THE APPLICATION OF FIRE SAFETY TO ARCHITECTURAL DESIGN

MIGUEL A. CERDA.C

Doctor of Philosophy

University of Edinburgh

1981

DECLARATION OF CONTENTS

This thesis is the result of a study conducted entirely by the author under the supervision of Dr E.W. Marchant, during the period from May 1978 to June 1981.

Background information on the knowledge content of fire safety engineering was gained partly by attending all the taught parts of the post-graduate course, run by the Department of Fire Safety Engineering (October 1978 to June 1979) and partly from the previous experience of the author.

The database for the study consisted of the results to a survey which was prepared and executed by the author; the analysis, interpretation and presentation of those results was also the responsibility of this author.

ABSTRACT

Safety from fire is a complex problem in today's society. It is considered to form part of a much wider problem conditioned by environmental, societal and political interactions. However, the consequences of fire are shown not to be unique to any particular country. Evidence indicating that fire in buildings is a considerable proportion of the total loss from fire is presented.
Traditional methods of dealing with fire safety (i.e. legislation and hardware provision) seem to have failed to reduce the impact of fire, partly because of the emphasis on physical aspects neglecting the social facets of the problem.

Within this framework, this thesis describes an investigation carried out to determine how fire safety is accounted for in the design of building and the conflicts associated with the integration of fire safety into architectural design.
A review of relevant literature indicated that previous attempts made in this area had a limited scope. Evidence was also found that the subject of fire safety was not receiving proper attention by the architectural profession (both in schools and practices) despite mounting pressures brought about by new legislation and recent fire disasters.

A cross sectional survey was conducted, early in 1980, among the people assumed to be most involved with fire safety in building design. Four postal self-administered questionnaires were sent out to the schools of architecture, all local fire authorities, architects in small practices and the largest architectural firms in this country. After several follow-up mailings, a good response was achieved. The results are presented in tabulated form and the main findings are discussed in some detail.

The survey indicated that the architectural profession seem to consider fire safety mainly legislative requirements; hence, its integration to building design appear

to be reduced to problems of interpretation and implementation of legislation.

It is suggested that ignorance within the profession and the inadequacy of the current legislative system are the main hindrances to the integration of fire safety into building design.

In the concluding part of the thesis, emphasis is placed on educating the architect in fire safety, as a viable alternative to teaching for compliance. Some general guidelines for an educational programme are given. The possible implications to fire safety in buildings of recently proposed changes in legislation are discussed also.

ACKNOWLEDGEMENTS

The work described in this thesis could not have been undertaken without the financial support provided by the "Fundacion Gran Mariscal de Ayacucho" (Venezuelan Scholarship Programme) to which the author is most indebted.

The author expresses his deep appreciation to Dr E.W. Marchant for his continuous encouragement and guidance throughout the duration of this work.
Recognition is due also to other members of the Department of Fire Safety Engineering for valuable discussions in the course of this study, especially to Dr A.N. Beard and Dr D.D. Drysdale.
Acknowledgement is made to the staff of the Program Library Unit of the University of Edinburgh; in particular to Mr D. Muxworthy and Dr E. Read for their assistance in the processing of the data, and to Mr M. Prentice for his advice on statistical analysis.
Special thanks are due to all those people without whose collaboration this investigation could not have been accomplished. Particularly to the groups of schools' staff, architects and fire prevention officers who contributed with their answers and comments which provided the data base for this study.
Finally, the author is grateful to Miss P. Armstrong for her expertise in the preparation, from a manuscript, of this presentation and to the Edinburgh Regional Computing Centre Reprographics Unit for the use of the facilities that made the format of presentation for both questionnaires and thesis possible.

TABLE OF CONTENTS

PART ONE: THE PROBLEM

PART TWO: THE STUDY

PART FOUR: THE RESULTS

PART FIVE: THE CONCLUSION

PART SIX: THE APPENDICES

APPENDIX

PART SIX

APPENDIX SIX: Tables of Results
Schools of Architecture

Table

APPENDIX SEVEN: Tables of Results
Architects in Practice

Table

APPENDIX EIGHT: Tables of Results
Architectural Firms

APPENDIX NINE: Tables of Results
Fire Prevention Officers

Table

LIST OF FIGURES

LIST OF TABLES

PART ONE
THE PROBLEM

INTRODUCTION

There are many different ways of defining a problem and as many ways of classifying its component parts or problem areas. This is thought to be largely influenced by the context or universe within which the problem and its components are being defined and their dynamism of change.

Problems in the context of today's society seem to have an ever increasing tendency to become more complex, hence the necessity to divide them into small manageable areas. From the foregoing it may be inferred:

a) the need to define problems as broadly as possible, with a clear perspective of their wholeness or entirety; and
b) the need for a multi-disciplinary approach, in order to consider the implications and interactions of all the parts involved.

Fire safety is but one of the 'new' disciplines to which, by its nature, the multi-disciplinary approach is essential. It has many different but inter dependent facets that should be considered in an ensemble.

None of these facets should be allowed to assume a leading role so that any strategy, proposition or attempt to solve the problem will not be limited by considering a narrow perspective.

The following sections of the first part represent an attempt to describe the current fire problem, before concentrating on the area of the problem which is the main subject of this study.

1. THE PROBLEM OF FIRE

The last world war showed once more the effects of fire in urban areas and its devastating potential. Perhaps for the first time, the necessity for a complete re-definition of the problem posed by fire to a rapidly changing society was realised.

Since the end of the conflict, many countries, the UK among others, have seen a re-organisation of the public fire service (including new duties such as fire prevention)[1a] and much effort has been devoted to curb fire and mitigate its effects. Public effort has been concentrated mainly in two broad categories: fire legislation and fire research.

Despite the efforts, every year, irrespective of the country considered, fire continues to claim a considerably high toll, one part of which is measured by the fire statistics as injuries and fatalities, and direct economic losses. The former is an expression of pain, incapacitation and death and the latter of wastage of resources and property, resulting in an inevitable reduction of the standard of living. The other part not evidenced by the statistics of fire refers to the traumatic experience of fire among the survivors,viz: the prolonged medical care for burn victims; the impact of property losses on individuals (i.ė. loss of homes or jobs); as well as the indirect economic losses that add to the consequences already mentioned.

1.1 COMPARISON OF FIRE EXPERIENCES

To put the problem in context, it has been thought appropriate to consider the fire experience in several countries.

It has been suggested that comparisons of international fire statistics are misleading[2], unreliable[3a] and "of doubtful validity"[1b]; because of the influence that social, economic and environmental factors have on the incidence and effects of fire[1c]; and because of the difficulties in establishing common bases among the reporting systems used in the different countries[4]. However, some "useful insights and directions for future research"[5] can be gained from such comparisons[6].

The fire problem is not unique to one nation albeit some of its causes might be specific to a certain environment. It is suggested that "we should be able to learn from the experience of other countries"[1d]. Thus, an international study may assist in distinguishing and making explicit common matters by a better understanding of the similarities and differences, particularly to-day with the expanding international implications of:

a) world economic interdependence (e.g. technology transfer and its products, trade and distribution, job markets, etc.)
b) organisations working towards unification of requirements and/or standards (e.g. EEC, CEN, ECE, ISO, ADR, IMCO, etc.)

In recent years, two major comparative studies of international fire losses have been carried out. The first of these[7] is related to the European experience and is mostly concerned with the economic aspects of fire losses; it has been widely referred to in the "Review of Fire Policy"[1e]. The other study[4,5] has a somewhat broader scope and for this reason it is more suitable for the purpose of this study.

To illustrate the magnitude of the incidence of fire, Table 1-1 provides a summary of the reported fire losses in seven countries.

It has been derived from "Selected International Comparisons of Fire Losses"[5] by regrouping the information, contained in Table 5 of that report, into fewer categories (i.e. structures and other). Currency conversion and inflation rates were used to adjust the monetary loss figures to Pound Sterling at 1979 constant value[8,9].

Recently published statistics for the UK[10] and the US[11] have also been included to present an updated version of the original table. In this case, both 1979 data

Table 1-1

Fire Loss Experience in Various Countries

	United States 1975 Number (PCT) Rate[3]	United States 1979[4] Number (PCT) Rate	United Kingdom 1973 Number (PCT) Rate	United Kingdom 1979[5] Number (PCT) Rate	Holland 1975 Number (PCT) Rate[3]	Japan 1975 Number (PCT) Rate	Belgium 1974 Number (PCT) Rate	France 1974 Number (PCT) Rate	Canada 1972 Number (PCT) Rate
Total Fires[1]	2600 (100) 12	2850 (100) 12.9	331 (100) 5.9	310.6 (100) 5.6	22 (100) 1.6	62 (100) 0.56	16 (100) 1.6	98 (100) 1.9	
Deaths	7500 35		1041 19	1096 19.6	65 4.8	1674 15	160 16	295 5.6	830 36
Injuries	110000 500	31000 142	6709 120	8883 159	663 49	8232 74	719 73	2100 40	
Loss	4200 20	5750 26			147 11	371 3.4		74.3 14	
[2]	(2423) (11.5)	(2447) (11)		(355.3) (6.4)	(84.8) (6.4)	(214) (1.9)		(429) (8.1)	
Total Struc		1036 (36) 4.7	138 (42) 2.4	117.3 (37.8) 2.1	12.2 (54) 0.89	39 (63) 0.30	10.2 (64) 1.04	46 (47) 0.88	78 3.4
Deaths			919 (88) 15.9	972 (88.7) 17.4		1296 (77) 11.7			774 (94) 34
Injuries			5786 (86) 103	8160 (91.9) 146		7430 (90) 67			
Loss		4964 (86.3) 22.5			136 (92) 9.9	359 (96) 3.3			330 13.7
Other Fires		1814 (64) 8.3	193 (58) 3.5	193.3 (62.2) 3.5	10.2 (46) 0.75	23 (37) 0.21		52 (53) 0.99	
Deaths			122 (12) 2.2	124 (11.3) 2.2		378 23 3.46			53 (6) 2.3
Injuries			923 (14) 16.5	723 (8.1) 13.0		802 (10) 7.3			
Loss		786 (13.7) 3.6			11 (8) 0.81	12 (4) 0.10			

[1]Thousands
[2]Millions: US$ 1975 value, (£ 1979 value)
[3]Rate: fires/thousands; death/million (population); Injuries/million; loss $ (£)/person
Sources: Reference 5
[4]Reference 11
[5]Reference 10

have been treated following the same criteria, as for regrouping and calculations, stated in the original report.

Table 1-1 also shows the significance of the proportion of fires occurring in structures – these latter being defined as "any assembly of materials forming a construction for occupancy or use"[12] – ranging between 36 per cent (US 79) to 63 per cent (Japan 75). By contrast, fires in structures have accounted for at least 77 per cent (Japan 75) and 86 per cent (UK 73) of the total number of reported deaths and injuries respectively.

Also in Table 1-1 is apparent that, for the countries reported, a very large proportion of the total monetary losses related to fire occur in structures (between 86 and 96 per cent).

1.2 FIRE EXPERIENCE IN THE UK

A similar pattern can be observed in the fire loss experience for the UK, depicted in Table 1-2, for the period 1969 to 1979. Here again, between 21 per cent and 36 per cent of the reported fires (other than chimney fires) were in buildings and no less than 83 per cent of the total casualties were associated with fire in occupied buildings during that period.

It must be noted that fires confined to chimneys have been excluded from the totals because they are not considered to represent a threat to life safety nor to property safety, although they are included in official UK fire statistics.

It seems obvious, therefore, that fire in buildings accounts for the most significant proportion of casualties both fatal and non fatal[1f], and at least one third of the reported number of fires and of monetary losses.

Table 1-2

Fire Loss Experience in the UK 1969-1979

	1969[3]	1970[3]	1971[3]	1972	1973	1974	1975[3]	1976	1977[3]	1978[3]	1979
Total number of fires	316443	333319	316787	362773	383606	349244	390000	496436	326772	328998	355498
Total fires (Other than chimney)	252580	273820	257004	303810	331164	303708	347000	449914	280977	279665	310577
Total Deaths	861	839	822	1078	1041	1046	920	895	849	946	1096
Total Injuries	5110	5200	5017	6330	6709	6198	5800	6394	6369	8231	8883
Total Direct Losses[1]	117	107	106	109	179	237	213	232	262	309	355
Fires in Occupied Buildings	90856	90412	89310	100081	105328	101522	96000	95795	93360	92978	99979
Deaths in Buildings	783	714	726	933	890	925	N.A.	774	746	820	954
Injuries in Buildings	N.A.	4472	4332	5567	5786	5466	N.A.	5324	5680	7193	7964
Other Fires[2]	161724	183410	167697	203729	225836	202186	250000	354119	187617	186687	210598
Deaths[2]	78	125	96	145	151	121	N.A.	121	103	126	142
Injuries[2]	N.A.	728	685	763	923	732	N.A.	1070	689	1038	919

[1]£ millions at current prices (Reference 1 s)
[2]Include derelict and demolition buildings
[3]Fire brigade dispute (Reference 1t)

Sources: Fire Statistics UK 1974,76,77,78,79
Home Office, London
UK Fire and Loss Statistics 1969,70,71,72,73
Fire Research Station, Borehamwood

2. FIRE IN BUILDINGS

The problem of fire in buildings has been recognised for a long time, a consequence of this recognition is the existence of a regulatory system devised at least originally, in an attempt to curtail the recurrence of disasters caused by similar unforseen conditions. Historical evidence associates building legislation in general terms, with the occurrence of disasters, fire or otherwise, as a response of governments "to what has been perceived as a demand from the public that they should not be exposed unnecessarily to the threat of fire in circumstances where they have no capability to secure their own protection"[1g].

Such was the case after the 'great fire' of London in 1666 when legislation was passed[1r] to control the characteristics of construction and materials used in the city[13] "in order to reduce the risk of fire spread both within and between buildings"[1g].

The 'great fires' of New York, Boston, Chicago, Quebec and Montreal are but a few of the many examples provided by the literature, after which land use and building legislation were introduced with the purpose of reducing the possibility of repetition of similar events and thus reducing "the increasing public concern at the cumulative evidence of the gravity of the threat of fire to the community's health and wealth"[1h].

2.1 CHANGE IN THE CONTEXT

More recently, during the second half of this century two distinct and unprecedented changes have occurred:

a) a social change characterised by the increasing rate of urbanisation (and conurbation for that matter) which has led to an increase in: population density, intensive and extensive land use in urban areas, and large scale construction, with the string of social problems attached to these factors (e.g.: discontent, overcrowding, vandalism, unemployment, ghettos, alienation, violence, etc)[3b].

b) the so called 'technological revolution', which has provided the 'hardware' for (a) above by extending the limits of buildings (i.e. height, size, etc.) mainly in relation to new products, materials and techniques (e.g. lifts, mechanical ventilation, etc) but in doing so, it has required an escalation of energy consumption and thus in the potential sources of ignition.

It appears that from the interaction of the above two factors a somewhat clearer view of the current fire problem can be perceived, namely: "as population concentrates the means for controlling and preventing destructive fires has become progressively more complex"[3c] that is to say that, a greater number of people are exposed to an increased risk of fire in a complex built environment, partly built with new materials which are being produced and used with little or no concern for fire safety[3d], all this within the context of a high energy-consumption society.

2.2 INCREASED FREQUENCY

Between the mid-60's and mid-70's there was a substantial increase in the incidence of fires in buildings, in terms of both frequency and severity, particularly in relation to life loss.

Table 1-3 shows a condensed list of fires in buildings that caused large loss of life and or property throughout the world, between 1966 and 1974.

During that period, the situation in the UK could be summarised as follows:

a) the total number of fires reported between 1965 and 1974 increased by 39 per cent (69 per cent if chimney fires are excluded) while fires in occupied buildings incremented by 41 per cent[14] (60 per cent in dwellings and 24 per cent in all other buildings). This increase has been said to be partially caused

Table 1-3

Major Fires in Buildings +

Year	Occupancy Type	Location – Country	Fatalities
1966	Ski Resort Hotel	Minakami, Japan	31
	Mental Hospital	Lipinlathi, Finland	29
	Salvation Army Home	Melbourne Austrialia	29
	Army Barracks	Erzurum, Turkey	68
	Terraced Dwelling	Wallasey, UK[59]	6
	Commerical and Offices	London, UK(ibid.)	8
	Dwelling Flats	London, UK (ibid.)	6
	Terraced Dwelling	Glasgow, UK (ibid.)	7
1967	McCormick Exhibit Centre	Chicago, US	na
	Penthouse Restaurant	Montgomery, Ala., US	25
	L'Innocation Dept. Store	Brussels, Belgium	325
	Prison Barracks	Jay, Fla. US	37
1968	Mental Hospital	Shrewsbury, UK	22
	Wedding Hall	Vijayawada, India	58
	Furniture Warehouse	Glasgow, UK	20
	Dwelling	Merthyr Tydfill, UK[59]	6
	Hotel	Brighton, UK (ibid.)	7
1969	Office Building	New York, US	11
	Nursing Home	Notre Dam-du-Lac, Canada	38
	Dwelling	Brixton, London, UK	6
	Apartment House	Kansas City, Mo., US[57a]	12
	Hotel	Ayr, UK[59]	6
	Dwelling	Parkesburg, W.Va., US[57a]	12
	Hotel	Saffron, Walden, UK (ibid.)	11
1970	Nursing Home	Marietta, Ohio, US[57a]	31
	Ozark Hotel	Seattle, Wash., US (ibid.)	20
	Discotheque	St. Laurent du Pont, France	146
	Apartment Building	Minneapolis, US[57a]	12
	Ponet S. Hotel	Los Angeles, US (ibid.)	19
	Pioneer Hotel	Tuscon, Ariz., US	28
	Dwelling	Wembley, London, UK[59]	6
1971	Nursing Home	Buechel, Ky., US[57a]	10
	Psychiatric Hospital	Burghoezli, Switzerland	28
	Imperial Hotel	Bankok, Thailand	24
	Opera House	Cairo, Egypt	na
	Apartment Building	Seattle, Wash, US (ibid.)	12
	Taeyunkak Hotel	Seoul, Korea	163
	Row of shops	Glasgow, UK	21
	Nursing Home	Salt Lake City, US	6
	Surgery and Dwelling	Hackney, London, UK[59]	6
	Hotel	Paddington, London, UK (ibid.)	9
	Nursing Home	Honesdale, Pa., US[57a]	15

TABLE 1-3 (continued)

Year	Occupancy Type	Location – Country	Fatalities
1972	Hotel	Tyrone, Pa., US[57a]	12
	Andraus Office Building	Sao Paolo, Brasil	16
	Textile Warehouse	Glasgow, UK[59]	7
	Cabaret-Dept. Store	Osaka, Japan	118
	Mental Hospital	Sherbornne, UK	31
	Cafe-Night Club	Montreal, Canada[1u]	37
	Restuarant-Night Club	Rhodes, Greece[60]	32
	Housing for Elderly Block	Atlanta, Ga., US[57a]	10
1973	School	Paris, France[1u]	23
	Cocktail Lounge	New Orleans, US[57a]	32
	Avianca Office Building	Bogota, Colombia[1u]	4
	Department Store	Eagle Grove, Iowa, US[57a]	14
	Leisure Centre	Isle of Man, UK	51
	Hafina Hotel	Copenhagen, Denmark	35
	Apartment Block	Los Angeles, US (ibid)	25
	Department Stores	Kumamoto, Japan[1u]	103
	Hotel	Oban, UK[59]	10
1974	School	Heuseden, Belgium	25
	Joelma Office Building	Sao Paulo, Brasil[1u]	179
	Building	Lahore, Pakistan	40
	Night Club Atop Building	Seoul, Korea	78
	Nursing Home	Edwalton, UK[61]	18
	Discotheque	Port Chester, NY, US[57a]	24
	Hotel	Lambeth, London, UK[59]	6
	Hotel	Islington, London, UK (ibid.)	8
	Hotel	Paddington, London, UK (ibid.)	7
	Hotel	Barkeley Square, W. Va. US[57a]	12

+ Source : unless otherwise stated information in this table was extracted from Reference 58.

by the improvements in communications (i.e. private telephones) and partially illusory [1i]

b) casualties rose by 42 per cent, representing a 49 per cent increment in the number of deaths and 40 per cent in the number of injuries.
c) an increase in the frequency of multiple fatality fires from 47 in 1964 to 111 in 1973 claiming 11 per cent (117) of the total fatalities in 1964, and 28 per cent (296) of the total for 1973. There was a fatal fire involving at least 18 victims every year between 1972 and 1974, excluding the 50 deaths from Summerland.[15]
d) an almost constant proportion (between 45 and 55 per cent) of the total number of fatalities were reported as being "overcome by gas or smoke" while the proportion of injuries reported under the same category increased from 12 per cent in 1968 to 19 per cent in 1974.
e) Economic losses went up from 117 £m in 1969 to 237 £m in 1974 at current values (see Table 1-2)

2.3 LEGISLATIVE REPONSE

This situation united to the mounting international record of large fires, as indicated in Table 1-3, produced an upsurge in the attention given by many governments to the problem of fire.

Both in the UK and the US reports from special committees and commissions were submitted[3,16,17,18,19,20] and further legislation was yet again passed.

Table 1.4 lists the legislation related to fire safety that have been passed since 1960 in this country. By 1970, when the Holroyd Committee Report was presented there were 38 statutes with some relation with fire precautions[19].

But most important of all were two Acts that in their different contexts would change radically the scope of fire safety legislation – they were the Fire

Table 1-4

Legislation Related to Fire Safety in the United Kingdom
(Passed since 1960)

1960	Public Health (E&W)[1]
1961	Housing (E&W) Home Safety Consumer Protection
1962	Education (Scotland)
1963	Offices, Shops and Railway Premises Building Standards (Scotland) Regulations[2]
1964	Licensing (E&W)
1965	Building regulations (E&W)
1966	Housing (Scotland)
1967	Private places of entertainments (E&W) Nightdresses (Safety Regulations)
1968	Theatres Social Work (Scotland) Gaming Act
1969	Housing (E&W) Education (Scotland)
1971	Fire Precautions Building Standards (Scotland) Regulation Electric Blankets (Safety) Regulations
1972	Building Regulations (E&W)[2] Heating Appliances (Fire Guard) Regulations Building Standards (Scotland Amendment Regulations
1974	Health and Safety at Work Toys (Safety) Regulations
1975	Nursing Homes (E&W) Building Standards (Scotland) Amendment Regulations Electric Equipment (Safety) Regulations
1976	Building Regulations (E&W) Licensing (Scotland) Electrical Equipment (Safety) (Amendments) Regulations
1977	Oil Heaters (Safety) Regulations
1978	Consumer Safety Building (First Amendment) Regulation
1979	Oil Lamps (Safety) Regulations

[1](E&W) Meaning legislation applying to England and Wales only

[2]Provisions for means of escape first introduced in Building Regulations.

Precautions Act 1971 in this country, and the Fire Protection and Control Act 1974 in the US. Their importance is considered to be based on the major emphasis that both placed on life safety and fire prevention instead of the more traditional approach of property safety and fire protection.

Each one, in their different fields, has become a central issue in the developments that followed, for they represent the forefront of a national fire policy which implies the acknowledgement of the problem of fire by central government. The British Act stemmed from the recommendations of the Holroyd Committee[16] referred to previously, while the American Act was prompted by the Report of the National Commission on Fire Prevention and Control.[3]

3. BUILDING LEGISLATION

As indicated in the preceding section, building legislation particularly that related to fire has developed over the years in response to the occurrence of specific fires or similar disasters, it follows that the regulatory controls thus conceived must be complex, contradictory, overlapping and most of all without a base policy that would guarantee an integrated body of requirements and therefore gain uniformity in their application. "One of the curses of this country in the past has been an overabundance of ill-considered, purely responsive legislation."[21]

3.1 FIRE PRECAUTIONS

This lack of unity was highlighted in the Holroyd Report[16] and its recommendations introduced a major split in fire safety legislation by suggesting two main categories: one dealing with new and altered buildings and the other applying to existing buildings.

The Building Regulations would cover the first group while the Fire Precautions Act 1971 was intended to bring control over buildings after occupation, and to supersede and unify many minor regulations applying to different occupancies.

It is the first piece of legislation dealing exclusively with fire precautions. Although it was supposed to be applied progressively to different classes of occupancies, by additional designating orders, some doubts about the viability of future extensions and the very validity of its application have been raised in the "Review of Fire Policy"[1] and the summarised "Future Fire Policy"[2].

The views expressed are in the main concerned with the search for cost-effective arguments, for which the Act was never intended, to justify a change of policy. The Act is said to entail high costs of administration, enforcement and compliance (£86.3m per annum at 1977/78 prices)[1j]; also it is said to be "an inflexible and extravagant instrument" and "fundamentally uneconomic system of fire precaution control"[1k] in respect to its enforcement.

3.2 BUILDING REGULATIONS

Another category of building control, the Building Regulations, in their current national basis were first introduced in 1963 in Scotland and in 1965 for England and Wales, made under the Public Health Act 1961. They derive from local Acts and Model Building byelaws.[13]

It has been suggested "that the aim of Building Regulations is to prescribe minimum standards of construction for buildings with view to safeguarding public health and safety"[1e]. Perhaps, a more realistic description of building regulations and codes for fire safety could be said to be a set of prescriptive definitions of geometrical requirements, for individual components of building hardware, "which are judged to achieve"[6] an unquantified 'acceptable standard'.

The Building Research Station conducted an extensive international comparative study of building control[47,48] concluding that a major role of building law is to make explicit responsibilities for safety and sound building[47].

The provision for means of escape has been a very recent addition to the Regulations (1963 in Scotland and 1973 in England and Wales) this seems to indicate that although the statement of intent is to safeguard life, the means used to achieve that end are generally more related to property protection rather than life safety.

Indeed, there is a strong reliance in the regulations on passive fire protection measures, as indicated by an estimation of the cost of compliance, said to be distributed ⅔ on structural requirements and ⅓ on means of escape[2b].

These passive measures usually call for protection of the structure and for limit to the spread of fire and, are expressed in terms of fire resistance. This has been defined as "the ability of building elements to continue to fulfil their assigned functions under conditions of maximum severity of exposure expected to occur in the building"[22].

However, this protection is necessary to withstand a fully developed fire (post-flashover) that would otherwise damage the structure[24] but not for an incipient fire (pre-flashover), which has been "considered to be the ultimate criteria of human tenability within an area of a structure"[23].
Moreover, the probability for safe escape from fire will depend to a great extent on the characteristics of the fire in its earliest stages of development.

In a study of some 5000 fires confined to the room of origin, North[24] concluded that 70 per cent of those fires caused no damage to the structure and only 10 per cent were reported to have caused destruction of some part of the structure. Bearing in mind that about 90% of all the fires in occupied buildings are confined to the room of origin, the foregoing seems to suggest that the Regulations are inadequate if the aim is primarily life safety.

Of course, the difficulties in assessing the merits or implications of any specific protective measure, be it for life or property safety must be acknowledged; on the other hand it is very likely that measures to protect life will contribute indirectly to protect the structure and will help to bring the potential fire under control. But the current international trend seems to associate life safety with active protection systems such as pressurisation and smoke control, detection and alarm systems, etc. which are not considered in the Regulations except in some local legislation.

Another criticism of the national building regulations, came in 1977 from the architects of the south west region[25], who summarised some of the reasons for the confusion and failure in building design, viz:

a) Multiplicity of legislation

b) Legal phrasing of regulations

c) Out-of-date guidance notes

d) Amendments of regulations too frequent

e) Inflexibility due to specific technical requirements being included in the statutory instrument

f) Multiplicity of controlling authorities

g) Disagreement on technical solutions

3.3 HEALTH AND SAFETY AT WORK

The other major piece of legislation concerned partially with fire and buildings is the Health and Safety at Work etc. Act 1974[26].

Similarly to the Fire Precautions Act 1971, the intention with this Act was to introduce a rational general system for both responsibilities and legislation, by replacing progressively the existing multiplicity of legal provisions, brought about in the same fragmented fashion mentioned before, dealing with the control of particular hazards[17a].

The new philosophy was that of creating "an integrated corpus of requirements enforced on a common basis" with the purpose of making "provisions for securing the health, safety and welfare of persons at work, for protecting other persons against risks to health or safety in connection with the activities of persons at work . . ."[26a]. This Act was drafted following the recommendations of the Robens Report[14] its implications are far reaching, by specifying requirements in general terms (vg. "so far as is reasonably practicable"), its scope in dealing with industrial hazards is unlikely to be limited by the introduction of new developments. Furthermore, it amended the Fire Precautions Act 1971 by extending its application to places of work, originally excluded from it, and by transferring responsibilities for general fire precautions to the local fire authorities, except in the case of special premises or risks vg. nuclear, explosive mines, large chemical and petroleum installations, of which the latter come under the Inspectorates of the Health and Safety Executive[27,2c].

In short, it is believed that the 1974 Act represents a legislative philosphy exactly opposite to that of the national Building Regulations, whereby it establishes a clear framework of statutory declaration of principles[17b], based on general duty obligations, with the flexible capabilities to modify, introduce or replace codes and regulations to meet specific hazards as the need arises. The responsibility for its implementation is shared by those who create and work with the risks and compliance is assessed through periodic and selective inspections, conducted by an enforcing authority with wide powers ranging from advice to criminal prosecution.

The advantages and differences with the system of application used by other building controls should be evident.

3.4 OTHER CONTROLS

There are other legislative controls, as listed in Table 1-4, but their relevance to fire safety and buildings is considered to be of minor significance for they have limited scope of application, i.e. they refer to specific occupancies, or are directed to particular areas such as the consumer protection and product safety regulations.

Nevertheless, it may be noted that they seem to follow the same general pattern as that for the other legislation mentioned before. That is, lack of unity in their requirements, promulgated in a haphazard way and without an apparent overall policy.

4. FIRE RESEARCH

As indicated in Section 1 above, fire research has been one of the areas in which much effort has been devoted in an attempt to diminish the effects of fire.

In various countries, the origin of fire research seems to be closely associated with fire insurance,[1r] in relation to devising and testing solutions for fire resistance and fire containment in structures.

A good example of a symbiotic relationship, lasting until recent years, is provided in the UK by the long tradition of research, sponsored jointly by the Department of the Environment and the Fire Offices' Committee, at the Fire Research Station.

As with building legislation, the development of fire research has been somewhat erratic and convulsive. It had to provide answers to specific existing problems in order to either generate remedial reactions to an event (by means of controls, legislative or otherwise) or to propose and test solutions for implementing established controls. This responsive, tactic or diagnostic process appears to be present in most of the groups conducting research. By contrast very little evidence exists of strategic or prognostic research, i.e. anticipating potential problems, as is the case with research in some of the well-established disciplines.

4.1 LACK OF FIRE POLICY

From the above, it might be inferred that generally fire research has not been carried-out following any defined research policy, which in turn would be assumed to conform to a determined strategy as part of an overall fire policy; nor has it contributed much to the development of policies. As has been suggested in a study carried out in the US, by the Rand Corporation[28] to assess the usefulness of fire research in various policy areas, the following conclusions were presented:

a) Research related to government policy decisions is sparse

b) With some exceptions the quality is low

c) Little is known about fire protection effectiveness

d) Little of the work is carried out through to completion and implementation

e) Better data are required, with a real sense of purpose

f) Research goals are often neither well-defined nor clearly understood

g) Statistical procedures are usually weak

On the other hand, much research is being carried-out into various aspects of fire safety ranging from incident investigation and field studies to a more formal type of research undertaken by research institutes and universities.

