Home Office

Further Development of Risk Assessment Toolkits for the UK Fire Service

Technical Note - Financial Loss Model

March 1999

Entec UK Limited

Report for Cath Reynolds

Home Office
Fire and Emergency Planning Department
Horseferry House
Dean Ryle Street
London, SWIP 2AW

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Further Development of Risk Assessment Toolkits for the UK Fire Service

Main Contributors

Michael S Wright
Karen H L Archer

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Karen Archer

Entec UK Limited

Validated by

Michael Wright

Entec UK Limited
17 Angel Gate
City Road
London
ECIV 2SH
England

Tel: +44 (0) 171278 8338
Fax: +44 (1, 171 113 1090

Certificate No. FS 37680

Contents

1 Introduction

1.1 Aims

Previous work has produced a method for estimating the frequency of uncontrolled fires in commercial and industrial premises. The aim of the current work is to predict the level of loss. The particular aims are:

i) To produce evidence demonstrating whether there is a relationship between response times and the level of loss incurred;

ii) To produce a statistical model of this relationship - of sufficient detail for application to fire cover review;

iii) To suggest how an understanding of the relationship between response times and fire loss can be used in fire cover review;

iv) To identify any long term research needs.

1.2 Approach to the work

The study has entailed:

i) A review of past research, including;

- experimental work,
- previous attempts to relate response times to losses.

ii) An analysis of recent data to produce a further response time loss relationship

iii) A Comparison of statistical models with experimental research and previous statistical work.

iv) Consideration of the issue of consequential losses on how to estimate the value of financial loss

v) Consideration of how to incorporate an understanding of response time-loss into fire cover review

2. Findings

2.1 Previous Fire Research and Models

Clearly, the rate of fire growth varies according to many interacting factors, including flammability of ignited items, first aid fire-fighting, size of area ignited, ceiling height, etc., hence, making any generalisation difficult. Nonetheless, estimates have been developed of the horizontal "doubling time" for fires within buildings which have reached their maximum rate of growth, such as:

- 14 minutes in a 2,500m^2 in a factory used for manufacture of yeast based food, with fire starting in a container storage area with empty cardboard boxes and carts. The factory lacked sprinklers, had wooden partitions and steel framework.
- Fire size was estimated to double every 41 minutes in the 100 or so minutes before peak growth rates were reached, i.e. prior to brigade arrival.
- The doubling time in terms of fire volume was estimated at 12 minutes, again once the fire had reached its maximum rate of fire growth. Other research, such as that by Factual Mutual Research, indicated a doubling time of 4 minutes for paper cartons with metal liners ignited at the bottom.

Thus, at least in these cases, the extent of damage can be said to double for every 10 to 18 minutes that the growth of fire is unrestrained. Given a situation where the fire is discovered only when it is visible to persons outside of the building, i.e. when it is well developed, it can be inferred that something close to the maximum fire growth rate would be occurring on arrival of the fire brigade.

From this analysis it was concluded that fires in unprotected premises will reach their fully developed stage (Hopkinson, 1984), especially if they are not discovered for 30 or more minutes, causing 70 to 80% of damage to such premises. In contrast, the provision of roof venting was found to reduce the floor area involved to 10% whilst sprinklers limit area damage to 20% (typically 25 -50m^2).

2.2 Fire growth models

There are a number of fire growth models. Fire models are developed for the purpose of fire safety engineering where a standard fire scenario or scenarios are assumed, with known fire loading compartment size etc and detection, against which engineering requirements for ventilation and compartmentation can be determined. The application of these models to fire cover review is limited because:

- fire cover is based on responding to a distribution of fire sizes - whilst fire models assume a standard fire size;
- many models are concerned with predicting heat and gas output for purpose of fire safety engineering, rather than predicting fire size;

- the distribution of fire sizes, rates of fire growth etc. has not been reported;
- the level of analysis required to apply models prohibits application in fire cover review;
- fire models do not incorporate the affect of fire brigade intervention;
- fire cover is likely to be based on a sample of buildings.

Notwithstanding this, the results of these models and past experimental fire research may be of assistance in devising greatly simplified "fire growth factors" for use in fire cover review, such as classifying fires in fast and slow growth fires with a standard flash over and fire size doubling time for each. Thus, for example, a typical factory fire may flashover in (say) 5 minutes and double in size every 15 minutes thereafter, whilst a plastics warehouse fire may flashover in (say) 2 minutes and double in size every 4 milltes thereafter. (Consideration of Home Office data indicates that most fires do not exceed $5m^2$ in size in first 5 to 10 minutes - suggesting a value of 2.5 m^2 to $5M^2$, which could be used as a standard initial fire size).

2.3 Previous attendance tirne-loss relationship research

There was a large body of research in 1970's aimed at deriving a relationship between fire brigade response times and the average loss per fire. This work did succeed in deriving a relationship. However, the work was criticised in a number of respects, namely:

i) the proposed models were considered to be overly complicated for the task of fire cover review;

ii) some work, such as that by Baldwin and Fardell failed to find a statistically reliable relationship between response times and spread of fire;

iii) some studies did not overcome problems of confounding variables, particularly occupancy;

iv) different studies derived different statistical models due to inconsistent data sets and methods, and;

v) the proposed approach to applying the models in fire cover overlooked local variations in the type and size of buildings and level of fire precautions.

Nonetheless, some of the 1970's studies did culminate in a statistical model. For example, Hogg's (197 1) study of fires between 1963-1967 examined the percentage of fires, which spread beyond the floor of origin in multi-storey buildings. As summarised in Table 2, 1, she found that the probability of fire spread beyond the floor of fire origin doubled as the response time increased from about 3 minutes to over 16 minutes in industrial and commercial premises.

Table 2.1- Study of Fires between 1963-1967 (Hogg, 1971)

Time between discovery and response (min)	% of fires spreading beyond floor of fire origin	
	Multi-storey dwellings	**Multi-storey industrial and commercial buildings**
3	12	25
8	14	29
13	18	48 (37% for 12 min & 48% for 15 min responses)
18	35	
>20	43	45 (over 16 min)

A subsequent phase of work in the 1980's work used a very naive approach to relating response times to level of loss and failed to derive a valid relationship.

2.4 Entec's Analysis of 1990s Data - Method and Results

2.4.1 Response Time - Percentage Fire Damage Method

The analysis of response times provides a consistent statistical relationship between response times and percentage level of loss, with an increase in average level of fire damage with each incremental increase in response times. Details of calculations made by Entec are given below.

Several samples of fire data were analysed to investigate the trend of fire damage with response time and reporting time. The samples of data were chosen according to the building type, as listed below.

- Schools
- Factories
- Retail
- Offices
- Licensed Premises
- Public Buildings
- Hospitals
- Care Homes
- Hotels
- Further Education

The reporting time is the sum of the time from ignition to discovery (IGNTDISC) and the time from discovery to the first call (DISCALL). The response time is the time from the first call to the time the fire brigade arrives at the fire (ARRVT1ME). The age of the fire when the fire brigade arrives is the sum of the reporting time and the response time.

All records where the fire brigade played no active part in extinguishing the fire (i.e. FFBRIG I = 11) were ignored as this would remove all hoax calls ftom the data set. When investigating room, floor and building damage, all data where the fire damage to the room (FRMPERC), floor (FFLRPERC) and the building (FBLDPERC) was either zero or not stated were ignored. These measures were taken to remove any data independent of the response or reporting time. If this data had been included it would introduce a bias to any trends identified.

Once the data samples were finalised, several methods of averaging the data were used. This included the average or arithmetic mean and a weighted average. The weighted average was used when it was necessary to retain the distribution of data points in the sample, e.g. when averaging the percentage damage meeting reporting and response time criteria for fires in all nondwellings. If an average represents a larger percentage of data then it is weighted in terms of the percentage of data points it represents in further average calculations.

The arithmetic and geometric mean are calculated as follows:

$$\bar{X}_{arith} = \frac{\sum_{i}^{n} x_i}{n}$$

$$\bar{X}_{geo} = \exp\left[\frac{\sum_{i}^{n} \ln x_i}{n}\right]$$

The geometric mean is another method of summarising data. It reduces the impact that outliers have on the average, it helps to retain information about the distribution of data. For example, for the data points 5,15, 20 and 100:

the arithmetic mean is (5+10+10+100)/4 = 31.3

the geometric mean is $(5 \times 10 \times 10 \times 100)^{1/4}$ = 15.0

2.4.2 Room, Floor and Building Damage

The detailed results are given 'm Appendix A. If the relationship between response times and level of loss is considered in isolation of fire discovery times,

- the percentage of fire damage doubles if the response takes over 20 minutes instead of under 5 minutes;
- referring to the arithmetic average, approximately 30% of the affected area if damaged by fire if an attendance is made in under 5 minutes, compared to 50% to 60% if the fire is attended in over 20 minutes;

- referring to the geometric average, which reduces the impact of outliers, approximately 15 to 20% of the affected area is damaged if fire attended in under 5 minutes, compared to 30 to 56% if fire attended in over 20 minutes, and;
- the geometric average percentage of fire damage of fires which affect floor of fire origin or the building increases by a factor of 2.5 and 3.5 respectively if the fire is attended in over 20 minutes instead of in under 5 minutes.

