were blocked by smoke. It was stated that 5 hours were taken for the fire to be brought under control by the fire brigade, Eleven stores were involved in the fire **but** another 32 stores were damaged by the roof collapse and smoke and heat effects.

High levels of smoke damage could have been reduced if non mesh type grilles at the front of shops had been replaced by glass. The air handling system was designed to be shut down manually but continued to operate and spread smoke around building. Venting in roof would have likely reduced smoke levels and spread in mall.

No emergency and evacuation warning system and no automatic detection system warning the brigade was provided. Manual pull-down alarms were also not connected to the fire brigade.

notes: Rapid spread of flame and smoke production as 460 litres of paint, 20 litres hair lacquer and curtains involved in fire. Fire spread up open staircase to first floor and through false ceiling. Extent of spread through ceiling void not stated. Smoke detectors had actuated and signaled the brigade. The building was heavily smoke logged upon arrival--contents of fire contributed to dense smoke production. Flashover occurred after brigades arrival. Fusible link activated fire door to close and saved part of ground floor from fire spread.

Shopping Centre—Missouri, USA (Fire Journal—September 1978)

date: Wednesday 10 May 1978
time at which fire noted: 12:47 pm
cause of fire: Unknown
description of centre: Contained 1 department store and 9 individual shops
type of construction: Unprotected, non combustibile construction. No fire walls separating shops
sprinklers: Partial-department store only-excluding coverage in concealed ceiling space
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Store room of shoe shop
area affected by fire: Fire confined to shop and storeroom of fire origin. Half of centre's roof collapsed due to excessive heat in ceiling space.

notes: Fire was detected by store manager in the storage area. Upon the arrival of the brigade, heavy smoke was throughout the store. Large amounts of heat and smoke contained within the concealed ceiling spaces'. The brigade were unsuccessful in venting the roof. The fire was contained within the store of fire origin by the brigade, but the excessive heat within the ceiling space resulted in half of the roof and ceiling assembly of the complex collapsing. A few sprinklers in the department store located underneath the shop of fire origin activated due to the excessive heat produced. Evacuation was successful although people did not wish to promptly evacuate. There was no building alarm provided.

Shopping Centre—California, USA (Fire Journal—November 1978)

date: Wednesday 17 May 1978
time at which fire noted: 9:42 pm
cause of fire: Electrical fault in ice making machine
description of centre: Single storey centre containing several structures. The building in which the fire occurred contained 8 stores and a department store at one end (2875 m² total building area, 875 m² department store)
type of construction: Timber framed and stucco construction. "Hotmop" tar roof
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Snack bar area
area affected by fire: Entire building-8 stores

notes: The fire started as an electrical fault in an ice machine. It was reported to have ignited adjacent timber stud walls in a snack bar area. The slow smouldering fire spread up to the concealed ceiling space. Once in the ceiling space the fire grew as result of the ignition of combustibile insulation and suspended ceiling material. The fire was detected by an employee when it spread into a store via the ceiling space. It was believed the fire was undetected in the ceiling space for up to 30 to 40 minutes. The entire building (8 stores) was destroyed.

Shopping Mall—California, USA (Fire Journal—January 1979)

date: Thursday 10 August 1978
time at which fire noted: 12:25 am
cause of fire: Unknown
description of centre: 2 storey mall consisting of 19 shops. (1432 m² building area)

Shopping Centre—Birmingham, UK (Fire Prevention No. 121)

date: Wednesday 12 January 1977
time at which fire noted: 7:30 pm
cause of fire: Unknown
description of centre: Constructed 1970-52 shops connected by roofed walkway. 2 open courtyards. All shops 2 storey. (16,000 m² total building area)
type of construction: Walls of brick infill, reinforced concrete floors, roof, beams and columns. Canopy of shops and roof of covered with timber.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ground floor furniture store
area affected by fire: 17 shop units involved. varying degree of fire, smoke and heat damage.

notes: A passerby noticed fire in display window and alerted security guard. In the few minutes it took for security to arrive, the fire developed and the front window started to crack. The guard broke the front window in an attempt to fight the fire. Flashover occurred and fire spread over the walkway to an adjoining newsagent store. Brigades arrival saw the two units alight and roof walkway alight. 20 minutes later, the roof collapsed. It was not stated if fire spread to second level. 17 shop units were involved in which 5 were not occupied by a tenant. It was stated that the brigade took 2 hours to control the fire.

Covered Market and Shops—West Yorkshire, UK (Fire Prevention No. 127—October 1978)

date: Friday 4 November 1977
time at which fire noted: 4:45 am
cause of fire: Electrical fault, ignited combustible stall materials
description of centre: Market area of 108 stalls surrounded at perimeter by 46 shops units, 1 supermarket and 3 storey car park on two sides.(14,000 building site)
type of construction: Walls of masonry and concrete. Concrete floors. Shop unit roof of asphalt covered concrete, mall roof of steel beams and timber battens with part resin bonded glass fibre, part bituminous felt.
sprinklers: Not present
smoke detectors: Not present-heat detector in 1 shop, break glass alarm in market hall and 8 shops
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Market stall
area affected by fire: En&ire market, 23 shops units

notes: Security guard saw one stall alight after short circuit. Dense smoke filled market area. Shortly after arrival of brigade, entire market area ablaze. LPG cylinder in marker area exploded intensifying fire. Entire market contents destroyed and market roof area collapsed.

Department Store—West Glamorgan, UK (Fire Prevention No. 128—December 1978)

date: Wednesday 15 February 1978
time at which fire noted: 9:00 pm
cause of fire: Unknown
description of centre: Constructed 1968. Four storeys and basement. (8100 m² per storey)
type of construction: Steel framed, masonry walls. Roof part asphalt covered concrete, part timber boarded and slate. Concrete floors
sprinklers: Not present
smoke detectors: Yes-linked to fire brigade
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ground storey
area affected by fire: Ground and 1st storey

appears there was insufficient time for the occupants to find their way to stairs on level 1. The roof at level 2 collapsed within another hour which vented the fire.

The fire caused spalling of the concrete elements, however much damage was caused by heat and smoke. The mall area was not effected by fire, but very light heat and smoke damage was evident. No sprinklers were set off in the mall.

Fire and smoke appears to have spread rapidly throughout the ceiling and up the vertical openings causing the rapid achievement of untenable conditions on the upper floor.

Department Store—New York, USA (Fire Journal—November 1979)

date: Saturday 20 Jan 1979
time at which fire noted: 1:30 pm
cause of fire: Arson-lighting of furniture and mattresses occupied in store room
description of centre: Single storey department store
type of construction: Masonry block construction with metal deck roof
sprinklers: Yes-1 metre clearance (3 feet) from storage racks
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Store room-polyurethane and timber furniture and bedding mattresses stored on four portable racks-0.5 x 2.6 x 2 (h) m racks and a single rack 4 m (12 feet) high (1500 m² store room area)
area affected by fire: Fire confined to store room-furniture and some mattresses.

notes: Employee discovered the fire in the store room and noted the sprinklers had not been activated. An attempt to use fire extinguishers to extinguish the blaze was ineffective. Soon after their attempt, the sprinkler heads activated, 9 minutes after the fire was noted. The sprinklers had the fire under control and the brigade completed the extinguishment.

Department Store—Vienna (Fire Prevention No. 131—July 1979)

date: Wednesday 7 February 1979
time at which fire noted: Unknown
cause of fire: Welding sparks ignited lubricating oil
description of centre: 3 storey department store--expansion renovations
type of construction: n/a
sprinklers: Yes-turned off due to renovations
smoke detectors: Yes-turned off due to renovations
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Second storey escalators connecting to 3rd storey
area affected by fire: Entire building

notes: Sprinklers and detectors turned off as extension works undertaken to escalators. Attempt to extinguish fire unsuccessful and entire building became involved.

Footwear and Furniture Shop—West Yorkshire, UK (Fire Prevention No 133—1979)

date: Thursday 15 February 1979
time at which fire noted: 2:04 am
cause of fire: Unknown
description of centre: 2 storey shop. Furniture retail at ground level, footwear retail at first level. (each floor area 900 m²)
type of construction: Masonry walls, ground floor concrete, first floor timber. Fibre board ceiling and slate on timber roof.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ground floor display and storage area

type of construction: Masonry construction with steel and timber framed roof.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Appliance store-first floor
area affected by fire: Vertical fire spread from first floor to second floor ceiling space through unprotected air conditioning ducts.

notes: Upon arrival of the brigade, heavy smoke was coming from the building. The fire was located at the rear of a first floor appliance store. Access to the fire was restricted due to a locked rear door and high piling of stock, The fire spread vertically through the air conditioning duct work to the ceiling space of the second floor. A section of the roof collapsed 27 minutes after the arrival of the fire brigade.

Department Store—Oklahoma, USA (Fire Journal—July 1979)

date: Wednesday 27 September 1978
time at which fire noted: Unknown-after opening hours
cause of fire: Overheating of aquarium electrical motor
description of centre: Store contained mezzanine level used for the storage of goods. Storage area separated from retail area by timber stud wall. Storage area contained artificial flowers and paper goods
type of construction: Unknown but mezzanine of timber construction.
sprinklers: Yes
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Below mezzanine level
area affected by fire: Above and below mezzanine level

notes: Brigade and police notified by activation of sprinkler system. Upon arrival, building heavily smoke logged and the fire was located above and below mezzanine level. During the fire, the mezzanine level partially collapsed and broke a sprinkler line feeding one **head**. Hand lines were then used to extinguish the fire.

Younkers Department Store, Merle Hay Mall,—Iowa, USA (Fire Command—July 1979)

date: Sunday 5 November 1978
time at which fire noted: 9:30 am
cause of fire: Leakage of air conditioning gas-explosion
description of centre: Constructed 1958. After many extensions, 2 storey mall contained many individual shops and a 2 storey department store (Younkers). (department store 8400 m² per storey). Department store consisted of 7 internal stairways and 2 banks of escalators. Two stairs discharged externally and the remaining internally into the ground floor.
type of construction: Reinforced concrete construction. Part unprotected and non combustible roof structure and reinforced concrete with tar and gravel covering.
sprinklers: Partial protection -mall area. Fire-affected Younkers Store not protected.
smoke detectors: Unknown
deaths/injuries: 10 civilian deaths. Number of injuries unknown
area of fire origin: Ceiling space-level 1 and 2 of department store
area affected by fire: Levels 1 and 2

notes: The building was only occupied by staff at time of fire. Five employees at other end of level 1 fire floor did not hear gas explosion. Once they were aware of the fire, they could not reach an exit due to rapid fire and smoke development They escaped through a window to the ground floor roof below.

Upon arrival of the fire brigade, (2 minutes after explosion) heavy smoke was coming out of the building and the flames were external of the store. The fire on level 1 was under control after 3:30 hours but the fire had also originated on level 2. After an hour of fighting the fire on level 1, they were notified that people were still on the level 2. Ten people were later found, overcome by smoke asphyxiation on level 2. It

type of construction: Steel framed, masonry walls, concrete floors. Part slate roof on insulation board and part bitumen on galvanised steel sheeting.

sprinklers: Not present

smoke detectors: Not present. Break glass alarms provided

deaths/injuries: 10 civilian deaths. Number of injuries unknown

area of fire origin: Second level

area affected by fire: Second level severe fire damage. Levels 3,4,5 heat and smoke damage and 1st level slight fire damage

notes: Fire started in 2nd level furniture display. Vertical stacking of furniture against walls and polyurethane foam filled mattresses caused rapid spread and heavy black smoke production. Heavy smoke movement down to first level by open escalator in middle of floor area. Three enclosed staircases were provided from the fire floor, One of the staircases became smoke logged as doors were continuously opened. The other 2 staircases were inaccessible due to the fire. Two staircases at the level above were padlocked with the key in glass box. Panic and smoke resulted in occupants not locating the key and subsequently finding an alternative exit to the roof.

At the time of the fire, 500 people were in the building with 70 to 100 in fire affected level (third floor). Once the fire was located, a communication breakdown led to the fire brigade never being called and an alarm being activated on selected floors. A taxi driver incidentally alerted the brigade of the fire incident and a security guard at the level below had also activated a break glass alarm bell. Occupants attempted to use a hose reel from 1st and 2nd level, but this was ineffective. It was reported that 2:30 hours were taken until the fire was brought under control by the fire brigade.

10 deaths occurred on level of fire origin. Occupants evacuated by the stairs and escalators until the stairs became smoke logged and many were saved from windows and at roof level. The lack of sprinkler protection, fire alarm activation and delayed call time to the brigade stalled any action to be taken in the initial stages of the fire. The excessive fire load and open escalator shafts allowed smoke to migrate between floors. The deceased were believed to be elderly and were eating meals at the restaurant.

Department Store—New York, USA (Fire Prevention No 133—1979)

date: Thursday 14 June 1979

time at which fire noted: During operating hours

cause of fire: Unknown

description of centre: 16 storey department store.

type of construction: Unknown

sprinklers: Yes

smoke detectors: Unknown

deaths/injuries: 1 fire fighter death. Number of injuries unknown

area of fire origin: 5th storey-sports department

area affected by fire: Confined to storey of fire origin

notes: Thousands of occupants and employees were evacuated. It was stated the evacuation took 90 minutes. Sprinklers were provided but failed to operate. The reason for their failure is undetermined. The sporting goods produced dense and toxic smoke. One fire man died while fighting the fire. The fire was confined to the storey of fire origin but the lower levels received varying amounts of smoke and water damage.

Furniture Store—West Midlands, UK (Fire Prevention No. 136—June 1980)

date: Wednesday 25 July 1979

time at which fire noted: 12:00 am

cause of fire: Unknown

description of centre: 4 storey furniture retail store (375 m² per storey)

type of cons: Unknown

sprinklers: Not present

smoke detectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Ground floor, *one* armchair and table

area affected by fire: Ground floor and first floor. First floor roof and all contents.

notes: Fire discovered by policeman as flames were external to the building. A 14 kg butane gas cylinder exploded during the fire. Fire spread to the first storey causing damage to the roof and all contents.

Shopping Centre—Missouri, USA (Fire Journal—July 1979)

date: Friday 23 February 1979
time at which fire noted: 9:30 pm
cause of fire: Unknown
description of centre: Mall consisted of a 14 small shops, a supermarket and a department store.
type of construction: Non combustible construction, with masonry block walls and steel deck roof supported on steel members. A suspended ceiling of non-combustible construction was also provided.
sprinklers: Yes-supermarket and department stores only—concealed space protection unknown
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Fire located within 2 shops
area affected by fire: Mall area and unspecified number of shops affected--excluding department store and supermarket

notes: The brigades arrival, 2 minutes after notification, found 2 rear shops involved in the fire. Access to the fire was limited. Unsuccessful attempts were made to ventilate the fire from the roof. The fire was contained to the mall and did not extend to the supermarket or department store. Half of the mall's roof collapsed within 30 minutes of the brigades arrival. Large concealed spaces and limited access to the fire were factors contributing to the development and spread of the fire. It was stated that the fire was extinguished within 3:30 hours.

Department Store—Wisconsin, USA (Fire Journal—November 1979)

date: Wednesday 18 April 1979
time at which fire noted: Occurred during operating hours of centre
cause of fire: Spontaneous ignition of soiled towels stored in canvas bag (hair-wave chemicals combining with sodium bromide)
description of centre: 2 storey department store connected to multi store shopping centre
type of construction: Generally fire resistant construction
sprinklers: Not present
smoke detectors: Not present-heat detectors provided
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Beauty salon storage area
area affected by fire: Spread to adjoining storage area of another store. Smoke and heat damage to 9 other shops.

notes: Estimated that fire remained undetected for at least 45 minutes. The ventilation system was reported to have delayed detection by extracting the smoke and heat produced. The heat detector was also located above the ventilation vent. Upon arrival of the brigade, occupants were evacuating and the fire had spread from within the storage area to the department store's storage area. The fire was extinguished by the brigade, but 9 shops reported smoke and heat damage.

Woolworths—Manchester, UK (Fire Prevention No. 138—October 1980)

date: Tuesday 8 May 1979
time at which fire noted: 1:25 pm
cause of fire: Electrical or arson
description of centre: 1929 constructed-1970 last extension. 6 storey, 2 basement.

area affected by fire: 4 shops involved

notes: Fire started in loft area of restaurant which was not sprinkler protected. A manual fire alarm was activated and the brigade telephoned. A back-draft explosion occurred as the open doors the brigade had used to gain access to the fire supplied oxygen to the fire area. As a result, fire spread to a total of 4 other stores through the concealed ceiling space and non-fire-resistant walls. The failure of the steel deck roof pushed out the rear external wall.