It is very difficult to perceive a clear picture of the general effect and intention of this activity, in the absence of a single coordinating body with a universal view of fire safety, and in which research priorities are assigned in accordance with a general fire policy rather than on staff availability [19]. The outcome of this seems to have been the concentration and repetition of work in some areas, perhaps neglecting others. Similar assertions have been made, in one of the few comprehensive studies hitherto carried out into the government general research policies.[56]

4.2 TREND OF RESEARCH EFFORTS

Generally, there has been no shortage of scientific fire research conducted along the lines of established disciplines such as Chemistry, Physics and so on. But since fire safety is not a clearly defined research discipline in its own right, the separate components or problem areas must be more closely integrated within a multi disciplinary approach, and therefore prevent the current conceptual fragmentation.

A recent Canadian survey[29] has identified nine main problem areas in which international research was conducted between 1973 and 1978.

Table 1-5 was derived from that survey and classifies the number of research projects undertaken in each problem area according to the contributing research disciplines. The source for this table was cited as the Directory of Fire Research[30].

The following considerations may be drawn from Table 1-5:

a) There is a strong predominance of research studies (about 80 per cent of projects/areas) on the 'hard' aspects of the problem areas along the lines of traditional disciplines (61 per cent adding chemistry, physics and engineering)

b) Contrarily, the few research projects assigned to the 'soft' components related to disciplines traditionally not associated with the fire problem. Even in disciplines such as care medicine and education, thought to be essentials[3e], they are responsible only for about 10 per cent of the projects.

Once more, there appears to be a major contradiction (as in the case of building legislation) between what has been stated and restated as the main goal of a national fire policy and that reflected by the research efforts (or building legislation) seen above.

That is to say that although "the government has a resonsibility to ensure that appropriate measures are taken to protect people from fire"[1n] and that "property protection has not been an acknowledged objective of government policy", because the traditional view has been that "property losses from fire have not been of sufficient economic significance to justify central government intervention"[1n]. Yet it is evident that most of the research efforts have been concentrated, and still are, on those areas most likely to be identified with property protection and therefore quantifiable in terms of cost effectiveness and easily related to direct fire losses[31].

Table 1-5

Fire Research: Number of Projects in Various Disciplines related to Problem Areas

Research Disciplines	Problem Areas: High-Rise Safety	Tactics & Suppression Equipment	Resource Management	Early Detection & Suppression	Life Safety	Fire & Smoke Behaviour	Public Educat. & Fire Prevention	Fire Protect Cost	Operational Planning & Organisation	Totals	Per Cent
Environm.				1		2		1		4	0.5
Forestry		5	3	23	2	6	1	3	1	44	5.6
Meteorolog.		1		6		6		1		14	1.8
Business & Public Adm			1	2		1		3	1	8	1.0
Managmt Science	1	6	5	4		4		1		21	2.6
Economics		2	1	2				2		7	0.9
Maths & Statistics	1	4	2	7	4	5	1	3		27	3.4
Computer Science	1	4	4	5	3	14	1	2		34	4.3
Engineer	2	26	1	75	4	63		3		174	22
Physics	5	9		19	10	87				130	16.4
Chemistry	1	26		32	8	110	1	5		183	23
Police Sciences			1	4		24				29	3.6
Architecture				2		9		1		12	1.5
Education		2	1	4	1	3	14	2	2	29	3.6
Psychology		2		3	11	2	1			19	2.4
Sociology				1	1					2	0.3
Physiology		4		6	32	7	1			50	6.3
Health & Care Medic			1		3	1	1			6	0.8
Total	11	91	20	196	79	344	21	27	4	793	
Percent	1.4	11.5	2.5	24.7	10.0	43.4	2.6	3.4	0.5		100

4.3 BIASED RESEARCH

Perhaps the biased tendency of fire research inferred above may be partially explained by taking into account the following factors:

a) The historic association between fire research and fire insurance, being this latter concerned with the protection of economic assets (cost and benefits thereof) produced a concentration of expertise and facilities round its main theme. This seems to have led to a tendency to persist in the familiar fields of research and making it more difficult in time, to extend the programme into new fields or to meet new demands.

b) Ordering of research priorities influenced by political sensitivity and other pressures, and limited by an a priori assessment of the potential benefits of the research results.

c) The contribution, to the whole of the problem, made by the 'human factor' being recognised only in the last decade or so[32]. Indeed, a pioneering work in this area noted in 1972, "it is surprising to discover that there has been little attempt to systematically investigate the patterns of behaviour which people adopt when faced with a fire situation"[33].

d) Some other social issues have hitherto been considered as forming part of a different 'problem' and thus attention is directed elsewhere, e.g. perception of risk, assuming that the societal perception represents the individual one whereby single casualty accidents are blamed on carelessness of the individual while multiple casualty events are the concern of society; relationship between wealth and safety; society, policy decisions and the inherent imposed risk levels, etc.[34,35].

4.4 APPLICATION AND DISSEMINATION OF RESULTS

Another noteworthy aspect of fire research is that of dissemination and application of research results. The Robens Report referring to occupational safety suggested that "research is useless unless it influences what happens at workplaces"[17c].

Elsewhere[3f,3g], it has been stressed that there is a need to ensure the prompt translation of research results into a body of principles and, ultimately made widely and readily available for operational practice and design. However there seems to be a large gap between those results and their implementation into building solutions[35], although apparently this is not unique to fire research[36]; additionally, it has been suggested repeatedly[1p,3e] that a central information centre or clearing house should be created where all interested parties could be made aware of the relevant research thereby avoiding the duplication of work.

This emphasises the difficulties in the dissemination of research information, and in obtaining or retreiving the existing information considered of interest for any other research or application.

4.5 FIRE TESTING

Much has been written about the relevance and validity or otherwise of fire testing of building materials and components[22,37,38,39].

Since building legislation specifies a minimum standard of material quality, generally expressed in terms of sound or heat insulation, combustibility or ignitability, surface spread of flame, structural stability, fire endurance, integrity, etc., the choice of materials is actually limited to those 'certified', 'tested' or 'approved' materials. Further, these materials are tested individually to determine their performance charactersistics according to standard test procedures; their behaviour is thus classified in one of the standard categories or classes prescribed for each test, as defined by the failure criteria.

Most of these tests have been developed over the years from idealised experimental static conditions, where a number of assumptions about the real world situation had to be made in order to reduce the number of variables. Although the laboratory tests are useful tools for research purposes, their wide application as 'standard' procedures may be questionable, particularly in relation to their ability to predict material behaviour in real fire conditions[34].

It might be argued that fire tests should be used as a common datum-line against which performance of materials may be assessed according to their relative achievements under the conditions of the test. Nevertheless, it is worth mentioning that some generic materials will perform differently under different conditions.

There are many important issues that remain yet either unsolved or their effects are not represented in the tests. The following are a few examples:

* analytical as opposed to prescriptive fire resistance[62,63,64]
* performance of combination and composite materials and their prediction from the results of testing individual materials
* production of smoke and toxic gasses not part of any standard test[65]
* economic interests of manufacturers and the validity of results obtained from certain tests
* effects of physical characteristics and placement of materials as opposed to their chemical composition[66,67]
* effects and interrelations of building geometry and materials with fire growth and spread[69,70].

5. BUILDING DESIGN

In the last 20 years, a great deal of material has been published in relation to design methodologies. Comprehensive studies have been devoted to the demonstration of the need for and advantages of using a particular design method over the traditional intuitive approach.

Representative of these studies are the works by Alexander[40], Gregory[41] and Jones[42]. A critical review of such methods has also been provided by Cross and Roy[43] and more recently in the book by Lawson[44].

Regardless of the methodology used, building design in its broadest sense, could be described as a decision-making process whereby a multidisciplinary team (or design team), traditionally led by the architect or designer, seeks to provide a solution to a real world problem. The end product of such a process is generally a three dimensional solution (building) that is expected to perform satisfactorily, at least, the functions stated by the design objectives.

Building design problems are often generated by needs of individuals (clients) or communities (users), they tend to be multivariate, and as in any other design problem, involve the consideration of interactive relationships defined as design constraints.

These constraints are said to result from "required or desired relationships between two or more elements"[44a], and their purpose is "to ensure that the designed system or object performs the functions demanded of it as adequately as possible"[44b].

5.1 A MODEL OF DESIGN CONSTRAINTS

Lawson[44] has reported various models, suggested by several authors, to explain the functions and relations of design constraints, and to help to understand the nature of design problems.

On the other hand, several models have been proposed in an attempt to represent, understand and predict the interactions of fire safety in buildings[45] either in a universal form[46] or for the study of specific occupancies[71,72]. Further attempts have been made to relate directly some of these models to the process of design in architecture[49].

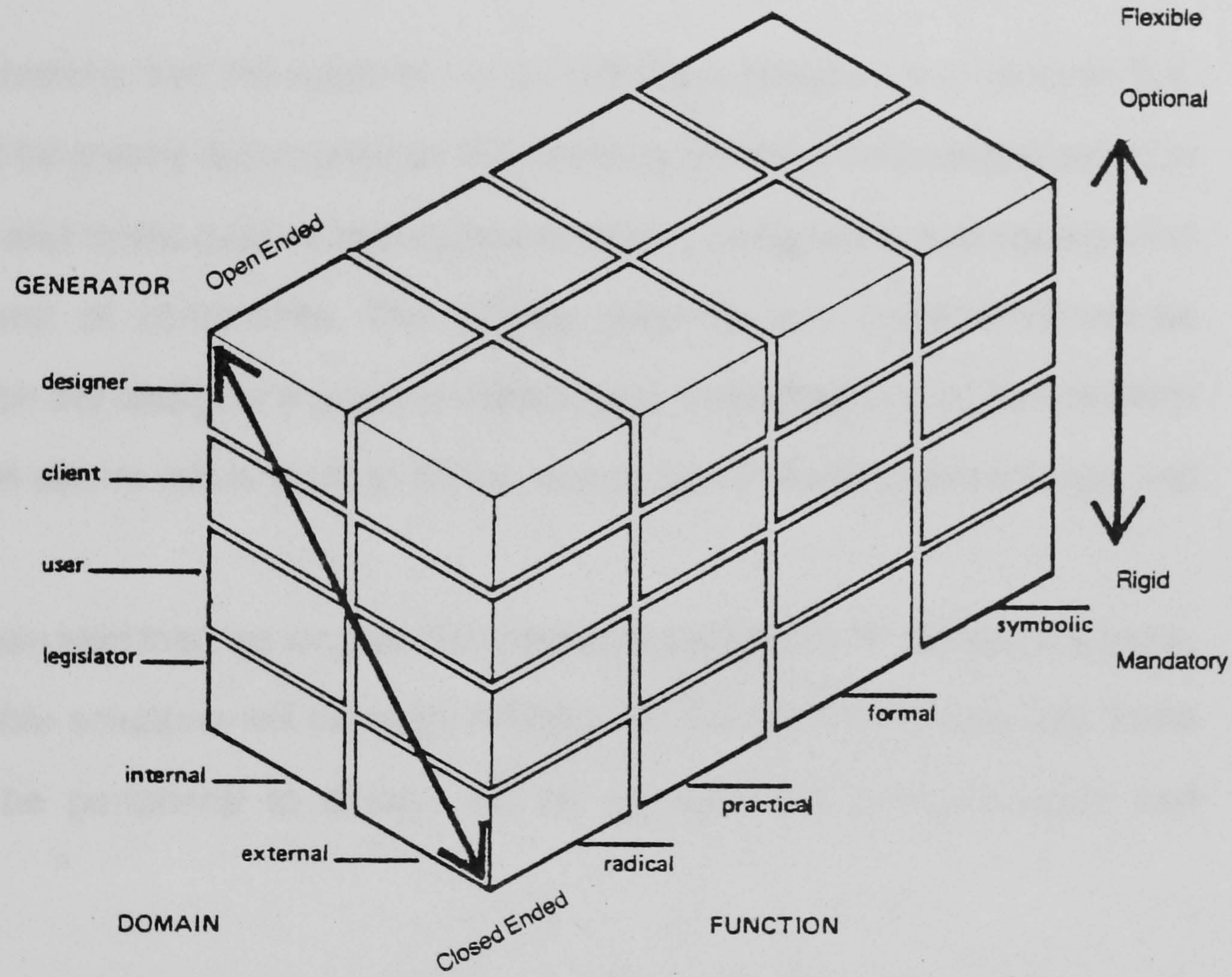
Most of these modelling tools are derived from techniques used in System Engineering and Operational Research. Generally their aim is to assess the probability of occurrence of a final event, in a given sequence of related events, by quantifying the probability of each component event. They also will provide comparative assessments, of the relative improvement in fire safety, for alternative combination of elements.
Hitherto, their application is being developed and their use as tools in the building design process is not in hand yet.

To clarify the relationships and interdependence of design constraints and design problems, the model suggested by Lawson[44c] has been considered particularly relevant and is reproduced here in Figure 1-1 and in the following description.
There are four groups of constraint GENERATORS: Designer, Client, User and Legislator (or enforcing authority) each one of them impose constraints on the solution with a varying degree of rigidity. The legislative constraints are absolute and *must* be satisfied while the rest can be open to discussion to a certain extent.
Further, constraints are divided in two categories according to their DOMAIN: Internal and External, the former being related to the desired or required relationship between parts of the system and allow for a greater decision freedom; the latter refers to relationship imposed by the context (site, insolation, etc.) and are not controlled by the designer.
Finally, the design constraints are also categorised by FUNCTION as:

Figure 1-1

A Model of Design Constraints

After Lawson (44)



a) Radical, in the sense of the fundamental activity or purpose of the intended design.
b) Practical, referring to the technological problem of the physical making or construction of the design (e.g. materials, techniques, services, etc.).
c) Formal, in relation to proportions, geometry, texture, shape, colour etc.
d) Symbolic, more often relevant to communicative and expressive design (graphic and stage design) but also present in certain type of buildings (e.g. churches, etc.).

It seems therefore, that the response of an individual designer to a problem (i.e. solution) will be greatly determined by the interplay between internal and external constraints, and by the relative importance or priority assigned to each group over the other sets of constraints. The priority given to any constraints will be dependent on the designer's own perception and understanding of the problem which in turn will be influenced, to some extent, by his existing knowledge and experience.
But it has been said that "as long as the issues are perceived as design problems, good workable solutions will be forthcoming from the profession; but any issue thought to be peripheral to design will be crowded out of the studios and ignored"[50].

In the present state of the regulatory system, fire safety requirements are considered to form part of the legislative group of the constraint 'generators' in the 'domain' of both internal and external constraints. This is represented in the model as meaning that they are taken to be close ended, rigid and mandatory; or something that must be complied with. Thus, they are impositions beyond the control or manipulation of designers. Indeed, there are very few examples where fire safety constraints are imposed by any means (users, clients or designers), but legislative controls. Yet there is evidence of the positive contribution made to building design by all other categories of constraints.

This seems to indicate that designers give a low priority to fire safety constraints in the design process because of the prescriptive nature of the hardware oriented legislative constraints which lead to a limited 'catalogue' of possible solutions, discouraging initiatives of improvement through building design and forcing a reliance on legislative advice. Moreover, this attitude carries the inherent assumption that compliance with legislative requirements implies an acceptable level of safety.

5.2 FAILURE OF DESIGNERS

The occurrence of a major fire is generally followed by an inquiry or investigation. The resulting report almost invariably points out failures of the architects or design team in providing fire safety measures that would have otherwise prevented the incident or mitigated the consequences.

This was the case in the Report of the Committee of the inquiry into the fire at Fairfield Home[20] which stated that: "the architects concerned knew too little about the behaviour of fire in the structure of buildings and the principle of fire protection, and relied too much on the building regulations, and on the recommendations of the Fire Prevention Officer. The building regulations impose only minimum standards, which in some cases . . . do not cover every set of circumstances."

Similarly, the Report of the Summerland Fire Commission[19] indicated among its recommendations that: "Architects and clients together should carefully consider the requirements and performance of a building in use at the stage when conceptual designs are proposed, and before proceeding with the details of the design and the later submission of plans to the authorities."

The Report emphasised the need for early consultation with enforcing authorities and that designers should take responsibility for the decisions agreed. The commission went further by recommending that:
"Architectural training should include a much extended study of fire protection and precautions."
Moreover it suggested that: "An assessment of safety, particularly fire safety, appears so far to have been generally neglected in architectural education."

In a report presented to the American president by the National Commission on Fire Prevention and Control[3j], it was indicated that:
"Designers of buildings, generally give minimal attention to fire safety in the buildings they design. They are content, as are their clients, to meet the minimal safety standards . . . often both assume that the codes provide completely adequate measures rather than minimal ones."

As in the case of the Summerland Commission, it was also recommended:
"to schools giving degrees in Architecture and engineering that they include in their curricula at least one course in fire safety"[3k] and urged professional associations to implement this recommendation.

Finally, Pauls[51] has made the following comment:
"Designers, owners and others should not feel that they have done their duty to society by merely meeting the code; after all a professional is expected to make judgements that go beyond merely reading a code and designing to a minimum standard."

From the extracts above, it is quite evident that there is concensus in claiming that architects are not fulfilling part of their responsibilities as building designers because of their lack of knowledge, understanding or interest in the problems of fire safety.

By contrast, there is also evidence indicating that fires occur even in buildings which have met all applicable requirements. Surely the responsibility will be other than the design team, be it carelessness of occupants, failure of management in maintaining fire safety, inadequacy in the way fire safety is applied, lack of awareness, etc.

5.3 FAILURE OF SYSTEM

The preceding section (5.2) attempted to evidence the failure of designers to cope with fire safety in building design. It could be argued that since fire safety is a relatively new legislative constraint in building design then, the majority of architects have not received any formal education on the subject, and hence their lack of knowledge. But it is believed that even if they would have had that education, given the current regulatory system, they would probably have not been able to do any better.

To summarize, it is suggested that parallel to the lack of knowledge or interest mentioned above, there are some other factors not directly attributable to architects that appear to be related rather to the regulatory system, its evolution and implementation.
Indeed, elsewhere[57b] this failure to mitigate the threat of fire has been blamed on the wrong social attitudes, business economics and politics. Further, safety in general and fire safety in particular, seems to be a vexed political issue for, as noted earlier, very seldom lawmakers will act but in response to public outcry caused by a major disaster that could have been averted.

The following are some of the most important points in showing the inadequacy of the present way of administering fire safety. Although many of them have been mentioned before it has been considered convenient to put them together:

a) The human component in the fire problem has been underrated, until recently. Although it has been recognised for a long time the significance of human behaviour as an important factor in fire, remedial efforts appear to be directed to the symptoms and effects rather than to the causes. The apathy shown towards the fire problem is generalised yet nobody has doubts about the importance of its consequences.

b) Par excellence, the traditional method of dealing with fire in buildings followed a strategy of provision of hardware and over-design of components, perhaps in an atetmpt to overkill the problem. Since there must be a limit to the possible hardware sophistication and because of the doubts expressed in relation to the success achieved with traditional strategies of dealing with the problem, alternative ways to tackle the problem are being devised.

Canter[52] suggested this search for new horizons as one of the reasons for seriously considering the human aspects of the problem. This particular view is echoed in the "Review of Fire Policy", where it is suggested that much of the current fire research in human behaviour could be justified as aiming at "the more economical achievement of the current containment of fire risk"[1g].

This seems to indicate that the interest in this field of research is being somewhat motivated by economic arguments rather than by its real importance in relation to the fire problem.

c) Legislative controls are mostly based on premises which are being constantly demonstrated as leading to false expectations or are being invalidated by research results.

Such is the case with egress requirements[51,53]; the assumptions behind the philosophy of fire resistance tests[38], assumptions as to what people will do in fires[33,54,55] in addition to other aspects already mentioned above.

Furthermore, controls are based upon prescriptions for traditional methods and materials, according to the aspects of the problems considered when the particular control was drafted. It seems then very difficult, if not impossible, to apply these controls to new materials and techniques (e.g. post-tensioned structural elements, standardisation, etc.) that were not in use nor were they envisaged by the regulation.

Moreover, the rate of change in current society, mentioned in previous sections, provides yet another indication of discrepancies, when considering its implications in building design.
Changes that are in escalation, not only reflected in innovations in the way buildings are designed (e.g. computer aided design) but in the way they are built (e.e. prefabrication, CLASP, etc.). Changes are also noted in how buildings are used and what they are used for (i.e. changes of use, multiple occupancies, etc.) and in the emerging new variety of non traditional buildings and complexes that did not exist a few years ago (e.g. 'atria' , large enclosed developments and shopping centres, inflated structures, etc.) and for which direct past experience is less relevant.

Consequently, even if one assumed that current building controls worked in the past they are unlikely to cope with this rate of change. "Innovations in design will most probably demand the re-thinking or re-interpretation of building codes, which in turn will demand institutional changes. That is the price we must pay for understanding".[49]

Part One References

1. "Review of Fire Policy"
   Home Office
   London 1980
   (1a) p.324; (1b) p.371, 403; (1c) p.76;(1d) p.222;(1e) p.30, 75, 371; (1f) p.15; (1g) p.105; (1h) p.3; (1i) p.25; (1j) p.118; (1k) p.128; (1l) p.132; (1m) p.146; (1n) p.6; (1p) p.215; (1q) p.223; (1r) p.244; (1s) p.56; (1t) p.11; (1u) p.374-381.

2. "Future Fire Policy: a Consultative Document"
   Home Office
   HMSO, London 1980
   (2a) p.5; (2b) p.8; (2c) p.9.

3. "America Burning"
   Report of the National Commission of Fire Prevention and Control
   US Government Printing Office
   Washington, DC 1973
   (3a) p.1; (3b) p.5; (3c) p.161; (3d) p.62; (3e) p.133; (3f) p.72; (3g) p.136; (3h) p.64; (3i) p.63; (3j) p.2; (3k) p.77, 168.

4. Rardin, RL and Mitzner, M
   "Final Technical Report", Determinants of International Differences in Reported Fire Loss: preliminary investigation"
   Georgia Inst. of Technology
   Atlanta, GA. June 1977

5. Rardin, RL et al
   "Selected International Comparisons of Fire Losses"
   Georgia Inst. of Technology
   Atlanta, GA. June 1978

6. Appleton, I
   "The Requirements of Research into the Behaviour of People in Fires"
   in "Fire and Human Behaviour"
   D Canter (ed)
   J Wiley & Sons, New York 1980

7. Wilmot, T
   "Will the Dangerous Gap in Fire Statistics be Closed at Last?"
   Fire 72 (895) January 1980, p.445

8. National Westminster Bank, Edinburgh
   Personal Communication

9. The Statistical Abstract of the United States
   US Government Printing Office
   Washington, DC. 1979, p.477

10. Fire Statistics UK 1979
    Home Office
    London 1981

11. Kanter, MJ
"Fire Loss in the United States During 1979"
Fire Journal 74 (5) September 1980, p.52-65

12. "Fire in the United States" 1978 Edition
Department of Commerce
Washington, DC December 1978

13. Franklin, P
"Building Control"
in "A Complete Guide to Fire and Buildings"
EW Marchant (ed)
Medical & Technical Publ. Co Ltd
London, 1972

14. UK Fire Statistics 1974
Home Office
London, p.3

15. UK Fire and Loss Statistics 1973
Joint Fire Research Organisation
Fire Research Station, Borehamwood 1975, p.viii

16. (Holroyd Report)
The Report of the Departmental Committee on the Fire Service
HMSO, London 1970

17. (Robens Report)
Safety and Health at Work
Report of the Committee 1970-72
HMSO, London 1972 (Rep. 1979)
(17a) p.6; (17b) p.41; (17c) p.132

18. Report of the Committee of Inquiry into the Fire at Coldharbour Hospital, Sherborne
HMSO, London 1972

19. Report of the Summerland Fire Commission
Isle of Man Government Office, 1974

20. Report of the Committee of Inquiry into the Fire at Fairfield Home, Edwalton, Nottinghamshire
HMSO, London 1975

21. Rudd, GT
"Fire Policy Reviewed"
Fire 73 (902) August 1980, p.125-128

22. Malhotra, HL
"Fire Resistance – Present and Future"
Current Paper CP 37/75
Fire Research Station, Borehamwood 1975

23. Bryan, JL
"Building Fires"
Journal of Architectural Education 33 (4) Summer 1980, p.32-37

24. North, MA
"Fire Damage to Buildings – Some Statistics"
Fire Research Note No.994
Fire Research Station, Borehamwood, 1973

25. "The Effects of Building regulations on Architecture"
Report of the South-West Region of the RIBA
Bristol Society of Architects
Bristol, 1977, p.5

26. Health and Safety at Work Etc. Act 1974
HMSO, London 1974 (Repr. 1980) (26a) p.1.

27. Cooke, G
"Additional Commentary on the Fire Precautions Act 1971
and Related Legislation"
The Fire Precautions Act in Practice
Taylor, J and Cooke, G (ed)
The Architectural Press, London 1978, p.60

28. Swersey, AJ and Ignall, E
"What Does Fire Research have to do with Fire Protection"
Fire Journal January 1980, p.63-74

29. Ahituv, N; Bernman, O and Parkan, C
"Fire Research: Canadian Survey Suggests Nine Problem Areas"
Fire 73 (903) September 1980, p.203-205

30. Directory of Fire Research (8th Ed)
National Academy of Sciences
National Research Council
Washington, DC 1978

31. Wilmot, T
"Costs of Fire Research Examined"
Fire 72 (891) September 1979, p.188

32. Pauls, JL and Jones, BK
"Research in Human Behaviour"
Fire Journal 74 (3) May 1980, p.35-40

33. Wood, PG
"The Behaviour of People in Fires"
Fire Research Note No 953
Fire Research Station, Borehamwood 1972, p.1

34. Green, CH and Brown, R
"Life Safety: What is it and How Much is it Worth"
Current Paper CP52/78
Fire Research Station, Borehamwood, 1978

35. Wiggins, J
"Balanced Risk Analysis"
Journal of Architectural Education, p.6-8
'op cit.'

36. Palmer, A
"How to Make Academic Research More Useful"
New Civil Engineer, 10 April 1980, p.24-25

37. Adams, FC
"Fire Tests"
in "A Complete Guide to Fire and Buildings"
'op cit.'

38. Harmathy, TZ
"Building Design and the Fire Hazard"
Wood and Fiber 9 (2) Summer 1977, p.127-144

39. Cooke, G
"Fire: The Unseen Problems"
The Architects' Journal 170 (35)
29 August 1979, p.415-467

40. Alexander, C
"Notes on the Synthesis of Form"
McGraw-Hill, New York, 1964

41. Gregory, SA
"The Design Method"
Butterworth, London, 1966

42. Jones, JC
"Design Methods: Seeds of Human Futures"
John Wiley, New York, 1970

43. Cross, N and Roy, R
"Design Methods Manual"
The Open University Press
Milton Keynes, 1975

44. Lawson, BR
"How Designers Think"
The Architectural Press
London, 1980
(44a) p.69; (44b) p.76; (44c) p.77; (44d) p.145.

45. Marchant, EW
"Modelling Fire Safety and Risk"
in "Fires and Human Behaviour"
'op cit.'

46. Roux, HJ and Berlin, GN
"Toward a Knowledge Based Fire Safety System"
in " Design of Buildings for Fire Safety"
'op cit.'

47. Atkinson, GA
"Building Law in Western Europe: How responsibility for Safety and Good Performance is Shared"
Current Paper CP6/71
Building Research Station, Garston 1971

48. Cibula, E
"The Structure of Building Control – an International Comparison"
Current Paper CP28/71
Building Research Station, Garston 1971

49. Lerup, L; Cronrath, D and Liu, JK
"Learning from Fire: a Fire Protection Primer for Architects"
University of California
Berkeley, 1977

50. Hartray, J
"The Functional Frieze"
The Journal of Architectural Education, p.1-2
'op cit.'

51. Pauls, JL
"Building Design Egress"
The Journal of Architectural Education, p.38-42
'op cit.'

52. Canter, D
"Fires and Human Behaviour – an Introduction"
in "Fires and Human Behaviour"
'op cit.'

53. Pauls, JL
"Building Evacuation: Research Findings and Recommendations"
in "Fires and Human Behaviour"
'op cit.'

54. Sime, JD
"The Concept of Panic"
in "Fires and Human Behaviour"
'op cit.'

55. Canter, D and Matthews, R
"The Human Behaviour of People in Fire Situations: Possibilities for Research"
Current Paper CP11/76
Fire Research Station, Borehamwood, 1976

56. "A Framework for Government Research and Development"
HMSO, London 1971 (rep. 1979)

57. McKinnon, GP (ed)
Fire Protection Handbook (14th Ed)
National Fire Protection Association
Boston, 1976
(57a) p.1-11; (57b) p.1-2

58. Nash, JR
"Darkest Hours"
Nelson-Hall, Chicago 1976,p.662

59. Rashbash, DJ
"Criteria for Decisions on Acceptability of Major Fire and Exlposion Hazards with particular Reference to the Chemical and Fuel Industries"
Paper given at the Conference Hazards VII
Institution of Chemical Eng., Manchester April 1980.

60. Fire Magazine, p.566
April 1973

61. Fire Engineers Journal
35 (100) December 1975, p.29-33

62. Lie, TT
"Fire and Buildings
Applied Science Publishers
London 1972, p.157

63. Peterson, O; Magnusson, SE and Thor, J
"Fire Engineering Design of Structures"
Swedish Institute fo Steel Construction
Publication 50
Stockholm 1976

64. Saito, H
"Engineering Design for Structural Fire Safety"
Paper given at the CIB Symposium "Systems Approach to Fire Safety in Buildings"
Tsukuba, Japan, August 1979

65. Drysdale, D
"Tests for Smoke and Toxic Gases Production"
Lecture at short course "Fire Testing of Materials with Particular Reference to Fire Science"
University of Edinburgh, March 1981

66. Thomas, PH
"Effects of Fuel Geometry in Fires"
Current Paper CP29/74
Fire Research Station, Borehamwood, 1974

67. Hilado, CJ and Murphy, RM
"Fire Response of Organic Polymeric Materials"
in "Design of Buildings for Fire Safety
Smith, EE and Marmarthy, TZ (eds)
American Society for Testing and Materials
Philadelphia, 1979

68. Lyons, J
"The Chemistry and uses of Fire Retardants"
J. Wiley, New York 1970, p.139

69. Thomas, PH
"Fire in Enclosures"
Current Paper CP30/74
Fire Research Station, Borehamwood, 1974

70. Drysdale, D
"Fire Growth in Compartments"
Fire 73 (81) July 1980, p.90-92

71. Beard, A
"A Systemic Look at Fire Safety"
Fire 73 (903) September 1980, p.196-198

72. Benjamin, IA
'A Fire Safety Evaluation System for Health Care Facilities"
Fire Journal 95 (6) March 1979, p.52-55

PART TWO
THE STUDY

1. RECAPITULATION

Failing to be able to remove all combustible materials from our environment, it seems that the hazard of fire will never be eradicated completely from society. Regardless of the policies adopted or measures taken, absolute safety will never be achieved for there will always be a probability, though small it might be, of failure, error or accident likely to lead to a fire. Some of the effort made to reduce this probability, within the limits assumed to be defined by society, should be a major concern of building design.

Previous sections have tried to demonstrate that, if anything, the fire problem has shown a trend to escalate in the past few decades. Some of the reasons thought to have contibuted to this situation have been outlined, along with what seems to be the inadequacy of building legislation, fire research and building design, in providing solutions that have proved to reduce the impact of fire.

Furthermore, at the beginning of Part One it was noted that the effects over the whole problem of any given 'solution' will be, to a certain extent, influenced by the definition of the 'problem' and its considered constituent parts. It follows that a further explanation, for that inadequacy in fire safety expressed before, could be by stating that major parts of the problem have been neglected or under estimated with respect to their influence and impact on building design. One such part was suggested to be the human aspect of the fire problem.