The relationship between fire discovery time and level of loss is less clear. That is, there is not a consistent increase in the average level of fire damage as the fire reporting time increases. One difficulty here is that the vast majority of fires are reported in under 10 minutes, leaving a very small sample of fires (only 10 out of 843 fires with damage to the building i.e. about 1%) on which to plot the level of fire damage for fires which take longer to be reported. However, the level of fire damage for fires reported in over 30 minutes is always greater than for fires reported sooner, typically 75% to 100% damage compared with 20 to 40% for fire reported sooner.

2.4.3 Response Time Versus Fire size (m^2)

The second stage of analysis related the average level of fire damage in m^2 to the total "age" of the fire (time from ignition until fire brigade attendance at the fire). As before, all records where the fire brigade did not contribute to controlling the fire were ignored. Figure 2.1 illustrates the variation of the extent of damage from direct burning (AREABURN) with fire age for each occupancy

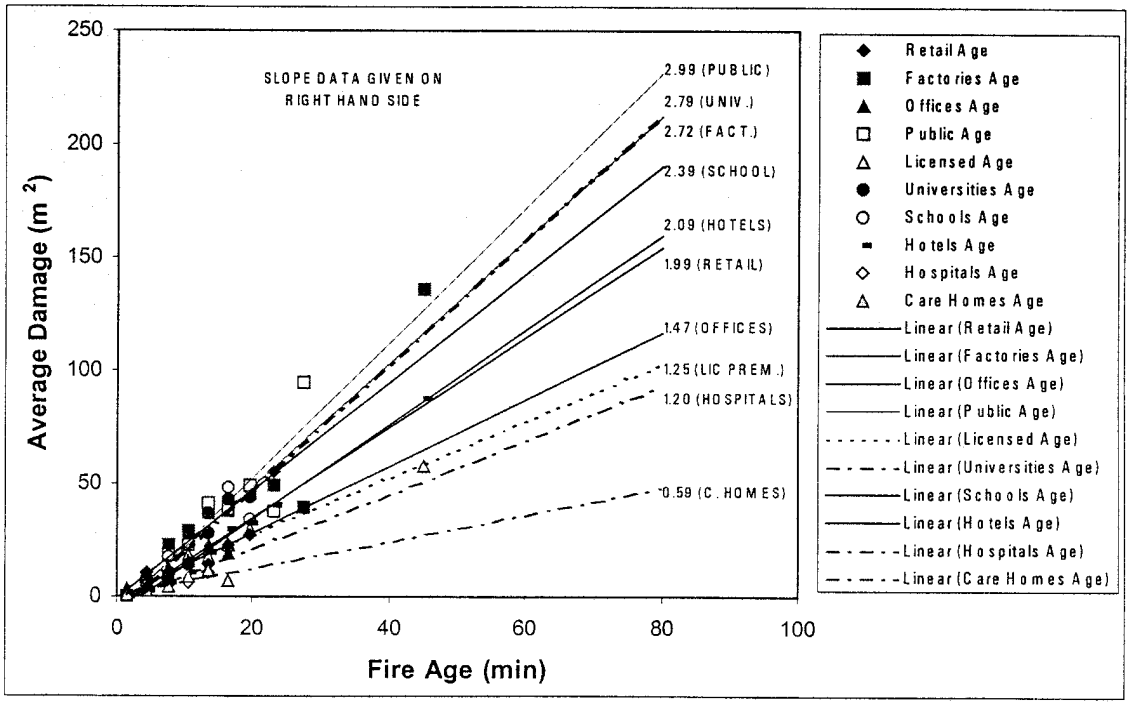

Figure 2.1: Variation of Damage from Direct Burning (AREABURN) with Fire Age (from time of ignition until time fire brigade arrives) for Various Occupancies.

There is a clear relationship between the level of fire damage from direct burning to the total time until the fire brigade arrives. Ignoring obvious outliers based on a small percentage of the data, a linear slope fits the data for each occupancy, further details are contained in Appendix B. Therefore, in the case of factories, if the response time of the fire brigade is delayed by 5 minutes, or the fire reporting is delayed by 5 minutes, then the increased area of damage from direct burning is estimated to be 13.6 (5 x 2.72) M^2. Rates of damage for various occupancies are contained in Table 2.2. The % decrease based on the maximum value', shows how the rate of damage from direct burning varies for each occupancy (based on the maximum value), i.e. the rate of damage for universities is 6.7% less than that of public buildings.

It would appear reasonable to categorise the occupancies fire growth rates as follows:

i) High - Public Buildings, Factories and Universities

ii) Medium - Retail, Hotels, Schools and Education Combined

iii) Low - Hospitals, Licensed Premises and Offices

iv) Very Low - Care Homes

It is understood that other characteristics of each occupancy will also play a role on the distribution of fire damage, e.g. typical size of building, size of compartments and therefore the maximum probable loss (MPL).

Table 2.2 - Rate of Damage (M^2) per Delay in Fire Brigade Attendance or Reporting Time (min)

Occupancy	Rate of Damage ($m^2 . min^{-1}$)	% Decrease, based on max value
Public Buildings	2.99	0.0
Universities	2.79	6.7
Factories	2.72	9.0
Education Combined	2.46	17.7
Schools	2.39	20.1
Hotels	2,09	30.1
Retail	1.99	33.4
Offices	1.47	50.8
Licensed	1.25	58.2
Hospitals	1.2	59.9
Care Homes	0.59	80.3

2.4.4 Estimated Occupancy Values

Using the number of fires, average fire damage and insurance statistics, an estimated value of loss per square metre for each occupancy was calculated (Table 2.3). Using the Home Office fire records, an average damage from direct burning (AREABURN), irrespective of reporting or attendance times, was calculated for each occupancy. Further, the average damage if the fire brigade attended the fire within (Including) five minutes was calculated for each occupancy. Details are contained in Appendix C.

The Fire Protection Association (FPA) publishes large fire statistics (Fire Prevention 306, p4148) for fires where the damage incurred exceeds £50,000 or there is at least one fatality. Using the total number of fires reported for commercial installations (published in the Home Office Statistical Bulletin, Summary Fire Statistics United Kingdom 1995, 10 April 1997) and the total value of commercial claims for 1995 (Association of British Insurers, Lloyds contribution estimated as 20%) the average loss incurred in small fires is £26,000.

Correlating the FPA large fire data with the total number of fires reported in each category by the Home Office, the value of damage for all fires and various occupancies was estimated. This value was then doubled to account for consequential loss. The work by Peaker et al. (1977) concluded that in most cases, consequential loss is double the cost of direct fire damage. Using the average damage figures, a value per square metre was estimated, and finally a rate of loss per minute fire attendance is delayed.

Table 2.3 - Value of Damage (M^2) per Occupancy

Occupancy	Average Damage (m^2)	Average Damage (Response within 5 min) (m^2)	Average Loss (#.m^{-2})	Average Loss Rate (#.min^{-1}), (Rank)
Public Buildings	7.12	21.40	2,800	8,400(6)
Universities	6.15	11.74	3,700	10,400(3)
Factories	11.72	28.18	2,600	7,100(8)
Education Combined	25.79	19.45	3,300	8,200(7)
Schools	15.34	21.31	3,700	8,900(5)
Hotels	23.86	8.06	5,000	10,500(2)
Retail	15.93	12.51	5,600	11,200(1)
Offices	25.45	13.54	3,800	5,600(9)
Licensed	14.53	15.10	3,500	4,400(10)
Hospitals	29.89	5.32	8,500	10,200(4)
Care Homes	12.85	6.18	7,300	4,400(11)

Once again, the average loss per minute can be categorised for each occupancy as follows:

i) Retail Buildings, Hotels, Universities and Hospitals - £10,000 to £12,000 per minute

ii) Schools, Education, Public Buildings and Factories - £7,000 to £9,999 per minute

iii) Offices, Licensed Premises and Care Homes - £4,000 to £6,999

The level of variation in loss rate between category 1 and 3 is significant, Also, given that a large proportion of premises are offices and factories, it is appropriate to use occupancy specific values for these, £5,600 and £7, 100 respectively.

Figure 2.2 gives an indication of how the cost of additional damage escalates with time. It must be noted that the total loss will be capped by the maximum probable loss (MPL). Further, it is understood that damage will not increase linearly with time indefinitely, but rather the graph will plateau when the maximum possible damage is approached. However, there is not sufficient data to model this phase of the relationship accurately.