Shopping Centre—Quebec, Canada (Fire Journal—May 1980)

date: October 1979
time at which fire noted: 5:30 pm
cause of fire: Unknown
description of centre: Single storey centre containing 74 shops including department store. Department store and food store located at opposite ends of the mall.
type of construction: Unknown
sprinklers: Yes-partial protection-Department store and food store protected
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Mall area-general
area affected by fire: 72 stores destroyed excluding department store and food stores. Contents of latter stores severely affected by smoke.

notes: Manager of food store noticed smoke coming from the mall area and employee notified brigade. At 6.30 pm glass doors and windows in the mall shattered by the heat of the fire and sprinklers in the food and department store activated. The stores are located at opposite ends of the mall. The fire destroyed 74 stores. The spread was stated to being from combustible loading and lack of fire walls within the non sprinklered mall. The food store activated 180 heads and the department store 55 heads. The brigades use of a large number of hose streams (hydrants) and the large number of heads activated reduced the water supply pressure for fire fighting. Damage to food and department mainly to contents.

Merseyside Shopping Centre—Liverpool, UK (Fire Prevention No. 136—June 1980)

date: Monday 17 December 1979
time at which fire noted: 9:30 pm
cause of fire: Overheated light located too close to combustibles in storage area containing boxed synthetic textiles.
description of centre: 3 storey shopping centre with basement and lower basement, 10 storey hotel and 4 storey ballroom suite above. 3 storey car park adjoining. 194 shops, 224 market stalls and 162 beds contained. (2.2 hectare site)
type of construction: Predominantly of reinforced concrete construction. Internal walls of masonry with one hour fire doors. Floors of reinforced, prestressed hollow block concrete. Roof mainly of concrete with 2 x 84 m² fibreglass dome roof lights automatically opening in the event of a fire.
sprinklers: Basement level only
smoke detectors: Smoke detectors in 7 shops-market, storage, plant and lift motor room.
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: First floor storage area of bed linen shop.
area affected by fire: 1st and 2nd levels. 25 shops and 224 stalls of market area.

notes: The fire was discovered by a security patrolman. As the fire was located in a bed linen storage area, it grew rapidly. The fire spread outside the shop of fire origin and across the mall to shops opposite. The shops opposite also opened to the market stalls. The fire went through these shops and out into the market stalls. The effect of wind on smoke and fire movement was noted. Eventually the fire vented itself through the roof.

Brigade encountered difficulties as the large scale of centre hampered access and positioning to fight the fire. Accurate assessment of fire size could not be made. It was stated that the brigade had the fire surrounded within 3 hours.

area affected by fire: Entire ground and part 1st floor. Other floor varying damage. Adjacent building slight radiant heat damage

notes: Upon discovery, only one arm chair and table were alight. Within 6 minutes as brigade arrived, entire ground floor alight and spreading to first floor. Furniture materials caused intense and rapid fire spread. All floor affected by fire and contents damage.

Department Store—North Yorkshire, UK (Fire Prevention No. 137—August 1980)

date: Tuesday 4 September 1979
time at which fire noted: 6:00 pm
cause of fire: Arson
description of centre: 2 storey and 1 basement. (650 m² per storey)
type of construction: Unknown
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Stockroom-first storey
area affected by fire: Stockroom

notes: Fire detected by passer by noticing smoke coming from roof. Entire stockroom damaged including walls, roof and contents. Stock in remaining building parts damaged. Steel roof members collapsed in stock room area. Aerosol cans, paints and lacquers exploded and aided fire intensity.

Department Store—Worcester, UK (Fire Prevention No. 139—December 1980)

date: Monday 1 October 1979
time at which fire noted: 1:40 pm
cause of fire: Arson-ignition of polyurethane filled pillows
description of centre: 3 storeys and 1 basement (2100 m² per storey)
type of construction: Masonry walls and concrete floors
sprinklers: Not present
smoke detectors: Not present-Fire alarm provided
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: First floor storeroom
area affected by fire: First floor and canteen of second floor

notes: Three hundred patrons and 100 staff were evacuated within 3 minutes. Goods in storeroom were stacked in metal shelving and bins that required close extinguishment. The manager attempted to use extinguisher and hose reel to fight fire but both methods were ineffective. Moments before brigades arrival, a front window exploded and smoke and flames became external. Fire spread externally to canteen at level above fire origin (1st floor). Rapid fire spread due to stockroom filled with plastics and being a non sprinklered building.

Front curtain wall collapsed and steel joist penetrated masonry party wall due to heat. General structure had not collapsed. It is reported that 3.30 hours were taken to control the fire. At 7 am the next day the fire was fully extinguished.

Shopping Centre—Iowa, USA (Fire Journal—Ma)

date: October 1979
time at which fire noted: After opening hours
cause of fire: Suspected arson
description of centre: Single storey shopping centre with several shops including a restaurant.
type of construction: Steel deck roof
sprinklers: Yes-partial sprinkler protection in limited areas
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Loft area of restaurant

The fire damage included 25 shops and the market area of 224 stalls being totally lost. Badly cracked and spalling concrete external wall and roof frame distorted but not collapsed. The partial installation of sprinklers is again ineffective if the fire origin is not within that sprinklered area.

Note that sprinklers had been recommended on two previous occasions by the fire brigade. Sprinklers had only been installed in basement areas.

Retail Store—Oregon, USA (Fire Journal—November 1980)

date: April 1980
time at which fire noted: 1:00 pm
cause of fire: Cutting and welding operations
description of centre: Constructed 1905. 4 storey retail store selling lighting fixtures.
type of construction: Masonry external walls supported by timber framing. A built up tar roof.
sprinklers: Yes-basement only
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: First level mezzanine
area affected by fire: Unknown

notes: The fire was detected within 3 minutes by an employee. Sparks from work on the second level fell onto cardboard boxes on the mezzanine level below. Extinguishers were used but were ineffective. It was reported the brigade took 2:30 hours to extinguish the fire.

Electrical Store—West Yorkshire, UK (Fire Prevention No. 140—February 1981)

date: Wednesday 7 May 1980
time at which fire noted: 5:12 pm
cause of fire: Waste paper ignited by unknown source at 4th storey
description of centre: 6 storeys—electrical retailer
type of construction: Unknown
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: 4th storey store room
area affected by fire: 4th storey store room and adjacent store rooms, water damage to 3rd storey and lower levels.

notes: Employee saw smoke and alerted manager. Manager went to fire affected storey and was confronted by smoke as he opened door to fire affected storeroom. Another employee raised the alarm. An unsuccessful attempt was made to distinguish fire by hose reel by the fire brigade. Fire was contained to the 4th storey and had minimal spread to an adjoining storeroom.

Retail Store—Michigan, USA (Fire Journal—November 1980)

date: August 1980
time at which fire noted: 9:00 am
cause of fire: Neon sign transformer overheating
description of centre: Centre consisting of several shops (including fabric shop) facing into a covered walkway.
type of construction: Store most affected by fire (fabric store) consisted of concrete block external walls. Ceiling of mineral tiles on steel supports. The walkway consisted of steel on steel supports with fire retarded acoustic cellulose insulation laid on top.
sprinklers: Yes-to covered walkway-excluding ceiling space.
smoke detectors: Not present
heat detectors: Yes-to walkway and fabric shop near fire origin
deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Ceiling space above walkway

area affected by fire: Little fire spread

notes: On the day before the fire, smoke was noticed by an employee. The smoke disappeared when the air conditioning system was shut down and doors were opened. No further action was taken. When the main centre's doors were opened the next morning, smoke was present and was heaviest in the fabric store. At 10:30 am access was obtained to the locked fabric store. Two fire extinguishers and pails of water were used to extinguish the fire in the ceiling space within the store. The brigade had not been alerted as yet. The brigade was notified at 10.44 am and finished extinguishing the fire shortly after. The neon sign's electrical transformer had been covered with insulation material which caused overheating. There was little fire spread but a large amount of smoke due nature of the insulation material.

Grocery Store—Quebec, Canada (Fire Journal—May 1981)

date: October 1980

time at which fire noted: 5:25 am

cause of fire: Electrical appliance fault in restaurant

description of centre: A shopping mall located adjacent to a grocery store. Shopping mall consisted of at least 6 stores-including a restaurant. The grocery store provided entry into the enclosed mall.

type of construction: The grocery store consisted of concrete block walls with masonry outer skins. Steel deck roof on steel joists. A suspended ceiling of plasterboard and decorative timber. The mall consisted of similar construction, except the ceiling consisted of mineral fibre tiles.

sprinklers: Grocery store-yes, including concealed ceiling space sprinklers
Shopping mall-not present

smoke detectors: Grocery store-unknown
Shopping mall-not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Restaurant

area affected by fire: Fire damage to restaurant of fire origin, mall and entrance ceiling area of grocery store. Grocery store's merchandise was damaged by smoke.

notes: Passerby discovered the fire in the restaurant and notified the brigade. They were unable to contain the fire due to insufficient hose lines and high wind currents. The fire spread into the mall area and at 8:15 am the grocery store's sprinklers activated. 34 heads were activated which prevented further spread into the store. At 12 noon, it was reported that the brigade had controlled the fire. Wooden ceilings of the grocery stores was limited to being scorched and blackened by the fire.

Floreat Forum Shopping Centre—Perth, Australia (Fire Prevention No. 143—August 1981)

date: November 1980

time at which fire noted: Opening hours

cause of fire: Unknown

description of centre: Constructed 1965. Single storey shopping centre.

type of construction: Ceiling and roof insulation combustible

sprinklers: Yes-partial protection to ceiling void compartment space.

smoke detectors: Unknown

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Food store

area affected by fire: Food store and ceiling space

notes: Shop owner efforts to fight fire with fire extinguisher failed. Fire spread rapidly into the ceiling space. A number of shops suffered damage by fire, smoke and heat. An adjoining retail store contained internal sprinklers, draft stop curtains within the ceiling space and a line of sprinklers heads outside of that barrier. The sprinklers in the void space were an added precaution to the curtains, if the fire became too large. Installation of the draft curtain and sprinklers were upon an audit recommendation by the Insurance Council of Australia after an extension to the centre. Their implementation saved fire spreading into their store via the ceiling space.

Mini Mall—Michigan, USA (Fire Journal—September 1981)

date: December 1980
time at which fire noted: 10:23 pm
cause of fire: Arson-accelerant sprayed on carpet outside of men's store.
description of centre: Single storey mini mall. Contained 6 shops-menswear, sporting goods. offices (816 m² total building area)
type of construction: Concrete block and brick veneer.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Carpet area outside menswear shop
area affected by fire: Entire mall destroyed

notes: Upon notification by a passerby, the brigade arrived seeing heavy black smoke coming from the building. The windows of a front store were already cracked but still in place. Attempts to ventilate the roof were unsuccessful due to the weakening roof structure. The building became totally involved soon after. It was stated that an accelerant had been sprayed on the carpet floor near the menswear store and flames had spread up the walls to the concealed ceiling space. The entire mall was destroyed.

Multiple Retail Store—London, UK (Fire Prevention No. 153—October 1982)

date: Thursday 30 April 1981
time at which fire noted: 5:09 pm
cause of fire: Arson-employee set fire to store room
description of centre: 3 storey building. (500 m² per storey)
type of construction: Masonry construction with part concrete and glazed roof covered with bituminous felt. Floors of part timber and concrete on protected and unprotected columns. Ground storey protected; 1st storey not protected.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 1 fire fighter death. Number of injuries unknown
area of fire origin: Stockroom—2nd floor
area affected by fire: Ground, first, second floors.

notes: Fire started on 2nd floor and spread both downward and vertically to roof. Internal fire fighting was difficult as walls started to crack and floor and ceilings started to collapse. One fireman died by being knocked unconscious or overtaken by flashover. Second storey contents and roof fully destroyed. Ground and first storey contents destroyed by fire and collapse of members. Heat, smoke and water damage to adjacent residential and office buildings.

Shopping Centre—Georgia, USA (Fire Journal—January 1982)

date: May 1981
time at which fire noted: 10:00 pm
cause of fire: Arson--gas explosion to hair salon
description of centre: Centre consisted of 3 buildings consisting of individual stores
type of construction: Concrete block walls. Metal deck roof
sprinklers: Yes
smoke detectors: Not present
deaths/injuries: 0 deaths. Arsonist caught in explosion-85 % burns
area of fire origin: Shop-hair salon
area affected by fire: Fire confined to hair salon. Adjoining shops slight water damage.

notes: The explosion was heard and after investigating, the employee saw flames coming from shop. The employee warned other shops of the explosion and notified the brigade. Upon the brigades arrival the sprinklers had controlled and extinguished the fire. It was not stated if a sprinkler flow switch was connected to the brigade.

Shopping Mall—Missouri, USA (Fire Journal—May 1982)

date: August 1981
time at which fire noted: 4:00 am
cause of fire: Arson
description of centre: Single storey centre containing 27 individual shops (24,600 m² total building area)
type of construction: Ordinary construction (timber)
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Cabinet in store
area affected by fire: 10 shops destroyed—fire spread through ceiling space. Remaining 17 stores heavily smoke and heat damaged.

notes: A policeman on patrol discovered the fire and notified brigade. The brigade found the store of fire origin and after venting the fire by breaking the front window, flashover occurred which forced them back due to the large flames. The fire spread to 9 other stores through the concealed ceiling space. The brigade vented the shopping centre through the roof. The fire was reported to have been brought under control in 2.30 hours.

Furniture Store—Sunderland, UK (Fire Prevention No. 151—July/August 1982)

date: Friday 2.5 December 1981
time at which fire noted: 7:30 pm
cause of fire: Unknown—assumed electrical fault
description of centre: 3 storeys and basement (525 m² per storey)
type of construction: Unknown
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ground floor
area affected by fire: Ground floor fire damaged, first floor partial fire damage but complete smoke damage to first and second level. Basement restricted damage by brigade.

notes: Polyurethane foam in furniture caused rapid spread of fire and large quantities of smoke. Brigade limited fire to ground floor. Stairway to first floor severely damaged by fire. Smoke caused damage to all first and second floors.

Shopping Centre—Illinois, USA (Fire Journal—September 1982)

date: Tuesday 26 January 1982
time at which fire noted: 1:53 pm
cause of fire: Arson—gas explosion to beauty salon
description of centre: Single storey centre containing 24 shops. (7800 m² total building area)
type of construction: Unprotected non-combustible construction
sprinklers: Yes
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Beauty salon
area affected by fire: Store of fire origin

notes: An arsonist attack on beauty salon was by timed gas explosion aided with petrol. The explosion caused damage to sprinklers in the immediate area but the other sprinkler heads controlled the fire until the brigade arrived. The fire appears to have occurred during the weekend as all shops were closed.

Department Store—London, UK (Fire Prevention No 160—June 1983)

date: Wednesday 28 July 1982
time at which fire noted: 5: 13 am
cause of life: Unknown-during renovation
description of centre: Building part 4 and 6 storeys.
type of construction: Unknown
sprinklers: Yes-shut off due to renovation
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of life origin: First storey
area affected by fire: Entire building severely damaged

notes: When the fire was discovered the first storey was well alight. The building was undergoing renovations and subsequently the sprinklers were turned off. Scaffolding hampered brigade access and oxygen and LPG cylinders were exploding. The entire building was severely damaged.

Hypermarket—Telford, UK (Fire Prevention No. 165—December 1983)

date: Tuesday 22 February 1983
time at which fire noted: 6:20 pm
cause of life: Unknown
description of centre: Built in 1981. Single storey, with part 2 storey. Built on extremities of shopping centre. (400 m² per storey)
type of construction: Steel framed, concrete block walls covered externally in steel. Concrete floor and metal deck roof covered by pre-felted polystyrene and layers of felt with chippings.
sprinklers: Not present
smoke detectors: Yes-linked to brigade.
deaths/injuries: 0 deaths. Number of injuries unknown
area of life origin: Single storey part-picture framing area
area affected by fire: Small section of sales damages. entire ground floor smoke and heat damage.

notes: Smoke detectors called brigade and they arrived within 4 minutes to find the building heavily smoke logged and flames along edges of roof. Quick smoke production and size of fire as rapid spread to roof space. Fire started on picture frames and then soft furnishings. All electrical circuits isolated except that 4 pendant lamps left on for security purposes. Steel frames above fire area collapsed and subsequently the entire roof beyond repair. It was reported the brigade took 68 minutes to control the fire.