The contribution of the human element to fire seems to be multifold, statistics reveal that most fires are started by human's actions, the list below contains some of the most common indicated causes:

- Ignorance and indifference to the fire problem at both societal and individual levels[1a].

- Accidents due to 'carelessness' which is said to cover "a range of behaviour from relative innocence and helplessness to subconscious attention-getting or self-destructiveness"[1b].
- Design errors of both buildings and products.
- Fire-setting or deliberate ignition either by a pyromaniac (thrill seeker), malicious or arson (benefit).

Conversely, human intervention can lessen the consequences of fire not only if appropriate actions are taken, should a fire occur, but also products could be designed accounting for careless usage, and buildings could be also designed to safeguard their occupants (by allowing them to escape or providing adequate protection) and facilitate the extinction of fire whatever its original cause.

2. PURPOSE OF THE PRESENT STUDY

Since the interaction of people–environment will greatly determine the consequences of fire, it is apparent therefore, that changes introduced in either or both factors (people and environment) will influence their interaction and the outcome thereof. The role played by people can be altered by behavioural changes brought about through education, and the environment can also be altered through improved design.

The commission that prepared the report "America Burning"[1], placed a major emphasis on education, indeed several of its recommendations referred to education at different levels. It suggested that: "Among the many measures that can be taken to reduce fire losses, perhaps none is more important than educating people about fire"[1c]. The belief that a plausible way of helping to mitigate the fire problem of any nation is through education and improved design has been a fundamental motivation in pursuing the present study.

At this point it must be stressed that, because of the social implications involved, this preventive approach aims at long term results and, as in the case of eductional strategies, it would be inappropriate (if at all possible) to assess its performance by the immediate impact on the incidence of fire, or by cost effectiveness arguments, as seems to be the tendency nowadays.

Any proposition of change is likely to be criticised unless supported by evidence indicating that the existing situation is not good enough. This is particularly more so, when the expressed official view[2] questions the validity of educational approaches to the problem of fire in buildings. Nevertheless, such an approach should not be rejected on purely economic grounds.

The purpose of the present study is an attempt to determine how fire safety is actually incorporated into the design of buildings, and what conflicts are ascribed to that interaction within the current context. Once this information is ascertained, it is then intended to offer suggestions aiming at the improvement of the integration of fire safety to building design. Throughout this study, and with the aim of widening its scope, an endeavour has been made to relate observed situations and experiences in the UK, with those existing in other countries, whenever suitable references have been available for this purpose.

2.1 ASSUMPTIONS AND LIMITATIONS

The following assumptions have been made in the course of this study and though some of them might seem self-evident, it has been considered important that mention should be made because they limit the scope of the present investigation.

a) As mentioned earlier, architects are traditionally assumed to be responsible for most of the design decisions and for the coordination of the design team. In that respect, it is further assumed that the design team will hold attitudes and views similar to those of the architects, and that generally, some issues applied to the architectural profession will also be applicable to other professions involved in the design team (e.g. engineers, etc.).

b) Although it has been stated before (Part One, Section 5.1, also Figure 1-1) that in building design there are four 'generators' of design constraints, viz: designers, clients, users and legislators (or enforcing authorities). Architects are assumed to cast the desires and requirements of clients and/or users into a design solution which will have to satisfy the expectations of building legislation, through the interpretation of the enforcing authorities. It follows that the confrontation of interests or interaction could be assumed to be reduced to two groups: the 'soft' requirements group (i.e. arguable) represented by the designer, and the 'hard' requirements group being represented by the enforcing authorities.

c) From above (b) it follows that the final design solution will be a compromise influenced by the architect's knowledge and the enforcing authority's interpretation of the legislation.

d) A Primary contractual responsibility for architects refers to the gaining of authoritative approvals. It could be assumed therefore, that an evaluation of the design project, and indeed of the architect's abilities, may be related to the success or failure in fulfilling the legislative requirements and thus, obtaining approval. Much more so if it is accepted that an architect is "judged by the solutions he produces . . ."[3].

e) Building Control Officers have not been included in this study because it was assumed that their domain is less open to individual interpretations; that ultimately, they refer to the fire prevention officer for fire safety advice and, that they are seldom involved in the education of building designers.

f) Likewise, fire insurance has also been excluded from the considerations of this study, because it is assumed that the decision of whether to insure or not is entirely a matter of free choice for the owner, hence not indispensable for the functioning of a building nor for its design. In theory, provided that the appropriate premium is accepted, almost anything could be insured; it seems to be a matter of finding an insurer prepared to 'take' the risk.

3. REVIEW OF RELEVANT WORK

Before attempting to go any further in deciding the possible means through which the stated end could be achieved, it was considered necessary to investigate whether any previous work had been done in this field; how this type of problem has been dealt with before; and how previous experiences, in similar areas, could be related to the problem under study.

It appears that the integration of fire safety into the design of buildings has been receiving increasing attention since the early 70's, perhaps because of the increasing fire frequency and other factors mentioned earlier (see Part One, Section 2). A literature search carried out twice, once in early 1979 and again in the latter part of 1980, confirmed that a substantial amount of material on this topic has been published in recent years.

To simplify this review of relevant work, it has been thought opportune to divide it into three groups, some of which are often inter-related, and present a brief summary of their scope, limitations and main findings. The 3 categories of work considered are:

1. Professional Associations
2. Publications
3. Surveys

3.1 PROFESSIONAL ASSOCIATIONS

The Royal Institute of British Architects (RIBA) and the American Institute of Architects (AIA) are regarded as representative of the architectural profession in their own countries. Both organisations have responsed to the question of adequacy of fire safety education and practice in building design, by appointing a working group or a task group to discuss and made recommendations on the subject. A review of the steps taken by each of these groups is presented below.

3.1.1 RIBA – Fire Protection Association (FPA)

After the promulgation of the Fire Precautions Acts in 1971, the RIBA in collaboration with the FPA organised a series of events related with fire safety in buildings. The first of such joint ventures was the conference "Fire and the Built Environment"[4] held in London, early in 1972. It had four sessions, namely: Fire Problems in a Socially and Technologically changing world, Fire Containment Problems Facing Insurers, Occupancy Problems, and Education and Communication.

A major emphasis was put on the improved service that architects could render to their clients by giving greater attention to fire safety design and considerations related to insurance requirements.

Later that year a working group was set up jointly by the RIBA and FPA, with the purpose of providing guidance to the schools of architecture in the teaching of fire safety. Amongst the investigations carried out by this group was a survey of the schools of architecture, that has been revised in some detail under a separate heading (see Section 3.3.2 below).

The publication of the Summerland Report[5], in which many of the recommendations were concerned with the architectural profession, produced a sudden awareness towards the problems of fire in buildings[6]. As a consequence of this, the working group gained prominence and recognition, leading to the publication of the model syllabus "Fire and the Architect"[7]. In time this model syllabus, reviewed elsewhere in this study (see Section 3.2.1 below), would be circulated and its adoption recommended to all 38 Schools of Architecture in the UK.

Early in 1975, upon a suggestion of the working group, a four day course was organised for members of the schools' staff who had the responsibility of teaching fire safety. The title of the course was "Integrating Design Against Fire in

Architectural Teaching", and the aim was to "study methods of integrating the teaching of design against fire in schools' courses as opposed to a study of fire technology"[8]. It was held at the Birmingham School of Architecture.
It is noteworthy that although the Summerland Report had been published only a few months before the course and that there was a drive to incorporate fire safety into design, only 18 schools (42 per cent) took part in the course.

The last event of this course was a plenary session which produced a number of recommendations, the more relevant to this study are quoted below:

a) need for a continuous feed-back of design failures
b) subject should be introduced before the students' year out (3rd year)
c) each school was to name a member of staff who would have responsibility for receiving and disseminating information on the subject
d) special projects with specific fire design problems to be introduced at various points during training
e) need for a working plan for architects, covering all points of the regulations

This course was the first occasion on which representatives of different schools sat together to talk about fire safety education for building designers. It also seems to have induced the acceptance of the model syllabus mentioned earlier.

Since then, several other courses have been set up, particularly directed to the architect in practice, in different parts of the UK. A typical example was the conference "Designing for Fire Safety" held at the University of Nottingham, in April 1976. It was sponsored by the Building Centre Trust and the FPA, and jointly supported by the RIBA and the Institution of Heating and Ventilating Engineers. The purpose of this two day event, which also had a related exhibition, was "to consider the part which the architect, the service engineer, the building material manufacturer, the fire officer and the fire insurer must play in the development of fire safety in buildings"[9].

The conference consisted of eight sessions in which a variety of topics were covered[10], ranging from industrial legislation for fire safety to fire and smoke control; the traditional aspects of fire service, fire insurance and building materials were also included. Throughout these lectures emphasis was made on the importance of the role played by the architect, his need to think beyond the legislation, and the convenience of early consideration and consultation.

Finally, in the Autumn of 1978, a seminar on "Design Against Fire" was organised, again jointly by the RIBA and FPA, and held at the Institute's headquarters in London. The objective in this case was to "review the whole situation of fire education for architects and of teaching of fire in the schools of architecture"[11]. Members of the schools' staff attending this seminar were those appointed by each school, according to the conclusions of the Brimingham course mentioned above, to receive and disseminate fire safety information, as well as being involved in the actual teaching of the subject. The fact was that there were more representatives from fire brigades than from the various schools (only 11 attended).

The approaches followed by several of the schools were presented, as were the results of a survey that will be discussed in more detail in the following section (Section 3.3.4). Little was considered in relation to new objectives and new ways of teaching fire safety. In the main, the seminar was a retrospective review, of the progress made and the experience gained so far, in the incorporation of fire safety into the schools' programmes. An account of this seminar has been published elsewhere[12].

Hitherto, the RIBA-FPA working group has remained in existence although very little has been published since that seminar.

3.1.2. American Institute of Architects

The report "America Burning"[1], similar to the Summerland Report in this country, evidenced no less serious charges and doubts about the expertise of architects in designing buildings for fire safety. Besides the comments from the report that have been cited earlier in Part One, there were three recommendations specifically directed to the building design profession[1d], viz:

"The Commission recommends to schools giving degrees in architecture and engineering that they include in their curricula at least one course in fire safety. Further, we urge the AIA, professional engineering societies and state registration boards to implement this recommendation" While recognising the sparsity of guidance and materials for teaching, the Commission urged the Society of Fire Protection Engineers to prepare model courses for architects and engineers in the field of fire protection engineering. Since it would take several years for the improvement in education to be felt in the practices, "the Commission recommends that the proposed National Fire Academy develop short courses to educate practising designers in the basics of fire safety design".

The Institute responded to the foregoing recommendations by appointing a task group, from within the Codes and Regulations Committee, to revise the fire safety education in the schools, and to suggest ways of implementing the recommendations of the Commission. The publication "Educating the Architect: Fire and Life Safety"[13] contains the findings of the task group.

3.2 PUBLICATIONS

A few publications have been reviewed separately under this heading. It is considered that they are rather special for they represent the precursory attempts to providing specific guidance on fire safety in architectural design. All were produced by architects and, as inferred above, for the use of architects.

3.2.1 RIBA–FPA "Fire and the Architect"

As indicated previously (Section 3.1.1 above) the RIBA–FPA working party produced the publication "Fire and the Architect"[7]. To some extent, it could be considered as the Institute's official reply to the charges of defficient fire safety education[14], suggested by the Summerland Fire Commission[5].

The subtitle of this publication provides its intended scope: "A guide for use in schools of architecture outlining the architect's responsibility in the design process for the prevention and control of fire". It goes further by stating that its main purpose is "to indicate the essential 'fire content' of the course and the literature, reference material and organisations to which tutors and students should turn for further assistance".

In the notes for its implementation, which are really more a justification, the publication presented a table of results from a survey (see Section 3.3.2 and Table 2-2) and criticised some schools that, for the sake of timetable simplicity, combined the subject of fire safety with other courses. It was rightly suggested that such a method failed to give appropriate importance to the subject and thus, there could be a lack of coverage and consistency. It was further stressed that such practice may overlook "the major area of expertise, integrated design studies involving fire as a vital design constraint to be weighed against all other functional requirements . . .".

Emphasis was made upon this "major area of expertise" when it was recognised to be the main contribution of architects to fire safety, by incorporating into biulding design "a sensitivity towards all those perceptive and behavioural factors that defy the legal draughtsman". Other important points purported in this first part of the publication were related to the desirability to stress to the students, from the outset, that the cost of fire protection is an essential part, rather than an optional extra, of a building project.

Finally, the need for architects to rely on specialists in this area was also noted. A condition for this collaboration to be effective was put on the capabilities of architects to communicate in this field hence, their necessity to understand the principles of fire protection. "Only then can he (the architect) meet his undoubted responsibility to design buildings which carry the minimum fire risk consistent with their function."

Model Syllabus

Against this background of policy statements, described above, the model syllabus was introduced. It contained seven major headings under each of which several related topics were presented with a brief descriptive comment; for some of these, references were also given. Table 2-1 shows an abbreviated version of the contents with the headings and sub headings only. At first glance, the topic breakdown in Table 2-1 may appear to be comprehensive, but a more careful examination will reveal its shortcomings: it seems to be devised to educate the potential architects in the use and application of legislative requirements, and in the traditional approach of 'hardware' provision. It follows, therefore, that most of the remarks made in Sections 5.2 and 5.3 of Part One are also applicable to this model syllabus. Furthermore, it could be argued that a model programme should also provide guidance information on at least the following aspects:

a) the number of hours necessary to cover adequately the subject (i.e. course duration)
d) suggested methods of teaching and assessment
c) the recommended year for its inclusion in the school curriculum
d) most important of all, the objective that the student is expected to achieve upon completion of the course.

Table 2-1

Fire Safety Course Content

(as recommended by the RIBA–FPA Working Group)[7]

---

1. Nature and Behaviour of Fire
   - Sources of ignition
   - Ignitability of building materials and contents
   - Physical factors affecting growth and spread of fire
   - Spontaneous ignition and pilot ignition by thermal radiation
   - Determination of safe distances for objects exposed to thermal radiation
   - Heat transfer by thermal convection and conduction
   - Estimation of potential severity of fires
   - Fire loading per unit floor and window areas
   - Standard furnace time-temperature curve for fire simulation

2. Planning Site Requirements
   - Access for fire brigade
   - Relationship to height, volume and perimeter of building
   - Special problems
   - Space separation between buildings and boundaries
   - Application in practice through the building regulations

   Means of Escape in Case of Fire
   - Principles of design and protection of escape routes
   - Relationship to height of building
   - Corridors, stairways, lifts, escalators, halls
   - Pressurization
   - Relationship to occupancy of building

3. Designing to Control Spread of Fire and Smoke within Buildings
   - Principles of internal space separation
   - Meaning of fire resistance
   - Compartmentation
   - Protection of openings
   - Fire Stopping
   - Fire dampers
   - Fire venting

Table 2-1 (continued)

4. Materials and Elements of Structure
   - Behaviour in fire
   - Properties of building materials and structural elements at elevated temperatures
   - Critical temperatures
   - Theoretical prediction of the temperature of structural elements
   - Tests methods and tests results – evaluation and limitations
   - Standard Tests

5. Services
   - Vulnerability to fire
   - Sources of fire and contribution to spread of fire

6. Fire Protection Equipment
   - Fire defence as a system
   - Manual equipment used by occupants
   - Automatic equipment
   - Extinguishing agents

   Equipment and Facilities to Assist Fire Brigades
   - Fixed fire extinguishing equipment: hydrants
   - Foam inlets
   - Smoke and heat venting
   - Fire lifts

7. Protection Against the Aftermath of Fire

In relation to the 'essential reading', the most commonly suggested references are the series of FPA leaflets "Fire and the Architect"[15] followed by regulations and codes of practice, and Landon-Thomas' book[16]. Additionally, a package of six audio-visual lectures was developed as a teaching aid for the schools implementing the model syllabus. Each lecture consists of some 24 slides, a recorded cassette and a tape script; the set covers five of the seven main parts of the syllabus (excluding parts 5 and 7, see Table 2-1). It seems that its use has not been wide spread among the schools, perhaps because of its high cost or the descriptive manner of presenting the subject.

3.2.2 L. Lerup (et al) – "Learning from Fire: A Fire Protection Primer for Architects"

The Architecture Fire Safety Group of the University of California at Berkely, has been active in fire research since the early 70's. Several studies, conducted under the direction of Lerup, led to the development of a descriptive technique, whereby sequential stages of fire development (realms) are graphically modelled (mapped) against their interaction with human behaviour (episodes) and the environmental setting of buildings (intra- and inter-compactment)[18]. This publication[17] is the final report of a project attempting to translate research results (i.e. decision trees) into architectural vocabulary by applying the mapping technique to American dwelling typologies.

The real contribution made by this report is not so much in the mapping technique or in the design evaluation matrix presented, but rather in the conceptual approach adopted towards fire safety. That is to say, the recognition that fire safety *is* an architectural problem that can be used by the architect for the design advantage, in contrast to the conventional conception that fire safety is something that architects must do or comply with.

The specific objective of the report was stated to be "to learn from fire so that the architect may deal comfortably with the fire phenomenon and be able to cooperate and co-design with the help of fire professionals, as well as incorporate fire protection early in the design process".

Emphasis is made in 'priming' the architect for a performance oriented approach "away from the prescriptive approach and the customary education through building codes which often result in the tack-on of fire protection rather than its integration in the design process".

Another area upon which Lerup and his collaborators made great emphasis was the relevance given to human behaviour in its interaction with environment and fire. The introduction of the publication stresses: "outside human behaviour, fire is the most complicated phenomena that the building designer encounters. Structure, plumbing, and ventilation are all tame phenomena, well behaved and quite predictable. But fire is a combination of chemistry, geometry, structure and materials that is intimately connected with human behaviour".

3.2.3 M.D. Egan – 'Concepts in Building Fire Safety'

Architects are known to conceptualise both problems and solutions in a graphical way. This premise seems to have been taken up by Professor Egan in preparing his book[19]. The objective of the book, as stated in its Preface is "to present in a graphical format the principles for building fire safety". Thus satisfying a long standing claim of many architects for the need to present the principles of building legislation in the form of diagrams, thereby avoiding the use of lengthy and difficult legislative written language[20].

This book was intended to be a text for students of building design and fire science, to help them "to understand the theoretical basis of building codes and standards and to develop the fundamental knowledge needed to achieve fire safety in the built environment". A second group of potential users was indicated to be architects, builders, interior designers and urban planners, "Who have not had exposure to building fire safety education or training . . ."[19].

Elsewhere, Milke[21] has suggested that this book is similar in its objectives, to the publication by Lerup et al, discussed in the preceding section (3.2.2). Although this may be true, in the sense that both have endeavoured to convey their messages by means of diagrammatic descriptions, one may argue that the approach emphasised by Egan is much more traditional for it relies on the current regulatory system.

A somewhat similar attempt, to illustrate the legislative requirements in graphic form, was made by Cooke [22] in what could be regarded as a catalogue of "constructional measures to prevent the spread of fire and smoke within buildings".

3.2.4 Other Publications

The above review has no pretention of being exhaustive, it has been limited to relevant material which has been published in the open literature, and a copy of which has been possible to obtain. There have been many more publications in relation to the problem of fire safety and building design but many of them either have concentrated on a small facet of the problem or have followed what often seems to be a generalised conception of fire safety. That is in terms of add-on hardware provision rather than, as indicated before, a sequel of the design decisions moulded by the societal context within which those decisions are being made.

3.3 SURVEYS

The literature search undertaken revealed that surveys are a commonly used method of collecting information, particularly when the information sought is held by individuals scattered in different places, and there are limitations in the resources and manpower available.

During the last decade, several surveys were conducted in various countries with apparently similar purpose, namely to find out the attention given to the subject of fire safety in building design. There has been great variation in the scope and emphasis among the different surveys, some of which were very limited (e.g. directed only to schools of architecture) others reached wider groups of population. Similarly, survey format varied from a simple letter-questionnaire to more protracted and elaborated instruments. A brief chronological account of those surveys directly touching the field of the present investigation is given below.

3.3.1 C.B. Wilson – University of Edinburgh

The first of such surveys was conducted early in 1972 by Professor C.B. Wilson, of the Department of Architecture, who reported it in the last session of the conference "Fire and the Built Environment" previously cited[4]. The premise upon which the survey was based was that the teaching of fire prevention was haphazard and piecemeal. A letter-questionnaire was sent to all 38 schools to find out if they agreed with that premise, what they did and what they would like to do about the subject.

It was reported that the answers received varied and there seemed to be no definite pattern. It appeared that "little attention was given to the part played by fire in design projects, but it was universal practice for later projects to be put to the fire prevention officer for comments. Fire was regarded as a gate through which the building had to pass"[4a].

3.3.2 RIBA–FPA Working Group

In December 1972, this working group conducted a survey among the schools of architecture in this country, to find out the way in which the subject of fire safety was being taught. No description has been found on how this survey was conducted nor if it included the totality of the schools.

The only results made available are those published elsewhere[7,12] which have been discussed previously (see Section 3.2.1). They are reproduced here in Table 2-3.

From those results, it was concluded that "the subject was not receiving the attention it warranted in some of the schools although a few were very conciencious in the matter"[23]. In brief, of the 23 schools that responded to the survey, 16 (70 per cent) reported to treat the subject intermingled with other lecture courses, only 4 (17 per cent) had a separate course and 6 had a separate course by a fire officer. It seems that the scope of the survey was rather limited for the information sought was mostly in relation to the method of teaching and not the course contents or anything else.

3.3.3 JT Blackmon – University of Tennessee

In March 1975, a thesis for an MSc degree was presented to the University of Tennessee entitled "In the design and construction of fire-safe buildings, who should know what"[24]. The core of the study was based on the results of a two stage survey conducted during the latter part of 1974, among four groups of population considered experts. The motivation for the study was provided by the report "America Burning"[1], and the goal pursued was "to gather information that could provide a potential data base for the guidance of curriculum experts and technical societies in the preparation of future educational programs for building designers, construction contractors, building officials, fire prevention specialists and building trade vocational education instructors"[24a].

The 5 groups mentioned were assumed to be responsible for fire safety in buildings. The problem was reduced to obtaining answers to the following questions:

a) what information should appertain to each group
b) which code (fire prevention or building) should have control over what area of information
c) whether the five groups would hold the same fire safety view points
d) which category of fire safety information was considered more important by each of the groups.

The first stage of the survey was carried out by means of a questionnaire containing 315 statements, abstracted from a selected bibliography, and arranged in seven broad categories (see Table 2-2). The questionnaire was mailed to the 40 members and consultants of the AIA's Codes and Standards Committee. They were asked to indicate:

a) whether the information in each of the statements was considered relevant to building design and construction, and
b) whether they agreed or disagreed (Likert scale) with the contents of each statement.

The 18 responses (36 per cent) obtained from this first questionnaire were classified in the seven broad fire safety categories (see Table 2-2) and the 75 statements, that would form the second questionnaire, were selected. The second questionnaire was circulated, to the following groups of population, as the "Building Industry Fire Safety Survey":

a) AIA Codes and Standard Committee 40 members, yet again, this time the response was 42 per cent.
b) Senior Fire Prevention Education Specialists of the National Fire Protection Association, who rendered a response of 84 per cent.
c) Professional Firefighters (22) in east Tennessee, reponding 84 per cent.

Table 2-2

Categories of Building Fire Safety Knowledge
(as considered by Blackmon)[24b]

Category	No. of Statements first Questionnaire	No. of Statements second Questionnaire	Title and Description
I	50	10	Fire problems in selected types of buildings: fire in different types of occupancies, combustion concepts
II	55	10	Basic Building Fire Problems: structural protection effects of fire in structures, fire tests.
III	50	10	Building Fires and Electricity: electrical fires, statics electricity, electrical code.
IV	35	10	Building Life Safety Concepts: escape routes, life safety.
V	48	10	Fire Detection and Suppression: fire extinction, fixed systems.
VI	35	10	Building Codes and Standards: reasons and purposes.
VII	42	15	Fire Hazards of Materials: dusts and metals, flammable liquids, gases.
Total Statements	315	75	

d) Nationwide in-house engineering staff of a large non ferrous metal producer, of whom 92 per cent responded.

These four groups of experts were asked to state their opinions in respect to:

a) which of the five sectors of the 'Building Industry' should posses the information contained in each statement, and
b) to which code (fire prevention or building) the information from each statement, was considered to be most applicable.

Although a total of approximately 180 people were involved in this survey, no mention was made of how the samples for each group of population were selected or the size of each sample group, nor why the four groups were chosen instead of others, that would seem more related to the problem studied, e.g. consulting engineers in lieu of salaried 'in-house' ones that perhaps were not involved in building decisions at all. It seems reasonable therefore to infer that the replies of some of those respondents could be regarded as an unreliable guide, because they have not had experience of the area in question: fire safety in building design and construction.

These and other limitations were made self-evident in the conclusions, where it was stated that "difficulty was encountered in formulating positive conclusions based on the results of this study"[24c]. Perhaps some of the difficulty was largely caused by the questionnaire design, i.e. based on a collection of statements, derived from existing literature, without due regard to whether those statements were author's opinions or facts. Moreover, the respondents were forced to fit their answers into those offered in the questionnaire, this may have limited the validity of some of the responses in two ways:

a) the categories were not exhaustive nor mutually exclusive, thus some important issues may have been overlooked (see Table 2-2), and

b) respondents were not allowed to express their own opinions, by means of comments or open-ended questions, should they have different views to those provided by the range of possible answers.

The main conclusions produced by the survey may be summarised as follows:

a) the four groups surveyed showed to have divergent opinions regarding what was important in building design and construction
b) there was a greater coincidence in the opinions from the groups directly involved in fire protection (e.g. firemen and education specialists) than among the group of architects and engineers.

3.3.4 F. Sykes – Leeds Polytechnic

In the course of the seminar "Design Against Fire", reviewed earlier in Section 3.1.1, the results of a survey were presented that seemed to be an updated or follow-up version of the survey conducted in 1972 by the RIBA–FPA working group reported in Section 3.3.2 above. Apart from a table, in which the results of both surveys are compared, and some comments made elsewhere[12], little more appears to have been published about this latter survey.

In Table 2-3, the comparison of the results from both surveys is reproduced. It should be noted that the results represent different proportions of respondents, namely 23 and 17 schools (60 and 45 per cent) for the 1972 and 1978 surveys respectively, out of a total of 38 schools. Despite this limitation, some general trends may be observed. It seems that there was a change in the method of teaching fire safety: fewer separate courses and lectures run by fire officers, more design tutorials and design lectures; also a larger proportion of schools have absorbed the subject into specific subjects; and there appears to be a reliance on the guidance of material produced by the FPA.

Table 2-3

Method of Teaching Design Against Fire in Schools of Architecture in the UK
(source: Reference 12)

Method Used	Number of Schools Responses 1972	1978
Separate Course	4	5
Separate Course by Fire Officer	6	1
Lectures by Fire Officer	11	8
Tutorials by Fire Officer	9	10
Absorbed into Lecture Courses	16	10
Absorbed into Specific Subjects:		
Materials	8	11
Construction	8	13
Structures	2	6
Service	7	11
Planning	2	6
Regulations and Professional Practice	12	11
Design Tutorials	11	15
Design Lectures	11	15
Visits to Fire Brigades	4	5
Fire Project/Simulations	4	4
[1]Model Syllabus (RIBA/FPA)	–	14
[1]FPA "Fire Prevention Design Guide"	–	15
[1]FPA "Design Guide Sheets"	–	8
[1]FPA Tape/Slide Packages	–	11
Total Respondents	23	17

[1]FPA publications mostly unavailable in 1972

3.3.5 G.P. Webber – University of Sydney

During July 1979, G.P. Webber of the School of Architecture, surveyed the 15 schools of architecture and building science existing in Austrialia[25]. The survey consisted of a single sheet with five questions, mailed to each of the heads of the schools in universities and colleges.

The aim was to find out how building designers were being educated in fire safety and the emphasis given to the subject in the schools. The areas of enquiry in the questionnaire were in relation to:

a) whether the subject was covered or not in the course for undergraduates
b) if it was dealt with in a separate lecture course, and if so, its duration; the discipline and background of the lecturer
c) whether it was a compulsory or optional part of the curricula
d) how an adequate coverage of the subject was assured, if it was dealt with in any other way (design studios).

All questions were of the open-ended type and respondents were encouraged to make comments. It was indicated that the results of these questions were "difficult to tabulate meaningfully"[26]. Reponses from 13 schools were received (87 per cent). Some of the more important findings are as follows:

a) some 85 per cent of the schools that responded had some form of compulsory lectures related to fire
b) formal lectures varied greatly in extent and in their relation with other subject matters: from a single 2 hour lecture to a year's 3 hour/week course. This latter was a new course 'Fire Technology' given at N.S.W. Institute of Technology, which appears to be the only comprehensive course available. On average, lectures on fire aspects are for a total of 6 to 7 lectures, given during the second, third or fourth years; interwoven into other matters under headings such as 'Building Technology' or 'Professional Practice'

c) lecturers had also a diversity of backgrounds, with no emerging pattern. Amongst the contributors there were architects, engineers, fire officers, etc.

d) with respect to design studios, fire matters were "largely left to the discretion of the individual tutor". Because of the time restriction on project work, the contribution made by this part of the course is said to be limited to basic layout and planning considerations, e.g. escape route, compartmentation, etc.

3.3.6 T.J. Scanlon and R. Hiscott – Emergency Communication Research Unit, Carelton University

The survey was conducted during the summer of 1980 and was summarised by T.J. Scanlon at the seminar on Human Behaviour in Fire[27]. It consisted in the sending of a simple letter to the head person of 27 schools of architecture, in three different countries (see Table 2-4). Unfortunately it was not mentioned how the particular schools were chosen.

The object of the survey was to determine whether the school's pensa included specific references to:

a) various building regulations "including those dealing with fire safety", and

b) effects of building design on human behaviour during an emergency.

Table 2-4 provides the details of the distribution of the schools surveyed in each country and their response rates which are proportions of the total for each country (rows).

TABLE 2-4

Results of Survey

Country	Number Schools	Number Responses	Percentage Responses
Canada	6	5	83
UK	8	4	50
US	13	4	31
Total	27	13	48

The following conclusions were provided by the authors:

a) The majority of the schools that responded (85 per cent) covered the subject matter indirectly, within design studio or other courses (e.g. building technology or materials). Only two schools, both in the UK had specific courses in fire safety. Some respondents had optional mini-courses on fire safety.

b) An unspecified number of schools invited fire officers and other experts, on an occasional basis, to participate in seminars and design studios.

c) Schools in the UK appeared to deal with the issue of fire safety more directly and comprehensively than other schools. A possible explanation for this was suggested to be the close involvement of the RIBA in the schools.

d) It appeared that the education of architects emphasises compliance with regulations rather than the human aspects of building design.

e) Because social aspects of design are not adequately considered in the schools, it was concluded that, architects fail to design buildings that meet the occupants' requirements.

3.3.7 Other Surveys

Several other surveys have been conducted in recent years in areas of fire safety or building design for a variety of purposes. Some representative examples are mentioned below.

An interesting survey was carried out by P. Johnson et al[28] of the Department of Architecture, University of Sydney, for the Commonwealth Board of Architectural Education which is part of the Commonwealth Association of Architects (CAA). It was intended to provide information, about schools of architecture throughout the Commonwealth, as a reference book compiled from the responses to a questionnaire.

The questionnaire was sent to all schools of architecture and member institutes of the CAA across five continents. A total of 100 schools participated and their responses, which were collected during 18 months (June 1977 to January 1979), are said to be good in general, although it seems that the response from the schools in the UK was poor. It should be noted here that fire safety was not mentioned in the questionnaires nor in the answers from the schools. Very few schools appear to offer building science in their courses (where fire safety could have been included) and no school indicated to have fire safety as an elective subject matter. In the report, fire safety is mentioned only once, as part of a long list of research subjects.