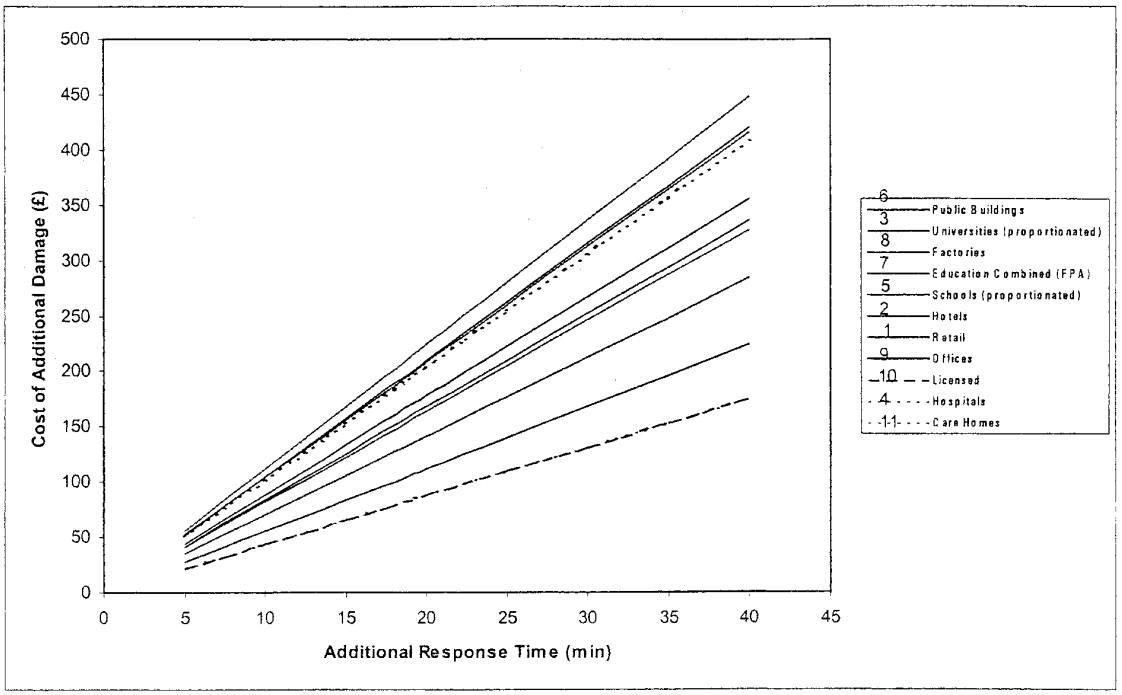

Figure 2.2 - Cost of Additional Damage (£) for Delayed Fire Attendance Time (min)

2.5 Home Office Findings

The Home Office have examined the statistical relationship between fire brigade attendance time and the spread of fire in dwellings and other buildings for fires reported in 1994-1997. The main findings of the Home Office analysis of "other buildings" are:

- the probability of a fire being confined to the item first ignited falls from about 40% to 27% for fires attended in under 5 and over 16 minutes respectively,
- the probability of a fire being confined to the room of origin falls from about 85% to about 75% for fires attended in under 5 and over 16 minutes respectively, ie a 40% increase in the number of fires spreading beyond the room of fire origin; and;
- the probability of a fire causing 5+ square metres damage increases from about 25% to 55% for fires attended in under 5 and over 16 minutes respectively

The percentage of fires causing 5+ metres of damage increases as follows:

Table 2.4 - Response Time versus Fire Size

Attendance time	% of fires causing 5+M^2 of damage
Under 5 minutes	25
6 to 10	35
11 to 15	45
16 to 60	55

Thus, the likelihood of a fire causing over $5m^2$ of damage approximately doubles if attendance is in 16 to 60 minutes rather than under 5 minutes. In addition, there is a consistent trend in fire size, with an incremental increase in probability of fires causing over $5m^2$ of damage with each incremental increase in response time.

The Home Office also examined the relationship between fire reporting time and fire spread. In this case the results are less consistent, as follows:

- the probability of a fire being confined to item of origin is 44%, 35% and 37% for fires reported immediately, in under 5 minutes and over 5 minutes;
- the probability of a fire being confined to room of origin is 86%, 83% and 83% for fires reported immediately, in under 5 minutes and over 5 minutes, and;
- the probability of a fire causing over $5m^2$ of damage is 27%, 33% and 38% for fires reported immediately, in under 5 minutes and over 5 minutes.

Thus, whilst the probability of a fire causing over 5^2 of damage appears related to fire discovery time, this finding is not clearly repeated for fires confined to item or room of origin.

2.6 Comparison of Findings and Way Forward

The four sets of findings are reasonably consistent in that they indicate that once a fire has reached its maximum rate of growth it roughly doubles in size every 10 or so minutes (until it is suppressed, reached limits of compartmentation or fuel or oxygen is depleted).

2.6.1 How can affect of fire brigade response be modelled?

There are at least four ways in which the affect of fire brigade response can be factored into the assessment, namely:

- Option 1: use an "average percentage of area lost" statistic, as in Table 2.5; or
- Option 2: use an average standard fire size for fires attended in (say) under 5 minutes, and increase this in line with the appraised affect of response times on fire size. Thus, for example, a fire might be said to increase in size from $5M^2$ to 10 M^2 for fires attended in under 5 versus 16 to 20 minutes, as demonstrated in Table 2.6.
- Option 3: apply a range of fire growth models to each occupancy, inferred from previous research and our analysis of fire size (see Table 2.7).
- Option 4: apply a range of fire loss curves per minute to each occupancy, as per the results shown in Section 2.4.4.

The fourth option is recommended. The method of application is elaborated in Section 3.

Table 2.5 - Illustrative factors for option 1 (fire growth of uncontrolled fires).

Attendance time (mins)	% of area fire damaged		
	Room only	Floor only	Whole building
<5	17	19	16
6 to 10	20	23	19
11 to 15	21	25	20
16 to 20	26	31	28
>20	31	48	56

Table 2.6 - illustrative values for option 2 (fire growth of uncontrolled fires)

Attendance time (min)	% of fires causing $5+M^2$ of damage
Under 5 minutes	25
6 to 10	35
11 to 15	45
16 to 60	55

Table 2.7-Illustrative factors for option 3 (fire growth of uncontrolled fires).

Fire growth	Fire loading & occupancy	Time to flashover (min)	Doubling time (min)
Slow	Standard office or living room/bedroom	10	30
Medium	Average factory or shop	5	15
Fast	Plastics, foam, plywood, paper & textiles in poorly	2	4
Ultra-fast	Fuels, hanging drapes etc	1	1

3. Proposed risk assessment method

The proposed method is described below:

1. What is the likelihood of an uncontrolled fire?

The likelihood of an uncontrolled fire would be assessed using the risk assessment toolkit. As detailed in previous reports, this assessment considers the affect of sprinklers, occupancy, fire safety management, building size etc. Thus, buildings with a reliable sprinkler system would be assigned a lower likelihood of an uncontrolled fire than other buildings.

2. What is the Maximum Probable Loss in the event of no fire service intervention?

Based on a consideration of the level and quality of compartmentation, building size and interbuilding separation, the analyst would ascertain the maximum probable extent of fire spread. For example;

1) is it reasonable to assume that the fire size will be confined to room of origin or floor of origin, perhaps due to passive fire protection,

ii) or would cavities and/or poor fire safety management (e.g. open fire doors) allow fire spread across the floor and/or throughout the building.

Next, the analyst would ascertain the size (in square metres) and value of the area that could be affected. A judgement would be made at this stage as to whether the building comprises an exceptional value and hence should be assigned a higher value. Based on this assessment the analyst determines the Maximum Probable Loss (MPL) area thought to be at risk from fire in event of no fire brigade intervention and failure of active fire suppression systems.

4. What is the likely fire reporting time?

The likely fire detection and reporting time would be given by an assessment of the level and type of fire detection in the building and the level of human occupation (e.g. is it occupied at night?). As the level of occupation varies across the day, a distribution of reporting times would be given.

5. The value of averted loss is given by fraction of MPL saved by attendance within n minutes to fires reported in less than 30 minutes.

The fire age - loss curves shown in Section 2.4 would be used to estimate the value of loss incurred for each reporting time - response time combination.

This method is being translated into a procedure within the high occupancy building toolkit.

4. References

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Appendix A

Room, Floor and Building Damage Varying with Response and Reporting Time

2 Pages

Table A.1 contains information relating to the percentage damage incurred by fires in all occupancies. Both the arithmetic and geometric mean damage are calculated, as well as a weighted average to better represent the variation of room, floor and building damage. Details of the calculation method are contained in Section 2.4. 1. For example, the weighted percentage room damage (averaged for all reporting times) for immediate fire brigade response (within 5 minutes) is 32.1%, 36.7% for a response within 5 and 10 minutes, 38.9 within 15 and 20 minutes and 52.3% for response times greater than 20 minutes.