Carpet Store—Pennsylvania, USA (Fire Journal—May 1983)

date: May 1983
time at which fire noted: 10:25 am
cause of fire: 200 watt light bulb located too close to carpet padding
description of centre: Single storey and basement level carpet retail store located in the single storey shopping centre. Basement level used for storage of polyurethane carpet padding. Fire wall separated store from centre. (1200 m² carpet store)
type of construction: Steel truss roof
sprinklers: Not present
smoke detectors: Yes
deaths/injuries: 0 deaths. Number of injuries unknown
area of life origin: Basement area of carpet store
area affected by fire: Entire store

notes: Upon arrival of the brigade, heavy smoke was noted to have been coming out from the front of the store. Flames were seen coming from the rear of the basement level. Hose reels were used by the

brigade but the fire was too intense. Within 10 minutes the entire rear section was ablaze. It was determined that the building could not be saved and protection of the other stores was necessary. Within two hours, the roof collapsed. It was reported that the brigade had the fire under control within 3 hours and extinguished in 8 hours.

Shopping Arcade—Lancashire, UK (Fire Prevention No. 168—April 1984)

date: Monday 6 June 1983
time at which fire noted: 12:22 am
cause of fire: Unknown-suspect fire started in restaurant kitchen.
description of centre: 3 storey arcade. 8 occupancies—Ground—hairdressers, electrical repair, delicatessen and furniture store. First—Restaurant, book store and printing store on first and second. (2625m² per storey)
type of construction: Constructed 1750. Generally timber construction
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: First storey-suspect fire started in kitchen of restaurant
area affected by fire: First and second floor totally destroyed. Ground floor smoke and heat damage.

notes: Two youths noticed smoke from the first floor and alerted brigade. The fire was able to grow quickly due to the large amount of timber in the construction including wall linings. The brigade arrived within 4 minutes. The fire destroyed the majority of the arcade and was only stopped from spread to adjoining residents by the brigade.

Shopko Plaza—Wisconsin, USA (Fire Command—August 1988)

date: Monday 4 July 1983
time at which fire noted: 2: 13 pm
cause of fire: Electrical fault in neon sign
description of centre: Constructed in 1977. L shaped single storey centre containing 14 shops. (8568 m² entire building)
type of construction: Masonry construction, with metal stud internal walls. Steel framed roof covered with metal deck. Continuous ceiling void spaces of combustible construction. (timber framed ceiling supports) Department store and storage area separated by fire wall. Two shops did not have continuous void spaces.
sprinklers: Yes- except in ceiling void spaces
smoke detectors: Yes-except in ceiling void spaces
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ceiling void space
area affected by fire: Extent of fire damage and spread not stated

notes: Fire developed within ceiling space for some time and spread throughout most of the of the space due to combustibles. The fire was not detected early due to a lack of detectors in the ceiling space. Smoke was finally detected in ceiling space by an employee and the brigade was called. Fire brigade arrived within approximately 1 minute. Fire could not be seen and no back up was called until fire fell from the ceiling space to floor level. Five sprinkler heads located at ceiling level were set off but were generally ineffective as the fire was above them. Sprinklers were turned off as they were considered to hamper the brigade's efforts.

Extent of fire spread and damage not certain. Shops that contained glass frontages received less damage than shops with open mesh roller shutters. Open mesh fronts to shops allowed smoke damage to contents in the shops.

Shopping Centre—Wurzburg, West Germany (Fire Prevention 164—Nov. 1983)

date: Tuesday 19 July 1983
time at which fire noted: Unknown
cause of fire: Unknown
description of centre: US army shopping centre.
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Fast food store
area affected by fire: 5 shops completely destroyed. 6 shops received damaged

notes: Fire was detected by a passer-by. The brigade arrived within 8 minutes of the call. It was stated it took them 3 hours to control the fire and 9 hours to extinguish the fire. Five shops were completely destroyed and 6 shops received varying amounts of damage.

Shopping Centre—San Jose, Costa Rica (Fire Prevention 165—Dec. 1983)

date: Sunday 28 August 1983
time at which fire noted: Unknown
cause of fire: Unknown
description of centre: Unknown
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Unknown
area affected by fire: Entire centre destroyed-shops, market, restaurants.

notes: Entire centre destroyed including shops, market, restaurants. It was stated the damage amounted to more than 6 million pounds.

Shopping Arcade—North Devon, UK (Fire Prevention No. 170)

date: Thursday 1 September 1983
time at which fire noted: 2:23 am
cause of fire: Unknown
description of centre: 5 storey arcade. One side of arcade consisted of 10 shops over 4 levels with flats above. A 5 storey hotel situated on the other side.
type of construction: Constructed 1890
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 1 civilian death-result of LPG cylinder explosion
area of fire origin: Ground level shop-leather shop
area affected by fire: Arcade, 10 shops and flats above, 40% of hotel

notes: Fire was detected by passer by. The brigade arrived within 10 minutes and upon arrival, the fire had already spread vertically and horizontally through 2 occupancies. 200 occupants safely evacuated. Insufficient mains water supply for the fire fighters-water from the sea was relayed to the site. An LPG cylinder exploded and blew a man from 1st storey into arcade. Within 20 minutes the arcade and buildings above collapsed. A gas main broke and fuelled fire in the arcade until supply authority turned off supply. Fire spread vertically from front of arcade externally to hotel windows above. Fire penetrated 3 storeys and roof of hotel. Fire doors restricted spread of fire in hotel. At 5:57 am the brigade started to leave the fire scene.

Georgia Shopping Centre—Georgia, USA (Fire Journal—1984)

date: Tuesday 20 September 1983
time at which fire noted: 2:30 am
cause of fire: Electrical fault in neon sign
description of centre: Constructed 1968. Single storey centre containing 40 shops. (19,500 m² entire building area)
type of construction: Heavy timber construction used over mail area. Tenant and stores areas classified as unprotected non-combustible. Concrete block internal walls separated shops. A metal deck roof supported by unprotected steel was provided over tenancies. Plastic skylights located in roof.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Neon sign at ceiling level
area affected by fire: 2/3 of centre effected by fire. Entire centre effected by smoke and heat

notes: This building was considered to not comply with the relevant building code by not being provided with a sprinkler system and had not been awarded a certificate of occupancy. The fire was first detected when a burglar alarm to a jewellers store was activated. Upon a police patrol's arrival, fire was coming through the roof and within the mall area of the centre. Upon the brigades arrival, fire was also seen to be on both sides of the corridor and other spot fires in other shops were also seen. Fire may have spread rapidly through concealed ceiling spaces to other occupancies. Internal fire attack was difficult due to the size of fire.

Being a non sprinklered building allowed the fire to grow undetected and spread rapidly through the heavy timber construction of the centre. It is reported that the brigade had the fire under control 11 hours after the fire was detected.

Denver Shopping Centre—Denver, USA (Fire Journal—May 1984)

date: Wednesday 23 November 1983
time at which fire noted: 12:22 am
cause of fire: Electrical fault within concealed ceiling space
description of centre: Constructed 1951 as open air centre. 1975 converted to enclosed shopping centre. Single storey centre containing 44 shops. A "May D-F" four storey department store attached. (30,000 m² entire mall area excluding upper floors of May D-F store)
type of construction: Masonry external and interior walls. Steel framed structure and built up roof incorporating with timber decking. Steel and concrete encased columns. Concealed spaces contained timber furring and adhesively fixed tiles. Another layer of timber and acoustic linings were also provided in some areas, below the fixed tiles.
sprinklers: Partially-to mall area and one line of heads inside shops abutting onto mall. Department store also protected. No sprinklers provided within concealed spaces.
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ceiling space
area affected by fire: 13 shops were destroyed. 2/3 of centre received various degrees of smoke and heat damage.

notes: Burglar alarm in drug store sounded at 12:22 am. Upon police arrival, fire was seen in the ceiling space and the ceiling tiles were falling. 12:25 am the brigade were notified. The brigade had difficulties locating the fire as the fire was spreading within the ceiling space. The line of sprinklers within the shops frontage were activated and were considered effective in addition with the brigade in stopping fire spreading from the shops to the mall. Steel trusses and columns and the concrete encased steel columns collapsed.

It was stated the brigade took 6 hours to control the fire. The partial sprinkler protection was stated to have limited fire spread. The ceiling spaces were detrimental as they were continuous, contained a heavy fire load of combustibles and were non sprinklered.

Manuka Village—ACT, Australia (Fire Prevention No. 165—December 1983)

date: Monday 12 March 1984
time at which fire noted: 8:45am
cause of fire: Charcoal Stove setting fire to grease within exhaust duct.
description of centre: Built in 1978. Single storey having a floor area of 1850m², with small mezzanine arpart 2 storey. Built on extremities of shopping centre. (400 m² per storey)
type of construction: Steel framed, concrete block walls covered externally in steel. Concrete floor and metal deck roof covered by pre-felted polystyrene and layers of felt with chippings.
sprinklers: Not present
smoke detectors: Yes-linked to brigade.
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Single storey part-picture framing area
area affected by fire: Small section of sales damages. entire ground floor smoke and heat damage.

notes: Smoke detectors called brigade and they arrived within 4 minutes to find the building heavily smoke logged and flames along edges of roof. Quick smoke production and size of fire as rapid spread to roof space. Fire started on picture frames and then soft furnishings. All electrical circuits isolated except that 4 pendant lamps left on for security purposes. Steel frames above fire area collapsed and subsequently the entire roof beyond repair. It was reported the brigade took 68 minutes to control the fire.

Manuka Village—ACT, Australia (Court Records)

dale: Monday 12 March 1984
time at which fire noted: 8:45am
cause of fire: Charcoal Stove setting fire to grease within exhaust duct.
description of centre: Built in 1978. Single storey having a floor area of 1850m², with small mezzanine areas. Centre broken into a variety of specialty shops with mall.
type of construction: Brick wall with timber trusses supporting a concrete tile roof and a steel roof in the mall areas.
sprinklers, Not present
smoke detectors: No, but thermal detectors to activate smoke relief and call fire brigade.
deaths/injuries: 0 due directly to fire, but 1 due to heart attack suffered at the time of the fire. Number of injuries unknown
area of fire origin: Fire occurred within an exhaust duct containing large quantities of grease and fat. Duct vented directly out of the roof.
area affected by fire: Entire building lost.

notes: Building was occupied by several shop keepers at the time of the fire. Fire spread into timber ceiling space and throughout the ceiling void. The fire brigade arrived within 5 minutes of the alarm but noted that by this time the building was virtually destroyed. No attempt was made to fight the fire.

Department Store—Pennsylvania—USA (Fire Journal—November 1984)

date: April 1984
time at which fire noted: 3:10 pm
cause of fire: Arson--clothes set alight
description of centre: Three storey department store connected to a large shopping mall.
type of construction: Unknown
sprinklers: Yes-partial protection. Department store provided with sprinklers

smoke detectors: Unknown
 deaths/injuries: 0 deaths. Number of injuries unknown
 area of fire origin: Clothes racks at second level of department store
 area affected by fire: 10 to 12 racks of clothing. 250 m² of carpet replaced and ceiling level of the floor below was extensively water damaged.

notes: Shoppers and employees noticed smoke at the area of fire origin. Upon locating the fire, the employee saw that two sprinkler heads had operated and controlled the fire. The fire was contained to 10 to 12 racks of clothing. The brigade was notified upon activation of the sprinkler systems water-flow alarm. 250 m² of carpet was replaced and the ceiling level of the floor below was extensively water damaged.

Department Store—East London, Republic of South Africa (Fire Prevention No. 176—January/February 1985)

date: Monday 21 May 1984
 time at which fire noted: 12:00 pm
 cause of fire: Electrical short circuit in electronics store room or careless discard of cigarette butt to cardboard boxes
 description of centre: 2 storey department store-plus mezzanine. Lower Ground-Electrical goods. Ground-soft furnishings, toys. Mezzanine-ffices. (2419 m² per storey)
 type of construction: Masonry walls, lower ground floor of concrete, mezzanine and ground of timber. Timber roof trusses and asbestos cement sheeting.
 sprinklers:
 smoke detectors: Not present
 deaths/injuries: At least 5 civilain deaths. Number of injuries unknown
 area of fire origin: Electrical store room-ground floor
 area affected by fire: Entire store destroyed

notes: Occupants initially detected smoke but dismissed concerns. Fire eventually detected at base of ramp connecting lower ground and ground level. Fire extinguishers were found to be non operational. Hose reel from lower ground was used but the occupants were overcome by rapid fire spread. Three people became trapped in lower ground level&disoriented in the darkness and smoke as no emergency lighting provided. They were eventually rescued.

A slow response to evacuation of occupants at mezzanine level. As the brigade's line was busy, the telephonist called police and again attempted to call brigade. The telephonist never escaped as smoke logged the internal stair case.

The brigade's notification was 30 minutes after smoke was detected. They were eventually notified by a patrol car in the area. Brigade only able to stop fire spreading across the road to other buildings and fight fire from outside. 9 minutes after their arrival, part of the roof collapsed. It took a further 23 minutes for the roof, floor and walls to collapse.

Lack of fire detection, alarm and evacuation plan caused slow fire fighting and evacuation response. Minimal compartmentation and internal construction of combustible material allowed fast fire spread.

Furniture Store—Maryland, USA (Fire Prevention No. 185—December 1985)

date: Monday 22 October 1984
 time at which fire noted: 1:31 pm
 cause of fire: Oxyacetylene cutting accident-ignited furniture or timber stud walls
 description of centre: Constructed 1938. 3 storey main building, 2 storey extension (2451 m² per storey) Four large openings in floors between storeys-conveyor belt, and 3 unprotected staircases.
 type of construction: Steel framed, masonry walls with timber columns and stud walls. Timber floors and timber roof covered with tar paper and tarred gravelled
 sprinklers: Not present
 smoke defectors: Not present

deaths/injuries: 3 fire fighter deaths. Number of injuries unknown
area of fire origin: 3rd storey of main building
area affected by fire: 2nd and 3rd floor of main building and 2nd floor of extension.

notes: Fire occurred 30 minutes after oxy-cutting of metal bolts. The welder saw paper covered sofas on timber racking alight and smoking. Fire extinguishers were not sufficient to contain fire. Ventilation fan spread fire and smoke through openings within the 2nd and 3rd floors. A telephone was inoperative and eventually a resident opposite the store called the brigade 17 minutes after the worker initially detected the fire.

The brigade assumed the building was of 2 storeys. Fire and smoke detected at ceiling on 2nd floor and extinguished. Fire was actually at 3rd floor and severe. Brigade had no drawings on building and missed doors leading to 3rd floor. Fire spread to extension part of building and worsened in the main building. It was stated that a lack of communication caused the fire fighters to be trapped in a flashover across combustible ceiling tiles, resulting in rapid fire spread from the front to the rear of the building. Sections of the roof and the front external wall of the building collapsed.

Shopping Centre—West Berlin, Germany (Fire Prevention—May 1985)

date: Tuesday 1 January 1985
time at which fire noted: Early morning
cause of fire: Suspected arson
description of centre: Unknown
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Unknown
area affected by fire: 26 shops destroyed

notes: Fire occurred in the early hours of the morning. It was stated several million pounds of damaged caused. 26 shops were badly damaged.

Shopping Centre—Illinois, USA (Fire Journal—September 1986)

date: September 1985
time at which fire noted: 3:15 am
cause of fire: Electrical fault in neon sign—external canopy
description of centre: Single storey centre containing 8 shops. (1,566 m² entire centre)
type of construction: Timber framed construction on concrete slab. Wooden framed canopy
sprinklers: Yes-wet pipe
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Wooden framed external canopy
area affected by fire: Canopy and frontage of shop below

notes: A police officer responding to burglar alarm first detected the fire of the canopy. It was reported that the early fog allowed the fire to spread undetected for at least 30 minutes. The burglar alarm sounded as the canopy fell and broke the front window of a shop below. 14 sprinkler heads in the store activated which inhibited the spread of fire.