In a major research project to study human behaviour in fires, Wood[29] made extensive use of questionnaires and interviews, as his "main data source", being administered by fire brigade officers at the scene of over 950 fire incidents. Similarly, Melinek et al[30] conducted a survey, to assess public awareness and attitudes towards risks, involving 870 people.

In a different context, Binns[31] carried out a survey "to assess the length of notice required by design offices of revisions to regulations and the amount of redesign necessary due to any changes in requirements". A reply-paid card was mailed to 2000 designers, of which 318 (16 per cent) were returned.

An interesting survey was carried out by Musgrove et al[32], as reported elsewhere[33], to study the existing links between schools of architecture and the profession. The means used were direct interviews to 20 schools and several mail questionnaires sent to some 420 practices, 56 per cent of which responded. Additional examples of survey usage are provided in the references[1e,34,35].

In concluding this section, from the foregoing revision of surveys several emerging issues have been considered noteworthy:

- Survey appears to be a widely used and proven technique for recording and measuring human responses. Its value, as a research tool, has been well established particularly in the fields of public opinion and attitudes and, in general behavioural research.
- Most of the surveys conducted in the area of fire safety and building design, as seen above, have a limited value for the purpose of the present study. This assertion is based on the limited scope of those investigations i.e. small samples, covering partial aspects (e.g. method of teaching) or relying on the opinions of single groups (e.g. schools).
- In the same area, it appears that very little attention has been given to the actual design of the survey instrument (i.e. interview or questionnaire) nor to the survey population sampling.
- Difficulties were experienced when trying to obtain the results or follow the procedure of some of these surveys. Published results tend to be partial or incomplete.
- There seems to be concensus in the aim of those surveys, namely to find out how fire safety is dealt with in the schools of architecture.

With respect to the information conveyed by the literature reviewed, there also appears to be some commonalities, viz:

- There is evidence suggesting that the subject of fire safety is not receiving proper attention by the building designers.

- The emphasis on compliance with and application of legislative building controls seem to dominate the strategy of education.
- The lack of uniformity regarding the attitudes held towards fire safety is notorious, as is its relevance to building design and related issues.
- There is little curricular guidance or teaching aids for the schools.
- Most schools seem to have absorbed the subject in other existing courses thus failing to give appropriated importance to the subject and diluting its relevance to building design.

Part Two References

1. "America Burning"
Report of the National Commission of Fire Prevention and Control
US Government Printing Office
Washington, DC 1973
(1a) p.4; (1b) p.134; (1c) p.105; (1d) p.77,168,169; (1e) p.153-4

2 "Review of Fire Policy"
Home Office
London 1980, p.197, 275

3. Lawson, B
"How Designers Think"
The Architectural Press
London 1980, p.32

4. "What can be done to make buildings safer from fire?"
Fire Protection Association
London, 1972, (4a) p.12

5. Report of the Summerland Fire Commission
Isle of Man Government Office, 1974

6. Barclay, D
"Summerland Report: The Institute's Response"
RIBA Journal July 1974, p.23

7. "Fire and the Architect"
FPA–RIBA
London, 1974

8. Hollins, P
Internal report to the RIBA Under Secretary (Education)
RIBA, London 1975

9. Programme for the Conference
"Designing for Fire Safety"
The Building Centre Trust – Fire Protection Association
London 1976

10. Synopsis of Papers Presented at the Conference "Designing for Fire Safety"
Nottingham April 1976
The Building Centre Trust
London 1976

11. Prospectus for the Seminar on Design Against Fire
RIBA–FPA
London, 11-12 September 1978

12. Marchant, EW
"Does FPO's Lack of Sympathy Cause Delay?"
Fire 71 (881) November 1978 p.287

13. "Educating the Architect: Fire and Life Safety"
Codes and Standards Committee
American Institute of Architects
Washington, DC 1975

14. Finch, P
"Schools Rapped on Fire Safety Studies"
Building Design 207, 28th June 1974

15. "Fire and the Architect" series of 14 leaflets
Fire Prevention Design Guide
Fire Protection Association
London

16. Langdon-Thomas, GJ
"Fire Safety in Buildings: Principles and Practice"
Adam E Charles
London, 1972

17. Lerup, L; Cronrath, D and Liu, JK
"Learning from Fire: a Fire Protection Primer for Architects"
National Fire Prevention and Control Administration
US Government Printing Office
Washington, DC 1977

18. Bryan, J
"Building Fires"
Journal of Architectural Education 33 (4) Summer 1980 p.32-36
Summer 1980

19. Egan, MP
"Concepts in Building Fire Safety"
John Wiley & Sons
New York, 1978

20. Parnell, A
"Fire Diagrams" in Reviews
The Architect's Journal 171 (9) 27th February 1980 p.424

21. Milke, JA
"Books"
Journal of Architectural Education, p.48
'op cit'

22. Cooke, G
"Fire the Unseen Problems"
The Architects' Journal 170 (35) 29 August 1979, p.425-68

23. Hollins, P
Internal Report to the Honorary Officers Committee
RIBA
London, May 1974

24. Blackmon, JT
"In the Design and Construction of Fire-safe Buildings,
Who Should Know What?"
M.Sc. Thesis, University of Tennessee, March 1975
(23a) p.3; (23b) p.34; (23c) p.57

25. Webber, GP
"Fire Education in Terciary Establishments"
Paper given at the 7th Australian National Conference on Fire
Australian Fire Protection Association
Melbourne, October 1979

26. Webber, GP
Personal correspondence, February 1981

27. Scanlon, TJ and Hiscott, RD
"Design Factors and Human Behaviour in Fire"
Paper given at the 3rd International Seminar on Human Behaviour in Fire
University of Edinburgh, September 1980

28. Johnson, P and Clarke, S
"Architectural Education in the Commonwealth: a Survey of Schools"
Department of Architecture, University of Sydney
Commonwealth Association of Architects, 1979

29. Wood, PG
"The Behaviour of People in Fires"
Fire Research Note No. 953
Fire Research Station, Borehamwood 1972

30. Melinek, SJ; Woolley, SK and Baldwin, R
"Analysis of a Questionnaire on Attitudes"
Fire Research Note No 962
Fire Research Station, Borehamwood 1973

31. Binns, GD
"Designers and Building Regulations: a Survey of Implications on Design Offices of Ammending a Building Regulation"
Current Paper CP28/76
Building Research Station, Garston 1976

32. Musgrove, J; Connor, J and Wakelam, A
"Schools of Architecture and the Profession"
Unit for Architectural Studies
University College, London 1976

33. Musgrove, J and Hunt, S
"Schools of Architecture and the Profession"
The Architect's Journal 14 June 1978, p.1153-1158

34. Phillips, AW
"Nationwide Survey: National Smoke, Fire and Burn Institute"
Fire Journal 70 (2) March 1976, p.11

35. Moore, DA and Vezzani, KL
"Continuing Education for the Fire Protection Engineer:
a Survey and Proposal" (Mimeo)
Department of Fire Protection Engineering
University of Maryland, December 1978

PART THREE
THE SURVEY

1. GENERAL CONSIDERATIONS

As the preceding review of relevant work and its concluding remarks have indicated, efforts made thus far to find out how fire safety is accounted for in building design have been incomplete. It was decided therefore, to make a fresh attempt to obtain first hand background information on the subject, from the groups of people concerned with fire safety in the design of buildings.

It was expected that the broad approach adopted, of gathering a variety of measurements from different populations during a given period of time, would eventually allow, by comparison and cross validation, a more comprehensive and realistic description to be made of the three fundamental motivations compelling this study, viz:

a) How fire safety is actually incorporated into the design of buildings;
b) Which are the conflict areas ascribed to that interaction; and
c) What improvements can be suggested.

Bearing in mind this intended purpose of the study and the limitations of manpower and resources, a survey was perhaps the only feasible methodological approach. Since the problem under study is relevant to various groups, parallel samples would have to be drawn from each of them. However desirable it may have been to obtain several measurements at different times, because of the time limit imposed on this study, the survey was of the cross-sectional type, i.e. data collected only once from a sample population.

During the preparatory stages of the survey, numerous attempts were made to obtain guidance and advice from those familiar with the methodological and other aspects of survey research. Unfortunately, the only guidance that was available was that provided in the literature, upon which most of the procedures and principles described and used in this part of the study are based. The most useful references were Babbie[1], Moser and Kalton[2] and, to a lesser extent Madge[3].

These books conveyed the core of information needed to plan and execute the survey. Considerable information was also gained from the review of previous surveys, as has been reported in the preceeding part.

An 'ex post facto' analysis of this survey revealed some short comings and pitfalls. It should be emphasised therefore, that the survey was carried out having no previous experience in the field, without any 'expert' guidance and with little external assistance.

1.1 POPULATION COVERED

In selecting the possible groups of respondents or survey populations, a set of criteria for that selection appeared of paramount importance, if valid answers were to be expected. The were stated as follows:

- Respondents should be able to provide the information sought by reference to their direct experience rather than by relying upon their predictions. Relating this with the purpose of the study, it follows that the respondents to be chosen should have experience in applying fire safety to building design and thereby the knowledge to identify the areas of conflict and possible improvements to the integration of fire safety into building design.
- Previously (Part One, Section 2.1) it has been assumed that, to some extent the fire safety provided in a building design is a consequence of the interplay between architects and fire prevention officers hence, these two groups should have the experience and should be included in the survey.
- A further group to be surveyed was that of the schools of architecture, for they have an essential part to play in providing the knowledge and skills for the building designers. Besides, changes in the profession are likely to influence or even be influenced by education.

- It could be argued that there are other groups whose decisions will modify the consideration of fire safety in building design (e.g. clients and occupiers, other enforcing authorities, insurance consultants, etc.) for reasons expressed elsewhere in this study (Section 2.1, Part 2)they have not been covered by this survey.

1.2 SAMPLING FRAME AND SIZE

Literature on survey methods places a major emphasis on sampling methods. The significance and representativeness of the results will largely depend upon how the sample has been selected and the sample frame used (i.e. list, record or index of population) that in practice defines the survey population.

One of the basic principles of sampling is to ensure that the portion of elements selected has the same heterogeneity as that existing in the population at large. In other words, that each element of the population has the same chance of being selected in the sample. Moreover, the ultimate reason for such sampling is to allow descriptions and estimations made for the sample to be extrapolated and generalised to the population from which the sample was taken. Biased results and lack of precision are two terms closely related to sample selection, sample frame and size; whereas sampling error is associated also with sample size and with variations (homogenety or otherwise) within the population.

All the foregoing arguments suggest that the selection must be a compromise between what would be theoretically desirable (e.g. large sample, high precision, low sampling error, etc) and what is practically viable (e.g. amount of resources and time available).

Except for the group of architects, the groups considered for the survey of this study have a small total number of elements hence, it is possible to undertake a survey of the whole population (i.e. full coverage) as opposed to a sample survey. It was also realised that each of the groups of population considered has perhaps, a greater degree of uniformity (homogenety) within itself, than the typical examples of surveys cited in the literature. For each of the above groups, the sample frames considered and the sample sizes were slected as follows:

1.2.1 Schools of Architecture

The sample frame used was a list of the schools of architecture recognised by the Royal Institute of British Architects. It contained 38 elements and, as stated before, because of the small number involved it was decided to conduct a full coverage survey.

Among the members of the school staff, those in the best position to provide the information were assumed to be those responsible for the teaching of the subject. It turned out to be the same staff that had been appointed as fire safety coordinators, following the recommendation of the RIBA-FPA course in Birmingham (see Part One, Section 3.1.1)

1.2.2 Architects

The total population of architects in private practices was in excess of 5 000. This number was far too large to undertake a complete survey and so it was necessary to select a sample. While speculating on the possible positions held by different architects towards fire safety, two distinct subgroups were supposed to exist, namely Architectural Firms and Architects in Practice:

a) Architectural Firms

The position represented by the large practices, called 'Architectural Firms' in this study, wherein because of the magnitude and diversity of their commissions, it is likely to find a degree of specialisation among their members. They are more likely to have a member in charge of fire safety, or even a fire safety consultant, who would deal with specific clients' requirements (e.g. large corporations with own fire safety policy) or different to those contemplated in the legislation for this country (e.g. overseas work).

The sample frame for this group was the RIBA membership list, from which the survey sample was drawn by defining the sampling element as large practices (Category IV onwards according to the RIBA Register of Practices, i.e. those with 11 or more members). The list thus prepared contained 442 elements being the largest practices in the UK (representing about 9 per cent of the total private offices). It was compiled by the Institute's statistical section and supplied in the form of a computer printout as a set of self adhesive labels.

b) Architects in Practice (Practitioners)

On the other extreme of the scale, the position held by the small practices (i.e. with one or two members) called 'Architect in Practice' in this study, should be radically different from that expressed in (a) above. It was thought that since the amount of expertise available in such practices is much smaller, then perhaps the individual practitioner will have to rely much more on external advice (e.g. fire prevention officer).

It was decided to include, as members of this group, individual practitioners associated or involved with the schools of architecture, because they would represent a mid point between those solely dedicated to architectural practice and those others dedicated to education. They were reached by sending the questionnaire to the recipient of the schools' survey and asking them to pass it on to a colleague. This decision proved to be a misjudgement, and this part of the survey did not render many results and was difficult to encourage responses.

1.2.3 Fire Prevention Officers

The other group considered to have a major experience in the application of fire safety to building design, though on the other side of the fence, comprised those people with responsibility for enforcing fire legislation. It was expected that they would provide the 'expert' views on how the architectural profession was performing in respect of fire safety in building design.

The sample frame used in this case came from a list of Senior Fire Prevention Officers, in public fire brigades in the UK, published in "The Yellow Book"[4]. Since there are 67 public fire brigades, it was decided to cover all this population, as in the case of the schools above.

Figure 3-1

'Willingness' Questionnaire

Fire Safety and the Architect
(Research Topic)

	Please Tick Yes	No
1. Are you willing to respond to questionnaires	☐	☐
2. Would you be willing to take part in discussions (interviews):		
a) by telephone	☐	☐
b) face-to-face		
i) at your school	☐	☐
ii) in Edinburgh	☐	☐

July 1979

Note: this questionnaire was printed on Departmental paper

2. INSTRUMENT DESIGN

Survey research literature indicates two main categories of instruments for data collection: interviews and self-administered questionnaires. The choice of method is dependant upon several factors e.g. subject and scale of the survey, unit of enquiry, resources available, etc.

2.1 WILLINGNESS TO PARTICIPATE

As a first step, an exploration of the population was required to determine their willingness to participate. In order to find out to what extent respondents were prepared to take part in a survey and, if they had a preference for one method over the other.

For that purpose, a simple one page postal self-administered questionnaire was devised and sent, with an explanatory letter, to all 38 schools of architecture in the UK, during July 1979. The questionnaire, reproduced here in Figure 3-1, was addressed to staff members with the responsibility for teaching the subject (see Section 1.2.1 above). The responses received from 26 schools (68 per cent) are depicted in Table 3-1 below.They evidenced a disposition to participate in the survey and, indicated a slight preference for questionnaires, closely followed by discussions (interviews) at the schools.

The results of this preliminary exploration confirmed suggestions found in the literature that, for this particular type of survey (i.e. various groups of population dispersed in different places) postal self-administered questionnaires was the best choice of method. It was decided therefore, to adopt this method as the principal data gathering vehicle for this survey.

Table 3-1

Summary of Results from 'Willingness' Questionnaire

Willingness to:	Yes	No	No Answer	Total
	Frequency of responses			
1. Respond questionnaires	25	1	12	38
(1)	65.8	2.6	31.6	100
2. Take part in discussions				
a. by telephone	21	3	14	38
	55.3	7.9	36.8	100
b. Face to face:				
i) at school	23	2	13	38
	60.5	5.3	34.2	100
ii) in Edinburgh	10	9	19	38
	26.3	26.7	50	100

Response rate: 68.4 per cent = 26 schools

[1]Percentages based on total population (38 schools)

2.2 QUESTIONNAIRES

It appears that one of the main problems with mail surveys has been to obtain a significant response rate so that, the likelihood of response bias influencing the results is reduced. On the other hand, mail questionnaires, being an indirect form of collecting data, are said to be "essentially an inflexible method"[2a] for their answers have to be considered as final (unless other techniques for rechecking the responses can be afforded). Once the anonymous respondents have completed and returned the questionnaire, it is practically impossible to go back to them to clarify some of the answers. It follows that questionnaire design is of crucial importance for the success of the survey. Questionnaires are self-contained instruments, they are expected to be understood and completed by the respondents on their own, only with the help of instructions printed on the questionnaire. In this respect, Babbie[1a] has suggested that "The format of a questionnaire can be just as important as the nature and wording of the questions asked. An improperly laid out questionnaire can lead respondents to miss questions, can confuse them as to the nature of the data desired, and in extreme, can lead to respondents throwing the questionnaire away". Moser et al[2b], concur and stated that "no survey can be better than its questionnaire" stressing further the need for uncluttered design and clear questions. Both authors have dedicated lengthy chapters in their books, to questionnaire design (i.e. format, wording, ordering, etc.). Most of their applicable recommendations have been followed; moreover, every step has been taken to increase the response rate, in the hope that in receiving a carefully designed questionnaire respondents would feel encouraged to participate and return it. Although it has been stated that "the response rate is really a measure of the researcher's success in persuading sample members to participate . . ."[1b] it must be recognised that these 'persuading' efforts can only go up to a certain point because, in the end, the response rate will reflect undoubtedly, the interest that respondents have in the subject matter of the survey, viz: fire safety in building design.

2.2.1 General Format

A different questionnaire was prepared specifically for each group of respondents (see Appendices 1, 2, 3 and 4). Although the content of the questionnaires varied, in the number, type or order of the questions as will be seen later, all four had the same basic format. They were produced in booklet form of standard A5 size, for a number of reasons mentioned below (see Section 2.2.5), with 6 to 8 pages printed on both sides; this allowed the questions to be spread out one or two to a page.

Except in the schools questionnaire, the first page was used to describe briefly the purpose of the research project, the groups being surveyed, and the aims of the survey. The next page presented a set of general instructions to facilitate the proper answering of the questionnaire; whenever a question departed from this general mode, specific instructions were given with the item. Also, personal comments were encouraged and the procedure to return the questionnaire concluded this introductory page.

In order to make items stand clear, each question and space for comments presented was 'framed' i.e. enclosed or outlined by a bold line. This was particularly important when more than one item was included in the same page, thereby the possibility of respondents confusing the items was avoided. This principle which has been suggested elsewhere[1c], was also used in contingency questions (see next section) where secondary questions were differentiated from primary ones, though connected by a directing arrow from the appropriate category. The presentation of the questions was further enhanced by using a different type face for the item's text and for the answers categories. Similar use of different type face was made in the case of contingency questions for their primary and secondary items.

Finally, to facilitate the conversion of answers into data for processing at later stages, respondents were instructed to give their answers in specific locations and according to a predetermined fashion. The format for responses varied according to the type of question concerned. In this way, close-ended or precoded questions were provided with adequately spaced boxes, for each category, to be simply ticked by respondents. When factual information was required a set of brackets with the appropriate spacing between them was included, so that respondents could fill in their information (e.g. proportions, rank order, number of hours, etc.). For the open-ended questions and space for comments, a suitable unruled blank space was provided to allow respondents to write in their own particular views and perspectives on the different topics.

2.2.2 Structure of Questions

The questions were developed in a funnel-like way. Having at the broad end the fundamental questions that prompted this study, as defined in Section 1 above. From each of these broad areas of inquiry, a series of questions common to all the groups of respondents were derived. Further still, the final set of questions devised for each individual group were more specific. Thus, a set of somewhat abstract questions were translated into questionnaires items that would allow the collection of data relevant to the analysis.

Some difficulty was experienced in deciding which questions should be discarded and which should be retained for the questionnaires. The tendency to cover as much as possible, to ask everything had to be weighed against indications in the literature that the length of the questionnaire, particularly the number of questions, is presumed to affect among other things, the quality of responses and the rate of refusal[2c].

The questionnaires in their final form contained several questions that were common to the four groups. Table 3-2 below, provides the cross reference for all those questions common to more than one questionnaire. Tables 3-3, 3-4, 3-5 and 3-6 present a summary of the questions contained in each group of questionnaires. A reproduction of the questionnaires can be found in Appendices 1, 2, 3 and 4.

Much has been written about the pros and cons of open and closed-ended questions. One of the essential differences is in relation to the stage at which answers are coded.

Open ended or written-in questions offer freedom to the respondents, by allowing them to decide the form, length and detail of their answer; but in contrast, they present a major difficulty for the researcher when typifying and compressing the answers for coding. Also, there is a greater difficulty in trying to control the relevance of the answers.

On the other hand, closed-ended (or pre-coded) questions, both dichotomous (e.g. Yes or No) and multiple-choice, have the advantage for the researcher of greater uniformity of responses and easier processing. Moreover, they are directive for respondents are forced to fit their answers into the limited range of categories provided and thus,some relevant items might be overlooked; although it has been suggested that this type of question is easier for the respondent because the list of possible answers is specified to him[2d]. This dilemma was solved by using both open-ended and closed-ended questions mixed with statements and providing space for comments. This combination gave more flexibility in the questionnaire layout and perhaps, also made the items more interesting for the respondents.

In general, when a question item could be presented in such a way that the number of possible response categories could be foreseen then, the choice was

Table 3-2

Cross Reference of Questions

Subject of Common Questions	Questionnaire Groups Schools	 Pract.	 Firms	 FPO's
	Question Number			
Relevance of Fire Safety to Design Aspects	1	5	5	4
Present Fire Safety Knowledge	3	2	8	14
Fire Safety Information Available	4	11	14	10
Ranking of Fire Safety Topics		9	6	7
People Consulted for Advice	1	6	11	3
Greater Awareness	13	12	7	11
Publications Used	11	7	13	
Fire Safety Problems in Design Efficiently Solved	14	10	10	9
Stage of Design First Considered		4	4	5
Main Problems in Application			15	8
Stages of Design Considering Fire Safety		3	3	
Type of Building Most Concerned With		1	1	
Origin of Fire Safety Knowledge		8	9	
Further Comments and Suggestions		13		15

for the closed-ended type. Since the range of categories provided is seldom final and exhaustive, and in order to lessen the possibility of having overlooked an important response, the 'other, please specify' category was added to most close-ended questions. Also this was further reinforced, whenever the questionnaire layout so permitted, by including space for comments which have been said to encourage responses by allowing respondents to write what they wanted or felt about the item[2e].

Conversely, when it was desired to have the repondents' own views and criticims, expressed in their own words or, when the expected possible answers for a given question were too numerous or diverse to be included in a list, the choice was in favour of an open-ended question.
In certain questions, depending upon the answer given, the need for further, more specfic information arose. In these cases, a combination of closed and open-ended questions was used: the primary question was a pre-coded dichotomy, and according to the answer, respondents were then asked to either continue to the next general question or tackle some secondary (contingent) one. This way of presenting questions avoided the use of double questions, that most certainly would have confused the respondents; it has been suggested also that it can facilitate the respondents' task in answering the questionnaire and improve the quality of the data[1d]. A summary of the questions used in each of the four questionnaires is provided in Tables 3-3, 3-4, 3-5 and 3-6. Also in these tables a description of the type and characteristics of each individual question can be found.

Other aspects of question design that received careful attention in the planning of the present survey were those related to question wording and the order of presentation of questionnaire items. They are perhaps, the two aspects that can affect most the quality of data, by influencing both the answers obtained and the

Table 3-3

'Schools of Architecture' Questionnaire, Summary of Questions

Question			
Number	Subject	Type	Variable Name
1	Relevance of fire safety to Building Design aspects	a, CL, MC, ST	RELEV
2	Role in fire safety	CL, MC, ST	ROLE
3	Present fire safety knowledge	a, CL, MC, ST	KNOW
4	Fire safety information available	O, DC, CO	INFAV
5	Topics included in course	CL, MC	TOPIC
6	Enclose syllabus	CL, MC, ST	SYLL
7	Number of hours per term	CL, MC, ST	TIME
8	Type of teaching	CL, MC	TEACH
9	Method of Assessment	CL, MC	ASSESS
10	Course status	a, CL, MC, ST	STATUS
11	Publictions used	CL, MC, ST	PUBLIC
12	Course contributors	CL, MC, ST	CONTR
13	Improve Awareness	O	GRAWAR
14	Fire safety problems in design efficiently solved	a, CL, MC, ST	SOLVED

Key: a – Space for comments
CL – Closed ended
CO – Contingent
DC – Dichotomous
MC – Multiple choice
O – Open ended
ST – Statement

Table 3-4

'Architect in Practice' Questionnaire, Summary of Questions

Question Number	Subject	Type	Variable Name
1	Type of building most concerned with	a, CL, MC, ST	TYPBLD
2	Present fire safety knowledge	CL, MC, ST	KNOW
3	Stages of design considering fire safety	CL, MC	STAGCON
4	Stage of design first considered	a, CL, MC	STAGFST
5	Relevance of fire safety to building design aspects	a, CL, MC, ST	RELEV
6	People consulted for advice	a, CL, MC, ST	CONSUL
7	Publications used	CL, MC, ST	PUBLIC
8	Origin of fire safety knowledge	a, CL, MC, ST	ORIKNOW
9	Ranking fire saftey topics	a, CL, MC, ST	TOPIC
10	Fire safety problems in design efficiently solved	a, CL, MC, ST	SOLVED
11	Fire safety information available	O, DC, CO	INFAV
12	Greater awareness	O, DC, CO	GRAWAR
13	Further comments	a, O	SUGG

Key: a – Space for comments
CL – Closed ended
CO – Contingent
DC – Dichotomous
MC – Multiple choice
O – Open ended
ST – Statement

Table 3-5

'Architectural Firms' Questionnaire, Summary of Questions

Number	Question Subject	Type	Variable Name
1	Type of building most concerned with	CL, MC, ST	TYPBLD
2	Permanent fire safety advisor	CL, DC, CO	PERMADV
3	Stages of design considering fire safety	CL, MC	STAGCON
4	Stage of design first considered	CL, MC	STAGFST
5	Relevance of fire safety to building design aspects	CL, MC, ST	RELEV
6	Ranking fire safety topics	CL, MC, ST	TOPIC
7	Greater awareness	O, DC, CO	GRAWAR
8	Present fire safety knowledge	CL, MC, ST	KNOW
9	Origin fire saftey knowledge	CL, MC, ST	ORIKNOW
10	Fire safety problems in design efficiently solved	CL, MC, ST	SOLVED
11	People consulted for advice	CL, MC, ST	CONSUL
12	Category of advice received	CL, MC, ST	CATADV
13	Publications used	CL, MC, ST	PUBLIC
14	Fire safety information available	O, DC, CO	INFAV
15	Main problems of application	O, ST	PROBAPL

Key: a – Space for comments
CL – Closed ended
CO – Contingent
DC – Dichotomous
MC – Multiple choice
O – Open ended
ST – Statement

Table 3-6

'Fire Prevention Officers' Questionnaire, Summary of Questions

Question Number	Subject	Type	Variable Name
1	Adequate fire safety knowledge in profession	O,DC,CO	ADEKNOW
2	Involvement in architectural education	CL, DC, CO,O	INVEDUC
3	Ranking of fire safety topics	CL, MC, ST	TOPIC
4	Relevance of fire safety to building design aspects	CL, MC, ST	RELEV
5	Stage to seek advice	CL, MC, ST	STAGADV
6	Stage of submission	CL, MC, ST	STAGSUB
7	People consulted for advice	a, CL, MC	CONSUL
8	Main problems of application	O	PROBAPL
9	Fire safety problems efficiently solved	a, CL, MC, ST	SOLVED
10	Fire safety information available	O, DC, CO	INFAV
11	Greater awareness	O, DC, CO	GRAWAR
12	Relationship with architects	O, DC, CO	RAPORT
13	Advice for special problems	a, CL, MC	REFADV
14	Present fire safety knowledge	a, CL, MC, ST	KNOW
15	Further comments	a, O	SUGG

Key: a – Space for comments
CL – Closed ended
CO – Contingent
DC – Dichotomous
MC – Multiple choice
O – Open ended

refusal rate, and therefore the validity of the results of the entire experiment. Question wording becomes particularly difficult when working with a foreign language and the literature, while suggesting only general principles and guidelines, emphasises the sensitivity of responses to semantic changes (15 to 20 per cent variation in opinion and attitude questions[4]). However, every effort was made to ensure that respondents would not be led to a particular answer by a leading or biased question. Furthermore, items were meant to be relevant and specific to both respondents and subject by the use of short, clear and simple terms, thus avoiding ambiguity of both questions and hopefully answers as well.

With respect to the sequence in which questions were presented to the respondent, it appears even more confusing in the literature because of the conditioning effect that a question has over subsequent ones[1c,2f]. This means that answers to latter questions will reflect those given to earlier ones, but the converse may also be true because respondents can see all questions before answering any.

The principle followed in the questionnaires was to begin with the easy and simpler questions to try and interest the respondents, leaving the more complex or sensitive issues for later stages. Information related to the respondents' identification (e.g. name, position,e tc) was always the last question.

2.2.3 Coding Scheme

Although this topic has been dealt with in greater detail in the next part, because the general decisions were taken during this stage of questionnaire layout and question design, it has been mentioned briefly here.

The questionnaires were designed with the additional aim of simplifying the transfer of questions' responses categories into code categories, for machine data processing. In general this was achieved by pre-coding the questions and by indicating the code categories corresponding to each possible answer, so that they could be directly punched onto computer cards. Since there were basically two types of question items (i.e. open and close ended) this process had to be tackled in two different ways. First, for every question in each questionnaire group, a particular variable (or group) was defined. The names of these variables are indicated in Tables 3-3 through 3-6 above. Next,a certain number of card columns (field) was assigned to each variable and so was indicated in the questionnaires, by a number enclosed in brackets beside the location of the possible answers. So far, the process was common for both types of items. Then, for some of the closed-ended questions, a value or punch assignment was given to every one of the possible response categories, within each field (digit to the right of the point in above numbers). In other cases, where a multiple response was required (e.g. Ranking of Fire Safety Topics) a column number was assigned to each response category and the value or position within each column was the number given by the respondent's answer. As indicated before, open-ended questions and space for comments had to be treated differently, for the coding scheme had to wait until sufficient number of questionnaires had been returned, before analysing their content and a suitable coding scheme could be drawn accordingly. In the general instructions given in the questionnaires, respondents were informed of the purpose of the coding numbers; to prevent their confusion with response categories, they were also advised to ignore them.

2.2.4 Pre-tests

Since a rigorous pilot test would have involved a significant amount of resources and time, the suitability of the format of the four questionnaires, the adequacy of their questions and the clarity of their instructions were informally pre-tested. Each questionnaire group underwent a similar trial in an attempt to ensure its practicality, as an instrument for data collection, before being sent out to the respondents.

Firstly, draft copies of each questionnaire were circulated amongst members of the Department of Fire Safety Engineering and a group of architects of mixed composition. These two groups provided opinions from both fields of interest. Their comments indicated lack of clarity in some items, weakness in the choice of words, missing categories of responses, etc.; that proved invaluable. The questionnaires were revised and modified accordingly before their final reproduction.

Secondly, the questionnaires were not all mailed at the same time but rather were sent staged in the following order: Schools, Practitioners, FPO's and Firms. Thus by monitoring the results of the incoming questionnaires, it was possible to detect further anomalies and correct them in the other questionnaires and in subsequent mailings of the same one.