TABLE A.1 - Response Time, Reporting Time versus % Damage: Schools, Offices, Shops, Factories, Licensed Premises, , Public Buildings, Hospitals, Care Homes, Hostels, Hotels, Further Education

room arithmetic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	3,846	813	40		4,699	30.94	37.11	40.43		36.16	32.09
5 < respond <= 10	2,877	580	3	1	3,461	35.16	43.90	100.00	100.00	69.76	36.70
10 < respond <= 15	305	85			390	37.32	44.42			40.87	38.87
15 < respond <= 20	51	12			63	43.71	48.92			46.31	44.70
respond > 20	18	9			27	49.56	57.78			53.67	52.30
Average % Damage						39.34	46.43	70.21	100.00		
Weighted Avg % Damage						33.06	40.37	44.58	100.00		
Total Records	7,097	1,499	43	1	8,640						

floor arithmetic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	708	209	15		932	32.47	32.74	32.33		32.51	32.53
5 < respond <= 10	625	183	3	1	812	35.84	41.49	46.67	75.00	49.75	37.20
10 < respond <= 15	85	34			119	38.38	45.59			41.98	40.44
15 < respond <= 20	18	4			22	56.44	26.25			41.35	50.95
respond > 20	6	2			8	57.50	75.00			66.25	61.88
Average % Damage						44.13	44.21	39.50	75.00		
Weighted Avg % Damage						34.68	37.59	34.72	75.00		
Total Records	1,442	432	18	1	1893						

building arithmetic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	316	133	7		456	30.27	22.11	30.00		27.46	27.88
5 < respond <= 10	229	82	2	1	314	30.60	30.88	60.00	75.00	49.12	31.00
10 < respond <= 15	39	16			55	31.05	32.00			31.53	31.33
15 < respond <= 20	8	3			11	53.88	48.33			51.10	52.36
respond > 20	3	4			7	86.67	45.00			65.83	62.86
Average % Damage						46.49	35.66	45.00	75.00		
Weighted Avg % Damage						31.05	26.51	36.67	75.00		
Total Records	595	238	9	1	843						

room geometic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	3,846	813	40		4,699	16.21	20.50	23.40		20.04	17.01
5 < respond <= 10	2,877	580	3	1	3,461	18.57	24.83	100.00	100.00	60.85	19.72
10 < respond <= 15	305	85			390	20.30	23.74			22.02	21.05
15 < respond <= 20	51	12			63	25.28	26.95			26.12	25.60
respond > 20	18	9			27	25.46	43.34			34.40	31.42
Average % Damage						21.17	27.88	61.70	100.00		
Weighted Avg % Damage						17.43	22.55	28.75	100.00		
Total Records	7,097	1,499	43	1	8640						

floor geometic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	708	209	15		932	18.81	20.43	18.64		19.29	19.17
5 < respond <= 10	625	183	3	1	812	21.50	25.60	37.80	75.00	39.97	22.55
10 < respond <= 15	85	34			119	22.77	30.57			26.67	25.00
15 < respond <= 20	18	4			22	35.04	14.14			24.59	31.24
respond > 20	6	2			8	39.92	70.71			55.32	47.62
Average % Damage						27.61	32.29	28.22	75.00		
Weighted Avg % Damage						20.50	23.59	21.83	75.00		
Total Records	1,442	432	18	1	1893						

building geometic mean	# Immediate Report	# 5 < report <= 10	# 10 < report <= 30	# report > 30	Total # records	immediate report	5 < report <= 10	10 < report <= 30	report > 30	Average % Damage	Weighted Average % Damage
immediate respond	316	133	7		456	16.87	14.15	22.72		17.91	16.17
5 < respond <= 10	229	82	2	1	314	18.87	19.36	44.72	75.00	39.49	19.34
10 < respond <= 15	39	16			55	20.33	18.21			19.27	19.72
15 < respond <= 20	8	3			11	27.37	28.84			28.11	27.77
respond > 20	3	4			7	86.07	33.10			59.58	55.80
Average % Damage						33.90	22.73	33.72	75.00		
Weighted Avg % Damage						18.36	16.72	27.61	75.00		
Total Records	595	238	9	1	843						

Appendix B

Variation of Damage with Age of Fire when Fire Brigade Attends Fire for Each Occupancy

11 Pages

Tables B.1 to B.10 contain information pertaining to the damage-fire age curves for each occupancy. The 'areaburn' and 'areatot ' categories of the Home Office fire data was expanded to a particular value (m^2) for each category. The tabulated data includes both the arithmetic and geometric mean of this damage data for various age criteria (min). Figures B.1 to B.10 displays the relationship between the arithmetic mean of 'areaburn' and the age of the fire when the fire brigade attends the fire (time from ignition in minutes). The distribution of data for each age criteria is presented by way of the 'percentage of total records'.

Table and Figure B.1 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive (all occupancies considered) - CARE HOMES

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	1	1	1	1	1	0	0
3 <= age < 6	5	3	2	27	9	66	0	5
6 <= age < 9	8	5	2	35	11	624	0	43
9 <= age < 12	11	9	2	44	11	558	0	38
9 <= age < 15	14	12	2	52	14	154	0	11
15 <= age < 18	17	7	2	45	11	37	0	3
18 <= age < 21	20	10	4	24	8	5	0	0
21 <= age < 25	23	2	2	34	13	3	0	0
25 <= age < 30	28	141	141	250	250	1	0	0
30 <= age < 60	45	2	2	7	7	2	0	0
60 <= age < 100	80	0	0	0	0	0	0	0
						1,451	1	100

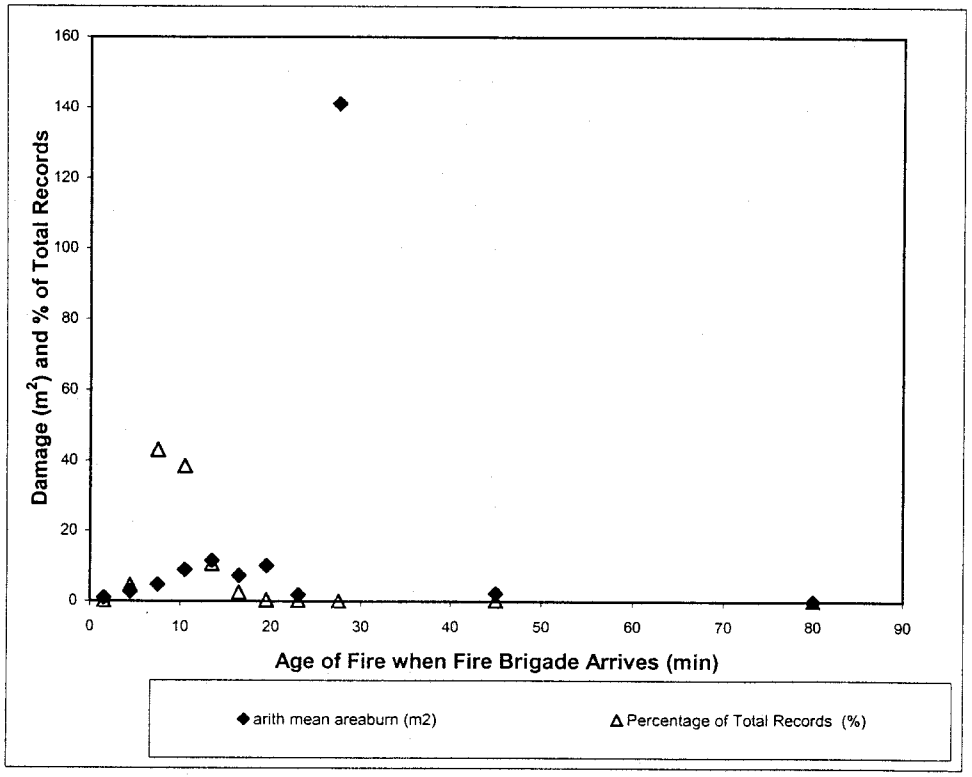


Table and Figure B.2 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive (all occupancies considered) – HOSPITALS

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0	0	0	0	0	0
3 <= age < 6	5	4	1	32	8	40	0	4
6 <= age < 9	8	5	1	36	8	432	0	45
9 <= age < 12	11	6	2	36	7	369	0	38
9 <= age < 15	14	11	2	46	10	101	0	10
15 <= age < 18	17	21	2	30	5	13	0	1
18 <= age < 21	20	12	4	57	10	10	0	1
21 <= age < 25	23	7	7	31	31	1	0	0
25 <= age < 30	28	0	0	0	0	0	0	0
30 <= age < 60	45	0	0	0	0	0	0	0
60 <= age < 100	80	0	0	0	0	0	0	0
						966	1	100

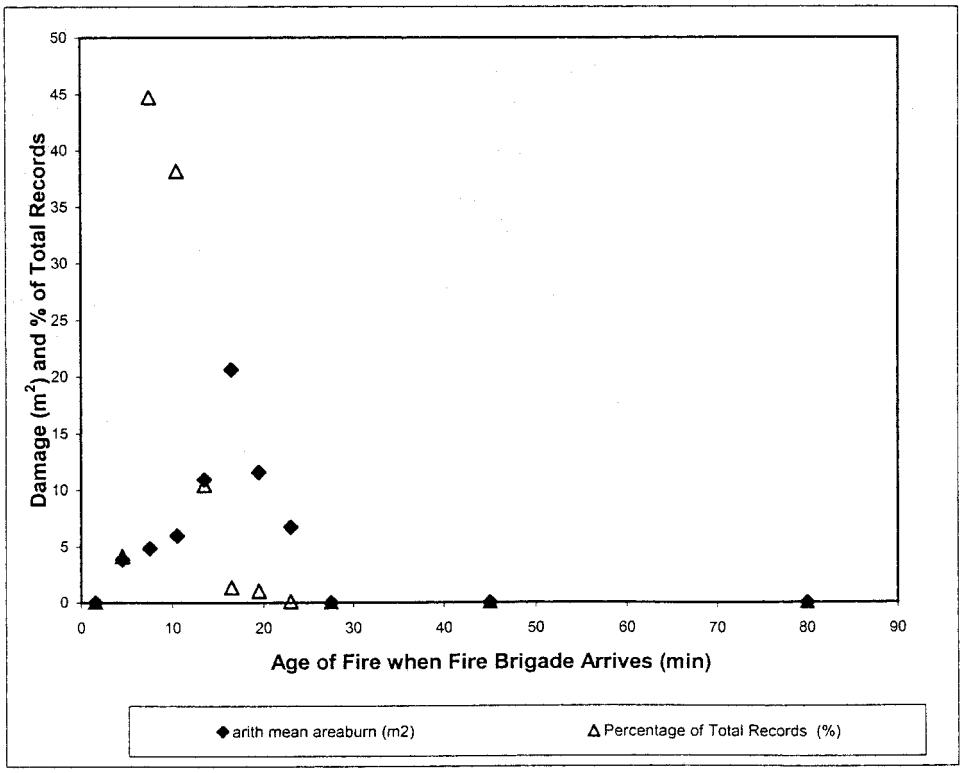


Table and Figure B.3 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive (all occupancies considered) – HOTELS