Mini Mall—Indiana, USA (Fire Journal—January 1987)

date: February 1986
time at which fire noted: 2:25 am
cause of fire: Electrical fault in switchboard located in store room
description of centre: Constructed in 1962. Single storey mall containing 3 shops—drug store, self-service laundry and grocery store. Store room of drug store separated by timber stud plaster wall constructed to mineral tile ceiling

level. Store room contained switchboard. gas fired water heater and overheat gas heater.

type of construction: Concrete block walls, concrete flooring and steel framed roof supporting metal decking. Mineral tiles at ceiling level within shops.

sprinklers: Not present

smoke detectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Drug store's store room (750 m² area of drug store)

area affected by fire: Store room. Roof collapsed.-no suspended ceiling in store room.

notes: When an employee smelt the signs of smoke, he notified the manager. After noticing smoke coming from the heating duct, they located a fire amongst cardboard boxes near the switchboard in the store room. As the employee went to alert the brigade, the manager attempted to fight the fire with an extinguisher. Aerosol cans began exploding and no further attempts were made to fight the fire.

The lights failed once the brigade were notified at 12:28 am. Upon the brigades arrival, 2 minutes after being notified, the fire had spread vertically to the roof, which subsequently collapsed within 5 minutes. The fire was confined within the store room. The goods were stacked 2 metres high in cardboard containers close to the electrical board.

Shopping Centre—Liverpool, UK (Fire Prevention No. 198—April 1987)

date: Friday 15 August 1986

time at which fire noted: 5:30 am

cause of fire: Unknown

description of centre: Single storey market and shopping centre. 8 existing buildings form the centre by a common roof. A single building contains 19 small shops, 2 supermarkets and 60 market stalls contained. (3,600m² entire building area)

type of construction: Existing structures of masonry with steel framed roof members.

sprinklers: Not present

smoke detectors: Heat detectors and break glass alarms to parts

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Market section.

area affected by fire: Entire complex-12 shops destroyed, 7 shops damaged, market area destroyed.

notes: Fire discovered by a passer by. The roller shutter doors of the shops and lack of windows covered the fire from possible early detection. Two minutes after call, heat detector connected to brigade signalled and 1 minutes after that, burglar alarm operated. Upon brigades arrival, roof members started to collapse followed by the masonry walls. After approximately 2.30 hours, the fire was under control but the entire market and shops were totally destroyed. Brigade prevented spread to adjoining buildings but due to late detection of the fire, it was able to grow and take control of the centre.

Shopping Centre—Maryland, USA (Fire Journal—July/August 1987)

date: 1987

time at which fire noted: 12:30 am

cause of fire: Electrical fault

description of centre: Single storey multi-tenanted centre

type of construction: External walls of concrete block walls. Roof construction of steel joists and steel columns encased in plaster supporting a gypsum deck roof. Non-combustible ceiling suspended 1 metre from roof deck.

sprinklers: Not present

smoke detectors: Yes

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Shop within centre

area affected by fire: Spread from shop to external canopy

notes: Newspaper delivery man notified the fire department at the same time the smoke detector signalled the fire department. The delivery man stated that the windows soon became cracked and flames became external. The fire spread to the external wooden canopy which ran the length of the building. The steel members in the roof above the area of fire origin became warped. The fire was reported to have only spread to the external canopy, It was noted that the fire brigade had controlled the fire within 20 minutes.

Shopping Centre—Liverpool, UK (Fire Prevention No. 203—October 1987)

date: Tuesday 24 February 1987
time at which fire noted: 9:28 pm
cause of fire: Arson-Ignition of plastic bread tray under walkway outside supermarket.
description of centre: 1 storey mini complex. 15 shop units. (2400m² total building area)
type of construction: External walls of concrete block work, concrete floor and felt and tile pitched steel and timber roof. Internal wall between shops constructed to underside of roof. Shop fronts provided with timber framed canopy. Canopy providing continuous void.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Supermarket (600m²)
area affected by fire: Shop of fire origin severely damage. 14 other shops had varying degrees of damage

notes: As fire incident was seen by eyewitness, the brigade was called immediately. After 1.5 hours it was reported the fire was under control within the shop and the roof space, however the bursting of a gas main required authorities to shut off gas supply to the premises. The supermarket was extensively damaged and the roof destroyed. The fire spread to the other 14 shops and they received varying degrees of damage.

It was stated that early alerting of brigade was crucial to limit the extent of fire growth. No sprinkler protection had been provided.

Shopping Mall—Ontario, Canada (Fire Journal—July/August 1988)

date: 1988
time at which fire noted: 1:30 am
cause of fire: Spontaneous ignition of oil based sealant material-renovation activities
description of centre: Constructed 1973. 2 storey complex containing 215 shops.
type of construction: Generally of reinforced concrete
sprinklers: Yes-wet pipe system
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Discarded renovation debris within shop
area affected by fire: Fire contained within shop of fire origin. 22 shops affected by smoke and heat

notes: At time of fire, the only items in store were tools, construction material, pile of discarded debris and cardboard packaging material. The break glass alarms on floor of fire origin and floor above did not operate when a night watchman attempted to activate the alarm. A second night watchman stated that the brigade had already been alerted due to activation of the sprinkler heads. Brigade arrived within 15 minutes of detection by night watchman. Six to eight sprinkler head in the store and within the mall activated. It was stated that the brigades use of internal hydrants extinguished the blaze and the sprinkler heads confined the blaze within the store.

Shopping Mall—Wisconsin, USA (Fire Journal—July/August 1988)

date: 1988
time at which fire noted: Occurred during operating hours of mall
cause of fire: Electrical fault in neon sign

description of centre: Single storey complex. (14,300 m² entire mall)
type of construction: Masonry external walls and concrete flooring. Metal deck roof on steel supports. Concealed space incorporated timber framing
sprinklers: Yes-excluding coverage in concealed ceiling space.
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Neon sign
area affected by fire: Unknown-but relatively small.

notes: Electrical fault of a neon sign ignited combustibles in a wall space and spread to concealed ceiling space. Fire smouldered within concealed ceiling space until smoke was sufficient to be detected below. It was not until the brigade arrived that a sprinkler head activated as the fire began to drop from the ceiling space. The air handling unit spread fire through the roof space. In total, 30 sprinkler heads were activated. It was stated that it took 2 hours for the brigade to extinguish the fire.

Shopping Mall—Tennessee, USA (Fire Journal—November/December 1988)

date: 1988
time at which fire noted: 1:06 pm
cause of fire: Unknown
description of centre: 2 storey mall (750 m² building area)
type of construction: Timber framed with masonry walls. Tar and gravel roof on steel supports
sprinklers: Not present
smoke detectors: Yes
deaths/injuries: 1 civilian death. Number of injuries unknown
area of fire origin: Second floor
area affected by fire: Non specified

notes: Employee of tanning saloon noticed fire at an early stage. Afterwards, an employee in an office smelt smoke and upon opening his door to the common corridor, was driven back by the intense heat and smoke. He was rescued by the brigade from his office. All other occupants on the second floor evacuated except a customer in the tanning saloon. The customer stopped to get dressed before evacuating and subsequently become trapped in the building and overcome by smoke.

Furniture Store—California, USA (Fire Journal—November/December 1989)

date: Monday 4 April 1988
time at which fire noted: 1:24 pm
cause of fire: Electrical short circuit
description of centre: Single storey mall containing 5 shops.
type of construction: Unprotected ordinary construction (timber)—concealed ceiling space connected all occupancies
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Wiring located in ceiling space above furniture store
area affected by fire: All five occupancies. Ceiling, roof, and mezzanine collapsed

notes: Short circuit in wiring ignited structural members in ceiling space. Fire spread through common ceiling space to all 5 occupancies. Fire doors were provided but were blocked open and therefore did not contribute to any fire separation. The ceiling, roof and mezzanine collapsed.

Grocery Store—New York, USA (Fire Journal—November/December 1989)

date: Monday 4 July 1988
time at which fire noted: 5:37 pm
cause of fire: Unknown-arson suspected

description of centre: Single storey mall which contained grocery store. Number of stores not specified (5600 m² total building area)

type of construction: Unprotected construction-one store separated by fire wall

sprinklers: Not present

smoke defectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Stacked pallets in goods loading area of grocery store

area affected by fire: Entire mall except one store separated by fire wall

notes: The fire was located on pallets of goods in the loading area of the grocery store. The fire growth was fast due to the fire load being dry gas and motor oil. The fire spread rapidly through the concealed ceiling spaces to other areas of the mall. The entire mall was affected except for an occupancy at the far end of the mall which was separated by a fire wall.

Shopping Mall—Nevada, USA (Fire Journal—November/December 1989)

date: Tuesday 20 September 1988

time at which fire noted: 2:09 am

cause of fire: Unknown-arson suspected

description of centre: Contained 8 stores

type of construction: Ordinary construction (timber)

sprinklers: Not present

smoke detectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Attic

area affected by fire: Unknown

notes: Fire of suspicious nature occurred in an attic space. A fire wall in the attic provided fire separation. Combustibles on the other side of the wall were heated by the radiant heat transfer through the wall. As a result, the front mansard roof collapsed and allowed the fire to spread around the fire wall. There was no sprinkler protection provided. The extent of the fire and damage caused was not specified.

Shopping Mall—Florida, USA (Fire Journal—July/August 19

date: 1989

time at which fire noted: During operating hours of the centre

cause of fire: Arson -rubbish bin set alight under walkway

description of centre: Single storey centre. Mall entrance accessible by non sprinklered exterior covered walkway

type of construction: Concrete block external walls, decorated with timber shingles. Steel framed and steel deck roof. Mineral tile suspended ceiling. Walkway constructed of timber with plywood on cedar roof supports. Walkway roof was approximately 2.6 metres high and extended 3.5 metres from the centre.

sprinklers: Yes-wet pipe system--concealed space sprinklers not provided

smoke detectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Trash can located under external walkway

area affected by fire: 80 % of walkway destroyed and exterior of building damaged and frontage of clothing store.

notes: Manager of a store noticed the smoke outside of the centre and went to investigate. Flames were spreading vertically to the walkway roof and timber shingles of the external wall. The brigade were not immediately notified as two suspected youths had lied about notifying the brigade when questioned by the manager. The fire involved 192 m² of walkway and caused three glass windows and doors of a clothing store to break. Fire spread into the stores front clothing display. Three sprinkler heads activated and prevented the fire from spreading further into the store. Once the brigade arrived, a singular hose stream was used and extinguished the fire within a reported 10 minutes.

Milton Keynes Shopping Centre—Buckinghamshire, UK (Fire Prevention No. 229—May 1990)

date: Tuesday 17 January 1989
time at which fire noted: 2: 17 am
cause of fire: Arson-ignition of fur coats
description of centre: Three storey complex with plant rooms above. Contains 140 small and medium shops and 7 department stores (127,500m² entire complex)
type of construction: Steel framed with protected steel within shops enclosed by glazed walls. Internal walls of 20 cm "thermalite" block walls with fire shutters to shops frontages. Floors are of 76 mm precast concrete. Walls and floors of 2 hour fire resistant construction. Roof constructed of felt on fibreboard covered by metal decking.
sprinklers: Yes-Dry Pipe system. Ceiling voids sprinklered
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ground floor of department store-fur coat section (4,900 m²)
area affected by fire: Ground and first floor-vertical spread via open staircase

notes: A dry pipe sprinkler system was installed throughout the centre including the ceiling void spaces where the ground and first storey parts of the system were controlled by 2 valve sets per storey. A system of smoke venting and extraction was also installed. The mall area comprised automatic venting on detection of smoke alarms however the air conditioning plant only operated in smoke extraction on the first floor upon manual operation of the system. The ground floor system was initiated by smoke detectors. The brigade was notified of the fire by the low air pressure of the sprinkler system. Upon arrival, it was found that the sprinkler system to both storeys were not functioning. The system was boosted via the water authorities city centre's booster pump and one of the systems started to flow water. After further investigations, the smoke control system was also inoperative due to it requiring manual initiation.

Factors affecting the sprinkler failure were undetermined and recommendations to upgrade the smoke control system to an automatic system had not been implemented.

Fire contained within shop compartment by fire rated construction and brigade. It was stated it took 3.30 hours for the brigade to control the fire.

Shopping Centre—Wiltshire, UK (Fire Prevention No. 233—October 1990)

date: Sunday 6 August 1989
time at which fire noted: 12:50 am
cause of fire: Electrical fault in refrigerator unit
description of centre: 16 shops at ground level, 7 residential units and shop storage at first level.
type of construction: Reinforced concrete frame and floors, external brick wall with internal concrete block walls. Timber trussed multi pitched roof. Clay tiles on bituminous felt battened on prefabricated timber trusses, with boxed eaves incorporating continuous strip ventilation.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Greengrocer store (1770m²)
area affected by fire: 4 shops totally destroyed, roof collapse of units and fire damage to other parts of occupancies

notes: Flames from refrigerator spread via ceiling vents into roof space. Rapid spread within timber roof space to other occupancies including flats. The use of bituminous felt in parts of roof allowed for quick fire spread within roof and over separating walls, igniting adjoining roofs. No detection system or suppression system provided. Occupants of flats were fortunate to detect fire and evacuate in time. Brigade arrived 4 minutes from being called. Brigade opened roof to allow ventilation of fire. The fire was stated to be under control within 3 hours by the fire brigade.

Clothing Store—Connecticut, USA (Fire Journal—March/April 1990)

date: 1990
time at which fire noted: 6: 19 pm
cause of fire: Light bulb located too close to clothing display
description of centre: Constructed 1984. Two storey *centre* containing 160 stores (50,000 m² total building area)
type of construction: Masonry and steel structure
sprinklers: Yes
smoke detectors: Yes-including heat detectors
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Front display window
area affected by fire: Mannequin and clothing in front display window

notes: The actuation of a sprinkler head notified the brigade. Upon their arrival it was noted that a single head had been activated and extinguished the fire. An electrical light was located too close to a clothing display in the front of the store. The fire spread up the mannequin, generating sufficient heat to activate the sprinkler head. The brigade only performed salvage operations.

Shopping Mall—Washington State, USA (Fire Journal—March/April 1990)

date: 1990
time at which fire noted: 2:55 am
cause of fire: Arson-unknown
description of centre: Two storey centre including restaurant in the middle of the mall.
type of construction: Building of masonry construction with a corrugated metal roof supported on steel members and covered with asphalt and insulation board.
sprinklers.. Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Restaurant
area affected by fire: Restaurant

notes. Fire was detected by a fire rescue car driving past the mall. Smoke was seen coming from the mall. Although firefighters were unable to save the restaurant, 2 hour fire walls prevented fire spread to adjoining stores on either side. A one hour fire wall collapsed within 30 minutes of the arrival of the brigade and this led to spread into the ceiling space above a suspended ceiling. The restaurant roof eventually collapsed.

Toy Store—Illinois, USA (NFPA Journal—January/February 1991)

date: 1990 (fires two months apart)
time at which fire noted: 11:00 am (first fire), 11:55 am (second fire)
cause of fire: Arson in both cases-soft toys set alight with open flame device
description of centre: Single storey retail toy storey.
type of construction: Unknown
sprinklers: Yes
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Toys within store
area affected by fire: Interior of store-most damage associated with smoke damage of contents

notes: Two minutes after ignition, the store clerk notified manager who ordered the building to be evacuated. This was achieved and several sprinkler heads were activated and contained the fire allowing mopping up by the fire brigade. Two months later, an almost identical incident occurred, In this case the 35-45 customers were evacuated and the staff tried unsuccessfully to extinguish the fire with

extinguishers and a hose reel. This was unsuccessful and 5 sprinkler heads activated controlling the fire—despite the fact that the spray patterns were obscured by shelving and stock up to 5m high.

Supermarket—Massachusetts, USA (NFPA Journal—January/February 1991)

date: 1990
time at which fire noted: 5:48 pm
cause of fire: Suspicious fire in storeroom
description of centre: Two storey grocery store.
type of construction: Ordinary construction
sprinklers: Yes
smoke detectors: Unknown
deaths/ir/juries: 0 deaths. Number of injuries unknown
area of fire origin: Rear storeroom
area affected by fire: Fire contained to storeroom
notes: 3040 customers inside the store were not injured. One employee tried to extinguish the blaze with a portable extinguisher but this was unsuccessful. Fire was extinguished by sprinklers.