2.2.5 Reproduction

Once the questions were assembled into a questionnaire and having made the corrections indicated by the pre-test, decisions had to be made on the method for reproducing the questionnaires. Though this is the last stage in the survey preparation, before the actual collection of data, it is by no means the least important. It has been stressed that "The method of reproducing the questionnaire is important to the overall success of the study, as a neatly reproduced instrument will encourage a higher response rate, thereby providing better data"[1e]. The choice of method among the various alternatives, was dictated by resources and time available (yet again) the format of the questionnaire and the number of copies required. Because of the varying number of copies of the questionnaires needed (being all different) two methods were used. Small runs (i.e. all except 'Firms') were reproduced by photocopying whereas the 'Firms' one was produced by off-set printing.

A set of 'originals' was prepared for each questionnaire group by typing the text, drawing the lines, arrows and boxes. The sequence of pages was arranged in such a way that, after reproducing them back to back, they could be collated in booklet form. The photocopying (or printing) was made on both sides of standard A4 paper, which became A5 when folded in the middle. The covers have three panels, i.e. front, back and a fold-out, this latter being intended to substitute the return envelope (see next section). The whole booklet was held together by means of two spine staples.

The resulting questionnaire format was found to have several features worth mentioning:

- it was attractive due to its 'professional' appearance
- easy to handle, pocket size
- substantial reduction of cost of production and distribution (i.e. less paper, no return envelope, etc.)
- easy to make additional copies as required for follow up.

3. DATA COLLECTION

After having spent quite some time planning the survey, designing and producing the questionnaires, the crucial stage of the survey was reached – the mailing of the questionnaires to the groups of respondents. Doubts about whether they would fulfil their function in bringing in the desired type and quality of data, were present until the first few questionnaires were returned and a scrutiny of their content indicated that at least, respondents seemed to have no major problems in understanding the instructions and filling in their answers.

Before the questionnaires were sent out, a mailing list for each group was prepared. In them, each element was identified with a code number (i.e. group's initial letter and three digits) and a corresponding questionnaire was identified with the same code number, so as to provide a reference check for several purposes (e.g. control of returns, follow-up mailings, mistakes while analysing the data).

3.1 MAILING AND RETURN

The questionnaires were sent out by first class mail, accompanied by a presentation letter in which the purpose and intention of the survey was explained, along with the possible use of the results; assurance of confidentiality of the information was also given (see Letter 1 in Appendices 1, 2, 3, 4). In order to facilitate their return, recommendations given elsewhere[1f] were followed. All four questionnaires were constructed for 'self-mailing', whereby the return address was printed on the back cover and, excluding the Firm's questionnaire, first class return postage was provided affixed onto the back of the questionnaire. The provision of return postage has been said to be "A natural courtesy and a commonsense step to increase response . . ."[2g]. Also, since the questionnaires were prepared in booklet form, the three-panel cover was devised so that the back cover had a fold-out panel tucked inside it. Upon completion, respondents were instructed to unfold the extra panel, fold it over the front cover and staple or glue it to the booklet. It could then be placed in the mail avoiding the need for a return envelope. It was found that this method contributed to the execution of the survey in several ways: it simplified the initial mailings of the questionnaires by reducing both the number of items to be sent out (no return envelope) and the time required to put all those items together; it also helped to keep down the overall costs of the survey; and perhaps, also improved the response rate of the survey, because it was an added appeal to the respondents, they could not lose the return envelope without losing the questionnaire.

As the completed questionnaires began to arrive back, they were opened (some of them with difficulty because they had been sealed all round) questions were checked for completeness, and a sequential number was assigned to each of them to indicate the return order. A separate record was kept, on a modified mailing list to monitor non-respondents for the future mailing of reminders or follow-ups. A summary of the survey, including the population surveyed in each group and the response rates achieved is shown in Table3-7 below. Further, the dates of mailings both initial and subsequent reminders, for each of the four groups of questionnaires are indicated in Table 3-8; and a more detailed account of mailing and responses is given in the following section.

3.2 FOLLOW-UP MAILING AND RESPONSE RATE

Literature on survey methods indicates strong evidence suggesting that the use of follow-ups or reminders is the most important and efficient method for increasing the response rate in postal surveys. Babbie[1g] noted an increase as high as 30 per cent with the use of two follow-ups, both accompanied by new copies of the questionnaires; whereas Moser[2h] cited examples of return rates being boosted by 7 per cent with one reminder, in one example and, up to 20 per cent was obtained with two follow-ups in another survey.

It appears therefore that the mailing of two reminders is a generally accepted practice and seems to be the most efficient in stimulating a higher rate of return. Though speculations are made in the literature regarding the quality of the data provided by the respondents who were persuaded to reply by the reminders. It has been argued that "The longer a potential respondent delays replying, the less likely he is to do so at all"[19], moreover ". . . persons who do not respond to the first mailing are less keen to be helpful and hence, if they are later persuaded to complete the questionnaire, they put less effort into it"[2i].

It was decided that it would be better to have a higher response rate, accepting that the quality of responses may be lower, rather than be satisfied with a low response rate that could invalidate the relevance of any inferrence, due to the poor representativeness. Further, the precaution of assigning a return serial number to each questionnaire would allow to make comparisons between the data from 'early' and 'late' respondents. It was later found that there was no consistent difference between the two subgroups of respondents.

The present survey involved four groups of respondents, with different size of populations (four surveys as it were). Consequently, the number and timing of follow-up mailings varied from group to group. The effect that each of the follow-up mailings had on the response rate of every group can be seen in Table 3-8 and in Figure 3-2. The cumulative response curves in this figure were recorded as the questionnaires came in and, it should be noted that since the dates of the initial mailings have been made to coincide with the graph origin therefore, the subsequent mailings on any curve (i.e. follow-ups: 1, 2, etc.) do not correspond with those in another curve. From the cumulative response curves, the increase in the response rate obtained with the use of follow-ups is quite clear. The details for these mailings and the responses for each group are given below.

Figure 3-2
Cumulative Response of Questionnaires

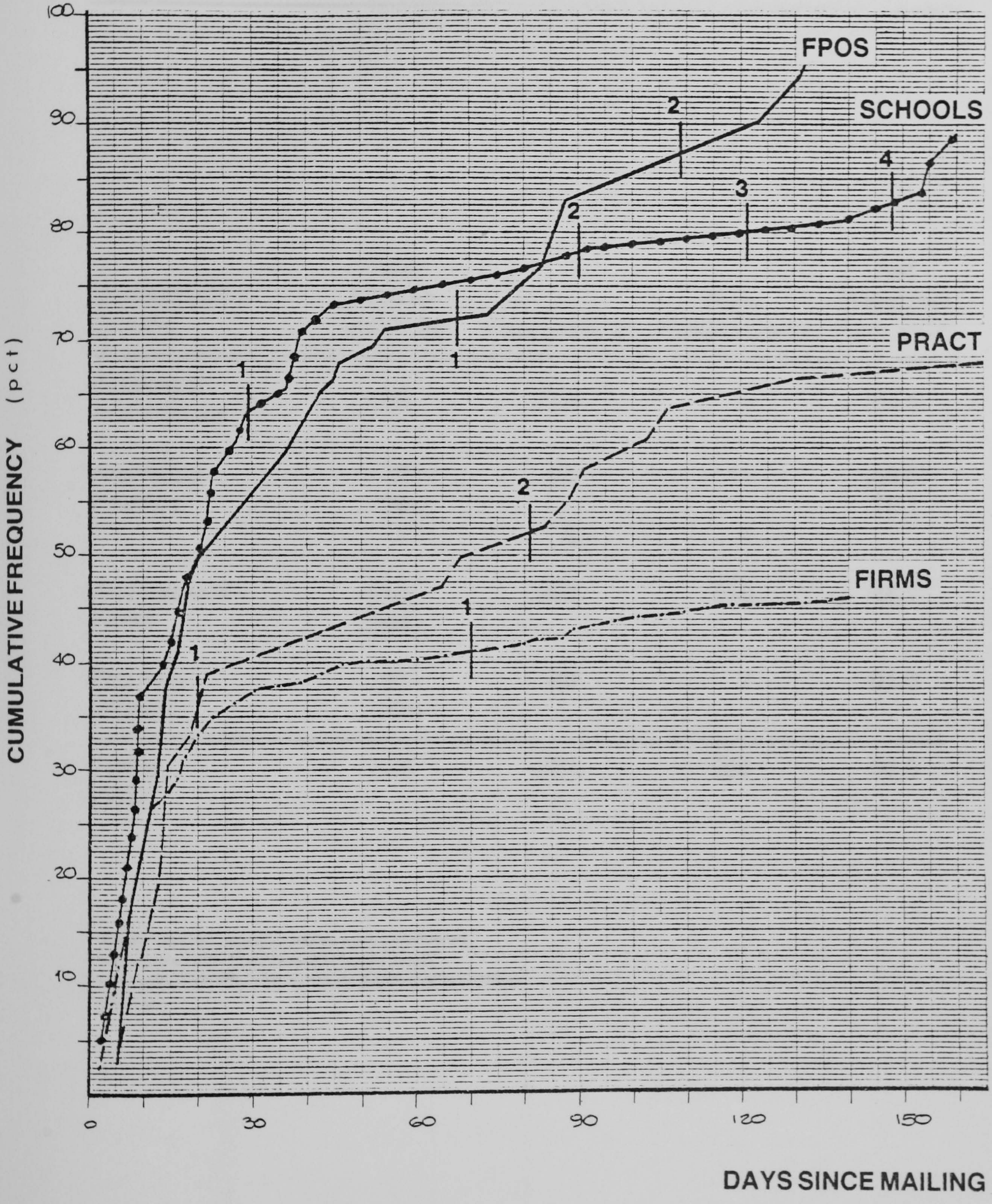


Table 3-7

Summary of Survey

Questionnaire Groups	Total Number Surveyed	Respondents	Non-Respondents	Net Response Rate (PCT)
Schools of Architecture	38	34	4	89.5
Architects Practice	38[1] (36)	25	11	(69.5) 72.1
	7[4]	6	1	
Architectural Firms	442[2] (438)	202	236	46.1
Fire Prev. Officers	67[3] (66)	60	7	91.0
Totals (585)	529	327	259	56.0

[1] Net sample (36) 2 questionnaires were undelivered
[2] Net sample (438) 4 undelivered (moved away)
[3] Net sample (66) Isle of Scilly has no Fire Prevention Officer
[4] See Text

Table 3-8

Mailings and Response Rates

		School of Architecture			Architects in Practice			Architectural Firms			Fire Prev. Officers		
		Date	Responses Number	Responses PCT	Date	Responses Number	Responses PCT	Date	Responses Number	Responses PCT	Date	Responses Number	Responses PCT
Initial		23 10 79	24	63.2	1 11 79	14	38.9	14 01 80	180	41.1	30 11 79	48	72.7
FOLLOW-UPS	1	22 11 79	5	13.2	21 11 79	5	13.9	24 03 80	22	5.0	5 02 80	10	15.2
	2	21 01 80	1	2.6	21 01 80	6	16.7				19 03 80	2	3.0
	3	21 02 80	1	2.6									
	4	19 03 80	3	7.9									
Total			34	89.5		25	69.5		202	46.1		60	90.9
Follow-up Increase			10	26.3		11	30.6		22	5.0		12	18.0

3.2.1 Schools of Architecture

Because this group involved fewer number of respondents, it was decided to launch it first, using it as a trial run for the whole process (i.e. mailing, return, etc.) including the respondents' reaction to the questionnaire. Its initial mailing was delayed until 23rd October 1979 to ensure that all schools would have begun their academic term.

After a period of about three weeks, some 50 per cent of the questionnaires had been returned (see Figure 3-2) and the response rate was declining. A week later the first reminder was sent out; it consisted of a letter, stressing the importance of each response for the success of the study (see Letter 2 in Appendix 1) and a new copy of the questionnaire, in case the original one had been mislaid. It could be said that this follow-up brought in an additional response of about 13 per cent (see Table 3-8).

Two months later (allowing for Christmas holidays) another reminder letter was mailed to the 9 non-respondent schools. A further attempt was made, a month later, when the RIBA Co-ordinator for Professional Training contacted those schools by telephone, encouraging them to return the questionnaires. Only 5 per cent was the response achieved with these two efforts. A final reminder was sent, to the remaining 7 schools, in March 1980 (see Letter 3 Appendix 1) offering to send a new copy of the questionnaire if requested. Two schools did so and the last of the questionnaires, returned after this final follow-up, was received on 25th April 1980 or about 160 days after the initial mailing.

In conclusion, as indicated in Table 3-8 it seems fair to say that the use of follow-ups accounted for more than 15 per cent of the final response rate of 89.5 per cent obtained from this group of respondents. Also, it should be mentioned here that despite the repeated efforts made, four schools (Belfast, Birmingham, Polytechnic of Central London and Sheffield) could not be persuaded or perhaps were not interested enough to participate in this survey.

3.2.2 Architect in Practice (Practitioners)

This group of questionnaires was the second to be launched and incorporated some improvements in the questions, hinted by the first few responses received from the previous group. Also, the description of the scope of the survey and related information was presented printed on the first page, instead of being in a separate letter.

The questionnaires were mailed on 1st November 1979 accompanied by a letter addressed to the same schools' respondents, in which they were asked to give the questionnaire to a colleague (see Letter 1, Appendix 2). Three weeks later, less than 40 per cent had been returned, and the first reminder was mailed. Similarly to the schools, the reminder consisted of a fresh copy of the questionnaire and a letter, but in this case, since one was not dealing directly with the respondents nor did one know who they were, one had to continue using the school respondents as intermediaries. However, almost 14 per cent could be credited to this follow-up. Finally, another reminder was sent on 21st January 1980, combined with the one sent to the school on that same date. A further six questionnaires were received by the date of closing. No additional follow-ups were mailed, because it was never clear whether the potential respondents were failing to return the questionnaires or the 'intermediaries' were not passing the questionnaires onto a colleague; two questionnaires were returned unanswered, for not having an appropriate colleague, and the sample size was adjusted accordingly. The response rate obtained for this group was close to 70 per cent and the rate increase brought in by the follow-ups was about 30 per cent (see Table 3-8).

During a half day seminar on fire safety for architects held at the Department of Fire Safety Engineering, on 14th November 1979, seven questionnaires were distributed amongst people attending the seminar with similar attributes to those of the original sample. A few days later six were returned in the post, which appear in Table 3-7, their answers have also been considered in the analyses of the results.

3.2.3 Fire Prevention Officers

This was the third group of questionnaires to be mailed, on 30th November 1979. It was accompanied by a covering letter, addressed to Chief Fire Officers or Firemasters for the attention of the Senior Fire Prevention Officers, in which the particulars of the survey were explained in detail (see Letter 1, Appendix 4). Similarly to the school s case, after the first three weeks as many as 50 per cent of the questionnaires had been returned (see Figure 3-2). The first follow-up was mailed on 5th February 1980 to the 19 non-respondents; as in previous cases it consisted of a fresh copy of the questionnaire and a letter, pointing out that many authorities had already returned the questionnaire (see Letter 2, Appendix 4). An increase of 15 per cent in the returns was noted after this mailing (see Table 3-8). A second and final reminder was sent on 19th March to the remaining 9 non-respondent Fire Authorities, encouraging them to reply stressing the importance of each individual response and offering to send a new copy of the questionnaire on request (see Letter 3, Appendix 4). A further 3 per cent was attained with this final mailing when the last questionnaire was received on 9th April.

A total of 91 per cent were returned within 130 days after the initial mailing. It should be mentioned that one questionnaire was returned unanswered; the Isles of Scilly have no fire prevention officer, such duties being carried out from Cornwall. Therefore, the sample size was reduced to 66 elements, as indicated in Table 3-7. Also the extensive use of comments made by this group was remarkable, even though their questionnaire had more space for comments and a greater number of open ended questions than the rest of the groups.

3.2.4 Architectural Firms

Although it was originally intended to be sent out following the 'Practitioners', this questionnaire was the last and most numerous to be mailed. The delay was caused by the longer time needed to reproduce it by offset printing. The questionnaire for this group incorporated minor improvements, derived from the experience of dealing with its predecessors.

The questionnaires were mailed on 14th January 1980, together with a letter explaining to a greater extent the details of the survey (see Letter 1, Appendix 3). Two weeks after the initial mailing, about 34 per cent of the questionnaires had been returned (see Figure 3-2) but, since the replies kept coming in, though at a lower rate, the mailing of the follow-up was delayed until 24th March. For this case, it consisted of a Post-Card specifically printed with a similar message, i.e. stressing the importance of each contribution and offering to send a new copy of the questionnaire on request. Some 18 respondents contacted the office asking for a questionnaire to be sent.

Because of the number involved and the mounting cost of postage, no further follow-up was mailed to this group. A final attempt was made, with non-respondents located near or in Edinburgh, by telephone; unfortunately, it was very difficult to ascertain whether the questionnaire had been received by the respondent and if so, who would have been answering it.

It is likely that the response rate for this group could have been increased further if more follow ups had been done. This is evident from the results obtained in the previous groups. However, the final response rate was 46 per cent when the last questionnaire was received on 30th June (130 days after initial mailing). The sample size was reduced to 438 because four questionnaires were undelivered due to change of address as reported by the Post Office.

With respect to the response rate obtained in this survey in general, reference to the literature revealed a great range of opinions regarding what can be considered a good response rate. Babbie[1b] indicates 50 per cent to be adequate for the purpose of analysis and reporting, 60 per cent being good and 70 per cent and over very good. Similarly, Moser et al[2j] have suggested that a low response rate constitutes a 'dangerous failing' and that 20 or 30 per cent can be considered critical to render the results of the survey of any use. On the other hand, some examples of surveys have been cited previously in this study (Section 3.3.8, Part 1) with response rates as low as 16 per cent being considered 'above average' for the survey involved. The crucial importance of response rate, as stated elsewhere in this study, is that it is indicative of the representativeness of the sample, thus a high response rate is less likely to have any significant reponse bias (i.e. non-respondents differing in opinion). Moser et al (op. cit) have stressed that "the only safe way to deal with non-response is to reduce it to a level sufficiently low as to ensure that it cannot cause serious bias". In view of the above comments, it could be concluded that the response rates obtained in this survey, as depicted in Table 3-7 above, could be regarded as sufficiently high as to represent the population from which they came. However, this confidence in the results, perhaps cannot be extended to the group of Practitioners and Firms; the former because of the way the sample was selected and the latter due to the relatively low response rate achieved.

Part Three References

1. Babbie, ER
   "Survey Research Methods"
   Wadsworth Publishing Co. Inc.
   California, 1973
   (1a) p.145; (1b) p.165; (1c) p.147; (1d) p.146; (1e) p.155; (1f) p.160;
   (1g) p.164

2. Moser, CA and Kalton, G
   "Survey methods in Social Investigation" (2nd edition)
   Heinemann Educational Books Ltd.
   London, 1977
   (2a) p.260; (2b) p.308; (2c) p.263, 309; (2d) p.344; (2e) p.264; (2f) p.346;
   (2g) p.265; (2h) p.266; (2i) p.267; (2j) p.268

3. Madge, J
   "The Tools of Social Science"
   Longmans Green
   London, 1953

4. Davis, J
   "Elementary Survey Analysis"
   Prentice-Hall, Inc.
   New Jersey 1971, p.20

5. Klopper, H (editor)
   "The Yellow Book" 1978 edition
   Unisaf Publications, p. 244-250

PART FOUR
THE RESULTS

1. DATA PREPARATION

In the immediately preceding Part, the planning and execution of the method of gathering the data for this survey has been discussed. The outcome was a collection of 327 completed questionnaires as returned from the different groups of respondents.

This Section describes the series of steps taken first, to convert the answers obtained for each question into machine-readable form (i.e. coding) and secondly, to transfer those data into a suitable medium for computer input (i.e. punched cards).

In every step of the survey errors can be made very easily (e.g. procedural errors, mistakes in transferring answers into codes, etc.) which when discovered at later stages in the process may prove to have serious consequences. Since these later parts of the survey are particularly critical and perhaps more prone to mistakes, some precautions were taken to try and detect and, as far as possible, reduce the number of errors.

The first of such steps was editing the completed questionnaires as they were received from the respondents. This necessary but tedious task consisted in reading through the answers for each question, in each questionnaire for the four groups of respondents. Every answer was revised for completeness, i.e. that a legible response had been given; inconsistencies, and contradictions between the answers to different questions; and to clarify ambiguous responses.

1.1 CODING

In Section 2.2.3 of Part Three, a brief explanation of the coding scheme employed in this survey was presented. Below, a more detailed and complementary description is given.

Elsewhere[1a] it has been suggested that the purpose of coding is "to classify the answers to a question into meaningful categories, so as to bring out their essential pattern". This assertion may be further qualified by stating that coding is an intermediate stage between data collection and data processing. It involves the summarising of questionnaire answers into response (or code) categories which, in turn, implies a process of data reduction. Thus, a compromise had to be made between providing the fullest data details, so that the original data could be recreated, without unduly complicating the analysis and, confusing its interpretation with excessive details.

In this respect, the decision was to devise the coding scheme thereby maintaining as much detail from the responses as possible, since it would be always feasible to reduce the initial categories by regrouping them into a smaller number, whereas the converse would be impossible.

1.1.1 Variables and Categories

During the design of the questionnaires, a variable name (i.e. mnemonic) was defined for each question; thereby closed-ended dichotomous questions had a simple variable whereas multiple choice and multiple answer (i.e. one from many and several from many) had a group of variables defined under a generic name. Similarly, for open questions and comments, this latter mode was adopted. Then, a field (i.e. number of columns in the card) was assigned to every variable. Additionally, since the response categories, for closed-ended questions (both dichotomous and multiple choice) were pre-determined, this enabled one to allocate the column position ('value') to each category. Response categories for multiple answer questions were treated differently, each category was considered as a separate variable, with a single column field assigned, thus avoiding the complication of columns with multiple punch.

On the other hand, response categories or rather, the dimensions considered for the coding of open-ended questions and respondent's comments proved to be extremely difficult and time consuming to devise, due to the great diversity of topics raised in the answers. The following process was repeated for each group. Once a sufficient number of questionnaires had been received, the content of the answers were analysed and typified. Then, a list of common phrases and key words was made by abstracting the most frequently expressed key words and concepts; to each of which a punch position (value) was assigned in the card columns previously reserved for these items. Least frequent reply types, i.e. those containing very few cases, were amalgamated into a residual category called 'out of group'.

In summary, questions generated variables that were coded in a pre-determined number of card columns in which the position would be according to the value assigned by the answer given to each response category.

1.1.2 Code Books

As questionnaires were being returned and their answers were edited, the need to modify and expand the coding scheme emerged. That is to say, the preliminary coding described above, was altered in the light of the types of replies actually given to the questions by the respondents.

Once the modifications were made and the final coding was completed, a codebook was prepared for each questionnaire group. The code books indicated the location of each variable and the keypunch assignments for the values given to each attribute conforming those variables[2a]. The purpose was twofold: it served as a guide to prepare responses for card punching and later, it was an index for locating the different variables in the data file for subsequent analyses.

The four code books prepared followed the same general guidelines, namely: because of the large number of variables involved and the length of the fields required to allocate them (more than 80 columns) the responses for each case (questionnaire) were contained in two cards (records). The first four columns in each card indicated the respondent's identification code, which was the same as originally used to identify each respondent in the mailing lists (i.e. group initial letter and three digits). The fifth column identified the card number (i.e. 1 or 2). Henceforth, the response categories along with the corresponding values of column position followed. All unanswered questions were assigned a value of zero for 'no answer'. A column was left blank to separate one question from another and to facilitate the preparation of the cards.

1.2 CARD PREPARATION

Having designed and precoded the questionnaires to simplify the conversion of responses into code categories and, having devised a code book to cipher those categories into a machine-readable form, the next step was the transfer of those coded responses to a suitable medium for computer input.

Amongst the different choices of computer input media (e.g. tape paper or magnetic, cards, etc.) punched cards were chosen as being more appropriate for this particular application for several reasons, viz:

a) They could be prepared in small batches at a time, i.e. as questionnaires were returned. This enabled one to carry on with the process of editing, coding and key punching, instead of having to wait until all the questionnaires had been returned.

b) Card punching is a relatively simple task and there was a punching machine conveniently located to allow preparation of the cards when suitable. This had the advantage of providing an added opportunity for a closer contact with the data (by learning about the particularities of individual responses) and with the whole process. Thus, problems that emerged were detected and solved immediately.

c) It is perhaps the only medium that offered the possibility of direct access to the data i.e. without having to rely on the use of equipment; therefore it was possible to read the information contained in each column by having the codes printed along the top edge of the punched card. This feature proved to be beneficial when tracing back errors and for quick reference to responses.

d) It is a universal medium offering a combination of low cost, permanent record and ease of handling.

Key Punching Stages

The transfer of responses from questionnaires to punched cards was carried out in three stages. First, as each questionnaire was received, all precoded questions (e.g. dichotonous, multiple choice and multiple answer) were keypunched directly from the questionnaire answers. This information was also copied in a coding form for later use. Second, when most of the questionnaires of a given group had been received, the coding for open ended questions and comments was completed. The corresponding codes were copied onto the coding form and from it, the cards were keypunched accordingly. Finally, once all the cards for a group of respondents had been completed, they were checked for mistakes made during the keypunching operation. This was done by means of a verifier machine and the coding form previously prepared (instead of having to go through all the questionnaires again).

Since there were a total of 327 cases, with two cards each, this rather repetitive process involved the punching and verification of 654 cards. Fortunately, the process was greatly simplified by the layout of the questionnaires and the use of the machine automatic features. In this way, the card puncher was programmed to stop only at those columns where it was wanted to include a value, and to skip over the rest of the columns. This allowed to speed up the punching of the codes in the two passes needed for each card: first for the pre coded questions and later for the open ended and comments. Furthermore, the blank column left between any two questions was also skipped automatically, both during keypunching and verification thus, providing an indication of the end (or beginning) of each question field and thereby obviating the need to continually check the card column being punched with that corresponding to the question.

A similar process was carried out for each group of questionnaires, the end product was a set of four decks of punched cards containing nearly all the data generated by the survey and ready for processing.

2. DATA PROCESSING

The ultimate purpose of the survey was to collect information from the respondents that would eventually allow descriptions to be made of the principal research questions indicated in Section 1, Part 3. In order to achieve that, the raw data produced so far had to be processed and analysed in some way.

Owing to the relatively large amount of data involved (each of the four groups of questionnaires contained between 95 and 105 variables) manual processing was discarded from the outset. In support of this decision, it has been suggested[1b] that when a survey has 200 cases or more, or when the number and type of tabulations and analyses that are going to be made is uncertain then machine processing is the best way to proceed.
On the other hand, the facilities available within the University at the Edinburgh Regional Computing Centre (ERCC) influenced the choice of machine processing, despite the lack of sound previous experience in this field.

From the early stages in the planning of the survey, enquiries were made at the ERCC to find out whether programs for this specific purpose existed and what user support was available. The Program Library Unit of the University suggested the use of the "Statistical Package for the Social Sciences" (SPSS) and kindly provided a copy of the Manual[3], the Update[4] and of the Introductory Guide[5]. With respect to user support, it was indicated that both general and specialist advice could be obtained through the Advisory Service. A special SPSS introductory course, which was attended at a later date, was also available.

The study of the manuals provided the information needed for that initial stage, namely that the package was designed for the analysis of surveys. Other important aspects considered were the requirements for data input and to ascertain that the numerical coding of the questionnaires would be consistent with those requirements.

2.1 SPSS

The Statistical Package for the Social Sciences is "an integrated system of computer programs designed for the analysis of social science data"[3a]. It was originally developed at Stanford University and it has been widely used and repeatedly improved during the last decade (release 8 was implemented at the ERCC during the course of this study).

The system consists of a main control program and a number of associated subprograms providing a comprehensive and flexible set of procedures for statistical analysis and data management. The set of instructions (control statements) defining the data and specifying the procedures to be carried out, are normally given in a deck of punched cards (control cards); their layout is simple and the language used is quasi-natural, making the system accessible to users with no previous computer experience.

After a few trial runs, a major inconvenience of the program was found to be its operation only as a batch program (i.e. job put in a queue and processed according to the order of arrival, FIFO). This meant that, after handing in the deck of cards for a particular run, it was neccesary to wait several hours (if not overnight) only to have the all too often frustrating experience, that no results were produced because the process had failed, due to some minor mistake or the misplacing of a card in the deck.

A way was devised to circumvent this drawback, whereby it was possible to use the program in a foreground mode from an interactive terminal. Therefore, the need to have to punch and prepare new card decks for every run was eliminated. Instead, all the runs were prepared and input from a VDU terminal, using the editing facilities existing in both the ERCC system (2980) and the SPSS program. Similarly, the output from each run was retrieved and displayed first, on the same terminal for inspection and then, on a convenient line printer.

This practice proved to be most convenient, particularly in this case because of the four groups involved and the need to develop the process in stages whereby previous results pointed the direction for further analysis. Hence, several consecutive runs were frequently required.

Once this 'by-pass' procedure was refined and tested, the four decks of cards containing the raw data from the questionnaires were read in and four files were created on magnetic disc. Thus, subsequent runs would use these data files as input data, without having to read the original raw data again.

The first SPSS run was then prepared to define the following parameters for each of the above data files: a) the order in which the variables were located and their respective field assigned (i.e. variable list and input format); b) the number of cases contained, and c) the labels to be associated with each variable and with each value of the variables. Using a facility provided by the program (save file) that allowed to create a system file at the end of a run, containing the results of that run, it was possible to have a file that re-created the information from the questionnaires. This was really the file that would be used as input for all future processing.

At this point, it was considered that human manipulation of the raw data was completed. It was decided to make a final clean up of the data, and make the corrections that might be necessary before embarking in further processing. The principle was that, since for each variable there could be only a limited number of values (i.e. punch assignments or cards) thus, by ckeching the range of values for each variable, it was possible to single out any value beyond the correct range.

2.2 TABULATIONS

The next four runs were to produce frequency tables for those variables that were specific or unique to each group in particular. Some difficulties were experienced when producing the tables for multiple response questions; fortunately, the new release of SPSS, which was being implemented at that time, offered a sub-program to handle that type of response.

The next task was to create a new master file that would combine the data from the four initial files, for those variables that were common to the four groups of respondents. But before doing this, it was essential to reorder some variables and recode others, so that they were located in the same form and sequential order on each file. Only then the four files were merged into one, with a subfile structure, (i.e. one subfile for each group). A list of these subfiles comprising the concatenation file is presented in Appendix 5. Also in that appendix, the labels and range of values for each of the 114 variables contained in that file are given. Such a file would eventually permit the generation of frequency tables for each of the common variables either individually for each subfile (i.e. group) or in any combination that might be desired.

The tables thus produced have been included in the Appendices 6 to 9, their results are presented and discussed in the next section.
Here again difficulties were encountered while trying to produce, in a single table, the results of questions with multiple answers. As has been indicated earlier, they had to be processed using a different sub program consequently, their presentation format is different from that of the other variables.

3. DATA ANALYSIS

In this section, the results of the survey are presented and discussed. For convenience of their presentation, the data from the respondents has been summarised in tabulated form. Thus, tables in Appendices 6, 7, 8 and 9 depict the responses obtained from the four groups of questionnaires, which are reproduced in Appendices 1, 2, 3 and 4, corresponding to the Schools of Architecture, the Architects in Practice, the Architectural Firms and the Fire Prevention Officers respectively.

To facilitate the reference between the two groups of appendices (i.e. questionnaires and tables) the order in which the tables are presented has been kept, wherever possible, the same as that of the questions in the questionnaires. Also, the list of tables in the List of Contents provides a cross reference between the question number, the variable name and the table number under the headings for the appendices containing the tables of results for the groups of respondents.