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0	0	0	0	0	0
3 <= age < 6	5	3	1	28	6	51	0	3
6 <= age < 9	8	6	2	49	14	626	0	39
9 <= age < 12	11	11	3	56	16	590	0	36
9 <= age < 15	14	19	4	62	18	218	0	13
15 <= age < 18	17	29	5	60	21	82	0	5
18 <= age < 21	20	32	8	77	28	29	0	2
21 <= age < 25	23	41	7	47	15	14	0	1
25 <= age < 30	28	14	5	40	17	8	0	0
30 <= age < 60	45	88	35	149	114	5	0	0
60 <= age < 100	80	1	1	7	7	1	0	0
						1,624	1	100

Table and Figure B.4 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - SCHOOLS

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	1	1	3	3	1	0	0
3 <= age < 6	5	8	3	52	9	31	0	2
6 <= age < 9	8	18	3	70	19	501	0	27
9 <= age < 12	11	24	4	82	25	850	0	46
9 <= age < 15	14	37	6	87	25	319	0	17
15 <= age < 18	17	49	9	92	29	101	0	5
18 <= age < 21	20	35	5	92	33	28	0	2
21 <= age < 25	23	25	6	106	47	8	0	0
25 <= age < 30	28	7	7	31	31	1	0	0
30 <= age < 60	45	14	14	141	141	1	0	0
60 <= age < 100	80	0	0	0	0	0	0	0
						1,841	1	100

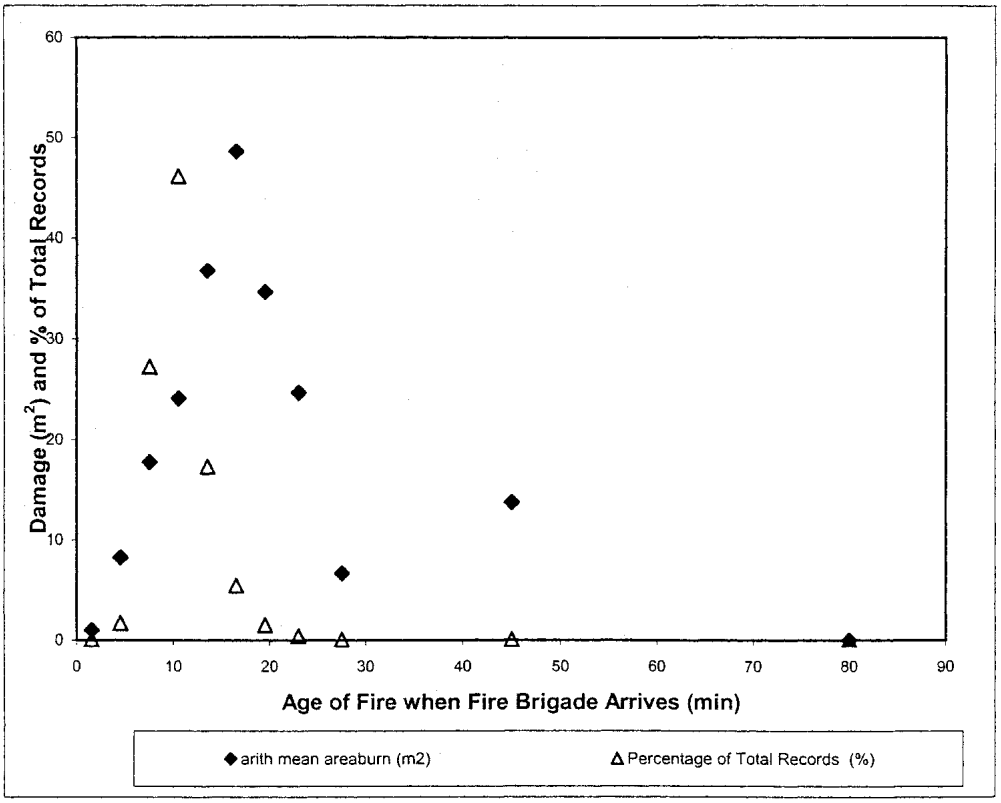
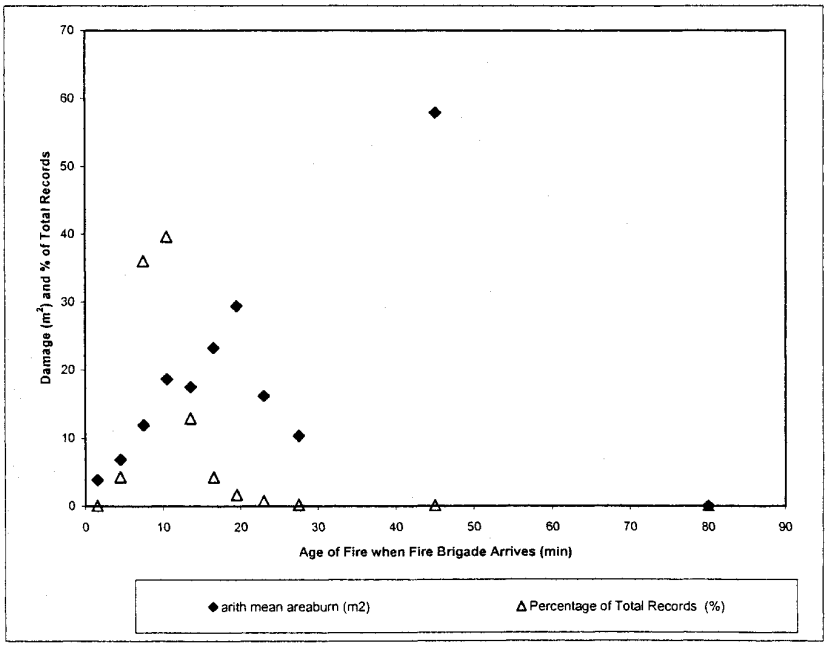


Table and Figure B.5 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - UNIVERSITIES

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0.00E+00	0	0.00E+00	0	0	0
3 <= age < 6	5	3	1.93E+00	68	2.05E+01	13	0	3
6 <= age < 9	8	8	2.10E+00	47	1.28E+01	142	0	34
9 <= age < 12	11	14	2.80E+00	64	1.97E+01	173	0	41
9 <= age < 15	14	28	4.85E+00	87	2.02E+01	69	0	17
15 <= age < 18	17	43	7.33E+00	95	3.88E+01	12	0	3
18 <= age < 21	20	44	9.88E+00	95	3.44E+01	5	0	1
21 <= age < 25	23	7	6.71E+00	31	3.13E+01	1	0	0
25 <= age < 30	28	141	1.41E+02	250	2.50E+02	1	0	0
30 <= age < 60	45	42	3.11E+01	250	2.50E+02	2	0	0
60 <= age < 100	80	0	0.00E+00	0	0.00E+00	0	0	0
						418	1	100

Table and Figure B.6 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - LICENSED PREMISES

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	4	2.59E+00	16	5.59E+00	2	0.1%	0
3 <= age < 6	5	7	2.12E+00	42	9.96E+00	160	4.3%	4
6 <= age < 9	8	12	2.82E+00	59	1.63E+01	1,333	36.1%	36
9 <= age < 12	11	19	3.74E+00	74	2.23E+01	1,465	39.6%	40
9 <= age < 15	14	17	3.80E+00	65	1.75E+01	476	12.9%	13
15 <= age < 18	17	23	3.76E+00	67	1.86E+01	158	4.3%	4
18 <= age < 21	20	29	5.95E+00	67	2.12E+01	63	1.7%	2
21 <= age < 25	23	16	3.36E+00	43	9.53E+00	28	0.8%	1
25 <= age < 30	28	10	2.42E+00	35	1.39E+01	8	0.2%	0
30 <= age < 60	45	58	1.84E+01	68	5.17E+01	3	0.1%	0
60 <= age < 100	80	0	0.00E+00	0	0.00E+00	0	0.0%	0
						3,696	100.0%	100