Department Store—Osaka, Japan (Fire Prevention No. 232—September 1990)

date: Sunday 18 March 1990
time at which fire noted: Opening hours
cause of fire: Arson-injected kerosene to bedding mattress
description of centre: 5 storey department store
type of construction: Unknown
sprinklers: Not present
smoke detectors.. Unknown
deaths/ir/juries: 15 people. 12 employees, 3 youths
area of fire origin: 4th storey-bedding department
area affected by fire: 4th and 5th storeys of department store
notes: Fire originated in bedding department. Employees and customers evacuated on 4th storey. Rapid spread to upper floor, filling canteen and games arcade with smoke. All deceased occupants overcome by smoke on level above floor of fire origin and were asphyxiated. All occupants from floor of fire origin and below evacuated. It was reported that the brigade took 4 hours to control the fire. Mattress and bedding material contributed to quick fire spread and smoke production.

Department Store—Essex, UK (Fire Prevention No. 237—March 1991)

date: Sunday 19 August 1990
time at which fire noted: 9:35 p.m
cause of fire: Arson-storage area
description of centre: Constructed 1990-2 storey department store near completion in a shopping complex. (6375 m² per storey)
type of construction: Concrete floors, metal deck roof, internal walls of plasterboard
sprinklers: Yes-not operational at time of fire
smoke detectors: Not present
deaths/ir/juries: 0 deaths. Number of injuries unknown
area of fire origin: Ground floor-storage area
area affected by fire: 1/2 ground floor destroyed-remainder of floor suffered smoke and heat damage. 10% of first and roof damaged by fire.
notes: Brigade arrived within 6 minutes. Severe fire already developed. The fire spread rapidly through the timber, plastic and cardboard shop fittings. Sprinklers were installed, but had not been commissioned. It was stated the brigade took 2 hours to control the fire.

Clothing Store—New Jersey, USA (NFPA Journal—January/February 1992)

date: 1991
time at which fire noted: After hours-precise time not known
cause of fire: undetermined
description of centre: Four storey building brick building with unprotected openings.
type of construction: Ordinary construction
sprinklers: Not present
smoke detectors: Yes
deaths/injuries: 1 fire fighter death. 7 fire fighters injured.
area of fire origin: Area within building.
area affected by fire: Fire spread to 8 other buildings.
notes: Fire spread to 8 other buildings due to fire exposure through openings and due to failure of external walls.

Shopping Mall—Wisconsin, USA (NFPA Journal—January/February 1991)

date: 1991
time at which fire noted: 1:26 am
cause of fire: Spontaneous ignition of varnish soaked paper towels in chemist store
description of centre: Shopping mall consisting of 21 individual stores
type of construction: Unknown
sprinklers: Yes
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: A storage shelf in chemist shop
area affected by fire: Limited to area of fire origin as sprinkler system operated
notes: The sprinkler system water flow switch notified the brigade. Upon arrival of the brigade there was no sign of fire or smoke. The brigade were unable to enter the mall as there were no keys available to access the building. After three hours of investigating the building, the brigade determined that the alarm was a malfunction as there was no smoke, fire, or water flow seen.
When the mall opened the next morning, the chemist's shops was flooded with water. A single sprinkler head had activated and suppressed the fire before the brigade arrived.

Shopping Mall—New York, USA (May 27 1991)

date: 1991
time at which fire noted: 8:15 pm
cause of fire: Suspected arson
description of centre: Single storey mall. Mall contained 80 individual shops including 2 department stores. Store of fire origin 4000 m². Mall walkway 200 metres long (total building floor area 100,000 m²)
type of construction: Steel framed roof with metal deck. Various masonry wall located within building. No doors or glazing between the walkway and stores.
sprinklers: Partial-protection provided within the walkway and department stores
smoke detectors: Yes
deaths/injuries: 2 civilian deaths. Number of injuries unknown
area of fire origin: Display of fire-retarded flowers within 4000 m² store
area affected by fire: Store of fire origin-4000 m²
notes: The smoke exhaust system operated but became overwhelmed. The store of fire origin was not sprinkler protected. The fire brigade had the fire controlled within 5 hours and was kept within the store of fire origin. The smoke spread within the mall walkway. The mall was evacuated within minutes but 2 people still died of *smoke* annihilation

Shopping Mall—Long Island, USA (Firehouse Volume 16 No 11—November 1991)

date: Thursday 16 May 1991
time at which fire noted: 8:25 pm
cause of fire: Suspected arson-artificial flower display area set alight
description of centre: Built in 1960's. Single storey centre containing 100 individual shops and two double storey department stores. Department store of fire origin 6,800 m². Levels connected by central stair and escalator-basement area half size of ground floor and contained storage, office and retail. Two fire exits provided in basements area. (total building floor area—100,000 m²)
type of construction: Department store-Steel beams, columns and corrugated steel roof. Suspended concrete floor. Masonry external walls
sprinklers: Partial-department store basement protected. Ground floor not protected
smoke detectors: Unknown
deaths/injuries: 2
area of fire origin: Artificial flower display-in ground floor department store
area affected by fire: Department store-ground floor and basement level

notes: An eyewitness account stated that within minutes the flames spread vertically up the wall and across the ceiling. The fire fighters had to cease roof venting efforts when the roof started to collapse. The water authority were called to increase water pressure. The brigade had the fire under control in 4.5 hours. The fire was contained within the department store. The fire spread to basement floors but the amount of damage in the was not stated, Adjoining stores sustained heat, smoke and water damage. Two employees of the department store did not survive escape despite rescue attempts. The centre contained a fire alarm but non-voice operated alarm was present. It was stated that only when smoke entered the mall, did occupants start to evacuate.

Cabramatta Shopping Mall—Sydney, Australia (Fire News Vol. 13 No 4—Summer 1991)

date: Tuesday 24 September 1991
time at which fire noted: 12:48 am
cause of fire: Electrical appliance in food store
description of centre: Single storey centre with a total building area of 2730 m²
type of construction: Precast concrete panel with a core of fibreglass insulation. Metal deck roof with steel columns and beam supports. Shops internal were fitted with roller shutters with a clear PVC covering. Ceiling of mineral fibre tile on steel grids
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Food store
area affected by fire: Unknown

notes: The fire started in a faulty electrical appliance in a food store. The fire spread to adjoining shops on the opposite side of arcade walkway and to horizontally to other parts of the shopping centre. The fibreglass smoke and heat vents in the forecourt area opened and allowed venting of the smoke. Upon brigade arrival to the fire scene, it was noted that the southern end of the centre appeared to be fully involved. Supporting steel members in one area did not sustain any deformation, while in another area, internal concrete spalling and deformation of steel members occurred. The area affected by fire was not reported although the damage was reported at approximately \$3 million.

Shopping Mall—Pennsylvania, USA (Firehouse No. 599—April 1992)

date: Tuesday 24 December 1991
time at which fire noted: 2:30 am
cause of fire: Electrical fault in storage area in chemist

description of centre: Built 1962-1965 as an open-outdoor centre. 1980 converted to covered mall. Two and three storey centre, containing 8 major stores and the specialty shops. (total building floor area 260,000 m²)

type of construction: Contained fire walls in several locations. Area of fire origin surrounded by fire walls.

sprinklers: Partial-not provided in area of fire origin

smoke defectors: Yes

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Storage area of chemist-(storage floor area-160 m²)

area affected by fire: Storage area

notes: The fire in the storage area spread up into the ceiling space and became external of the building. Smoke within the mall was escalating and the mall's ventilation system was put into reversal to extract the smoke. A positive pressure was also being provided from another system. The fire appears to have been contained within the storage area and to have been under control after 30 minutes. Smoke damage occurred within mall and other stores. Sprinkler protection was being installed as renovations were carried out to individual stores, but subsequently the fire affected store had yet to be renovated.

Clothing Store—New Jersey, USA (NFPA Journal—January/February 1992)

date: 1992

time at which fire noted: 10:35 pm

cause of fire: Assumed discarded cigarette butt in rubbish pile in storage area.

description of centre: Two storey mall containing large clothing retail store. (3600 m² area of retail store with associated 302 m² storage area)

type of construction: Concrete. block walls with built-up roof covering, over deck roof supported by steel members

sprinklers: Yes-wet pipe system

smoke detectors, Not present

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Cardboard boxes containing merchandise in storage area of clothing store located at second level mezzanine.

area affected by fire: Fire did not spread past area of fire origin-cardboard boxes in storage area

notes: The store was under interior renovation at the time of fire. The brigade were alerted by the water flow switch of the sprinkler system. A security guard also notified the brigade as they were alerted of the fire by the operation of the sprinkler alarm. They attempted to suppress the fire with fire extinguishers but were unsuccessful. Upon the brigades arrival within 5 minutes, a single sprinkler head was noted to have activated and the fire affectedly extinguished. The brigade were not required to supplement the sprinkler system.

It was stated that if the building was not sprinklered, the rear of the store would have been a total loss due to the high combustible fire load in the storage area and the lack of available access to the store due to the construction works.

Department Store—Michigan, USA (NFPA Journal—November/December 1992)

date: 1992

time at which fire noted: 5:50 pm

cause of fire: Arson-cotton towels were set alight by the use of an aerosol can and blow torch.

description of centre: Single storey department store. (10,800 m² total building area)

type of construction: Unprotected, non-combustible construction

sprinklers: Yes-wet pipe system

smoke detectors: Unknown

deaths/injuries: 0 deaths. Number of injuries unknown

area of fire origin: Cotton towels set alight

area affected by fire: Fire did not spread beyond area of fire origin

notes: The brigade were notified via the water flow switch of the activated sprinkler system. Upon the brigades arrival, the fire was already suppressed by a single sprinkler head and by the aid of a dry chemical fire extinguisher.

Shopping Centre—Karachi, Pakistan (Fire Prevention No. 261—July/August 1993)

date: Thursday 17 December 1992
time at which fire noted: 2:30 am
cause of fire: Electrical-shop facade
description of centre: 5 storey complex--= 103 shops per storey
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Shop front facade
area affected by fire: Nearly entire ground floor-103 shops

notes: Electrical fault in a shop's front facade. Eyewitnesses reported that there was rapid spread of fire to adjoining shops. 103 shops were destroyed. It was claimed that 12 hours were taken to control fire.

Food Store—Pennsylvania, USA (NFPA Journal—November/December 1993)

date: 1993
time at which fire noted: 8:00 pm
cause of fire: Hot plastic wrap machine ignites combustible materials
description of centre: Single storey L shaped mall containing a food store which contained merchandise and checkout counters. The rear contained stock room, freezers and loading area (2000 m² food store building area)
type of construction: Unprotected steel frame, concrete block walls
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Central display in food store
area affected by fire: Entire food store severely damaged by fire. The fire did not spread past the food store

notes: Manager noticed fire and smoke coming from the ceiling near a centre display. The electricity supply cut out and the emergency lighting illuminated, however the phone lines were not operable which delayed notification to the brigade. By the time the brigade arrived, 6 minutes after notification, the store had been evacuated.

The brigade had limited water supply from 2 nearby hydrants. Additional water tankers and pumpers were called to boost their supply. The fire was kept within the food store and was extinguished at 6: 12 am the next morning.

The fire was caused by an electric hot wrap machine igniting polystyrene packing materials which spread the fire to timber tables and the packaging materials before reaching the ceiling of the display area when it was detected.

Department Store—California, USA (NFPA Journal— September/October 1993)

date: 1993
time at which fire noted: During operating hours of the store
cause of fire: Arson-ladies synthetic bags set alight
description of centre: Single storey department store.
type of construction: Ordinary timber framed construction with stucco exterior walls
sprinklers: Yes
smoke detectors: Not present

deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Ladies synthetic bag display
area affected by fire: Fire did not spread past area of fire origin-ladies synthetic bag display
notes: Employees noticed the fire and telephoned the brigade. The sprinkler system activated and extinguished the fire. The employees had used extinguishers, but their efforts had not been all that effective.

The fire had developed rapidly and spread to adjoining displays. A single sprinkler head extinguished the fire before the brigade arrived.

Shopping Mall—Nevada, USA (NFPA Journal—March/April 1993)

date: 1993
time at which fire noted: 9:48 pm
cause of fire: Mall involved in rioter attacks
description of centre: Single storey mall
type of construction: Fire-resistant concrete-block construction
sprinklers: Yes-partial protection provided to one section of building
smoke detectors: Not present
deaths/injuries: 1 civilian death-assumed to be one of the rioters
area of fire origin: Roof over food store-rioters started fire on the roof.
area affected by fire: Nine stores destroyed in fire. The sprinkler protected building only sustained moderate damage.

notes: The rioters started a fire in the roof over a food store. The brigade was called to the scene but were not allowed into the area for 15 minutes due to the unsafe condition caused by the rioters. Once they were allowed in to fight the fire, the entire food store was noted to have been ablaze as flames were seen coming from the windows, door and roof. Windows of adjacent occupancies had cracked but the fire had not spread past the store of fire origin. The fire fighters were allowed to fight the fire for 20 minutes until the rioters started to shoot at them. It wasn't until 1:07 am when the brigade returned to the mall, that the fire had spread to other occupancies and the roof over various sections had collapsed. The sprinklers that were provided in some areas had activated and were controlling the fire and prevented additional fire spread to other occupancies. Nine stores were destroyed. The sprinkler protected building only sustained moderate damage. One victim was found in the area of fire origin-it is highly probable that the victim was involved in the rioting.

Shopping Mall—West Midlands, UK (Fire Prevention 271—July/August 1994)

date: Tuesday 13 July 1993
time at which fire noted: 10:30 am
cause of fire: Careless use of propane gas
description of centre: Constructed 1979-3 storey centre containing individual specialty shops and supermarket. (total building area of 20,000 m²)
type of construction: Masonry external walls, plasterboard and timber ceiling. Bituminous roofing material.
sprinklers: Not present
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Roof
area affected by fire: 600 m² of roof area

notes: Propane gas explosion occurred within roof. The bituminous material was ignited, spreading flames across the roof. The brigade arrived within 8 minutes and had the fire under control in approximately 2 hours. 600 m² of the roof was damaged including extraction fans and 2 refrigeration plant coolers, The floor below sustained water damage.

Department Store—Mississippi, USA (NFPA Journal—January/February 1994)

date: 1994
time at which fire noted: During operating hours of the store
cause of fire: Arson-aerosol cans used to light display area
description of centre: Department store located at end of mall (3,120 m² total department store building area)
type of construction: Unprotected steel framing, concrete block walls, metal deck roof with a built-up covering.
sprinklers: Yes-wet pipe system
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Display area
area affected by fire: Fire did not spread area of fire origin--display area
notes: An employee investigating the sound of aerosol cans being used saw youths running from a display area that was on fire. The employee called the brigade. Two sprinkler heads activated that extinguished the fire and stopped any potential fire spread.

B & Q Store—Hull, UK (Fire Vol. 87 No 1071 —1994)

date: 1994
time at which fire noted: 12:30—12:45 pm
cause of fire: Unknown
description of centre: Single storey steel-framed building of 7500m² floor area. Open-plan layout.
type of construction: Columns in-filled with masonry.
sprinklers: Not present
smoke detectors: Not present
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Near self-serve carpet area
area affected by fire: Store totally destroyed.
notes: Estimated that fire developed rapidly at the self-serve carpet area—carpets were hung on rails. 3040 people present in the building at the time of the fire were evacuated.

Logan Valley Mall—Logan Township, USA (Firehouse Vol. 20 No 3—March 1995)

date: Friday 16 December 1994
time at which fire noted: 2:32 am
cause of fire: Unknown
description of centre: Since constructed in 1960's many additions occurred including a 2 storey addition. Mall consisted of 4 single storey department stores and a 2 storey department store.
type of construction: Unknown
sprinklers: Partial—Area of fire origin not protected. Portable deluge sprinklers provided by brigade
smoke detectors: Unknown
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Department store
area affected by fire: Department store and 15 individual stores destroyed. Four roof sections and department store wall collapse. Various damage to mall.
notes: Upon brigade arrival, heavy smoke was seen coming from the area of fire origin—department store. Initial reports by the brigade were that within the area of fire origin, flames and smoke were spreading across and inside the ceiling, were floor to ceiling high and flash over had occurred. Fire spread to the roof structure of the department store and within 20 minutes of the brigades arrival the roof and 2 side walls collapsed. The brigade positioned many portable deluge systems in an attempt to stop fire

spread. The fire destroyed the department store, 15 individual stores and caused the concourse roof to collapse. The damage was estimated at \$20-35 million.