It should be noted that since most variables are discrete and of nominal level, most of the descriptive statistics (e.g. measures of dispersion and location) are not applicable[8d] therefore, only absolute frequencies (i.e. counts) and relative frequencies (i.e. percentages) are included in the majority of the tables. Unless otherwise stated, the frequencies are based on responses received to each question rather than the number of questionnaires or the proportion of population; though many tables have percentages based on both.

The coding for the response categories of variables marked as 'common', i.e. those present in more than one of the groups of respondents (see Table 3-2) can be found in Appendix 5. In general, columns represent the variables and rows indicate the different categories of response, but in some tables the converse is true.

3.1 TABLES OF RESULTS

Each completed questionnaire can be regarded as a set of observations displaying the traits of a respondent. By summarising the responses to each question in frequency distribution tables, it is intended to show how the respondents' answers are distributed and to give a descriptive account of the main features of the survey aggregate.

3.1.1 Schools of Architecture

As stated previously, the questionnaire for this group has been reproduced in Appendix 1 and the tables of results are to be found in Appendix 6.

Variables: Group RELEV (common) **Question 1**

Definition: Relevance of fire safety to aspects of building design.

This was one of the questions that, as indicated in Section 2.2.4 of Part 3, underwent a change of format following the comments received from some respondents that it was difficult to answer. The modified version was incorporated into follow-up mailings for this group and into all other groups of questionnaires. The 'Other' variable was eliminated from the analysis because the answers received could be classified under one of the remaining variables (e.g. structural under 'constructional').

The responses to this question made by the 33 respondents are depicted in Table 6-1, in which the following points are noteworthy: for the three variables (i.e. aspects) the model category of the answers (i.e. that with maximum frequency) correspond to 'Constraint'. A greater number of responses are concentrated on this category for the 'Visual Aesthetic' variable (73 per cent); this concentration (skewness) is reduced for the 'Environmental' variable (45 per cent) and further still for the 'Constructional' variable (41 per cent). Conversely, it appears that for the 'Positive Contribution' and 'Set of Rules' categories, the frequency of responses increases as one moves towards the 'Constructional' variable.

This seems to indicate that school respondents consider fire safety as a 'Constraint' more relevant to 'Visual-Aesthetic' than for 'Environmental' or 'Constructional' aspects of building design. Also, fire safety is more a "Set of rules for compliance" that appears to "Make a positive contribution", in respect of these two latter aspects, but not for the 'Visual-Aesthetic' one. It should also be noted that only one respondent indicated fire safety as irrelevant to the aspects of building design. The assertions made above are similar to those made under Section 5.1 and 5.2 in Part 1.

Table 6-2 contains the 14 comments received to this question. Besides those expressing the difficulty in answering the question indicated earlier, three respondents stated that fire safety should be part of the design process and that problems could be alleviated by early consideration; two others suggested that the answer to the question depended upon how the idea (fire safety) was approached. A further two respondents noted that constraints made a positive contribution to building design.

Variable: ROLE **Question 2**

Definition: Role of respondent with respect to fire safety.

This question was answered by 33 respondents and due to their multiple responses, new categories had to be added to the coding i.e. combination of initial categories.

Table 6-3 summarises the responses, of which the most common category (39 per cent) is a combination of 'Coordinator' and 'Teacher', if this is added to that of 'Coordinator' only, some 58 per cent of the people responding to the questionnaire were as expected, coordinating fire safety education in the schools. Furthermore, only 2 respondents indicated a role different to coordinating and/or teaching.

Variable: KNOW(common) **Question 3**

Definition: Present fire safety knowledge.

As in the case of the previous question, this one was also answered by 33 respondents, additional response categories were also required to take account of answers combining some of the initial categories.

Table 6-6 shows the responses given to this question, it is noteworthy that most respondents (over 70 per cent) considered as 'Adequate' their fire safety knowledge; about 20 per cent declared it to be 'Inadequate' and under 10 per cent regarded their knowledge to be 'More than adequate'. These responses were complemented by some comments, which are condensed in Table 6-7. The two "More than adequate" respondents qualified their answer by stating that is was so in relation to lecturing and to the course time allocated; two others considered to have 'Adequate' knowledge only to teach.

Variables: INFAV (common) **CMINF** and **CMINFAV** **Question 4**

Definition: Fire safety information available.

This dichotomous question combined with a contingent open-ended question was answered by 31 respondents. Their responses are provided in Table 6-10 for the dichotomy and Table 6-11 for the written in part. Although the latter was supposed to be used by those respondents who answered 'No' to the dichotomy in fact it was used by 22. Of the 31 respondents (Table 6-10) 58 per cent were not satisfied with the fire safety information available at present to the schools of architecture. One of the reasons given for this dissatisfaction (4 responses) was in relation to the great emphasis made in legislation whereas there is very little guidance on general principles beyond the basics, existing in current information. The lack of suitable teaching aids (5 responses) and of a text book "from which a student can learn the basic facts about the relationship between building design and fire safety" was also repeatedly suggested (7 responses). Finally, another group of comments (5 responses) pointed out the uncoordinated, fragmented and dispersed nature of the existing fire safety information which seems to be hidden in legislative jargon.

Variables: Group TOPIC **Question 5**

Definition: Topics included in fire safety course.

Respondents from 32 schools answered this item; their responses are shown in Table 6-5. All respondents appear to include in their course the topics of 'Smoke Control', 'Escape Route Design' and 'Fire Resistance'; whereas 'Legislation' is covered by all but one of the schools. However, this uniformity of coverage disappears when less traditional topics are considered; e.g. 'Management' and 'Risk Assessment' which were indicated to be covered in about one third and one half of the schools responding respectively.

Among the replies given in the 'Other' category, single mention was made of access for fire appliances, water supplies, compartmentation, insurance requirements and case studies; several of which were included in some of the main categories.

Variables: SYL , COM6 **Question 6**

Definition: Fire safety course syllabus.

The principle behind this question was to check the information given in the previous question and to ascertain the number of schools which had a separate course in fire safety.

The distribution of the 33 responses and the 10 comments received to this question are indicated in Tables 6-8 and 6-9. Only 27 per cent of the respondents enclosed some form of syllabus; nearly 49 per cent admitted to have no syllabus available, whereas the remaining 24 per cent did not enclose it. Of the 9 syllabi received, only 2 could be considered to correspond to a fire safety course in their own right (one term) 2 others were block courses (10 days in one and 2 days in the other). In 3 more cases the subject was presented scattered with other subject matter (e.g. environmental sciences and services, building technology) while the other 2 schools indicated a programme of talks (about 4 hours/year) to complement studio project work (one of these used the RIBA/FPA slide package as main input material). Except in very few cases, the emphasis made in the subject seemed to be aimed at providing answers of how to design to meet the legislative requirements.

This question failed to glean the intended information, for when revising the comments, it became evident that some respondents have misunderstood it or perhaps its wording was slightly ambiguous. It was expected that respondents having a syllabus but unable to send it for any reason (e.g. being redrafted) would use the "Not Enclosed" category, while those respondents not having a course syllabus at all would indicate so in the "Not Available" category. This confusion in the responses was recitifed, as far as it was possible, during the initial editing of the questionnaires therefore, the results shown in the tables are in accordance with the above criteria. Hence 51 per cent of the schools that responded seem to have some form of syllabus for teaching fire safety.

Variables: Group TIME, COM7 **Question 7**

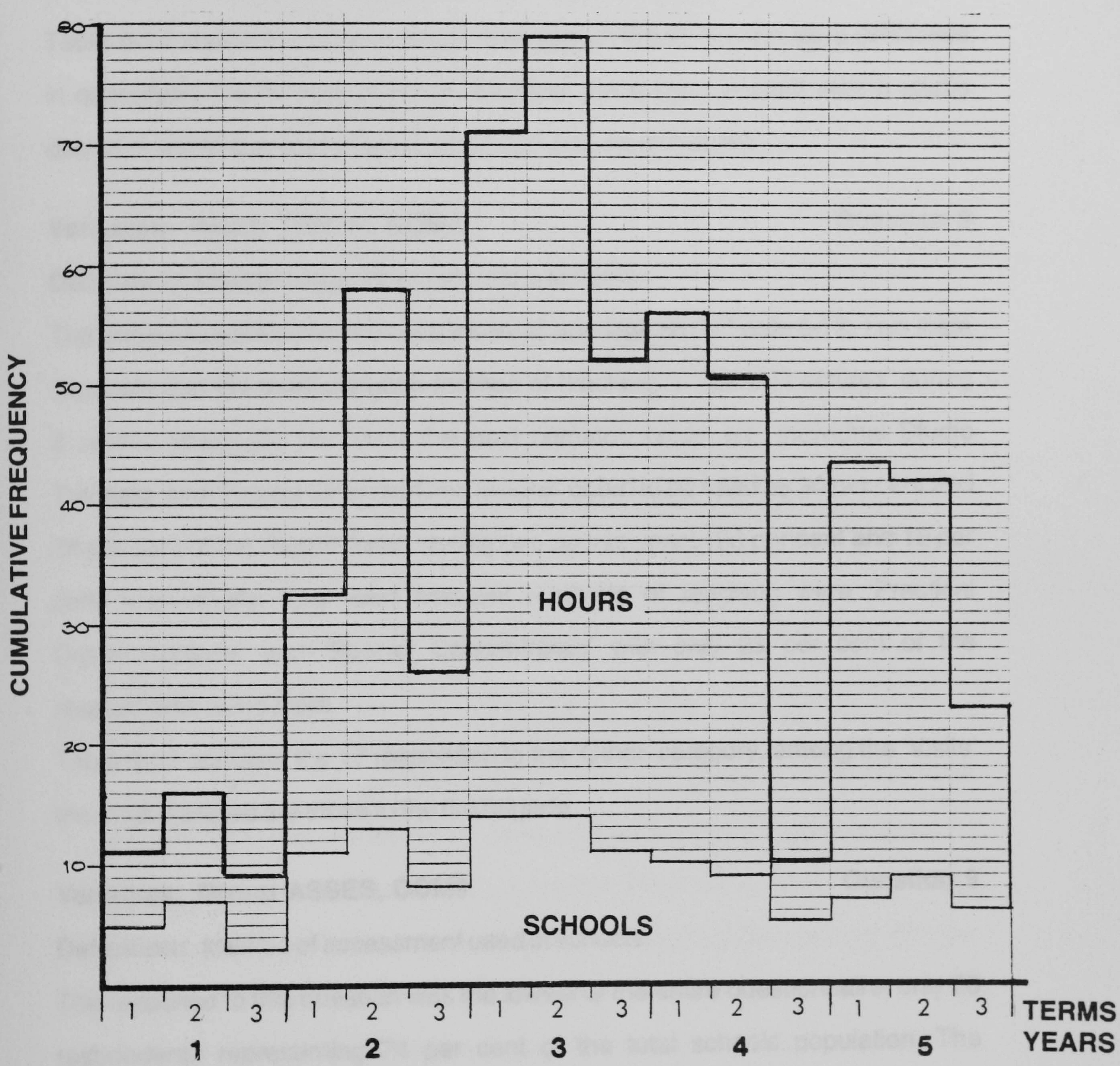
Definition: Time dedicated to fire safety.

The 32 respondents that answered this question have been represented in Figure 4-1 below. The double histogram shows the distribution of both the number of hours dedicated to fire safety (in the upper part) and the number of schools that indicated to cover the subject, according to the terms of the architectural course.

The figure reveals a pattern of dedication that during the first 3 years of studies appear to increase. From the first term to reach a peak in the second term, falling back in the third term to a lower level. Whereas during the last two years the pattern is reversed, the maximum dedication appears to concentrate in the first terms decreasing thereafter.

Figure 4-1

Time Dedicated to Fire Safety in Schools



The major effort seems to be made during the first and second terms of the third year when 44 per cent of the respondents indicated some coverage of the subject; however, the mean time of dedication for that period is just over 5 hours per term. Over all, the modal dedication to fire safety appears to be 2 hours per term.

Table 6-14 shows the 12 comments received; of these, 4 expressed difficulties in quantifying the number of hours, because the subject is dealt with in studio design or within a project oriented approach instead of lectures.

Variables: Group TEACH, COM8 **Question 8**

Definition: Method of teaching used in the schools.

The answers received from 31 respondents are depicted in Table 6-12. This table suggests that the most common method of teaching is 'Formal Lectures' during 3 course years (26 per cent) the next common types are 'Individual Studio Tutorials' and 'Project Oriented Discussions' noted to be used by 90 per cent and 74 per cent of the respondents, during two course years (26 per cent and 19 per cent respectively. The least frequent methods of teaching were 'Practical Demonstrations' and 'Special Concentrated' with only 23 per cent of the respondents using them.

Table 6-15 contains the 17 responses to the 'Other' category, among the 'Visits' the most prefered are those to the fire brigade.

Variables: Group ASSES, COM9 **Question 9**

Definition: Method of assessment used in schools.

The response to this question was the lowest of the entire questionnaire, only 28 respondents representing 74 per cent of the total schools population. The answers have been condensed in Table 6-13. Following from the results of the previous question, it was expected that the most frequent method of assessing the students' performance would be by means of formal examination but this seems not to be so. In fact, of the 16 respondents that stated to use 'Written

Report' (column 3) 11 of them were also using written and oral examinations. It appears therefore, that most schools tend to assess fire safety as part of a design project (column 4) during more years of the course than by other methods considered, 25 schools use it during two or more years, whereas only 10 schools use written examination (as part of general papers) in two or more years.

Table 6-16 shows the seven comments made to complement the answers discussed above. The 'Other' category has been re-coded into the rest of the variables.

Variable: STATUS **Question 10**

Definition: Status of the fire safety course.

The aim with this question was to determine whether the fire safety course was optional or obligatory. Table 6-4 shows the answers received from 33 schools, which indicate that in nearly 85 per cent of them students are exposed to fire safety obligatorily. The two schools having 'Optional' courses stated that all their lectures were not obligatory.

Variable: Group PUBLIC (common) **Question 11**

Definition: Publications used in the schools for fire safety education.

The intention behind this question was to obtain an indication of the approach emphasised in the schools, by knowing the publications most commonly used.

The distribution of the 32 respondents is listed in Table 6-17; according to which the publications most frequently used were the 'Building Regulations' (81 per cent) followed by 'Fire Legislation' (81 per cent). Next in order were found to be 'BRE Digest' and 'FPA' publications (both 75 per cent) and 'BSI Codes" (72 per cent). 'Text Books', 'Journal Articles', 'Government Department Publications', 'BRE Current Papers', 'Fire Research Station Reports' and 'BSI Standards' are reported to be used by some 19 to 20 schools (59 to 63 per cent). Finally, the least frequently used group of publications has been indicated to be those included in the 'Other' class (e.g. GLC – means of escape, trade literature) and those from the 'Home, Welsh and Scottish Offices' (34 per cent).

It is interesting to note that the groups of official-legislative publications accounted for 48 per cent of all the responses.

Variables: Group CONTR **Question 12**

Definition: People contributing to fire safety course.

This question was drawn with the purpose of providing information on the type of input made to fire safety education. Table 6-18 provides a summary of the 33 respondents. Here as in previous cases, the response categories had to be re-arranged in accordance with the answers received. Thus, the responses to the 11 variables were divided in classes and a special category was necessary to respresent those respondents that ticked the box, but failed to give the number of hours for the different contributors.

As expected, the principal contributors are the group of staff lecturers (91 per cent for full time and 33 per cent for part time). However, the high frequency noted for the 'Building Control Officers' (64 per cent) and the relatively low number of contributions indicated for the 'Fire Prevention Officers' (39 per cent) was contrary to expectations.

Variables: Group SUGRAWAR (common) **Question 13**

Definition: Improvements of awareness to fire safety problems.

This open ended question was answered extensively by 33 respondents, most of whom provided several suggestions. It was one of the more difficult to synthetise into meaningful response categories because of the diversity of points. Tables 6-19 and 6-20 show the responses as they were classed according to the coding frame for common variables indicated in Appendix 5. Since the response categories restrict, out of necessity, the full meaning of the suggestions made a more complete description is given below. Although this question was intended to purport two streams of suggestions (i.e. for students and for architects) very few respondents differentiated their answers in that way. Therefore, categories indicated in the tables are of general application, though some of them relate to schools.

In Table 6-19, nearly one quarter of the respondents suggested that an increase in the awareness towards fire safety problems could be achieved by the greater use of audio visual aids (e.g. films, slides, etc.) designed specifically for the architectural profession, in which architects' role and responsibilities, along with the lessons learnt from previous incidents and research results, would be highlighted. An equal number stated the need for practical demonstrations ('FRS, FSTC, Demons') at the Fire Research Station, Fire Service Technical College or anywhere else; whereby the threat of fire and smoke and the consequences of bad practice in building design could be shown.

These suggestions were taken one step further by 18 respondents indicating that personal experience of fire was the best possible way to increase awareness. It was suggested that in order to gain first hand practical experience and appreciate the consequences of fire in buildings, scenes of recent fires should be visited. A similar proportion of respondents stressed the need to increase fire publicity within the profession, by a more wide spread coverage in professional publications of the impact of fire in buildings (e.g. fire statistics and losses, architect's responsibilities, etc.). There were also 15 per cent of respondents noting that more time should be devoted to the coverage of the subject in the schools and that it should form part of the formal schools' curriculum being therefore examinable.

This latter point on the quality of coverage was echoed by 18 per cent of the respondents (Table 6-20) indicating that the issue was to place more emphasis on principles and concepts rather than on legislation and ways of negotiating or circumventing it. Also in Table 6-20, 24 per cent of respondents were concerned with the absence of a handbook, illustrated textbook or comprehensive publication emphasising and relating the fire problems from a building design viewpoint as opposed to the legal or scientific one.

Finally, amongst the 12 responses amalgamated in the residual category 'Out of Group', there were 3 indicating that awareness was acceptable and sufficient and 2 expressed difficulties in obtaining specialist lecturers.

It should be noted that some of the suggestions made by the respondents in this question are very similar to those made under question 4 described above. It seems possible that the answers given to that question influenced those given to this one. A check was made with that purpose, it was found that in five cases, one of the points made in the former question was repeated in the latter.

Variables: Group SOLVED (common) **Question 14**

Definition: Ways of solving fire safety problems in building design.

This last question was answered by 32 respondents whose 87 responses are shown in Table 6-21. Nearly 91 per cent of the respondents indicated that fire safety problems in building design could be solved more efficiently by 'Better Understanding and Education of Architects'. Three respondents complemented their answers by stating (Table 6-22) that there was no substitute for the architect's responsibility than a deeper understanding of the subject; a further two suggested research at various levels into the fire problems at the schools.

The next preferred category (72 per cent) was 'Constructional Design'. None of the respondents ticked the box corresponding to 'Full Enforcement of Existing Regulations' and only one suggested the need for 'Additional regulations' but clarified that it was in the sense of "clearer, less complicated legislation, more easily accessible with responsibilities of parts involved clearly defined". Moreover, three respondents (Table 6-22) indicated that more regulations would only "confuse the issue" and would be difficult to observe and enforce.

It should be interesting to note that the two categories related directly to the architectural profession (i.e. 'Architectural Design' and 'Better Understanding') accounted for 60 per cent of all the responses.

3.1.2 Architects in Practice

As indicated earlier (see Section 3.2.2, Part 3) the questionnaire for this group was circulated first to practitioners associated with the schools and later, to a smaller number of similar individuals attending a half day seminar. However, the results presented below and shown by the tables in Appendix 7, correspond to the combined answers from both sets of respondents. The questionnaire has been reproduced in Appendix 2.

Variable: Group TYPBLD (common) **Question 1**

Definition: Types of building most concerned with.

This introductory question obtained an indication of the types of buildings most commonly dealt with by the practitioners. Table 7-1 shows the answers of the 30 respondents. As expected, 'Residential' is the most frequent type of building (87 per cent) followed by 'Educational' and'Industrial', 'Offices' and 'Institutional' buildings. The type indicated as least common was the category of 'Hotels' (17 per cent). Among the 9 comments that accompanied the responses, 3 respondents stated their concern with restoration and conversions as particular problems that required particular attention.

Variable: KNOW (common) **Question 2**

Definition: Present fire safety knowledge.

This question as the previous one, was answered by 30 respondents. Table 7-4 shows that the majority of them (73 per cent) described their fire safety knowledge as 'Adequate'; none considered to have a 'More than adequate' and almost a quarter (23 per cent) of the respondents reported to have an 'Inadequate' knowledge. Very few comments (3) were offered and therefore, have not been included in the tables.

Variables: Group STAGCON (common) **Question 3**

Definition: Stages of design where fire safety is considered.

Here again, 30 repsondents provided their answers to this question; Table 7-2 summarises their responses. They indicate that at least 56 per cent of the respondents seem to consider fire safety in the following stages of building design: 'Feasibility', 'Spatial Design', 'Materials Specifications' and 'Constructional Design'. While only 23 per cent appear to pay attention to fire safety aspects from 'Inception'. The two most frequent categories were 'Spatial Design' and 'Materials Specification'.

Variable: STAGFST (common) **Question 4**

Definition: Stage of design where fire safety is first considered.

Although this question is similar to the previous one, it was intended to indicate the stage of building design in which respondents first considered fire safety. It appears that the similarity in the wording and content of these two questions have caused some confusion among the respondents; this could explain the low response obtained.

However, the answers of the 23 respondents, shown in Table 7-3, indicate that for 43 per cent of them the first consideration is made during 'Spatial Design', this coincides with the modal category in the previous question. Also similar to that case is the small proportion of those considering fire safety from inception (22 per cent here). Moreover, from the comments that accompanied this question depicted in Table 7-5, the following extracts typify the majority: "Probably should be from inception but more often, in practice it is at spatial design stage that it is really dealt with". In the same line of argument, another respondent offered: "Although one is aware of the problem from inception, it does not become part of the design process until spatial design stage".

Variable: Group RELEV (common) **Question 5**

Definition: Relevance of fire safety to aspects of building design.

The answers received to this revised question are reproduced in Table 7-7. For the three variables (aspects) the modal category was 'Constraint' with a greater number of responses concentrated on the 'Visual-Aesthetic' variable, as noted in the case of the schools. However, for this group the difference with the second most frequently chosen aspect is not as large. It should also be indicated that three respondents under 'Visual-Aesthetic' and two under 'Environmental' variables stated that fire safety was irrelevant, but none did so under the 'Constructional' variable.

Most of the comments (3) indicated in Table 7-6 were to point out that constraints could make a positive contribution if dealt with adequately.

Variable: Group CONSUL (common) **Question 6**

Definition: People consulted for fire safety advice.

This question was devised with the intention of identifying the people to whom practitioners turn to for fire safety advice and the proportion contributed by each of the contributors (variables) listed. The responses given by the 30 respondents are contained in Table 7-8; in it the group that received the highest frequency (modal) is the 'Fire Brigade Officer' (28 responses) with a contribution in excess of 30 per cent for 17 of them. The second most frequent variable was indicated to the 'Building Control Officer', though with contributions ranging between 11 and 50 per cent for the same proportion of responses. Among the comments made, 4 respondents stated that the percentages of the contributions were dependent upon the type of project concerned.

Variable: Group PUBLIC (common) **Question 7**

Definition: Publications used for fire safety information.

With this question, instead of determining the sources of fire safety advice as in the preceding question, the intention was to identify the publications that practitioners more frequently refer to for information. Table 7-9 shows that 'Building Regulations' were indicated to be used by all 30 respondents; 'BRE Digest' and 'BSI Codes of Practice' seem to be used by approximately an equal proportion of respondents (70 and 67 per cent) whilst 'Journal articles' and 'Fire legislation' shared similar frequencies (60 and 57 per cent respectively).

It may be worth mentioning that the official-legislative type of publications accounted for 55 per cent of all responses, including 4 responses in the 'Other' variable that were assigned to GLC Code of Practice (means of escape).

Variable: Group ORIKNOW (common) **Question 8**

Definition: Origin of fire safety background knowledge.

To complement the previous questions on knowledge and information, this item was included to obtain an indication on where the practitioners got their knowledge from and the proportions ascribed to each of the source categories listed. Although it was answered by 30 respondents, Table 7-10 shows that the highest frequency were 25 responses related to 'Previous Design Experience'; 68 per cent of which indicated that at least one third of their knowledge came from that source. Comments made by 6 of these respondents (see Table 7-12) observed that their answers were based on consultations with fire prevention officers in the course of project design.

Surprisingly, 'Trade literature' attracted 20 responses, 80 per cent of which noted a contribution of one third or less made by this category. Not less unusual could be considered the low frequency of the 'Architectural Schools' category with only 17 responses, 65 per cent of which indicated a contribution of one third or less. This includes the 3 respondents that stated their involvement in teaching, as shown in Table 7-12. Finally, 'Talks and Seminars' and 'Short Courses' combined, appear to have received the same number of responses as the 'Schools' (5 and 12 reponses respectively) however, with a lower proportion of contributions.

Variable: Group TOPIC (common) **Question 9**

Definition: Ranking of fire safety topics.

This question was devised to obtain a ranking of the importance of 10 topics, considered to be relevant to fire safety in building design.

Since this same question has been included in the remaining two questionnaires, it may be opportune to describe here the procedure followed to analyse the responses thus avoiding its repetition. Although it could be argued that the priority or order given to each topic by the respondents, will depend upon a number of issues which are bound to vary from individual to individual (e.g. attitude to the fire problem, previous experiences and knowledge possesed on each topic) hence, it may appear as if the data is being forced into a linear scale. However, it was thought that, even allowing that the ranking from each respondent could be regarded as his particular view of the problem, since there should be some homogeneity within each group, it should be expected therefore to find some degree of agreement among the rankings for each group of respondents or at least, a 'characteristics' ranking of the topics. The comparison of these 'best' rankings should then allow to make an estimate of the most preferred priority assigned to each topic.

Table 7-11 shows the results for the group of 'Practitioners', the columns represent the topics (variables) while the rows indicate the ranking order, each cell contains the frequency yielded by each topic in that particular rank. In the upper most row, the total frequencies for each topic are not equal because some respondents failed to rank all 11 topics. Hence, the 'Other' variable and the 11th position have been excluded from the table due to the low responses collected on them. It was then necessary to correct the data accordingly.

Little more could have been done with the results in the table, although the mode indicated the rank that obtained the highest frequency, it was not sufficient to estimate the group's ranking nor did it provide any evidence about the agreement, or otherwise, among the different sets of rankings. After some consultations, the use of non-parametric statistics and rank correlation methods were suggested[6]. A review of specialist literature revealed two statistical techniques particularly suitable, viz: Kendall's coefficient of concordance and Friedman's two-way analysis of variance by ranks[7,8,9].

Kendall's Coefficient of Concordance (W) would allow a measure of the overall agreement in the rankings of the respondents, taken as a group, to be obtained. In other words, it will provide a measure or index of the extent of association amongst the m sets of rankings (respondents) of n variables (topics). The coefficient has been defined as:

$$W = \frac{S}{\frac{1}{12} m^2(n^3 - n)}$$

where S is the sum of the observed deviations from the mean of the sum of ranks (Rj) for each topic:

$$S = \sum_{j=1}^{n} [Rj - \sum(Rj/n)]^2$$

The values of W vary between 1 for a 'perfect agreement', i.e. all respondents ranked the 10 topics in the same order and 0 for a 'perfect disagreement' i.e. sums of the various ranks (Rj) more or less equal. From the data in Table 7-11, the values indicated in Table 4-1 below where calculated and the coefficient of concordance was determined to be equal to 0.40 which indicates a moderate agreement.

It has been suggested[8a] that for more than 7 variables (i.e. $n > 7$) W is approximately distributed as Chi-square with n–1 degrees of freedom. Hence, it was possible to test the significance of the calculated value of W by determining the probability associated with the occurrence, under the null hypothesis, of values as large as that observed. In the same reference[8], an expression is given that relates W to Chi-square, viz:

$$\chi^2 = m(n-1)W$$

The value calculated with this formula was $\chi^2 = 90.9$ with 9 degrees of freedom; by referring to Chi-square tables, it was determined that the value was significant at the 0.001 level. It can be concluded therefore, that the agreement amongst the respondents is greater than it would be by chance. The null hypothesis, that the rankings of the respondents were unrelated, is rejected due to the low probability of occurrence.

The Friedman's two-way analysis of variance by ranks (T) is a statistical test to determine whether the rank sum (Rj) for the different topics differ significantly. As in the case of W above, T is considered to be distributed as Chi-square with n–1 degrees of freedom. Thus it is used in the customary way of accepting or rejecting the null hypothesis, that the ranking of the topics by each respondent is the same (i.e. each topic was given equal-order of importance).

Using the same nommenclature as before, for n m-variate mutually independent variables, the test statistic is expressed as:

$$T = \frac{12}{mn(m+1)} \sum [Rj^2 - 3n(m+1)]$$

From the data cast in Tables 4-1 and 7-11, the value calculated was T = 91.7; by turning to chi-square tables it was determined that the probability associated with the occurrence of values $\chi^2 \geqslant 91.7$ with 9 d.f., was better than 0.001. Therefore, the null hypothesis was rejected and alternatively, it can be concluded that there seems to be agreement among the ranking of the different respondents, significant at the 0.001 level.

Having established that there is evidence of some agreement, among the respondents in the ranking of the 10 topics, as shown by the magnitude of W and the significance of both W and T, the question of determining a 'characteristic' ranking for each group was still unanswered. Kendall[7a] suggested that a procedure for the 'best estimation' of this true ranking, is by ranking topics according to the order of the sums of ranks for each topic (Rj). The decision of the final ranking was further clarified by taking the mean ranking for each topic. Table 4-1 shows the 'true' ranking of the topics for the group of 'Architects in Practice' derived following the above criteria. The topics or variables identification numbers correspond to those in Table 7-11, which are also indicated in Appendix 3 under the variable label.

Table 4-1

True Ranking from 'Architects in Practice'

Variables Topics	1	2	3	4	5	6	7	8	9	10
Sum of Ranks (Rj)	95	95	58	106	147	195	202	146	144	185
Mean	4.1	3.8	2.3	4.2	5.9	7.5	7.8	6.4	6.0	8.4
True Ranking	3	2	1	4	5	8	9	7	6	10

The seven comments made with this question have been summarised in Table 7-13; two of them indicated that since all topics should be considered jointly it was therefore impossible to rank them in order of importance. Another comment pointed out that all topics were qually important. Finally a respondent suggested that "Legislation comes so high up in the list because it is an unavoidable topic that dictates much of the way in which we design buildings".

Variables: Group SOLVED (common) **Question 10**

Definition: Ways of solving fire safety problems in building design.

The responses from the 30 respondents that answered this question are presented in Table 7-15. This table shows that the majority (70 per cent) of the respondents indicated that fire safety problems in building design could be solved more efficiently by better understanding and education of architects; 40 per cent of the respondents also included in their answers the variables of 'Constructional design' (it should read 'Architectural design') and 'Full enforcement of existing regulations'. Only one noted 'Additional Regulations' though two of the comments (see Table 7-16) indicated that with more legislation there was the danger that it would not be observed.

Here again in the results of this group, it can be seen that the highest frequency of responses (55 per cent) were concentrated in the two variables appertaining to the architectural profession (e.g. design and understanding). Two of the comments reported in Table 7-16 referred to the failure of clients (and public) in appreciating the need for fire safety; a further two suggested that it was imperative to unite fire safety requirements under one authority.

Variable: INFAV (common) **CMINFAV** **Question 11**

Definition: Fire safety information available.

The answers to the dichotomous part of this question are shown in Table 7-17. There is little difference between the frequencies for the two response categories, 53 per cent of the respondents manifested dissatisfaction with the fire safety information available at present to practising architects.