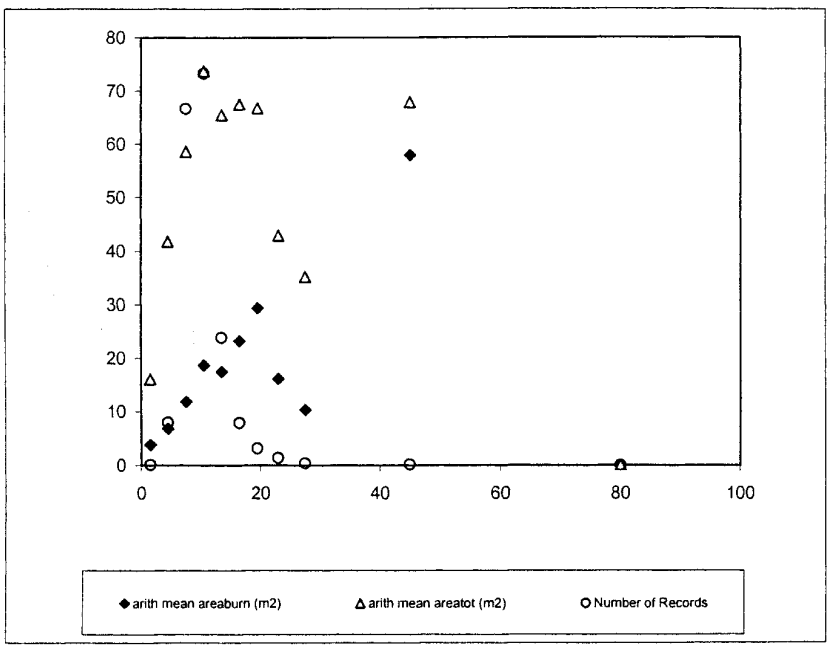


Table and Figure B.7 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - PUBLIC BUILDINGS

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0.00E+00	0	0.00E+00	0	0.0%	0
3 <= age < 6	5	4	1.91E+00	46	9.24E+00	37	2.2%	2
6 <= age < 9	8	18	3.36E+00	60	1.51E+01	460	27.5%	28
9 <= age < 12	11	23	4.55E+00	68	1.92E+01	769	46.0%	46
9 <= age < 15	14	41	9.09E+00	87	3.01E+01	263	15.7%	16
15 <= age < 18	17	38	9.35E+00	71	2.51E+01	90	5.4%	5
18 <= age < 21	20	49	1.30E+01	92	3.37E+01	33	2.0%	2
21 <= age < 25	23	38	1.22E+01	84	4.75E+01	12	0.7%	1
25 <= age < 30	28	94	2.71E+01	96	5.11E+01	3	0.2%	0
30 <= age < 60	45	13	4.25E+00	15	7.44E+00	5	0.3%	0
60 <= age < 100	80	0	0.00E+00	0	0.00E+00	0	0.0%	0
						1,672	100.0%	100

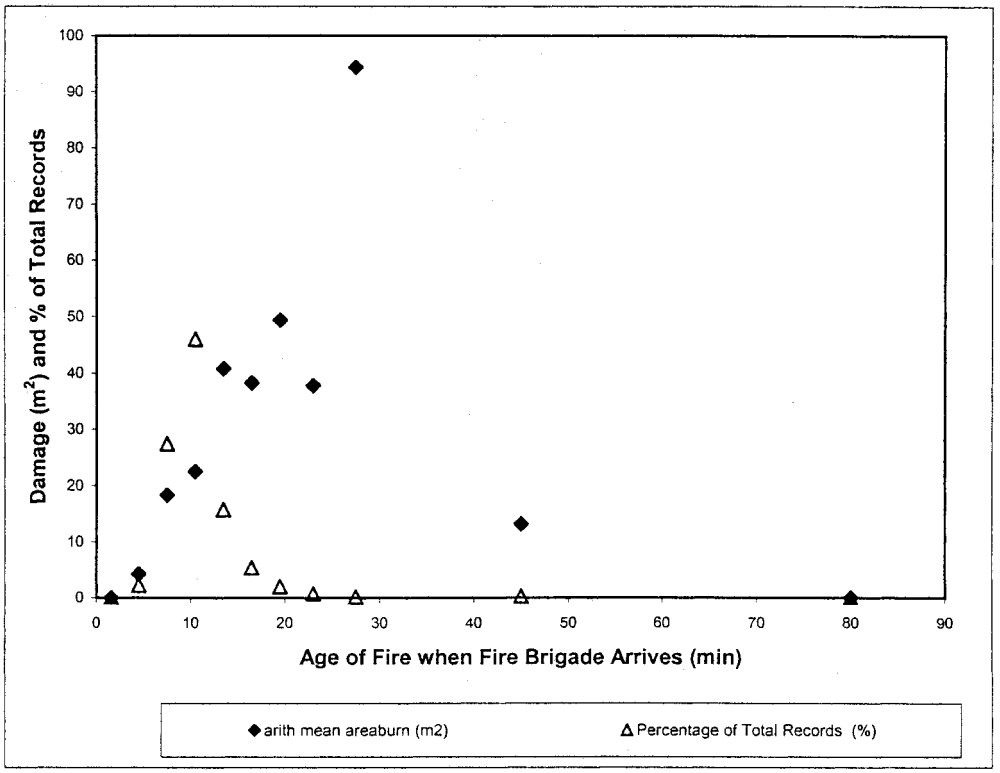


Table and Figure B.8 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - OFFICES

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0.00E+00	0	0.00E+00	0	0.0%	0
3 <= age < 6	5	17	2.53E+00	71	1.67E+01	54	4.0%	4
6 <= age < 9	8	10	2.37E+00	59	1.46E+01	496	37.2%	37
9 <= age < 12	11	16	3.19E+00	69	1.87E+01	575	43.1%	43
9 <= age < 15	14	23	4.69E+00	72	2.11E+01	155	11.6%	12
15 <= age < 18	17	19	4.51E+00	72	1.97E+01	39	2.9%	3
18 <= age < 21	20	5	2.99E+00	45	1.44E+01	11	0.8%	1
21 <= age < 25	23	3	1.75E+00	21	7.50E+00	4	0.3%	0
25 <= age < 30	28	1	1.00E+00	1	1.00E+00	1	0.1%	0
30 <= age < 60	45	0	0.00E+00	0	0.00E+00	0	0.0%	0
60 <= age < 100	80	0	0.00E+00	0	0.00E+00	0	0.0%	0
						1,335	100.0%	100

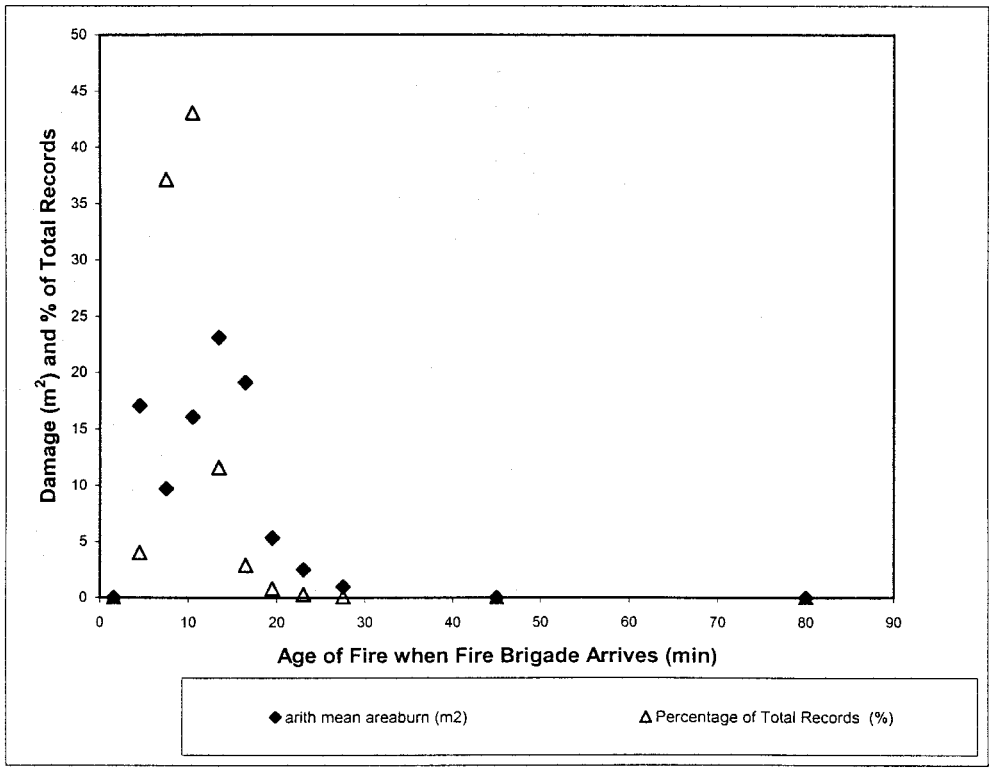


Table and Figure B.9 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - FACTORIES

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0.00E+00	0	0.00E+00	0	0.0%	0
3 <= age < 6	5	33	5.53E+00	72	1.74E+01	234	2.8%	3
6 <= age < 9	8	23	4.42E+00	70	1.65E+01	2,526	30.2%	30
9 <= age < 12	11	29	5.74E+00	77	2.09E+01	3,487	41.8%	42
9 <= age < 15	14	37	6.89E+00	81	2.25E+01	1,385	16.6%	17
15 <= age < 18	17	38	8.06E+00	76	2.06E+01	455	5.4%	5
18 <= age < 21	20	46	9.75E+00	71	1.80E+01	170	2.0%	2
21 <= age < 25	23	49	1.15E+01	86	2.88E+01	55	0.7%	1
25 <= age < 30	28	40	1.07E+01	70	2.66E+01	25	0.3%	0
30 <= age < 60	45	136	4.00E+01	156	8.57E+01	10	0.1%	0
60 <= age < 100	80	39	1.32E+01	64	2.11E+01	5	0.1%	0
						8,352	100.0%	100