Zurich Shopping Centre—Zurich, Switzerland ("Private Communication")

date: Tuesday 8 August 1995
time at which fire noted: 12:00 pm
cause of fire: Arson
description of centre: Not clear whether more than one storey--this is likely-total floor area approx. 50,000—60,000m².
type of construction: Non-combustible construction.
sprinklers: Yes
smoke detectors: Yes
deaths/injuries: 0 deaths. Number of injuries unknown
area of fire origin: Unknwon
area affected by fire: Local area only
notes: Fire detected by smoke detectors, two staff tried to fight with extinguishers but were unsuccessful. Sprinkler head activated a short time later and extinguished the fire. Main damage was smoke damage to content and need to clean building.

Dusseldorf Airport—Dusseldorf, Germany (Der Spiegel No.16—1996)

date: Thursday 11 April 1996
time at which fire noted: 5:30 am
cause of fire: Welding work on expansion joints associated with access road ignited bitumen which flowed down into the ceiling above a flower shop.
description of centre: Airport Terminal incorporating shopping areas
type of construction: Fire-resistant construction
sprinklers: No-except in the kitchen and restaurant.
smoke detectors: Not present
deaths/injuries: 16 civilian deaths. 60 injuries
area of life origin: Ceiling space above flower shop in arrival area
area affected by fire: Smoke and fire spread to several areas including VIP lounge and walkway to aircraft (see Figure x).

notes: Ceiling space above flower shop contained significant quantities of PVC cabling. Fire and smoke spread throughout the building via combustible cabling and air ducts providing a ready means for transporting smoke upwards and along. Significant fire amongst the strip shops in the arrival area (where the flower shop located). All people died from smoke inhalation. 8 people died in the VIP Air France lounge as only one exit and heavy smoke prevented use of this exit. Estimated that 2500 persons were in the fire-affected part of the airport.

APPENDIX B
Cases where Fatalities due to Fire in
Retail Buildings in the US
(1983 to 1993 (except 1986))

date: Monday 5 /4/ 93
time at which fire noted: 0027
cause of fire: Unknown (vehicle, heat due friction ignited flammable liquid
description of centre: Shopping complex-Professional supplies, services shop or centre (trade supply, sales)
type of construction: Unprotected non-combustible or limited combustible
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 33 years. This fatality was a fire casualty and a civilian. They had known the building for less than one day. They were intimately involved in ignition, Before the fire they were bedridden or handicapped and had no time to escape. Injured when escaping. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The injured civilian was a male aged 21 years whose familiarity with the building was less than one day, was intimately involved in ignition and was impaired by drugs or alcohol at the time. He had no time to escape and was attempting rescue when injured. He was exposed to fire products. suffered burns to multiple body parts and was taken to hospital by a non-fire department vehicle.

The estimated loss was \$100,000.

Case 2

date: Monday 25 /1/ 93
time at which fire noted: 0027
cause of fire: Suspicious (not during civil disturbance-ignition involved appliances, etc. (television, radio, etc)-heat from improperly operating electrical equipment ignited multiple materials)
description of centre: Food or drink shop or centre
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Present and operated
deaths/injuries: 1 civilian death, 2 civilian injuries, 3 fire fighter injuries
area of fire origin: Residential area (kitchen)
area affected by fire: Confined to structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 46 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were asleep and had no time to escape. Injured while sleeping. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The two civilians injured were a male age 86 and female age 29 years also with unknown building familiarity. At ignition they were in the building of fire origin, the male was asleep and had no time to escape, the female unknown location and no conditions preventing escape. The male was exposed to fire products resulting in asphyxia/smoke only, the female fell or stepped on, over or into something causing a wound, cut or bleeding to her leg(s). The male was taken to hospital by non-fire department vehicle and the female treated at the scene and released.

The three injured fire fighters were all male of ages 32, 36 and 31 years. The first and third suffered strains or sprains, the first to the groin, the third to the arm-hand area, both due over exertion, The second suffered internal trauma to the leg and foot when struck by something (blunt).

The estimated loss was \$150,000.

Case 3

date: Sunday 27 /3/ 83
time at which fire noted: 0034
cause of fire: Misuse of material ignited (improper storage-ignition involved service, maintenance equipment, heat from spontaneous ignition or chemical reaction-acetylene ignited)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Extended beyond structure of origin and smoke damage was of unknown extent

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

Mobile property involvement unknown. The estimated loss was \$40,000.

Case 5

date: Sunday 8 /12/ 85
time at which fire noted: 0046
cause of fire: Incendiary (not during civil disturbance, open flame-match-ignited petrol from pipe or container)
description of centre: Clothing, etc shop or centre (clothing)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death, 2 civilian injuries
area of fire origin: Service facilities (display window)

area affected by fire: Confined to room of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$3000.

[REDACTED]

date: Saturday 15 /4/ 89
time at which fire noted: 0101
cause of fire: Suspicious (not during civil disturbance-man-made fibre ignited)
description of centre: Clothing, etc shop or centre (tailor, dressmaking)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke deflectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (supply storage room or area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$25,000.

[REDACTED]

date: Monday 18 /5/ 87
time at which fire noted: 014 1
cause of fire: Incendiary (not during civil disturbance-open flame (match) ignited petrol which ignited exterior wall surface)
description of centre: Shopping complex-Food or drink shop or centre (market, grocery store)
type of construction: Unprotected wood frame
sprinklers: Unknown
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 73 years. This fatality was a casualty of unknown type and a probably a civilian (unknown). They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was bums and asphyxia/smoke. Leg injured.

The estimated loss was \$30,000.

[REDACTED]

date: Thursday 31 /3/ 88
time at which fire noted: 0151
cause of fire: Unknown (No equipment involved)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)

sprinklers: Not fitted in room of fire origin
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Means of egress
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 40 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin, Before the fire they were asleep and had no time to escape. Injured while sleeping. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$100,000.

date: Saturday 3 /8/ 85
time at which fire noted: 0159
cause of fire: Unknown (no equipment involved, multiple materials ignited)
description of centre: Shopping complex-Clothing, etc shop or centre (clothing accessories, shoes)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (product storage room, area. tank or bin)
area affected by fire: Confined to structure of origin and smoke damage was zero

notes: The fatality was male and aged 57 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the storey of fire origin. Before the fire they were asleep and had no time to escape. Injured while sleeping. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$118,409.

Case 10

date: Tuesday 29 /3/ 83
time at which fire noted: 0202
cause of fire: Mechanical failure, etc (ignition involved cooking equipment-portable cooking or warming unit and arc due short circuit ignited plastic electrical cable insulation)
description of centre: No complex-Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 58 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was unknown

Case 11

date: Wednesday 22 /9/ 93
time at which fire noted: 0225
cause of fire: Misuse of material ignited (combustible too close to heat-ignition involved processing equipment (chemical process equipment), heat from gas fuelled equipment ignited gas)
description of centre: Motor vehicle or boat sales or services
type of construction: Protected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to area of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 46 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but did not escape-why is not known. Unknown activities at time of injury. Exposure to chemicals or radiation caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire. Fire involved automobile.

Mobile. The estimated loss was \$28,500.

Case 12

date: Tuesday 24 /11/ 92
time at which fire noted: 0245
cause of fire: Mechanical failure, etc (short circuit, ground fault-ignition involved electrical distribution equipment, fixed wiring-arc due defective insulation ignited electrical cable insulation)
description of centre: No complex-Food or drink shop or centre (market, grocery store)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 2 civilian deaths
area of fire origin: Structural area (ceiling and roof area, space)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 33 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were in unknown condition and escape was prevented by fire. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The fatality was male and aged 52 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were in unknown condition and escape was prevented by fire. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The estimated loss was \$20,000.

date: Sunday 29 /5/ 83
time at which fire noted: 0248
cause of fire: Misuse of heat (falling asleep)
description of centre: Professional supplies, services shop or centre (laundry, dry cleaner)
type of construction: Unknown
sprinklers: Unknown

smoke detectors: Unknown
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Residential area (sleeping room for < 5 people)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian, They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury, Cause of injury unknown. Nature of injury unknown. Injury details unknown.

No details of the fire fighter injury are known.

The estimated loss was \$7 1,000.

Ci

date: Friday 24 /11/ 89
time at which fire noted: 025 1
cause of fire: Suspicious (not during civil disturbance)
description of centre: Shopping complex-Specialty shop or centre (books, stationery)
type of construction: Unprotected non-combustible or limited combustible
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injuries
area of fire origin: Means of egress
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and of unknown age. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The injured firefighter was a male aged 38 years who was moderately injured but treated only at the scene. The injury was a sprain or strain to the trunk with unknown cause. No other details are known.

The estimated loss was \$75,000.

Case 15

date: Thursday 1 /10/ 92
time at which fire noted: 0300
cause of fire: Misuse of material ignited (fuel spilled, etc accidentally-from vehicle, heat from fuel igniting multiple materials)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Fire resistive (non-combustible building)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Vehicle, transport area (fuel tank, fuel line)
area affected by fire: Confined to room of origin and smoke damage was beyond the structure of origin

notes: This fatality is female and aged 35 years. This fatality was an ems casualty and a civilian. They had unknown building familiarity. They were not a fire casualty. Before the fire they were in unknown condition and did not escape-why is unknown. Injured when unable to act. Cause of injury unknown. Nature of injury unknown. Multiple body-parts injured. They died at the fire.

Fire involved automobile. The estimated loss was \$10,000.

date: Wednesday 17 /7/ 85
time at which fire noted: 0301
cause of fire: Unknown (no equipment involved-sawn wood (structural member) ignited)
description of centre: Shopping complex-Clothing, etc shop or centre (clothing accessories, shoes)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Storage area (supply storage room or area)
area affected by fire: Confined to structure of origin and smoke damage was beyond the structure of origin

notes: This fatality is female and aged 67 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were asleep and did not escape-why is not known. Injured while sleeping. Exposure to fire products caused injury. Injury was heart attack, stroke, etc. Internal injuries. They died at the fire.

The injured fire fighter was male aged 33 years and suffered a moderate severity injury to the head but of unclassified type, He was involved in suppression using a hand tools on a ladder or aerial apparatus, had attended three fires in the previous 24 hours, was rested and was asleep at the rime of alarm. The injury was caused by flying glass and was treated at the scene. Full protective clothing was being correctly worn but no breathing apparatus. No failure of any protective equipment was noted.

The estimated loss was \$30,000.

Case 17

date: Thursday 1 /6/ 89
time at which fire noted: 0309
cause of fire: Mechanical failure, etc (electrical fault-ignition involved refrigerator (arc due short circuit) ignited plastic electrical cable insulation)
description of centre: Food or drink shop or centre (liquor, beverage)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 36 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but did not escape-why is not known. Injured when escaping. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The estimated loss was \$40,000.

Case 18

date: Monday 19 /6/ 89
time at which fire noted: 0333
cause of fire: Misuse of heat (abandoned, discarded material cigarette ignited cotton or rayon-upholstered sofa, chair or seat)
description of centre: Motor vehicle or boat sales or services (motor vehicle, trailer sales)
type of construction: Unknown
sprinklers: Unknown

smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Means of egress (hallway, corridor, mall)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$120,000.

date: Wednesday 11 /11/ 87
time at which fire noted: 0 352
cause of fire: Unknown
description of centre: No complex-Motor vehicle or boat sales or services (public service station)
type of construction: Unprotected non-combustible or limited combustible
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 3 civilian injuries
area of fire origin: Means of egress
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 48 years. This fatality was a fire casualty and a civilian. They had known the building for less than one day. At ignition they were in the storey of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Injured when unable to act. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The injured civilians were a female aged 42, a male aged 31 and a male aged 42. Their familiarity with the building varied-the female had known it for over one year, the 31 year old male 3 to 6 months and the male less than 1 day. Their activity of time of injury was recorded as unable to act. escaping and escaping respectively. The first two were take to hospital by a fire department vehicle, the last by a non-fire department vehicle. All other details are as for the fatality.

The estimated loss was \$500,000.

date: Sunday 8 /1/ 89
time at which fire noted: 04 11
cause of fire: Design, construction, installation deficiency (too close, exposure (heat from another fire-radiation) ignited hardwood or plywood structural member (exposure fire number three))
description of centre: Specialty shop or centre (gifts)
type of construction: Unprotected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 5 civilian injuries
area of fire origin: Storage area (supply storage room or area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality is female and aged 74 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were asleep and escape was prevented by fire. Injured when unable to act. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The civilian casualties were a female aged 49 years and four males aged 81, 26, 31 and 18 years. The female and the first and third males were fire casualties, the other males were action casualties. The first two had been familiar with the building for over one year, the third and fourth less than one day and the fifth three to six months. The first two and the fourth were in the building of fire origin at ignition, the others were outside the building but on the property at ignition. The first two were asleep when ignition occurred, the fire was between them and the exit, and they were escaping at the time of injury; the others were awake and unimpaired at that time, there were no factors preventing escape-they were attempting rescue at the time of injury. The fourth of them was injured by being struck by something and the injury was a wound, cut or bleeding; the others were injured falling or stepping on, over or into something and suffered a strain or sprain. They were all taken to hospital by a non-fire department vehicle.

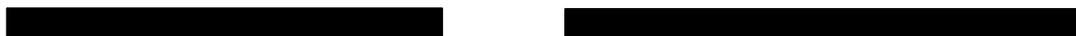
The estimated loss was \$5000.



date: Sunday 5 /4/ 92
time at which fire noted: 0430
cause of fire: Mechanical failure, etc (electrical fault, not short circuit, etc-ignition involved electrical distribution equipment, plug or cord. heat from overloaded equipment ignited paper)
description of centre: Shopping complex-Food or drink shop or centre (market, grocery store)
type of construction: Unprotected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (garage, carport, etc)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 54 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the enclosure of fire origin, Before the fire they were in unknown condition and did not escape--why is not known. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They were taken to hospital by fire brigade.

The estimated loss was \$10000.



date: Sunday 1.5 /3/ 92
time at which fire noted: 0430
cause of fire: Misuse of heat (falling asleep, no equipment involved)
description of centre: Shopping complex-Motor vehicle or boat sales or services (motor vehicle accessory sales)
type of construction: Unknown
sprinklers: Unknown
smoke defectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Residential area (office)
area affected by fire: Unknown and smoke damage was of unknown extent

notes: The fatality was male and aged 26 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Injury was asphyxia/smoke only. Injury details unknown.

The estimated loss was unknown.

Case 23

date: Friday 27 /10/ 89
time at which fire noted: 05 15
cause of fire: Mechanical failure, etc (no maintenance, worn out, ignition involved a portable heater liquid fuelled-ignited combustible liquid)
description of centre: Motor vehicle or boat sales or services (boat, pleasure craft sales)
type of construction: Unknown
sprinklers: Unknown
smoke detectors.. Unknown
deaths/injuries: 1 civilian death
area of fire origin: Unknown
area affected by fire: Unknown and smoke damage was of unknown extent

notes: The fatality was male and aged 35 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were impaired by drugs, alcohol, etc and did not escape-why is not known. Unknown activities at time of injury. Exposure to fire products caused injury. Nature of injury unknown. Injury details unknown. They died at the fire.

Fire involved motor boat. The estimated loss was unknown

Case 24

date: Monday 16 /5/ 88
time at which fire noted: 05 17
cause of fire: Incendiary (not during civil disturbance--open flame (lighter) ignited paper magazine, newspaper, etc
description of centre: Household goods sales/repair shop or centre (appliance repair)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Unknown (multiple use location)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 77 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were bedridden or handicapped and did not escape-why is unknown. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$175,000.

date: Thursday 6 /1/ 83
time at which fire noted: 0701
cause of fire: Unknown
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 53 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Injured while attempting to control fire. Entrapment caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$88,000

Case 26

date: Friday 7 /2/ 92
time at which fire noted: 0702
cause of fire: Incendiary (not during civil disturbance-ignited petrol from container)
description of centre: Food or drink shop or centre (liquor, beverage)
type of construction: Protected wood frame
sprinklers: Unknown
smoke defectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to room of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 44 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were impaired by drugs, alcohol, etc and did not escape-why is unknown. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$15,000.