The responses for the second, open ended part of the question are depicted in Table 1-18. Among the various points raised, the most frequent (27 per cent) pointed out the need for a single reference source, textbook, compendium or handbook, consolidating the information and giving design guidelines. On a similar argument, 18 per cent of responses stressed the fact that the information available was scattered, fragmented and spread in too many publications and sources. In addition to this, another 15 per cent indicated that while information was available, it was a case of upgrading architects' priorities by improving motivation. A further 15 per cent of responses referred to the need to simplify existing information, prising it out from written legislation and making it available in diagrammatic form.

Variable: GRAWAR Group SUGRAWR (common) **Question 12**

Definition: Greater awareness to fire safety problems and suggested ways to improve it.

Similarly to the previous question, the structure of this item was also a dichotomy followed by a contingent open ended part. Unlike the latter question, where responses showed an almost 50 per cent split, in this case, 83 per cent of the respondents thought that architects should have a greater awareness towards fire safety problems as indicated in Table 7-19.

The requested suggestions to achieve a greater awareness, are summarised in Table 7-20. Responses were divided into two classes: those related to education and the profession, represented in the upper part of the table and those other of more general nature, which have been included in the lower part of the table. The suggestion more frequently made (8 responses) was in relation to mid-career education for practising architects, by means of short courses devised for architect's needs to upgrade their existing knowledge. Complementing this suggestion and to achieve a better fire safety education throughout the profession, seven responses emphasised the need for a more vigorous and formal approach at the schools, with a longer dedication to the subject, perhaps examinable. Also seven responses indicated once more, though from different respondents, the lack of a concise manual, consolidating the information in architectural design terms in a single reference source. Finally, five responses were concered with current legislation, e.g. the need for their unification and coordination, (3) the lack of consistency in their interpretation and, application and the recurrent tendency for its presentation as a 'set' solution rather than a conceptual approach (i.e. performance).

Variable: Group SUGG (common) **Question 13**

Definition: Further comments and suggestions.

The last item in this questionnaire was more a space provided for a final comment or suggestion. The condensed responses from the 7 respondents that made use of it are to be found in Table 7-14. The majority of them were elaborations on issues made previously, while responding to other questions.

3.1.3 Architectural Firms

The questionnaire for this group of respondents, the largest and last to be mailed, has been reproduced in Appendix 3, while Appendix 8 contains the tables for the responses obtained.

Variable: Group TYPBLD (common) **Question 1**

Definition: Types of buildings most concerned with.

The responses from the 198 respondents that answered this question are shown in Table 8-1. The first thing apparent in the table is the wider range of building types that seems to be handled by the firms; that is to say, there is less clustering of responses on a particular type. However, 'Offices' seems to be the most frequent type, being indicated by 76 per cent of the respondents. Next is the type 'Industrial' with nearly 68 per cent, followed by 'Residential' (50 per cent), 'Institutional' (45 per cent), 'Sports and Leisure' (43 per cent) and 'Mercantile' (41 per cent). As in the group Practitioners, the least common type was 'Hotels' which was ticked by 23 per cent of the respondents.

Variable: PERMADV, QUADV **Question 2**

Definition: Permanent advisor and qualifications.

It was expected (see Part 3, Section 1.2.2a) that large firms would be more likely to have, among the staff, a permanent advisor or a member dealing with fire safety. Quite the contrary, only 9 per cent of the 194 firms answering this question met that expectation (see Table 8-2). Moreover, the qualifications of the advisors, as indicated in Table 8-3, were distributed as follows: 61 per cent were architects, none were of engineering background and the remaining 39 per cent were composed of 2 surveyors, 1 ex-fire prevention officer, 1 office manager, 1 senior technician and 2 with unspecified qualifications.

Variable: Group STAGCON (common) **Question 3**

Definition: Stages of design where fire safety is considered.

This question was answered by 186 respondents, Table 8-4 shows their responses. Here again, the responses appear to be distributed more evenly over a greater number of variables (stages) than in the case of Practitioners. That is to say, more firms seems to consider fire safety in more stages of design. Indeed, between 59 and 65 per cent of the respondents indicated to consider it during 'Feasibility', 'Spatial Design','Materials Specification', 'Constructional Design' and 'Working Drawings'. However only 25 per cent reported to consider fire safety from 'Inception' and 47 per cent for 'Performance Specifications'.

Variable: STAGFST (common) **Question 4**

Definition: Stage of design where fire safety is first considered.

Only 156 out of the 202 respondents replied to this question, their responses are contained in Table 8-5. Consistent with the results of the previous question, 25 per cent of the respondents indicated to first consider fire safety during 'Inception', whereas 48 per cent seem to do so at 'Feasibility' stage, and 26 per cent at the stage of 'Spatial Design'. It follows that 73 per cent of the respondents reported to first consider fire safety before this latter stage is reached.

Variable: Group RELEV (common) **Question 5**

Definition: Relevance of fire safety to aspects of building design.

The total number of responses recevied for each of the 3 variables as indicated in Table 8-6, differ because some respondents did not provide complete answers. It may be observed that there is a decrease in the response frequencies for the category 'Constraint' when moving across from 'Visual-Aesthetic' to 'Constructional' aspects (from 68 to 41 responses). This seems to suggest that architectural firms tend to regard fire safety more as a constraint for the 'Visual-Aesthetics' than for either of the other two aspects of building design and least as a constraint for the constructional aspects; whereas the converse appears to hold for the 'Set of Rules' category (from 50 to 63 responses). This decrease of frequency as a 'Constraint' and increase as a 'set of rules' becomes even more evident if the combined response categories (e.g. 1+2, 2+3, 1+3) are cast back into the original categories.

Variable: Group TOPIC (common) **Question 6**

Definition: Ranking of fire safety topics.

This question was not answered fully by all respondents, some failed to rank all topics, while others gave tied ranks (i.e. same rank) to several topics. This called for corrections to the data and since the number of responses allocated to the 'other' variable were very few, it was excluded from the analysis along with the 11th positions. However, a maximum of 178 responses are shown in Table 8-7, from the values of which Table 4-2 was derived.

Following the procedure outlined during the discussion of the results to this question for the Practitioners (see Section 3.1.2 above) the value for the coefficient of concordance (W) calculated for this group was 0.35. The probability associated with the occurrence, under the null hypothesis (i.e. unrelated rankings) of a value as large as $\chi^2 = 511.9$, with 9 degrees of freedom, is better

than 0.001. On the other hand, the Friedman test was also performed, obtaining a value T = 608.1, which is significant at the 0.001 level. Hence, it can be concluded that there seems to be a significant moderate agreement among the Firms' respondents with respect to the importance given to each topic. The true or 'characteristic' ranking derived for this group is shown in Table 4-2 below.
The variable identification numbers in the upper row of the Table correspond to those indicated in Table 8-7 and in Appendix 5 under the variable name Topic.

Table 4-2
True Ranking from 'Architectural Firms'

Variables Topics	1	2	3	4	5	6	7	8	9	10
Sum of Ranks (Rj)	686	627	332	533	954	947	1173	932	1010	1242
Mean	4.3	3.9	1.9	3.0	5.5	6.8	7.7	5.9	6.2	8.1
True Ranking	4	3	1	2	5	8	9	6	7	10

The comments made by 31 respondents are condensed in Table 8-12. The 2 modal categories suggested that the rankings would depend upon the type of building considered (32 per cent) and that all topics were of equal importance and therefore the ranking was pointless. Some 26 per cent of the respondents echoed this latter comment indicating that all topics should be considered jointly. Finally, nearly 23 per cent of the respondents stated to have found the question difficult to answer.

Variable: GRAWAR, Group SUGRAWR (common) **Question 7**

Definition: Greater awareness to fire safety problems and suggested ways to improve it.

The dichotomous first part of this question was answered by 154 out of the total of 202 respondents. As shown in Table 8-8, 74 per cent of them indicated that architects should have a greater awareness of fire safety problems.

In elaborating on this point 245 responses were provided, as reported in Table 8-9. As in the previous group, the responses were divided into two classes, viz: those related to the profession and education in the top part of the table and the others, dealing with general issues, in the lower section of the table. In absolute terms, 90 responses suggested that more and better education was needed: 46 of these responses indicated that the schools should provide special (i.e. particular) courses as part of the formal cirriculum and that they should be examinable; an additional 44 responses indicated mid-career, short and specialised courses at regular intervals, so that fire safety "in the use of buildings is synonymous with function in use" could be continually emphasised and reminded. Another 28 responses were concerned with an increase of fire publicity among the profession with a greater feed-back from actual fires and design errors. Finally, 33 responses suggested, as a way to improve awareness, comments in relation to current legislation; 23 of them stressed the lack of unity and coordination in its general structure and implmenetation; and a further 9 responses were to do with the inconsistencies in the interpretation of regulations (blaming the legal jargon).

Variable: KNOW (common) **Question 8**

Definition: Present fire safety knowledge.

This question was answered by 161 respondents, as indicated in Table 8-10, of whom 78 per cent described as 'Adequate', the fire safety knowledge existing in their firms. About 10 per cent of the respondents considered their knowledge to be 'More than adequate', while a similar proportion reported to have an 'Inadequate' fire safety knowledge.

Variable: Group ORIKNOW (common) **Question 9**

Definition: Origin of fire safety background knowledge.

The responses given to each of the group of 7 variables (sources of knowledge) comprised in this question are shown in Table 8-14. The highest frequency of responses (156) was yielded by the variable 'Previous Design Experience', about 85 per cent of them stated that it was the origin of at least a third of their knowledge, mostly derived from consultation with fire prevention officers (35) and with other kinds of advisors (18) e.g. fire safety, insurance, etc. (see Table 8-13). The next most common source was indicated to be 'Trade literature' accounting for 113 responses, though representing a proportion of one third or less for 79 per cent of these responses. About 87 per cent of the 75 responses attained by the variable 'Talks and Seminars' indicated that a third or less of their knowledge came from that source. The low frequency and proportion of contribution received by the 'Schools of Architecture' was most unexpected. They were given only 62 responses of which 92 per cent indicated to have derived one third or less of their fire safety knowledge.

Finally, among the 72 responses given to 'Other' sources, 33 stated publications (e.g. legislation, books, reports and journal articles) 9 indicated their own interest in the subject and a further 4 responses reported their involvement in teaching as origins of their fire safety knowledge (see Table 8-13).

Variable: Group SOLVED (common) **Question 10**

Definition: Ways of solving fire safety problems in building design.

The distribution of the responses, from the 155 respondents who answered this question, is given in Table 8-15. The majority of the respondents (67 per cent) were of the opinion that fire safety problems in building design could be solved more efficiently through better understanding and education for architects. The second variable being subscribed by 41 per cent of the respondents was 'Scientific Research', followed by 'Constructional Design' (meant to read 'Architectural design' in the table) with 29 per cent of the respondents. Some 53 per cent of the responses were retrieved between the two variables that could be considered within the domain of the architectural profession, i.e 'Architectural Design' and 'Better understanding - education'. On the other hand, about 25 per cent of the respondents indicated 'Full enforcement of existing regulation' while close to 6 per cent claimed 'Additional Fire Regulations'.

Although this question had no space assigned for comments nor had it the 'Other' category, 11 respondents chose to complement their answers with the comments shown in Table 8-16. Five of those comments were associated with some of the respondents who had claimed for additional or full enforcement of regulations, elaborating that new simiplified and rationalised legislation would go a long way in solving current fire safety problems.

Variable: Group CONSUL (common) **Question 11**

Definition: People consulted for fire safety advice.

The responses for the 9 variables in this group are shown in Table 8-17. In this table, the group of people that seems to be the most consulted for fire safety advice are the fire prevention officers, having received 159 responses; two thirds of these responses indicated a contribution in excess of 30 per cent. The second most fequently consulted group is that of the 'Building Control Officer' gaining 133 responses, with a contribution of one third or less for 61 per cent of them. The third order is shared between 'Fire Research Station' (71) and 'Central Government Officials' (70) with contributions of up to a third indicated by 89 per cent and 80 per cent of the responses respectively.

Variable: CATADV **Question 12**

Definition Category of fire safety advice received.

This question was devised to complement or rather qualify, the information attained by the previous one: having determined who gives the advice, it was considered important to ascertain how good it was, as judged by the receiver of that advice. The answers given by 180 respondents are shown in Table 8-11.

From the type of answers received, some misunderstanding seems to have been caused by this question. The first category (i.e. 'General Interest') was intended to cater for those respondents who thought that the advice received was applicable to both, the project involved and others whilst, the second category (i.e. 'Particular Interest') was for advice relevant to the project considered. Unfortunately, 15 per cent of the respondents used both categories. If these responses are re-arranged into the original categories, the distribution would be as follows: 'General Interest' 39 per cent and 'Particular Interest' 60 per cent.

Variable: Group PUBLIC (common) **Question 13**

Definition: Publications used for fire safety information.

This question was answered by 192 respondents therefore, it is one of the questions obtaining the highest response frequency. Table 8-18 displays the distribution of the responses among the 13 variables.

The publication indicated, by 96 per cent of the respondents, as the most frequently used is the 'Building Regulations'. The next most used publication is the 'BRE Digest' noted by 71 per cent; followed by 'Fire Legislation', said to be used by 63 per cent; 'Government Departments' Publications' obtained 59 per cent and 'BSI Codes and Standards' were reported by 57 and 52 per cent of the respondents respectively. The publications used by the least number of respondents appear to be 'Home, Welsh and Scottish Office' documents and publications from the 'Fire Protection Association' with only 15 per cent. It is noteworthy that the combination of the official legislative groups of publications represented 58 per cent of all responses given to this question.

Variable: Infav, Group CMINFAV (common) **Question 14**

Definition: Fire safety information available to the profession.

The dichotomy forming the first part of this question was answered by 171 respondents, as shown in Table 8-19. It indicates that 70 per cent of the respondents seem to think that the information available to the architectural profession is sufficient to deal with fire safety problems in building design.

The second part of this question, being contingent to the first, was intended to be answered by those respondents that expressed dissatisfaction. It was divided in two parts, thereby guiding the type of responses into two streams of suggestions, namely: how the respondents thought fire safety information should be presented and what additional type of information they would like to be made available. Although only 51 had given a negative answer to the first part of the question, about 102 respondents contributed with their suggestions to either part, and 40 of them did so to both parts; Table 8-20 summarises all these responses, it has been divided in two sections corresponding to the parts of the question. In the upper part (presentation of information) the plea of 27 responses was, here again, for a comprehensive, authoritative and illustrated handbook or manual, regularly updated (loose-leaf) with information on each type of building, designed for the architect's needs and with references for further consultations. Some 20 more responses were concerned with the publciation of guides to regulations, with specific design information on each building type, and with simple and clear distinction between requirements and recommendations. A further 29 responses were related to the legislation, 9 of which (lower half of table) suggested that they should be consolidated under one authority and one publication; 14 suggested the need for better regulations, clearly written in plain language and with reasons behind the requirements, thus less open to individual interpretations; 12 others stressed the need for simplification of the current legislation with diagrammatic presentations and of national coverage; another two indicated that is was a problem of having too many fragmented requirements scattered in as many different publications, suggesting the need for a general cross index to all fire safety information for building design.

A considerable number of responses (46) indicated that all too often legislation is changed without proper due notice to those affected by the changes. On the other hand, it was stressed that much of legislation has not been amended to include new techniques and new developments.

Variables: Group PRBAPL, PROBAPL (common) **Question 15**

Definition: Main problems in the application of fire safety to architectural design.

This final open-ended question was answered by 195 respondents; from their suggestions and comments 540 responses were generated which are shown in Tables 8-21 and 8-22.

By and large, the most frequently indicated problem associated with the application of fire safety seems to be in relation to legislation, its implementation and interpretation. Indeed, out of the 317 respondents condensed in Table 8-22, at least 56 per cent were concerned with these issues. Their distribution is as follows: lack of coherency and consistency in its interpretation among the authorities involved, was included by 92 responses; the architect is caught in the middle of any discrepancies, having to satisfy the requirements from all parts including cost reduction to the client in the process. The rigidity of the requirements and the inflexibility in their application as a hindrance to design freedom, was reported by 59 responses; thus, attempts made to provide new solutions are rejected unless they fall within the pre set range in the legislation. Moreover, no indication of possible relaxation is ascertained before an official decision, which usually takes a long time, hence the tendency is to accept the norm solution for expediency. A further 28 responses pointed out the complexity, lack of clarity and fragmentation of existing regulations, with precise wording carefully phrased for legal as opposed to practical application purposes, albeit that the majority of users are not lawyers. This unreadable and confusing nature of regulations has been indicated as the main cause for the difficulties in understanding and for the multiplicity of their interpretations.

Another group of 27 respondents blamed themselves (i.e. architects) for a lack of knowledge on the entire fire problem, understanding of the basic principles behind the requirements of legislation, awareness of its integral importance in functional design and ability to translate that knowledge into design decisions.
Cost was remarked by 27 responses mainly in respect to the low priority given to fire safety by clients, while considering project budget during brief preparation; similarly, difficulties in foreseeing requirements for costing purposes.

The other group of problems being indicated, frequently by the responses (Table 8-21) are those related to materials selection, their specification and performance for fire safety (42 responses) emphasising particularly the case of new materials where there is insufficient guidance and coordinated reports available, leaving test interpretations almost to personal preference. Means of escape is another area that 41 responses indicated as problematic, because of difficulties in achieving protected routes while having to satisfy other requirements; this is more so when criteria are not available for all bulding types, hence relying on the fire prevention officers' interpretations.

A variety of points (79 responses) were made stressing the conflicts between fire safety requirements and other aspects of building design. Such is the case of 33 responses indicating the confrontation with client's brief. Since some clients are unaware of the full implications of fire safety, their briefs are often devoid of any provisions in that respect. Hence architects have to overcome their objections and convince them that the precautions are necessary, despite their reluctance (paranoia) to accept requirements which often reduce their expectations and profits. Similarly, 29 responses indicated the conflicts existing with fire safety requirements and the normal day to day operation of buildings, as in the case of the contradiction between maintaining both fire exits and access control for security purposes (insurance) or, the restrictions imposed on personal activities and movement by fire doors. Finally, still under the same line of conflicts created by fire safety requirements, 17 respondents emphasised the limitations introduced to internal planning and decor, particularly in relation to compartmentation and means of escape, fire resistance and siting of fire protection equipment. Such conflicts were suggested to be caused by the "rigid application of simplistic and arbitrary dimensional rules".

Bearing all the above in mind, it was perhaps not unexpected that 30 responses were emphatic in stating that the main problem of fire safety in architectural design was to achieve a balanced solution, whereby fire safety is conciliated with all other requirements.

3.1.4 Fire Prevention Officers

This last questionnaire comprised more open ended questions and space for comments than any of the others. The 60 respondents made extensive use of these features by providing lengthy answers, which required equally lengthy and careful consideration to abstract the set of words that best represented the ideas expressed in their answers.

The questionnaire has been reproduced in Appendix 4 and the tables of results are contained in Appendix 9.

Variables:ADEKNOW and **COMADEK** **Question 1**

Definition: Present fire safety knowledge in architectural profession adequate.

This dichotomy complemented with a contingency question, was answered by all 60 respondents. Table 9-1 shows that 88 per cent of them thought that the fire safety knowledge existing amongst the architectural profession was not adequate for them to achieve acceptable design solutions.

The suggestions to increase that knowledge, made by 44 respondents are found in Table 9-2 and, since this question is specific to this group, a brief explanation of the categories in that table is given below. It was divided into two parts, viz: the upper part including comments of general nature mostly applicable to practitioners while the lower part is more concerned with educational issues. Nearly 30 per cent of the respondents suggested that architects should put more emphasis on fire safety and on the requirements of codes and regulations, from the early design stages, because "with notable exceptions, architects do not seem convinced of the need for fire safety precautions . . .". An equal number of responses indicated that architects should be made aware of the effects upon design of existing regulations and of their responsibilities. Some 25 per cent stressed the benefits of improved liaison and communication between architects and FPO's, including greater contacts and consultation. Reinforcing this point, 18 per cent of the respondents complained about the reluctance of architects to accept advice, considering it as an intrusion into their designs. Another 11 per cent indicated that the RIBA should change its attitude and become more involved in activities related to fire safety (i.e. greater participation).

In relation to education (lower part of table) 84 per cent of the respondents that offered comments suggested that the subject should receive a greater attention at the school level, with a deeper coverage on a compulsory basis, with greater dedication and as part of the formal examinations or qualifications required. Another 57 per cent indicated that practitioners should attend periodical short courses and seminars, ('Mid Car Educ') organised or sponsored by the RIBA and combined with practical demonstrations, that would improve and update their knowledge and stimulate their interest in the subject. Finally, 18 per cent pointed out that an apparent lack of understanding of the fundamental concepts related to fire, seemed common among practitioners.

Variables: INVEDUC, COM21 **Question 2**

Definition: Involvement in architectural education.

This question was perhaps a little more complicated than the rest because there were 4 in 1. The first part was a dichotomy which was answered by all 60 repsondents. Table 9-3 shows that only one third of the Fire Brigades participate in fire safety education in the school of architecture.

The remaining 3 parts of the question were intended to be completed by those respondents who were related to any of the schools. Table 9-4 lists the 17 schools with which fire prevention officers indicated to be collaborating. Three more were noted but since they were technical colleges (e.g. further education) they have been omitted.

The most frequent form of contribution made by the brigades are lectures (65 per cent) project work revision (40 per cent) and occasional talks (20 per cent). The mean duration of those contributions is 9 hours per year for the 12 respondents who indicated their contribution (range 2-25 hours/year).

Variables: Group TOPIC (common) **Question 3**

Definition: Ranking of fire safety topics.

A maximum of 56 out of the total of 60 respondents indicated their order of importance for most of the fire safety topics in this question. Table 9-5 shows the frequencies achieved by each topic. It should be noted though, that only 9 topics appear in the table; 'Combustion Technology' and 'Other' were included in the ranking of so few respondents (6 and 4 respectively) that they would have produced unrealistic results, had they been considered in the calculations which follow. Consequently, the 11th rank position was also excluded and the data in the table was adjusted accordingly.

Having done that, the consideration outlined previously (see Section 3.1.2 above) for the analysis of the responses to this question were followed and Table 4-3 was prepared. The coefficient of concordance was determined to have a value of W = 0.51 which can be regarded as a substantial association and χ^2 value of 224.7 with 8 degrees of freedom is significant beyond the 0.001 level. The two way analysis of variance by ranks test was also calculated, obtaining a value of T = 236.5 which is also significant beyond the 0.001 level. Therefore, it can be concluded that the rankings produced by the respondents of this group show a substantial agreement which is higher than it would be by chance.

Table 4-3

True Ranking from Fire Prevention Officers

Variables Topics	1	2	3	4	5	6	7	8	9
Sum of Ranks Rj	180	241	129	224	328	429	378	408	368
Mean Rank	3.2	4.6	2.3	4.0	5.9	8.1	6.9	7.3	6.6
True Ranking	2	4	1	3	5	9	7	8	6

Several comments were made by the respondents, among them, three indicated difficulties in ranking the topics. Another two stated that since many of the topics were interrelated and in most cases should be considered jointly, their ranking in isolation was not practical.

Variable: Group RELEV (common) **Question 4**

Definition: Relevance of fire safety to aspects of building design.

The answers given to this question, by 58 respondents, are collected in Table 9-6.

It should be noted that the modal category of response for the 3 variables (aspects) is as follows: for the 'Visual-Aesthetic', fire safety is a 'Constraint' (67 per cent) whereas, for 'Environmental' and 'Constructional' aspects of building design, 'It Makes a Positive Contribution' (for about 46 and 53 per cent of the respondents respectively). Moreover, the frequencies for the second most common categories are well below the modal, for the case of 'Visual' and 'Constructional' aspects (twofold at least) but not for the 'Environmental' aspects, where the difference is only of about 14 per cent. This seems to suggest that the agreement of respondents, about the relevance of fire safety, for environmental aspects is less than for the rest. Fire safety was considered 'Irrelevant' to 'Visual-Aesthetic' and 'Environmental' aspects by 4 respondents, but none did so for the 'Constructional' aspects.

Variable: STAGADV **Question 5**

Definition: Stage of design where advice should be first sought.

Table 9-7 contains the responses from the 59 respondents who answered this question. It shows that the majority (61 per cent) of those respondents suggested that architects should seek fire safety advice during the preliminary stages of the building design process.

Looking at these results, it seems possible that some confusion and misunderstanding was caused by the wording used in the response categories offered by this question. It was assumed, perhaps wrongly, that since FPO's are involved in building design (though indirectly) they were familiar with design phraseology, hence they should not have any problem in differentiating the meaning of the categories, particularly the first two (i.e. inception and feasibility).

Variable: STAGSUB **Question 6**

Definition: Stage of design where projects are submitted for comments.

This question tried to determine the stage of design where projects are actually submitted to the FPO's for comments before submission for formal approval. The answers from the 58 respondents are shown in Table 9-8.

Some 48 per cent of the respondents indicated that new building projects are submitted to them at an 'Advance Stage' (i.e. detailed plans almost completed); only two per cent seem to receive the projects at an 'Early Stage'; about 24 per cent do so at an 'Intermediate Stage' and the remaining 26 per cent stated to receive projects in a too late stage, with plans completed.

It should be mentioned that the above fractions were derived by converting into the initial categories the multiple answer categories (e.g. 2 + 3, etc.).

Variable: CONSUL (common)**CMCONS** **Question 7**

Definition: People consulted for fire safety advice.

This question differs from its homologue in other questionnaire groups in that the 'Fire Prevention Officer' as a possible answer has been excluded. The distribution of the 96 responses contributed by the 58 respondents is depicted in Table 9-9.

It appears that the 'Building Control Officers' are the group most frequently consulted for fire safety advice, besides FPO's as indicated by 95 per cent of the respondents. Second most common are 'Central Government Officials' (e.g. DoE, HSE, etc.) noted by 45 per cent of the respondents.

The comments subscribed with this question are shown in Table 9-10. It is noteworthy that the most usual comment (28 per cent) referred to the fact that consultation takes place mainly due to the statutory requirements because "people are concerned more with mercenary attitudes". Another group of comments (14 per cent) indicated that architects seem not to be aware of the [illegible] were not greatly interested in the subject.

Variable: PROBAPL, PROBAPL (common) **Question 8**

Definition: Main problems in the application of fire safety to archtiectural design.

This open ended question was also answered by 58 respondents and the 158 responses abstracted from their comments are shown in Tables 9-11 and 9-12. The most frequently repeated response (26) pointed out that fire safety requirements inhibit the architect's design freedom. These effects were said to be augmented by the architects' reluctant attitude to alter designs for purely aesthetic reasons, due to the common 'fait acomplis' or afterthought of fire safety,regarding any suggestion as detrimental. This situation often leads to unnecessary antagonisms and compromises in the solutions achieved.

Another common problem indicated by 19 responses, seems to be the incompetent architects "who apply rules without the understanding of concepts on which they are based", failing to appreciate the implications of fire safety in their design schemes and to advise their clients adequately.

Similarly, 18 responses stressed as one of the main problems the 'extra' cost to implement the requirements. Clients cannot understand the reasons for the requirements because priorities are placed elsewhere. It seems that "architects' first aim is to satisfy clients' needs and then, try to build fire safety around them at minimal cost". This could explain why "architects often contest the cost of implementing requirements rather than questioning the need and reasoning leading to the requirements".

As noted in the previous questionnaire group, 16 responses indicated that the main problems were related to means of escape, compartmentation and the like. A further group of 26 responses were concerned with the conflicts which stemmed from fire safety requirements such as clashes with client's briefs e.g. aesthetic features, continuous spaces (12); those associated with movement of people and with normal operation of buildings e.g. fire doors (7) and, the reduction in usable space and other planning limitations (7).

Variables: SOLVED (common) **CMSOLVED** **Question 9**

Definition: Ways of solving fire safety problems in building design.

The six variables in this question received 111 responses from 59 respondents, as shown in Table 9-13. It seems that 88 per cent of the fire prevention officers are of the opinion that fire safety problems in building design could be solved more efficiently by a 'Better Education and/or Understanding' on the part of the architects. The second most frequent answer was given as 'Constructional Design' (34 per cent) followed by 'Full Enforcement of Existing Regulations' (22 per cent) and 'More Scientific Research' (20 per cent). For this group of respondents, the responses given to 'Constructional Design' and to 'Understanding Education for architects accounted for 65 per cent of the total.

The above responses were qualified by comments made by 35 respondents, which have been summarised in Table 9-14. The most usual (8) emphasised the need for architects to give greater attention to the study and application of fire safety requirements during design stages, rather than expect to obtain all the answers from somebody else. Some seven responses indicated the necessity to improve the overall knowledge of fire research findings, so that their application to building design would be increased. Of those respondents who in Table 9-13 suggested that a solution would be in 'Additional' or 'Full Enforcement' of regulations, five observed that a rationalisation and improvement in the legislation would solve part of the current problem. A similar number of responses expressed that a greater liaison between architects and FPO's, by means of earlier and more frequent consultation, would perhaps solve some of the problems.

Variable: INFAV (common) **CMINFAV** **Question 10**

Definition: Fire safety information available to the profession.

The answers given by 59 respondents to the first part of this question, are shown in Table 9-15. They indicate that 76 per cent of the respondents thought that the information available to the architectural profession was sufficient to deal with fire safety problems in building design.

The second part was an open ended question, answered by 27 respondents (46 per cent), their responses are to be found in Table 9-16. According to 12 of those responses, the issue seems to be that although there is sufficient information available many architects appear not to be aware of it, nor where to find it or how to use it. Some respondents took this point further, suggesting different ways to remedy that situation; among which six responses stressed the need to consolidate existing information into a single comprehensive book. Another three added that the book should contain a simplified and improved version of current information. An equal number of responses suggested the creation of a national information centre on fire matters; another three asked instead, for the publication of a general fire safety index that would serve all interested parties.

Variable: GRAWAR, Group SUGRAWR (common) **Question 11**

Definition: Greater awareness to fire safety problems and suggested ways to improve it.

From the results obtained for the dichotomy of this question, there can be no doubts how respondents felt about it. Table 9-17 shows that all except one (98 per cent) of the 59 respondents coincided in considering that architects should have a greater awareness of fire safety problems.

The contingent open ended part of this question was answered by 57 respondents, their 152 responses have been summarised in Table 9-18. The comment most repeatedly made suggested more education throughout the architectural profession. Thus 32 responses stated the need for more involvement with fire safety at school level, with a greater emphasis for its integration into design from early training and for its requirement as part of final examinations. Whereas specialist short courses and seminars were indicated for the practising available information to building design was also expressed here (as in Question 9 above) but by a larger number of responses (21).

Finally another possible way to improve awareness, which was suggested in 11 of the responses, was to encourage professional journals to place more emphasis on the subject by devoting a permanent section to report on incidents caused by, or related to faults in design.

Variable: RAPORT, CMRAPORT **Question 12**

Definition: Present relationship with architects.

Table 9-19 shows that 70 per cent of the 60 fire prevention officers answering this question felt satisfied with the relationship between their department and the architects in practice. The above dichotomy had a contingent open ended question intended to be answered by those respondents not satisfied with the relationship with the architects. The question was divided into parts, in which respondents were asked first, to state their reasons and second, to make suggestions to improve the relationship. As noted in previous questions with similar structure, a greater number of respondents made more comments than they were expected to make (27 instead of 18). Their responses are shown in Table 9-20, the table has also two parts corresponding to those in the question.

Amongst the reasons given for an unsatisfactory relationship, 12 responses noted the reluctance of architects to seek or accept advice (specially if it meant changes in the design). This attitude worsens with insufficient consultation in early stages of design. Another two responses indicated problems of insufficient qualified personnel, due to manpower reduction and rotation within the brigades, which made it difficult to provide a consultancy service.