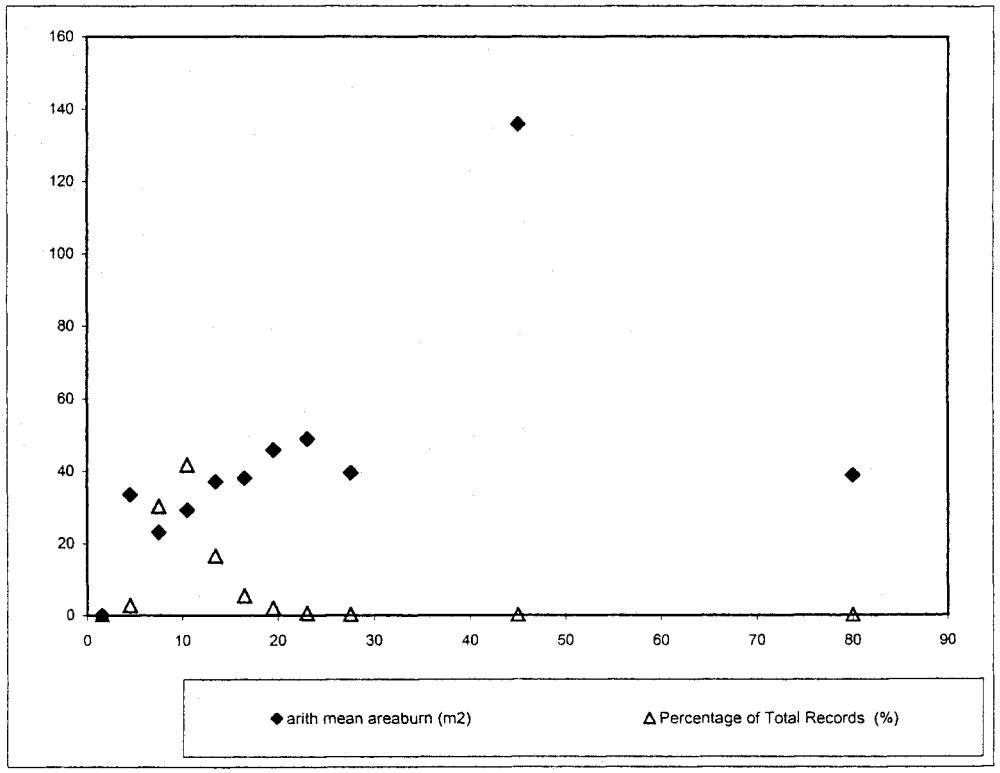
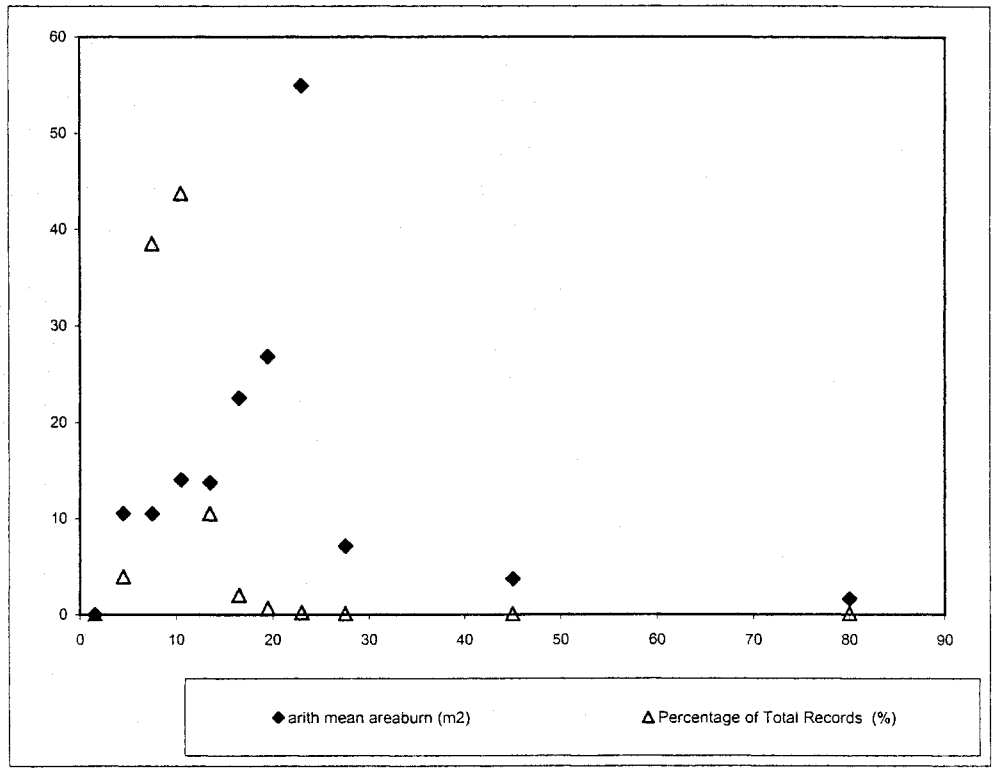


Table and Figure B.10 - Damage from Direct Burning (areaburn) and Total Damage (areatot) Data versus Fire Age when Fire Brigade Arrive - RETAIL BUILDINGS

age criteria (mins)	arith mean age criteria	arith mean areaburn (m^2)	geo mean areaburn (m^2)	arith mean areatot (m^2)	geo mean areatot (m^2)	Number of Records	Number of Records (%)	Percentage of Total Records (%)
0 <= age < 3	2	0	0.00E+00	0	0.00E+00	0	0.0%	0
3 <= age < 6	5	11	2.10E+00	47	8.98E+00	188	3.9%	4
6 <= age < 9	8	11	2.45E+00	51	1.15E+01	1,836	38.6%	39
9 <= age < 12	11	14	3.05E+00	56	1.47E+01	2,083	43.8%	44
9 <= age < 15	14	14	3.20E+00	53	1.33E+01	502	10.5%	11
15 <= age < 18	17	23	3.74E+00	57	1.17E+01	97	2.0%	2
18 <= age < 21	20	27	4.53E+00	62	2.13E+01	32	0.7%	1
21 <= age < 25	23	55	9.34E+00	82	2.04E+01	11	0.2%	0
25 <= age < 30	28	7	2.13E+00	29	3.31E+00	5	0.1%	0
30 <= age < 60	45	4	2.85E+00	7	4.52E+00	3	0.1%	0
60 <= age < 100	80	2	1.36E+00	74	2.29E+01	4	0.1%	0
						4,761	100.0%	100



Appendix C

Average Financial Damage

4 Pages

Table C.1 displays the calculation of the 'average loss per small fire' as detailed in Section 2.4.4. The Association of British Insurers (ABI) reported that Lloyds cover 20% of commercial establishments. thus the total commercial claims published by the ABI represented 80% of all commercial claims for the year.

This value of £25,880 per fire is taken through to Table C.2 and used in the calculation of the commercial losses for large and small fires per occupancy, using 1995 statistics from the Home Office, Fire Protection Association (FPA) and the Association of British Insurers (ABI), For each occupancy category reported, the total number of fires published by the Home Office was correlated with the number of large fires reported by the FPA. The contribution from small fires to the total commercial loss was estimated based on the average loss per small fire (Table C.1), and the calculated number of small fires giving an estimated total loss for all fires. For example, for metal manufacture, there were 5 large fires with a total loss of £1,625,000. The Home Office reported a total of 350 fires in mainland Britain (in keeping with FPA statistics), giving 345 small fires in mainland Britain. The losses from these fires sum to 345 x £25,880 = £9m. Thus the total loss for 350 fires is £10.6m and an average of £30,150 per fire in the metal manufacturing occupancy category.

The FPA reported education combined, whereas the Home Office reported both universities and schools. Large fires in these categories and the respective losses were divided between schools and universities according to the ratio of fires.

These values were summed for the categories of interest e.g. care homes, factories, hotels, universities, etc, as illustrated in Table C.3. The fire loss was doubled to account for consequential loss thus doubling the average total loss for all fires in mainland Britain. The average burn damage (M2) was used to estimate the average value per occupancy per M2 . The rate of damage incurred (Appendix B) was used to estimate the rate of financial loss (£/min). the final section of Table C.3 illustrates how additional loos is incurred with time (min).