Case 27

date: Friday 1 /5/ 92
time at which fire noted: 0730
cause of fire: Incendiary (during civil disturbance--open flame-match)
description of centre: Food or drink shop or centre (market, grocery store)
type of construction: Unknown
sprinklers.. Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to room of origin and smoke damage was of unknown extent

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$ 1 ,000,000.

date: Thursday 28 /1/ 88
time at which fire noted: 0833
cause of fire: Unknown
description of centre: Shopping complex-Household goods sales/repair shop or centre (wallpaper, paint)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Unknown
smoke defectors: Not present

deaths/injuries: 1 civilian death
area of fire origin: Structural area (ceiling and roof area, space)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 59 years. This fatality was a casualty of unknown type and a probably a civilian (unknown). They had known the building for over a year. At ignition they were not on the property of fire origin. Before the fire they were awake and unimpaired but did not escape-why is unknown, Unknown activities at time of injury. Exposure to chemicals or radiation caused injury. Injury was burns and asphyxia/smoke. Internal injuries.

The estimated loss was \$350,000.

date: Friday 6 /1/ 84
time at which fire noted: 0920
cause of fire: Misuse of material ignited (fuel spilled, etc accidentally-open flame - (lighter) ignited petrol)
description of centre: Motor vehicle or boat sales or services (public service station)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: I civilian death
area of fire origin: Residential area (toilet, locker or cloak room)
area affected by fire: Confined to structure of origin and smoke damage was of unknown extent

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$1000.

date: Wednesday 9 /11/ 83
time at which fire noted: 0953
cause of fire: Unknown (multiple materials ignited)
description of centre: Motor vehicle or boat sales or services (private service station)
type of construction: Unknown
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Extended beyond structure of origin and smoke damage was confined to the structure of origin

notes; The fatality was male and aged 19 years. This fatality was a fire casualty and a civilian. They had known the building for 7 to 12 months. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Injured when unable to act. Entrapment caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They were taken to hospital by fire brigade.

The injured person was male and aged 27 years. All other details are identical to the fatality above except familiarity with building was over one year.

The estimated loss was \$85,300.

[REDACTED]

[REDACTED]

date: Thursday 14 /4/ 88
time at which fire noted: 1000
cause of fire: Unknown (no equipment involved)
description of centre: Motor vehicle or boat sales or services (public service station)
type of construction: Unprotected wood frame
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Extended beyond structure of origin and smoke damage was of unknown extent

notes: The fatality was male and aged 90 years. This fatality was a fire casualty and an emergency service officer. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were in unknown condition and had no time to escape. Unknown activities at time of injury. Entrapment caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$50,000.

Case 32

date: Thursday 5 /11/ 92
time at which fire noted: 1039
cause of fire: Misuse of heat (inadequate control of open fire ignited atomised or vaporised petrol)
description of centre: Motor vehicle or boat sales or services (public service station)
type of construction: Unprotected non-combustible or limited combustible
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Residential area (toilet, locker or cloak room)
area affected by fire: Confined to object of origin and smoke damage was zero

notes: The fatality was male and aged 52 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Injured when escaping. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

The estimated loss was unknown

[REDACTED]

date: Wednesday 13 /1/ 93
time at which fire noted: 1047
cause of fire: Ignition involved cooking equipment (fixed: stove, etc- heat from gas fuelled equipment ignited flammable or combustible liquid and multiple materials)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Fire resistive (non-combustible building)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to room of origin and smoke damage was confined to the room of origin

notes: The fatality was male and aged 37 years. This fatality was a fire casualty and a civilian, They had known the building for over a year. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They were taken to hospital by fire brigade.

The estimated loss was unknown

Cas

date: Saturday 17 /3/ 90
time at which fire noted: 1116
cause of fire: Operational deficiency (collision, overturn, knockdown-heat from gas fuelled equipment ignited flammable liquid)
description of centre: Shopping complex-Specialty shop or centre
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 4 fire fighter injuries
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was aged 29 years. This possible fatality was a casualty of unknown type and a probably a civilian (unknown). They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown, Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The four injured fire fighters were all male ages 38, 42, 39 and 41 years and were the injuries were of moderate severity. All suffered from asphyxiation and were admitted to hospital. All were involved in suppression, three handling hose lines the other operating a pump. All but one were outside on level ground, the other at grade. None had previous fires in the previous 24 hours and were awake and rested at the time of alarm. All were properly clothed and had self contained open circuit breathing apparatus. No equipment is said to have failed.

The estimated loss was \$100,000.

Case 35

date: Monday 18 /12/ 89
time at which fire noted: 1132
cause of fire: Incendiary (not during civil disturbance--open flame-match ignited paper-box, carton or bag)
description of centre: Shopping complex-Household goods sales/repair shop or centre (furniture)
type of construction: Fire resistive (non-combustible building)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to floor of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 43 years. This fatality was a fire casualty and a civilian. They had known the building for 1 to 7 days. At ignition they were in the building of fire origin. Before the fire they were impaired by drugs, alcohol, etc and moved too slowly to escape. Unknown activities at time of injury. Cause of injury unknown. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

The estimated loss was \$2000.

date: Sunday 21 /12/ 91
time at which fire noted: 1150
cause of fire: Mechanical failure, etc (part failure, leak, break-spark, etc from gas fuelled equipment ignited natural gas and insulation)
description of centre: Household goods sales/repair shop or centre
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 2 civilian deaths
area of fire origin: Service facilities (display window)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 84 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were too old to respond to fire and had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

This fatality is female and aged 79 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were too old to respond to fire and had no time to escape. Unknown activities at time of injury. Entrapment caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$150,000.

date: Friday 24 /8/ 84
time at which fire noted: 1242
cause of fire: Unknown, petrol ignited
description of centre: No complex-Motor vehicle or boat sales or services (private service station)
type of construction: Unprotected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 38 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Unknown activities at time of injury. Entrapment caused injury. Injury was burns only. Multiple body-parts injured. They were taken to hospital by others.

The injured civilian was a male aged 26, had familiarity of the building of undetermined or not reported and was reported as having no condition preventing escape compared with fire between casualty and exit for fatality above.

The estimated loss was \$90,000.

date: Wednesday 30 /10/ 85
time at which fire noted: 1252
cause of fire: Misuse of heat (involved service, maintenance equipment-welding or cutting torches, etc ignited gas or liquid from pipe or container)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)

type of construction: Unprotected non-combustible or limited combustible
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Structural area
area affected by fire: Confined to area of origin and smoke damage was confined to the storey of origin

notes: The fatality was male and aged 52 years. This fatality was a fire casualty and a civilian. They had known the building for 3 to 6 months. They were intimately involved in ignition. Before the fire they were awake and unimpaired but did not escape-why is not known. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They were taken to hospital by others.

The estimated loss was \$5000.

date: Sunday 1 /10/ 89
time at which fire noted: 1305
cause of fire: Operational deficiency (improper start up or shutdown ignited polyester exterior roof surface)
description of centre: Motor vehicle or boat sales or services (car washing facility)
type of construction: Protected non-combustible or limited combustible (protected steel, etc)
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (heating equip room or area)
area affected by fire: Confined to object of origin and smoke damage was confined to the area of origin

notes: This fatality of unknown sex was aged 21 years. This possible fatality was a casualty of unknown type and a probably a civilian (unknown). They had known the building for over a year. They were intimately involved in ignition. Before the fire they were asleep and escape was prevented by fire. Injured when escaping, Cause of injury unknown. Injury was burns only. Head/neck injured.

The estimated loss was \$5000.

Case 4

date: Thursday 13 /6/ 87
time at which fire noted: 13 12
cause of fire: Unknown (No equipment involved) (heat)
description of centre: Household goods sales/repair shop or centre (furniture)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to room of origin and smoke damage was confined to the room of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The injured civilian details were identical to those for the fatality above.

The estimated loss was \$200,000.

Cas

date: Saturday 18 /10/ 84
time at which fire noted: 1345
cause of fire: Incendiary (not during civil disturbance-heat from hot object ignited petrol which ignited exterior wall surface)
description of centre: Professional supplies, services shop or centre
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Residential area (office)
area affected by fire: Unknown and smoke damage was of unknown extent

notes: The fatality was male and of unknown age. This fatality was a fire casualty and a civilian. They had known the building for less than one day. They were intimately involved in ignition. Before the fire they were in unknown condition and did not escape-why is not known. Injured when acting irrationally. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire. Fire involved automobile.

The estimated loss was \$17,500.

Case 42

date: Wednesday 4 /1/ 89
time at which fire noted: 14 13
cause of fire: Unknown, multiple materials ignited
description of cen tre: Shopping complex-Specialty shop or centre
type of construction: Unknown
sprinklers: Not fitted in room of fire origin
smoke detectors: Present did not operate (should have)
deaths/injuries: 1 civilian death, 3 civilian injuries, 2 fire fighter injuries
area of fire origin: Unknown
area affected by fire: Confined to floor of origin and smoke damage was confined to the storey of origin

notes: The fatality was male and aged 29 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were bedridden or handicapped and did not escape due to incapacitation. Injured when escaping. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The civilians injured were all males aged 73, 26 and 18 and they were said to be injured five minutes before the fatality occurred. The first was a fire casualty, the others were "other" emergency personnel and were action casualties. The first had over one years familiarity with the building and was in the room of fire origin, the others building familiarity of less than one day and were outside the building but on the property at the time of ignition. All were awake and unimpaired before ignition, nothing prevented their escape, all were attempting rescue when injured and were injured by exposure to fire products, suffering asphyxia or smoke only-suffering internal injuries. The first two were treated at the scene and released, the third taken to hospital by a fire department vehicle.

The fire fighters injured were both male aged 39 and 34 years. Both were moderately injured suffering pain only, the first in the shoulder, the second in the lower back. They were treated at the scene. Both were listed as involved in suppression, but the first is listed as injured lifting a victim and had no protective clothing or equipment on. The second was handling a charged hose line and cause of injury is given as overexertion. He was wearing appropriate clothing and equipment but no clothing or equipment is noted as having failed-although the boots are stated to have been burned.

The estimated loss was \$5000.

Case 43

date: Thursday 27 110188
time at which fire noted: 1420
cause of fire: Misuse of heat (inadequate control of open fire-ignition involved incinerator, spark ignited cardboard box, carton or bag
description of centre: Shopping complex-Food or drink shop or centre (supermarket)
type of construction: Protected non-combustible or limited combustible (protected steel, etc
sprinklers:, Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (supply storage room or area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 82 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Injured when escaping. Entrapment caused injury. Injury was asphyxia/smoke only, Internal injuries. They died at the fire.

The estimated loss was \$939,000.

date: Thursday 30 /4/ 92
time at which fire noted: 1500
cause of fire: Incendiary (during civil disturbance-flame-match)
description of centre: Food or drink shop or centre (supermarket)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: I civilian death
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$1,000,000.

Case 45

date: Monday 3 /8/ 87
time at which fire noted: 1.542
cause of fire: Unknown (arc due short circuit ignited sawn wood interior wall surface)
description of centre: Shopping complex-Motor vehicle or boat sales or services (motor vehicle **accessory** sales)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: The fatality was male and aged 72 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire

they were bedridden or handicapped and escape was prevented by fire. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$30,000.

Case 4

date: Monday 31 /1/ 83
time at which fire noted: 1555
cause of fire: Misuse of material ignited (fuel spilled, etc accidentally, ignition involved a heating system-fixed heater, heat from gas fuelled equipment ignited petrol)
description of centre: No complex-Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 47 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Entrapment caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The estimated loss was \$13,000.

date: Saturday 5 /10/ 85
time at which fire noted: 1630
cause of fire: Misuse of material ignited (fuel spilled, etc accidentally-ignition involved service, maintenance equipment, open flame-cutting torch, etc ignited flammable or combustible liquid from pipe or container
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unknown
sprinklers: Not fitted in room of fire origin
smoke detectors.. Not present
deaths/injuries: 2 civilian deaths
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality is female and aged 1 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were too young to respond to fire and escape was prevented by fire. Injured when unable to act. Entrapment caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire. The estimated loss was \$ 85000.

This fatality is female and aged 3 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were too young to respond to fire and escape was prevented by fire. Injured when unable to act. Entrapment caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

The estimated loss was \$85,000.

[REDACTED]

date: Wednesday 19 /7/ 89
time at which fire noted: 1644
cause of fire: Mechanical failure, etc (short circuit, ground fault)-ignition involved electrical distribution equipment-arc or spark from switch, etc ignited polyvinyl electrical cable insulation
description of centre: Shopping complex---clothing, etc shop or centre
type of construction: Protected ordinary (masonry walls, floors protected)
sprinklers: Unknown
smoke detectors: Present (in room) but fire too small to activate
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (switchgear, transformer)
area affected by fire: Confined to object of origin and smoke damage was confined to the area of origin

notes: This fatality of unknown sex was aged 39 years. This possible fatality was a casualty of unknown type and a probably a civilian (unknown). They had known the building for 1 to 7 days. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Injured when unable to act. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They were taken to hospital by others.

The estimated loss was \$2500.

Case 4

date: Saturday 27 /10/ 90
time at which fire noted: 1653
cause of fire: Misuse of material ignited (washing part, cleaning, painting, etc--- ignition involved a heating system (fixed heater liquid fuelled) ignited petrol)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to object of origin and smoke damage was zero

notes: The fatality was male and aged 78 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were awake and unimpaired but did not escape-why is not known. Injured when escaping. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

The estimated loss was unknown

Case 50

date: Wednesday 23 /3/ 83
time at which fire noted: 1732
cause of fire: Misuse of material ignited (ignition involved a heating system-water heater, heat from gas fuelled equipment ignited petrol from pipe or container)
description of centre: Motor vehicle or boat sales or services (public service station)
type of construction: Fire resistive (non-combustible building)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Service, equipment area (heating equip room or area)

area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 24 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The fire fighter injured was a male 40 years of age. The injury was of moderate severity, primary symptom a laceration or cut to an arm or hand. Treated at scene. Prior to alarm fire fighter was awake and when injured was extinguishing fire. Injury caused when struck by something.

The estimated loss was \$30,000.

Case 51

date: Wednesday 29 /4/ 92
time at which fire noted: 1800
cause of fire: Incendiary (during civil disturbance-open flame-match)
description of centre: General item store or centre (large variety store)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian, They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$2,000,000.

date: Friday 5 /4/ 9 1
time at which fire noted: 1818
cause of fire: Suspicious (not during civil disturbance)
description of centre: Shopping complex-General item store or centre (mall)
type of construction: Protected non-combustible or limited combustible (protected steel, etc)
sprinklers: Unknown
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Storage area (product storage room, area, tank or bin)
area affected by fire: Confined to area of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 39 years. This possible fatality was a casualty of unknown type and a probably a civilian (unknown). They had unknown building familiarity. At ignition they were in the building of fire origin. Before the fire they were awake and unimpaired but did not escape-why is not known. Injured while attempting to control fire Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They refused help.

The injured fire fighter was male aged 32 years and was operating an engine/pump. The injury was minor, a cut to the wrist and was treated at the scene. The firefighter was wearing gloves but not a coat and no equipment failure is recorded.

The estimated loss was \$10,000.

Case 53

date: Monday 2 /10/ 89
time at which fire noted: 19 12
cause of fire: Operational deficiency (improper start up or shutdown-ignition involved a water heater, open flame (match) ignited LP gas which ignited interior wall surface)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Protected non-combustible or limited combustible (protected steel, etc)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (heating equip room or area)
area affected by fire: Extended beyond structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 59 years. This fatality was an action casualty and a civilian. They had known the building for 7 to 12 months. They were intimately involved in ignition. Before the fire they were awake and unimpaired but with burning clothing did not escape. Injured when escaping. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire. Fire involved caravan.

The estimated loss was \$1500.

Case 54

date: Sunday 3 /2/ 85
time at which fire noted: 1927
cause of fire: Misuse of heat (discarded material-cigarette ignited cardboard rubbish or waste)
description of centre: General item store or centre (department store)
type of construction: Unprotected wood frame
sprinklers: Unknown
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Means of egress (exterior stairway)
area affected by fire: Confined to room of origin and smoke damage was of unknown extent

notes: The fatality was male and aged 60 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the storey of fire origin. Before the fire they were impaired by drugs, alcohol, etc and did not escape due to incapacitation. Unknown activities at time of injury. Cause of injury unknown. Injury was burns only. Multiple body-parts injured. They died at the fire.