Table C.1 - Calculation of the Average Loss (£) for a Small Fire (no fatalities and <£50,000 loss)

Average loss per Fire (FPA Large Fires) - Mainland Britain

Fire Prevention 306	1995	1995	1995
Occupancy	Loss £m	# fires	loss (£)/fire
Food, drink and tobacco	30.235	13	2,325,769
Education (schools and colleges)	29.893	50	597,860
Recreation and cultural services	25.08	37	677,838
Retail distribution	22.75	49	464,286
Transport and communication	17.864	22	812,000
Chemical and allied industries	11.529	8	1,441,125
Dwellings	7.821	69	113,348
	145.172	248	585,371

Home Office Statistics - Mainland Britain, All primary fires

Home Office Statistics	1995
Occupancy	# fires
Dwellings	62,902
Private Garages and Sheds	9,793
Agricultural premises	1,736
Industrial and transport premises	5,736
retail distribution buildings	5,318
other buildings	4,895
Total	90,380

FPA Total (non-dwellings)	137.351	179	767,324
Home Office Total (non-dwellings)		17,685	
ABI Loss Total (non-domestic)	492		27,820
Lloyds estimated Loss (non-domestic)	98.4		
Total Commercial Losses 1995	590.4		
Total fires <£50k (non-dwellings)		17,506	
Total loss <£50k (non-dwellings)	453.049		
Average loss per small fire (<£50k)			25,8801

Table C.2 - FPA and Home Office Fire Statistics, Average Losses, Mainland Britain

1995 - Summary Fire Statistics, Home Office - Fire Prevention 306, 1998

cost per small fire, based on 1995 ABI Totals,20% Lloyds estimation: *25,880*

	# large fires	loss £m	avg loss large fires (£)/fire	total # fires (UK)	total # fires (Northern Ireland)	total # fires (Mainland Britain)	# small fires (Mainland Britain)	loss from small fires	total loss	avg loss all fires (£)/fire
Agriculture										
Agriculture, forestry and fishing	*26*	*7.341*	*282,346*	*1,813*	*77*	*1,736*	*1710*	*44*	*51.60*	*29,721*
Industrial Premises										
mining and quarrying				57	4	53	53	1	1.37	25,880
food drink and tobacco	13	30.235	2,325,769	544	18	526	513	13	43.51	82,721
coal and petroleum products										
chemical and allied industries	8	11.529	1,441,125	336	1	335	327	8	19.99	59,677
metal manufacture	5	1.625	325,000	352	2	350	345	9	10.55	30,153
engineering	14	5.716	408,286	654	5	649	635	16	22.15	34,129
manufacture of transport										
equipment and parts	8	5.031	628,875	257	4	253	245	6	11.37	44,947
production of man-made fibres										
textiles, footwear and clothing	15	2.866	191,067	496	27	469	454	12	14.62	31,163
leather and leather goods										
manufacture of non-metallic										
mineral products (pottery and										
glass)	8	1.887	235,875	180	3	177	169	4	6.26	35,371
timber, furniture, upholstery and										
bedding	9	3.023	335,889	276	5	271	262	7	9.80	36,175
paper, printing and publishing	14	6.401	457,214	547	7	540	526	14	20.01	37,062
rubber and plastics	8	6.578	822,250	308	18	290	282	7	13.88	47,848
other manufacturing industries	23	5.632	244,870	914	15	899	876	23	28.30	31,482
construction industry premises										
(not building sites)	3	0.84	280,000	700	46	654	651	17	17.69	27,045
nuclear fuel, gas, electricity and										
water				310	38	272	272	7	7.04	25,880
sub total	*128*	*81.36*	*635,648*	*5,931*	*193*	*5,738*	*5610*	*145*	*226.55*	*39,482*
Transport and Distribution Premises										
Transport and Communications	22	17.464	793,818	1,012	15	997	975	25	42.70	*42,825*
Wholesale Distribution	7	2.726	389,429	284	4	280	273	7	9.79	*34,968*
Retail Distribution	49	22.75	464,286	2,272	127	2,145	2096	54	76.99	*35,895*
Scrap and Waste	4	0.505	126,250	125	1	124	120	3	3.61	*29,117*
Repair of Consumer Goods and										
Vehicles	13	2.082	160,154	1,130	42	1,088	1075	28	29.90	*27,484*
sub total	*95*	*45.527*	*479,232*	*4,823*	*189*	*4,634*	*4539*	*117*	*162.99*	*35,174*
Other Service Premises										
Insurance, banking and business										
services	8	2.221	277,625	595	4	591	583	15	17.31	*29,287*
education	50	29.893	597,860	2,272	95	2,177	2127	55	84.94	*39,017*
recreational and cultural services	37	25.08	677,838	2,802	80	2,722	2685	69	94.57	*34,742*
hotels, boarding houses etc	16	5.824	364,000	999	18	981	965	25	30.80	*31,394*
hostels and holiday camps	2	1.45	725,000	1,226	22	1,204	1202	31	32.56	*27,041*
cafes and restaurants	11	2.074	188,545	1,517	57	1,460	1449	37	39.57	*27,105*
clubs and public houses	21	4.503	214,429	1,596	55	1,541	1520	39	43.84	*28,449*
other services (including										
churches)	9	0.919	102,111	836	19	817	808	21	21.83	*26,719*
public administration, defence										
and law enforcement	5	1.145	229,000	1,348	26	1,322	1317	34	35.23	*26,648*
hospitals	3	0.48	160,000	2,717	52	2,665	2662	69	69.37	*26,031*
homes for the disabled,										
orphanages etc.	1	0.15	150,000	1,559	33	1,526	1525	39	39.62	*25,961*
sub total	*163*	*73.739*	*452,387*	*17,467*	*461*	*17,006*	*17304*	*448*	*521.56*	*30,669*
Other and Unspecified Premises										
other and unspecified	*33*	*33.92*	*1,027,879*	*3,938*	*108*	*3,830*	*3797*	*98*	*132.18*	*34,513*
Summary of Losses										
Industrial and Agriculture	154	88.704	576,000	7,744	270	7,474	7590	196	285.13	*38,150*
Transport and Distribution	95	45.927	483,442	4,823	189	4,634	4728	122	168.29	*36,315*
Other Services	163	73.739	452,387	17,467	461	17,006	17304	448	521.56	*30,669*
Dwellings	69	7.821	113,348	64,939	2,037	62,902	64870	1679	1,686.63	*26,814*
Other and Unspecified	33	33.92	1,027,879	3,938	108	3,830	3905	101	134.98	*35,243*
Total	*514*	*250.111*	*486,597*	*98,911*	*3,065*	*95,846*	*98397*	*2546*	*2,796.59*	*29,178*
Non Dwellings	445	242.29	544,472	33972	1028	32,944	33527	868	1,109.96	*33,692*

Table C.3 - Calculation of Rates of Loss (£/min) for Various Occupancies

Table C.3 - Calculation of Rates of Loss (£/min) for Various Occupancies

Occupancy	category	fire loss (£m)	conseq loss (£m)	total loss (£m)	total fires, mainl. UK	Weight - 1994-1997	Count (#)	Burn Damage (m2)	avg tot loss all fires (£)/ fire / m2	Rank	%Variation compared to max value
Care Homes	1	40	40	79	1526	3,928	1,451	7.12	7,290.98	2	86.1%
Hospitals	2	69	69	139	2665	2,842	966	6.15	8,463.33	1	100.0%
Hotels	3	63	63	127	2185	4,234	1,624	11.72	4,946.73	4	58.4%
Schools (proportionated)	4	70	70	139	1783	5,841	1,841	25.79	3,694.14	6	43.6%
Universities (proportionated)	5	15	15	30	543	1,246	418	15.34	3,624.77	7	42.8%
Education Combined (FPA)	4	85	85	170	2177	6,887	2,259	23.86	3,271.06	9	38.6%
Licensed	6	83	83	167	3001	10,481	3,696	15.93	3,489.37	8	41.2%
Public Buildings	7	95	95	189	2722	5,214	1,672	25.45	2,729.97	10	32.3%
Offices	8	53	53	105	1913	4,168	1,335	14.53	3,780.50	5	44.7%
Factories	9	135	135	270	3584	24,335	8,352	29.89	2,516.45	11	29.7%
Retail	10	77	77	154	2145	14,674	4,761	12.85	5,585.78	3	66.0%
All Occupancies											

Occupancy	avg tot loss all fires (£)/ fire / m2	Rate of Damage					
		m^2/min	rank	% variation	£/min	rank	% variation
Public Buildings	2,800	2.99	1	0.0	8,400	6	25.0
Universities (proportionated)	3,700	2.79	2	6.7	10,400	3	7.1
Factories	2,600	2.72	3	9.0	7,100	8	36.6
Education Combined (FPA)	3,300	2.46	4	17.7	8,200	7	26.8
Schools (proportionated)	3,700	2.39	5	20.1	8,900	5	20.5
Hotels	5,000	2.09	6	30.1	10,500	2	6.3
Retail	5,600	1.99	7	33.4	11,200	1	0.0
Offices	3,800	1.47	8	50.8	5,600	9	50.0
Licensed	3,500	1.25	9	58.2	4,400	10	60.7
Hospitals	8,500	1.2	10	59.9	10,200	4	8.9
Care Homes	7,300	0.59	11	80.3	4,400	10	60.7

Occupancy	Additional Loss (£1,000s) Incurred per Additional Response Time (min)											
	5	7.5	10.00	12.5	15	17.5	20	25	30	35	40	rank
Public Buildings	42	63	84	105	126	147	168	210	252	294	336	6
Universities (proportionated)	52	78	104	130	156	182	208	260	312	364	416	3
Factories	36	53	71	89	107	124	142	178	213	249	284	8
Education Combined (FPA)	41	62	82	103	123	144	164	205	246	287	328	7
Schools (proportionated)	45	67	89	111	134	156	178	223	267	312	356	5
Hotels	53	79	105	131	158	184	210	263	315	368	420	2
Retail	56	84	112	140	168	196	224	280	336	392	448	1
Offices	28	42	56	70	84	98	112	140	168	196	224	9
Licensed	22	33	44	55	66	77	88	110	132	154	176	10
Hospitals	51	77	102	128	153	179	204	255	306	357	408	4
Care Homes	22	33	44	55	66	77	88	110	132	154	176	10