The estimated loss was \$50.

date: Sunday 31 /12/ 89
time at which fire noted: 1948
cause of fire: Incendiary (not during civil disturbance, no equipment involved)
description of centre: Shopping complex-Food or drink shop or centre (market, grocery store)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was aged 0 years. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$75,000.

Case 56

date: Saturday 2 /7/ 83
time at which fire noted: 2006
cause of fire: Incendiary (not during civil disturbance, open flame-match ignited petrol)
description of centre: Shopping complex-Food or drink shop or centre (supermarket)
type of construction: Protected ordinary (masonry walls, floors protected)
sprinklers: Fitted and operated
smoke detectors: Not present
deaths/injuries: 5 civilian deaths, 13 civilian injuries
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to area of origin and smoke damage was confined to the structure of origin

notes: This fatality is female and aged 20 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

This fatality is female and aged 23 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

This fatality is female and aged 4 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

This fatality is female and aged 27 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

This fatality is female and aged 16 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. They were intimately involved in ignition. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns only. Multiple body-parts injured. They died at the fire.

The civilian injuries consisted of four males and nine females. The males were aged 16, 22, 26 and 32 and the females aged 7, 12 (two), 26, 28 (three), 49, 56. The male aged 26 had familiarity with the building for over 12 months whereas all the other casualties familiarity was undetermined or unreported (unknown). All other details were identical to those for the fatalities above.

The estimated loss was \$100,000.

date: Friday 22 /2/ 85
time at which fire noted: 2012
cause of fire: Operational deficiency (heat from improperly operating electrical equipment ignited supplies or stock)
description of centre: Food or drink shop or centre (supermarket)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death

area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

Mobile property involvement unknown. The estimated loss was \$350,000.

Case 58

date: Thursday 16 /5/ 9 1
time at which fire noted: 2025
cause of fire: Suspicious (not during civil disturbance. no equipment involved-heat ignited multiple materials)
description of centre: Shopping complex-General item store or centre
type of construction: Unknown
sprinklers: Not fitted in room of fire origin
smoke detectors: Unknown
deaths/injuries: 2 civilian deaths, 12 fire fighter injuries
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Extended beyond structure of origin and smoke damage was beyond the structure of origin

notes: This fatality is female and aged 27 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Injured when escaping. Entrapment caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The fatality was male and aged 20 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Injured while attempting rescue. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The firefighters injured were all male and aged 51, 21, 22, 21, 28, 33, 24, 25, 25, 26 and 29 years. All but two suffered minor injuries, the others moderate injuries. Most had difficulty in breathing, two were burned one on the foot by traffic flares while directing traffic, another to the upper body and another had a sprained or strained neck from a collapsing ceiling. Most were handling charged static lines at the time. Equipment and protective clothing worn varied but no failure of these is noted. Six were treated at the scene, seven were treated in a hospital emergency room.

The estimated loss was \$1,750,000.

date: Sunday 25 /6/ 89
time at which fire noted: 2034
cause of fire: Suspicious (not during civil disturbance, no equipment involved)
description of centre: Shopping complex-General item store or centre (mall)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 civilian injury, 1 fire fighter injury
area of fire origin: Residential area (office)
area affected by fire: Confined to fire rated compartment of origin and smoke damage was confined to the storey of origin

notes: The fatality was male and aged 50 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. They were intimately involved in ignition. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Exposure

to fire products caused injury. Nature of injury unknown. Multiple body-parts injured. They died at the fire.

The injured civilian was a female aged 47 years, treated at the scene and released. The other details were either undetermined, not reported or not classified.

The injured fire fighter was a male aged 44 years. It was classified as minor, involved dizziness or fainting, was treated in a hospital emergency room and was classified as a fire ground injury. The fire fighter had been to nine (9) fires in the previous 24 hours and was fatigued but awake at the time of alarm. He was involved in fire suppression outside on level ground at the time and was lifting hand tools. Proper equipment was being worn and no equipment failure was noted.

The estimated loss was \$100,000.

Case

date: Monday 23 /12/ 85
time at which fire noted: 2037
cause of fire: Unknown (vehicle involved, heat due friction ignited flammable liquid from pipe or container--exposure fire number one)
description of centre: Shopping complex-General item store or centre (mall)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 3 civilian deaths
area of fire origin: Means of egress (hallway, corridor, mall)
area affected by fire: Confined to structure of origin and smoke damage was of unknown extent

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown.

The estimated loss was \$150,000.

date: Thursday 28 /12/ 89
time at which fire noted: 2040
cause of fire: Suspicious (not during civil disturbance-petrol ignited)
description of centre: Motor vehicle or boat sales or services (motor vehicle, trailer sales)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Unknown
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to area of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 39 years. This fatality was a casualty of unknown type and a probably a civilian (unknown). They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were in unknown condition and did not escape-why is

unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Multiple body-parts injured.

The estimated loss was \$10,000.

[REDACTED]

date: Friday 14 /1/ 83
time at which fire noted: 2043
cause of fire: Incendiary (not during civil disturbance, paper ignited-supplies or stock)
description of centre: Food or drink shop or centre (supermarket)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to room of origin and smoke damage was confined to the storey of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian, They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown,

The details for the injured civilian are identical to those above for the fatality.

The estimated loss was \$70,000.

[REDACTED]

date: Friday 14 /6/ 9 1
time at which fire noted: 2122
cause of fire: Incendiary (not during civil disturbance-flammable or combustible liquid ignited gas or liquid from pipe or container)
description of centre: Shopping complex-Food or drink shop or centre (market, grocery store)
type of construction: Protected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Unknown (multiple use location)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 0 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Cause of injury unknown. Nature of injury unknown. Injury details unknown. They died at the fire.

The estimated loss was \$ 85000.

[REDACTED]

date: Tuesday 22 /3/ 88
time at which fire noted: 2126
cause of fire: Misuse of heat (ignition involved open flame (cutting torch, etc)—ignited petrol from pipe or container)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Protected wood frame
sprinklers: Not fitted in room of fire origin

smoke detectors: Not present
deaths/injuries: 2 civilian deaths
area of fire origin: Service, equipment area (maintenance area)
area affected by fire: Confined to fire rated compartment of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 17 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the storey of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Cause of injury unknown. Injury was burns only. Multiple body-parts injured. They died at the fire. The estimated loss was unknown

The fatality was male and aged 44 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the storey of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Cause of injury unknown. Injury was burns only. Multiple body-parts injured. They died at the fire.

The estimated loss was unknown

Case 65

date: Monday 7 /6/ 93
time at which fire noted: 2208
cause of fire: Misuse of heat (discarded cigarette ignited paper and linen (not bedding))
description of centre: Hobby, personal services, etc shop.
type of construction: Protected non-combustible or limited combustible (protected steel, etc
sprinklers: Not fitted in room of fire origin
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Storage area (rubbish area or container)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 25 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the storey of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Injured when escaping. Exposure to fire products caused injury. Injury was asphyxia/smoke only. Internal injuries. They died at the fire.

The estimated loss was \$350,000.

date: Tuesday 3 /9/ 91
time at which fire noted: 2225
cause of fire: Misuse of heat (abandoned, discarded material, no equipment involved--open flame (candle, etc) ignited polish
description of centre: Shopping complex-Household goods sales/repair shop or centre (furniture)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Sales, assembly area (lounge area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 47 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury.

Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The injured fire fighter was a male aged 39 years. He suffered a minor strain or sprain to the trunk while on suppression activities and was treated at the scene. *NO* other details known.

The estimated loss was \$50,000.

[REDACTED]

date: Sunday 11 /2/ 90
time at which fire noted: 2225
cause of fire: Suspicious (not during civil disturbance, no equipment involved)
description of centre: Hobby, personal services, etc shop. (sporting goods)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death
area of fire origin: Sales, assembly area (very large open room)
area affected by fire: Unknown and smoke damage was of unknown extent

notes: The fatality was male and aged 22 years. This possible fatality was a casualty of unknown type and a probably a civilian (unknown). They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape-why is not known. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was asphyxia/smoke only, Internal injuries. They were taken to hospital by others.

The estimated loss was unknown

[REDACTED]

date: Tuesday 27 /7/ 93
time at which fire noted: 2231
cause of fire: Incendiary (not during civil disturbance, no equipment involved-petrol incendiary device ignited fuel)
description of centre: Food or drink shop or centre (market, grocery store)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 3 civilian injuries,
area of fire origin: Sales, assembly area (sales, showroom area)
area affected by fire: Confined to floor of origin and smoke damage was confined to the storey of origin

notes: The fatality was male and aged 47 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the enclosure of fire origin. Before the fire they were awake and unimpaired but escape was prevented by fire. Injured when escaping. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The injured civilians were a male aged 42, female aged 62 and a male aged 28 years. All injuries and the fatality are indicated as happening six minutes before the alarm was raised. The time the injured had known the building is not recorded, but the first male was in the room of fire origin at ignition, the female off the property at ignition and the second male intimately involved in ignition. All casualties were awake and unimpaired before ignition. The fire was between the first male and the exit, the female had nothing preventing escape but the second male had no time to escape-the fire progressed too rapidly. The first male was attempting escape at the time of injury, the activity of the other two injured is not reported. The cause of injury is exposure to fire products for the males and not classified for the female. The nature of injury is asphyxia/smoke for the first male, unclassified for the female and burns only for the second male. The body parts injured were internal for the first male, unclassified for the female and multiple parts for the second male. The first male was taken to hospital by fire department vehicle, the other two injured were treated at the scene and released.

The estimated loss was \$70,000.

date: Thursday 4 /2/ 93
time at which fire noted: 23 14
cause of fire: Design, construction, installation deficiency (too close-heat from another fire (radiation) ignited sawn wood (structural member), exposure fire number one)
description of centre: Motor vehicle or boat sales or services (public service station)
type of construction: Protected ordinary (masonry walls, floors protected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of fire origin: Storage area (supply storage room or area)
area affected by fire: Confined to area of origin and smoke damage was zero

notes: The fatality was male and aged 38 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were outside the building of fire origin. Before the fire they were in unknown condition and had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury, Injury was burns and asphyxia/smoke. Multiple body-parts injured. They died at the fire.

The estimated loss was \$200.

Case 70

date: Sunday 3 /2/ 90
time at which fire noted: 2323
cause of fire: Misuse of heat (falling asleep--open flame--candle, etc ignited fabric or textile bedding)
description of centre: Food or drink shop or centre (liquor, beverage)
type of construction: Unknown
sprinklers: Unknown
smoke detectors: Unknown
deaths/injuries: 1 civilian death, 1 civilian injury
area of fire origin: Sales, assembly area (lounge area)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality of unknown sex was of unknown age. This fatality was a casualty of unknown type and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and did not escape--why is unknown. Unknown activities at time of injury, Cause of injury unknown. Nature of injury unknown. Injury details unknown.

There is no more information available on the injured civilian than on the fatality above.

Fire involved mobile building. The estimated loss was \$10,000.

Case 71

date: Saturday 26 /7/ 85
time at which fire noted: 2329
cause of fire: Incendiary (not during civil disturbance--multiple materials ignited)
description of centre: Food or drink shop or centre
type of construction: Protected ordinary (masonry walls, floors protected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death, 1 fire fighter injury
area of fire origin: Residential area (office)

area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 58 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. At ignition they were in the storey of fire origin. Before the fire they were awake and unimpaired but had no time to escape. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Multiple body-parts injured. They were taken to hospital by others.

The injured fire fighter was male aged 35 years and suffered a moderate injury. The injury was recorded as a closed fracture in the trunk area and the casualty was taken to a hospital emergency room. At alarm the casualty was awake and was involved in extinguishing fire when injured falling or slipping. No other details are recorded.

The estimated loss was \$37,500.

date: Saturday 24 /1/ 87
time at which fire noted: 2353
cause of fire: Misuse of material ignited (combustible too close to heat-ignition involved a heating system. (central heating unit), heat from another fire (flame or convection) ignited sawn wood interior wall surface)
description of centre: Specialty shop or centre
type of construction: Protected wood frame
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 1 civilian death
area of life origin: Means of egress (hallway, corridor, mall)
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: The fatality was male and aged 60 years. This fatality was a fire casualty and a civilian. They had known the building for over a year. At ignition they were in the building of fire origin. Before the fire they were in unknown condition and did not escape-why is unknown. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire. Fire involved

Mobile building. The estimated loss was \$15,000.

Case 73

date: Friday 15 /11/ 9 1
time at which fire noted: 2356
cause of fire: Misuse of heat (children playing, etc-no equipment involved)
description of centre: Motor vehicle or boat sales or services (vehicle repair or paint shop)
type of construction: Unprotected ordinary (masonry walls, floors unprotected)
sprinklers: Not fitted in room of fire origin
smoke detectors: Not present
deaths/injuries: 4 civilian deaths, 1 fire fighter injuries
area of fire origin: Means of egress
area affected by fire: Confined to structure of origin and smoke damage was confined to the structure of origin

notes: This fatality is female and aged 3 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and escape was prevented by locked door. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

This fatality is female and aged 4 years. This fatality was a fire casualty and a civilian, They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and escape was prevented by locked door. Unknown activities at time of injury.

Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

The fatality was male and aged 6 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and escape was prevented by locked door. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

This fatality is female and aged 8 years. This fatality was a fire casualty and a civilian. They had unknown building familiarity. Their location at the time of ignition is unknown. Before the fire they were in unknown condition and escape was prevented by locked door. Unknown activities at time of injury. Exposure to fire products caused injury. Injury was burns and asphyxia/smoke. Internal injuries. They died at the fire.

The injured fire fighter was a male aged 55 years who suffered a minor bruise on the buttocks while ventilating the fire while on a wet roof. He was taken to a hospital emergency room. Prior to the fire he was rested and awake.

The estimated loss was \$10,000.

APPENDIX C
Review of Australian Fire Statistics
-Death and Injury Rates

APPENDIX C: Review of Australian Fire Statistics-Death and Injury Rates (1989 to 1993)

The data used for this review were provided by the CSIRO Division of Building, Construction and Engineering and are for structure (building) fires. The data are presented for two categories of buildings: Residential and Commercial. In this context Residential means buildings classified as residential in AS 2577 (1983) field Fixed Property Use (FPU). Commercial means all other buildings, including Public Assembly property, Educational property, Shop/Store, Office property, Basic Industry, Utility, Defence property, Manufacturing property, and Storage property. A third category is included for the balance of fires specified in the data as being structure fires in which the FPU was not classified or the field omitted.

The data are summarized in Table C1. It can be seen in this table that there are major differences in the casualties and losses between the two building categories. There were 7.1 civilian fatalities per 1000 fires in residential buildings compared with 1.2 per 1000 fires in commercial buildings. Similarly, for civilian injuries the comparable figures were 62.1 and 30.4 per 1000 fires for residential and commercial buildings respectively.

TABLE C1: FROM SMOKE AND FLAME DAMAGE BY CONSTRUCTION TYPE AND BY STOREY DATA
(ALLSAMERESULT)

<i>Building</i>	<i>Fires</i>	<i>Civilian Injuries</i>	<i>Fire Brigade Injuries</i>	<i>Civilian Fatalities</i>	<i>Fire Brigade Fatalities</i>	<i>\$ Loss</i>
<i>Commercial</i>	24491	74.5	461	30	1	1.3253e9
<i>Residential</i>	35303	2192	382	250	4	4.8346e8
<i>Unknown</i>	570	11	1	1	0	6.2327e6

The figures for fire fighters for residential and commercial buildings are 0.11 and 0.04 deaths respectively per 1000 fires and 10.8 and 18.8 injuries respectively per 1000 fires.

The fires resulted in losses estimated by the fire fighters that average about \$13,700 per fire for residential buildings and \$54,100 for commercial buildings.

It can be seen from these figures that there are major differences in the rates of human casualties and property damage resulting from fires in the two categories.

Nearly six times as many civilians are killed per 1000 fires in residential buildings compared with commercial buildings, while the comparable rate for fire fighters was just under three.

The figures are far closer for civilian injuries there being about twice as many civilians injured per 1000 fires in residential compared with commercial buildings. However for fire fighters the ratio was reversed, about twice as many firefighters being injured per 1000 fires in commercial compared with residential buildings.

The estimated property losses were about four times higher per fire for commercial buildings than for residential buildings.