On the other hand, the 3 main groups of suggestions made to improve the relationship were as follows:

a) 11 responses indicated better liaison between architects and fire prevention officers, both at national and local levels, to encourage mutual understanding

b) 8 insisted again that the need was for better eduction throughout the profession and

c) 5 responses advocated for consutlation at the earliest possible stage.

Variable: Group REFADV, CMREFADV **Question 13**

Definition: Reference for special advice.

The purpose of this question was to determine the sources of fire safety advice to which fire prevention officers turned, when faced with special problems beyond the scope of legislation. The responses contributed by 58 respondents are shown in Table 9-21. Most fire prevention departments (86 per cent) seem to use the Fire Research Station for special advice, the second most commonly indicated was the Home Office (78 per cent) followed by consultation with other prevention departments (64 per cent). The Health and Safety Executives are consulted by 53 per cent and the least frequently consulted, as indicated by 38 per cent of the respondents, are the building control officers.

The comments offered by a total of 37 respondents have been condensed in Table 9-22. Some 11 responses stated that the people consulted would depend on the project or problem concerned, another 9 responses indicated that the majority were used indiscriminately whenever necessary. The rest of the responses identified additional groups used for advice.

Variable: KNOW (common) **CM KNOW** **Question 14**

Definition: Present fire safety knowledge.

The distribution for the 59 responses obtained for this question is indicated in Table 9-23. It shows that 73 per cent of the respondents described as adequate (or sufficient) the fire safety knowledge existing in their department. Some 14 per cent considered to have a more than adequate and only 10 per cent noted an inadequate knowledge.

Some 37 respondents made comments with this question which are shown in Table 9-24. As indicated by 12 responses, it seems that the expertise of the fire prevention officers is open to question due to the new duty system in the fire brigades (i.e. greater interchangeability of roles) which means less practical experience. Another group of 10 responses stressed the constant problem of keeping abreast with new developments and materials which calls for a continual updating of existing knowledge. Finally, 9 responses noted that in some specialst areas, if sufficient knowledge was not available, advice was sought elsewhere.

Variable: Group SUGG **Question 15**

Definition: Further comments and suggestions.

As in the case of the questionnaire for the 'Architects in Practice', this last item was a space provided for final remarks or any additional suggestions that respodnents may have felt worthwhile mentioning. Some 23 did so, but in the main, it was to emphasise points already made when answering the questions. Therefore, a table for those comments has not been included.

3.2 SUMMARY OF RESULTS

The justification for considering the three groups of population included in the survey for the present study, has been established previously in Section 1 of Part 3

The conclusions that could be drawn from the survey results obtained for each group would allow, at best, a generalisation about the problem associated with fire safety in building design, as seen partially or reflected by the group being considered. Several identical questions were included in the various questionnaires. They have been identified in Table 3-2 and in the preceding description of results by the word 'common' alongside the variable name. Some of these questions were only common to both questionnaires for the architects whereas some others were common to all four questionnaires.

The aim pursued with these questions was to obtain a measurement from each group of respondents for the same variable or group of variables. By comparing the results obtained, an indication of the degree of agreement or disagreement existing among the groups surveyed should be provided. This in turn, should be indicative of areas of generalised attitudes (opinions) in the former case, or on the contrary, areas of possible conflicts for diverging opinions, in the latter case. In this way, it is expected that conclusions may be drawn to embrace a larger portion of the whole problem of fire safety in building design. Some preliminary findings of the survey have been published elsewhere[10].

This section is intended to summarise the results described in the preceding one and to aggregate the results from both architects' groups, so that in the next section the results can be compared. Thus, the survey findings and conclusions should provide answers to the research questions defined in Section 2 of Part 2, namely: how fire safety is accounted for in building design and what conflicts are ascribed to the interaction of fire safety and building design.

3.2.1 Schools

The 34 respondents of the questionnaire sent to the schools were, with two exceptions, coordinators and/or lecturers for the subject of fire safety. Most of them (70 per cent) considered themselves to have an adequate knowledge of fire safety, at least for teaching purposes. According to the opinions expressed in the answers, fire safety seems to be regarded mainly as a constraint in respect to its relevance to visual-aesthetic, environmental and constructional aspects of building design. Though, for these latter two it also seems to make a positive contribution.

In relation to fire safety information, 58 per cent of the respondents were not satisfied with the information available to the schools. The lack of a comprehensive book and suitable teaching aids were some of the reasons given; the great emphasis placed on legislation and the small amount made on principles and the fragmentation of existing information, were also pointed out.

Better education and understanding for architects was suggested by 91 per cent of the respondents to be a more efficient way of solving fire safety problems in building design. To increase awareness of these problems, suggestions were made by some 85 per cent of the respondents. The improvements most commonly suggested were: more teaching aids, e.g. audio-visual presentations and demonstrations (25 per cent); a comprehensive publication or handbook (24 per cent); three equal proportions (18 per cent each) indicated visits to scenes of fires to gain personal experience; publicity on fire within the profession; and more principles and less legislation. A final group of 15 per cent wanted more time to cover the subject at the schools.

Regarding the attention and dedication given to the subject of fire safety in the architectural course, although 85 per cent of the respondents reported it to be obligatory, only 27 per cent sent some form of syllabus. Furthermore, a closer look at these course outlines revealed that only 4 schools (13 per cent) seemed to have a separate course on the subject (duration ranging from 2 days to 1 term).

A large proportion of the schools responding (44 per cent) appeared to concentrate their efforts on the subject during the first and second term of the third year; which is before the year out for the students, as recommended by the Birmingham course plenary session (Section 3.1.1, Part 2). The mean dedication time was 5 hours/term and the mode was 2 hour/term.

The fire safety input to the architectural course consisted of lectures in all 31 schools responding to this question (52 per cent in 2 or more years). Studio tutorials and project discussions seem also to be used in 90 and 74 per cent of these schools respectively (86 and 74 per cent in 2 or more years).

The main groups of people contributing to fire safety teaching in the schools were full time lecturers, indicated by 91 per cent of the respondents; building control officers by 64 per cent; fire brigade officers by 39 per cent and part time lecturers by 33 per cent.

The course contents included the topics of smoke control, escape route design and fire resistance in the 32 schools that responded to this question; legislation (97 per cent) detection systems (81 per cent) suppression systems (78 per cent) risk assessment (56 per cent) and management (31 per cent). The six publications most commonly indicated by 32 schools respondents were: Building regulations used in 97 per cent of them; fire legislations (81 per cent) BRE digests and FPA publications (75 per cent) and text books, government department publications and BSI standards (63 per cent each). Moreover, the responses cast on legislation and authoritative guidance accounted for 48 per cent of the total.

Finally, the assessment of the students' performance in this subject was indicated to be carried out mainly as part of a design project in 28 of the responding schools (89 per cent of which during 2 or more years) written examination was used in 21 of them (48 per cent of which during 2 or more years) and written report was used as a method of assessment in 16 of those schools (25 per cent of which in 2 years).

3.2.2 Architects

The results for the groups 'Architects in Practice' (Practitioners) and 'Architectural Firms' (Firms) have been presented in Section 3.1.2 and 3.1.3 above. Since these groups were both samples for the same population (i.e. the architectural profession) it was therefore necessary to determine whether they shared similar views or not. Their answers would indicate their relative positions regarding the main issues under enquiry, as it was assumed to be the case in Section 1.2.2 Part 3. This was achieved by comparing the results obtained in those 13 questions that were common to both groups. Thus, the proportions of responses in the various categories for the different questions from one group, were compared with the proportions of responses for the same questions from the other group. Then, the Chi-square test was used to determine the significance of the differences between the frequencies of the two independent samples[8b,9a]. Of course, in all cases the null hypothesis being tested was that the distribution of the responses in the different categories was the same for both groups of architects.

To avoid dull repetitions, only those cases where the differences have been found to be significant will be discussed in some detail; for the rest, that is where both groups seemed to coincide, or the differences are not significant, the discussion will consider both responses as if they were from one single group of architects.

As could have been predicted, a larger proportion of firms seem to deal with those types of building associated with larger scale design projects and also, they seem to be engaged with more types than the individual practitioner. Indeed, firms' respondents indicated the following as the most frequent types of buildings: offices (76 per cent) industrial (68 per cent) residential (59 per cent) and sports and leisure (43 per cent) whereas for the practitioners, residential (87 per cent) educational and industrial (40 per cent) and offices (37 per cent) were given as the most frequent types of buildings. This difference in the responses was confirmed by the test of significance, the calculated χ^2 value was 15.81 with 8 degrees of freedom which is significant at the 0.05 level. Therefore, the null hypothesis was rejected and it was concluded that there is a significant difference between the responses of the two groups.

The stage of the design process where fire safety is first considered, by practitioners and in the firms, was also found to be different. For the former group 'Spatial Design' was the modal stage (about 44 per cent) followed by 'Feasibility' (30 per cent) and 'Inception' (22 per cent) whereas in the Firms group, 'Feasibility' was the modal (48 per cent) with 'Spatial Design' and 'Inception' receiving about 25 per cent of the responses each. This difference was tested, obtaining a value of $\chi^2 = 8.37$ with 2 d.f. which is significant at the 0.016 level. Here again the null hypothesis was rejected concluding that a greater proportion of firms seem to consider fire safety earlier than the practitioners. It was thought that the existence of a fire safety advisor amongst the members of the firms could have induced the earlier consideration but only 10 per cent of the firms stated to have such an advisor.

The distribution of the responses obtained for the stages of design where fire safety is taken into account, indicated that both groups gave uniform consideration during most stages. The exceptions being the 'Inception' stage where consequent with what has been said above, only 25 per cent or less admitted that they consider fire safety; also 'Maintenance Manual' stage noted a drop of frequency being indicated by about 30 per cent of the respondents.

The relevance of fire safety to aspects of building design was expressed in respondents' written opinions. It appears to be considered as a 'Constraint' for the 'Visual-Aesthetic' aspects of building design by some 63 per cent of the practitioners and by 49 per cent of the firms. It has also been indicated as a 'Constraint' for 'Environmental' aspects by 45 per cent of each group. However, the responses for its relevance to 'Constructional' aspects were divided, about 52 per cent of the practitioners indicated it to be a 'Constraint' whereas 51 per cent of the firms stated it to be a 'Set of Rules for Compliance'. The significance test yielded χ^2 values of 3.74, 2.72 and 8.8 with 3 degrees of freedom; of which the latter is the only significant at 0.035 level. It can be concluded that both groups consider fire safety as a 'Constraint' relevant to 'Visual-Aesthetic' and 'Environmental' aspects of building design. Practitioners also considered it as a 'Constraint' for constructional aspects but for the firms its relevance is as a 'Set of Rules'.

The fire safety knowledge existing among the architects seems to be 'Adequate', at least for 75 per cent of the respondents; nearly 9 per cent of the firms described their knowledge as 'More than Adequate'. On the other hand, about 10 per cent of the firms and 23 per cent of the practitioners stated that they have an 'Inadequate' knowledge of fire safety.

The most common origin of fire safety knowledge was indicated to be 'Previous Design Experience' for 83 per cent of the practitioners and 77 per cent of the firms. The modal proportion of its contribution was between 31 and 50 per cent for the former, and between 51 and 70 per cent for the latter. Some respondents noted in their comments that it was gained mainly in consultations with FPO's and other advisors. The next most frequently indicated source of knowledge was 'Trade Literature' with 67 and 56 per cent respectively and with a modal contribution proportion between 11 and 30 per cent for both groups. It should be emphasised that few responses indicated 'Schools of Architecture' as a source of knowledge; 57 per cent from the practitioners group and 31 per cent from the firms. Moreover, the maximum frequency observed for the proportion of contributions was between 11 and 30 per cent in both groups.

Regarding the information available to the architectural profession, the two groups expressed different opinions. Some 53 per cent of the practitioners stated disatisfaction, per contra 70 per cent of the firms reported to be satisfied with the information available. This discrepancy was proven to be significant at the 0.013

level, for a χ^2 value of 6.35 with 1 degree of freedom. The analysis of the comments attached to this item showed that a large proportion of them were dedicated to legislation and regulations. It seems as if the respondents had taken 'fire safety legislation' as a synonym of 'fire safety information'.

The types of publication used by respondents provided additional evidence on this latter aspect. Indeed, over one half of the responses (53 and 58 per cent for practitioners and firms) indicated publications of the official or legislative type, whereas few responses were received on text books (4 to 5 per cent). The publications that were indicated by most respondents were: Building regulations (100 per cent) BRE digest (70 per cent) BSI codes (67 per cent) journal articles (60 per cent) and fire legislation (57 per cent) for the practitioners' group. Similarly, the firms indicated: Building Regulations (96 per cent) BRE digest (71 per cent) fire legislation (63 per cent) government department publications e.g. DHSS (59 per cent) and BSI codes (57 per cent). The differences between the two groups were not found to be significant.

Also in this area of knolwedge and information available, further evidence was indicated by the respondents regarding the people consulted for fire safety advice. Fire prevention and building control officers were the first and second most common answers for both groups. The modal contribution made by the former was between 31 and 70 per cent for the practitioners and between 31 and 50 per cent for the firms. The modal proportion of the contributions made by the latter were indicated to be between 11 and 30 per cent to both groups.

The quality of the advice received from these sources was classified as of 'Particular Interest' (i.e. direct use) for the specific project under consideration by 60 per cent of respondents from the group of firms. A further 39 per cent qualified the advice as of 'General Interest'.

Both groups of respondents were asked to rank in order of importance 10 topics related to fire safety in buildings. The 'best estimation' of the true ranking and the sum of ranks for each group are given in Table 4-4.

Table 4-4

True Ranking from Architectural Groups

	Variables (Topics)	Risk Assessment 1	Smoke Control 2	Escape Route Design 3	Fire Resistance 4	Detection Systems 5	Suppression Systems 6	Management 7	Legislation 8	Human Behaviour 9	Combustion Technology 10
Practitioners	Sum of Ranks	95	95	58	106	147	195	202	146	144	185
	True Ranking	3	2	1	4	5	8	9	7	6	10
Firms	Sum of Ranks	686	627	332	533	954	947	1173	932	1010	1242
	True Ranking	4	3	1	2	5	8	9	6	7	10
Architects	Total Sum of Ranks (Rj)	781	772	390	639	1101	1142	1375	1078	1154	1427
	Mean Rank	4.3	4.1	2.0	3.2	5.6	6.9	7.7	6.0	6.2	8.1
	Architects True Ranking	4	3	1	2	5	8	9	6	7	10

The agreement or correlation between these two sets of rankings was measured by Kendall's rank correlation coefficient[7b]. The value of this coefficient equals 1 for a perfect concordance (i.e. same ranking) and −1 for a perfect discordance (i.e. reverse ranking)[9b]. The value calculated was 0.87 which indicates a very strong positive correlation between these two rankings. The significance of this association was determined by finding the probability associated with the occurrence under the null hypothesis (i.e. independence between rankings) of value as large as the observed value. Since there were 10 topics being ranked therefore, it was possible to determine such probability from tables[8c] which indicated a value of 5.6×10^{-5}. Hence, the null hypothesis was rejected and it can be concluded that the observed correlation between the true rankings from practitioners and firms is highly significant.

The estimation of true ranking for the architects as a combined group, shown in the lower part of Table 4-4, was derived in a similar way as described in Section 3.1.2 above, by adding the sum of the rank frequencies obtained for each topic from each of the two groups of respondents (i.e. sum of Table 7-11 and Table 8-7). The agreement among the rankings from the architects was measured by the coefficient of concordance (W) (as per Section 3.1.2 above) it was determined to have a value of 0.35 which indicates a moderate agreement. The χ^2 value associated was 578.4, with 9 degrees of freedom, being significant beyond the 0.001 level. Similarly, Friedman's analysis of variance by ranks was calculated, yielding a value of 35.1 which is also significant beyond the 0.001 level. It can be concluded therefore, that the moderate agreement among the respondents' ranking was not due to chance.

Another area where both groups of respondents coincided in their opinions was in respect to whether or not architects should have a greater awareness of fire safety problems in building design. Some 83 per cent of the practitioners and 74 per cent of the firms responded affirmatively. A total of 290 comments were made by both groups, suggesting ways to achieve a greater awareness, among which the most frequently made were concerned with better education throughout the profession (36 per cent) improvements in legislation e.g. unification, more principles, coordination and interpretation (13 per cent). Increased publicity on fire within the profession was also indicated (10 per cent) and the need for a fire safety handbook or manual for the architects was emphasised (9 per cent).

The need for a greater awareness towards fire safety, identified by the responses above was evidenced further by the answers given to a question asking respondents to indicate their opinion on ways of solving fire safety problems in building design more efficiently. Better understanding and education for architects was the category which collected the highest frequency of responses (70 per cent from practitioners and 67 per cent from the firms). The next most common categories indicated by the practitioners were 'Architectural Design' and 'Full Enforcement of Existing Regulations' (40 per cent each) and 'More Scientific Research' (37 per cent). For the firms' respondents, this latter category was shown to have second preference (41 per cent) and was followed by 'Architectural Design' (29 per cent) and 'Full Enforcement of Existing Regulations' (25 per cent). Between 55 and 53 per cent of all the responses were collected on the two categories most concerned with the architectural profession (better understanding – education and architectural design).

3.2.3 Fire Prevention Officers

The status of the 60 respondents in this group varied from firemaster to fire prevention officer; however, 65 per cent of them were reported to be senior fire prevention officers. They are responsible for the enforcement of most of the existing fire legislation and in doing so they are used as the primary sources for advice. Any inadequacies in that legislation are likely to be blamed on them as a misinterpretation or misapplication. This is especially so if there appears to be ingorance about the principles and concepts behind the requirements.

The ignorance in fire safety that seems to exist in the architectural profession was manifested by 88 per cent of the fire prevention officers responding to the survey. They indicated that the fire safety knowledge existing among architects was not adequate for them to achieve an acceptable design solution (assuming 'acceptable' to mean meeting the requirements). Of the suggestions made to increase that knowledge, about 47 per cent were related to improvements in architects' education both at the schools and professional levels; 36 per cent indicated wrong attitudes and lack of awareness observed among the architects.

That architects should have a greater awareness towards fire safety problems in buildings, was the almost unanimous opinion expressed by the respondents (all but one). Among the suggestions made to achieve a greater awareness, one third emphasised, again as above, the need for more and better education for the profession. Their contribution to that educational improvement was reported by the responses which indicated that one third of the brigades are involved in teaching at the schools of architecture. The contributions were mostly made as lectures (65 per cent) and project work revision (40 per cent) with a mean duration of 9 hours/year (for 12 respondents).

Better education and understanding for architects was indicated by 88 per cent of the respondents, as a more efficient way of solving fire safety problems in building design, it was followed by 'Constructional Design' (34 per cent) 'Full Enforcement of Existing Regulations' (22 per cent) and 'More Scientific Research' (20 per cent). The first two categories above, considered to be the architects' domain, attracted 65 per cent of all the responses.

Regarding the relevance that fire safety has to aspects of building design, the responses suggested that it is considered relevant as a 'Constraint' for the 'Visual and Aesthetic' aspects (68 per cent). It was also indicated that 'It Makes a Positive Contribution' for both 'Environmental' (48 per cent) and 'Constructional' (55 per cent) aspects of building design.

Since this group has been indicated as the main source for fire safety advice, their opinion were asked about the stage of design in which architects should first seek their advice. The responses showed that 62 per cent suggested 'Preliminary Design' stage while some 18 per cent stated 'Inception' stage. In relation to the stage of design in which the majority of new building projects are actually submitted for their comments and advice, about 48 per cent of the respondents reported that they received projects in an 'Advanced Stage' (i.e. detailed, almost completed). While some 24 per cent indicated that they received projects at an 'Intermediate Stage' (i.e. scheme design) other 26 per cent noted that they received projects at a stage which was too late (plans completed).

With respect to other people consulted for fire safety advice, 95 per cent of the respondents confirmed that building control officers are the second most frequently consulted people. Central government officials (e.g. DoE, HSE) were next indicated by 45 per cent of the respondents.

Despite criticisms made of each other by both architects and fire prevention officers, about how fire safety is taken into account by one group and how its relevant legislation is implemented by the other; 70 per cent of the respondents stated that they were satisfied with the present relationship between architects and fire prevention departments. Some respondents qualified their answer with comments which pointed out the architects' reluctance to accept advice as the main reason for conflicts. Also, better education of the profession, better liaison between both groups and early consultation, were the principal suggestions made to improve the relationship.

Fire safety information available to the architectural profession was considered sufficient by 76 per cent of the respondents. Some 20 per cent of them stressed that generally, it was a matter of making architects aware of what is available and how to use it, rather than the lack of information. However, several suggestions were made to consolidate information in one handbook (10 per cent) and to upgrade existing information.

On the other hand, the fire safety knowledge existing in the fire prevention departments was described as 'Adequate' by 73 per cent of the respondents. Some 14 per cent indicated it to be 'More than Adequate' while 10 per cent considered it to be 'Inadequate' to deal with fire safety problems in building design. Continual changes in personnel due to the new duty system in the fire brigades was the reason given by the latter group of respondents.

When additional specialist advice is required, for special cases (e.g. beyond the scope of legislation) respondents indicated that they referred to the Fire Research Station (86 per cent) Home Office (78 per cent) other fire prevention departments (64 per cent) and to the Health and Safety Executive (53 per cent) for that special advice.

According to the respondents' experience, the main problems associated with the application of fire safety to architectural design were identified as follows: requirements inhibiting architects' design freedom (49 per cent) architects' lack of knowledge and understanding (36 per cent) 'extra' cost represented by provisions (34 per cent) fire safety requirements conflicting with client's requirements, building operation and internal planning (49 per cent) and, requirements related to means of escape and passive measures (30 per cent).

3.3 COMPARISON AND DISCUSSION OF RESULTS

Most of the answers to the questionnaires were concerned with one or more of the following broad areas:

a) education, knowledge and information

b) attitudes and opinions; and

c) legislation and conflicts related to its implementation and application.

In the comparison and discussion of the results for the common questions that follow, an endeavour has been made to keep that order however, because of the interdependence among these issues, sometimes it has not been possible to maintain it.

It seems reasonable to assert that in general, the teaching-learning process in the schools of architecture provides the basis of knowledge and skills in those areas which somehow have been defined as important for the profession and that will allow graduate architects to perform their role within a given historical and societal context. In this country, the quality control of the schools' product is ascertained by the RIBA-ARCUK visiting board system.
Bearing in mind the evidence in the literature, as presented in Part 2 and in the survey results of this study, it appears that fire safety is one area considered to be important for the profession.

Because of the particular relationship existing between school and practice, changes in one of them are likely to be reflected in the other (Section 1.1, Part 3). Hence information from the real world of architectural practice is fed back into the schools and used as one of the arguments to tailor the course contents for the different areas of study. Assuming that the true ranking of the fire safety topics, shown in Table 4-4 above, represents the views of the profession in this area, its comparison with the topics that the schools include in the course (Table 6-5) would point out the relation between what is considered important by the profession and what is being offered in the schools.
Several points may be noted from such a comparison: the topics that were ranked in the first 3 positions were being covered by all responding schools, representing 84 per cent of the total school population (e.g. escape route design, fire resistance and smoke control) the second least important topic (i.e. management) was being included by the fewest number of schools (26 per cent) and although legislation

was ranked in sixth position, all schools except one reported that they include it in the course (82 per cent). It follows that most schools seem to cover the topics that the architects considered as most important.

On the other hand, in Table 4-3 the 'best' estimate for the ranking of the topics according to the fire prevention officers was shown. A comparison with that of the architects in Table 4-4, reveals that the ranks for some topics either coincide or are very close. Indeed, the association between the two sets of rankings, as measured by Kendall's rank correlation coefficient (Section 3.2.2 above) was 0.78 which can be interpreted as a strong positive correlation, though weaker than that observed among the architects. The probability of occurrence of a value as large as that calculated was determined to be 0.0012. Therefore it may be concluded that there seems to be a significant agreement, on the rank or importance assigned to each of the topics, between the architects and the fire prevention officers.

Previous design experience and trade literature were the most frequent origins of fire safety knowledge indicated by responding architects, as shown in Tables 7-10 and 8-14. Per contra, the comparatively low proportion of respondents that indicated schools of archtiecture as source of their knowledge suggests a mismatch between the assertion made previously, that schools are covering the topics considered most important and the type of knowledge that appears to be required in actual practice.

It could be argued that part of this discrepancy could be accounted for the relatively recent inclusion of fire safety in the schools' curricula, hence most architects have not had formal training and therefore, whatever their knowledge, it must have come from elsewhere (e.g. consultations, seminars, short courses, etc.). Another argument that may be offered is that, although the schools have reported that they cover the subject, there is mounting evidence suggesting that the treatment of the subject at the schools is far from comprehensive.

Besides the indications from previous works that were reviewed in Section 3 of Part 2, in the preceding section it has been shown that only about one half of the schools seemed to have some form of course syllabus for fire safety (Table 6-8). One could assume that those schools without it either have the subject intermingled with other matters, or teach it on an 'ad hoc' basis (i.e. informally) or even worse, do not cover the subject at all. Moreover, the mean time of dedication of 5 hours/term (with a modal value of 2 hours/term) and maximum concentration during the second term of the third year (5.6 hours/school) (Figure 4-1) may seem rather low, although it was not possible to compare these figures with the dedicaton for other subjects.

Further indications were provided by the schools' responses in relation to the course status, most of which indicated (Table 6-4) that fire safety was an obligatory part of the course (28 schools). Yet whilst the most common form of teaching the subject (Table 6-12) was by formal lectures (31 schools) and individual studio tutorials (28 schools); the most frequent method of assessing (Table 6-13) fire safety was as part of a design project (28 schools) and written examination (21 schools) mostly in the form of a few items in combined exam papers. All the above leads to the corroboration of many of the findings from previous surveys (Section 3.3, Part 2).

The inadequacy of the present educational approach has also been emphasised by 104 comments from all the groups of respondents (e.g. 5 schools, 53 architects and 46 FPO's) stressing the need for fire safety to be given more time, greater attention and a formal part in the curriculum of the schools.

Respondents from all groups have also coincided in indicating a better understanding and education for architects as a way of solving fire safety problems in building design more efficiently (i.e. comparison with the other response categories offered). In fact, between 53 and 60 per cent of all the responses to this question were polarised on the two categories that may be considered related directly to the architectural profession (better understanding and design). This may be interpreted as a universal recognition that fire safety problems in building design would be amenable to the profession by design improvement through better education in fire safety. It could also mean a rejection of the legislation as it stands, by choosing those response categories which respondents felt to offer an alternative different to legislation and more within their domain.

But most important of all seems to be the other possible aspect that may have influenced this response, the indirect acceptance of the lack of knowledge among the profession which makes it difficult to achieve approvable designs in terms of current legislation. In this respect, a comparison of the results indicates that although most respondents from the profession (i.e. schools and architects) described their knowledge as 'Adequate' (Tables 6-6, 7-4 and 8-10) in contrast, 88 per cent of the responding fire prevention officers (Table 9-1) considered that the knowledge in the profession was not adequate.

There seems to be evidence also from within the profession supporting the views of this latter group, provided by more than 50 suggestions, which state the need for mid-career courses and other forms of upgrading the standard of education and thus, the fire safety knowledge among practices.

Furthermore, the majority of respodnents from all the groups agreed in expressing the need for the architectural profession to have a greater awareness to fire safety problem in building design (Tables 6-19, 7-19, 8-8 and 9-17) which reveals the contradiction between the respondents describing their own fires afety knowledge as adequate and their suggesting that the profession should have a greater awareness of the same area.

Accepting that knowledge appears to be to some extent dependent on the quantity and quality of available information (i.e. information as a means for knowledge transfer) given a degree of interest, then the information available on fire safety should provide further indications on the existing knowlegde.

Responses on the information available indicated mixed opinions. On the one hand, from the firms' respondents (Table 8-19) considered the information to be satisfactory (70 per cent) whilst among the group of practitioners (Table 7-17) there was not a clear majority (though 53 per cent were not satisfied). Additionally, fire prevention officers (Table 9-15) were definite in indicating that the information available to the profession was sufficient to deal with fire safety in building design. On the other hand, schools' respondents (Table 6-10) noted dissatisfaction with the information available to them (58 per cent). Therefore, it appears that fire safety information available is cosndiered satisfactory for practice but not for teaching purposes.

The comparison of the types of publications used in the schools and in the practices indicated a distinct pattern (Tables 6-17. 7-9 and 8-18). About half of all responses were concentrated on legislation and authoritative guidance publications. It follows that there seems to be a reliance on those types of publications as main sources of information.

The reliance on legislation, though forced it may be, is reflected in almost every answer throughout the different groups of respondents to such an extent that 'Information Available' seems to be taken as 'Legislation Available' and vice-versa. A substantial proportion of all the comments and suggestions made were related to legislation content and its implementation.

The reliance on legislation observed within the architectural profession seems to have pervaded into an attitude of regarding fire safety almost exclusively as if it were only a set of fixed legislative requirements with a restrictive influence on building design. In this respect, the majority of respondents from the architectural profession (e.g. architects and schools) have indicated that fire safety is considered either as a constraint, mostly for visual and aesthetic aspects, or as a set of rules for compliance for environmental and constructional aspects of building design.

Moreover, except for the group of fire prevention officers, very few responses indicated that fire safety made a positive contribution, and those few were generally associated with the constructional aspects. By contrast, even fewer responses indicated that fire safety was ocnisdered irrelevant (Tables 6-1, 7-7, 8-6 and 9-6).

Similarly, the predominance of legislation may also be observed in the groups of people that archtiects consult for fire safety advice (Tables 7-8 and 8-17) where there is an evident agreement of responses indicating fire prevention and building control officers as the most frequent sources of advice. Further, it is also noticeable in the schools (Table 6-12) for building control and fire prevention officers are the second and third most common contributors to the course, only after full time lecturers.

Part Four References

1. Moser, CA and Kalton, G
"Survey Methods in Social Investigation" (2nd edition)
Heinemann Education Books Ltd.
London, 1977
(1a) p.414 (1b) p.248-9

2. Babbie, ER
"Survey Research Methods"
Wadsworth Publishing Co. Inc.
Belmont, California, 1973
(2a) p.195

3. Nie, N; Hull Hadlai, C; Jenkins, J; Steinbrenner, K and Bent, D
"Statistical Package for the Social Sceinces" (2nd edition)
McGraw-Hill Inc.
New York, 1975
(3a) p.1

4. Hull Hadlai, C and Nie, N
"SPSS Update: New Procedures and Facilities for Releases 7 and 8"
McGraw-Hill Inc.
New York, 1979

5. Rice, S (editor)
"SPSS Introductory Guide" (5th edition)
University of Edinburgh, Program Library Unit, 1975

6. Prentice, M
Department of Statistics, University of Edinburgh
Private communication, 1980

7. Kendall, MG
Rank Correlation Methods
Charles Griffin & Co. Ltd.
London, 1948
(7a) p.86; (b) p.3

8. Siegel, S
"Nonparametric Statistics for Behavioural Sciences"
McGraw-Hill Inc.
New York, 1956
(8a) p.236; (8b) p.104; (8c) p.220, (8d) p.23

9. Conover, WJ
Practical Nonparametric Statistics
John Wiley & Sons
New York, 1971
(9a) p.141' (9b) p.250

10. Marchant, EW
"How Designers Approach Fire Safety"
Fire 72 (898) April 1980, p.612

PART FIVE
THE CONCLUSION

1. VALIDITY

This study has been based on a postal self administered questionnaire which was distributed among those groups of people whose interaction was assumed to influence the way fire safety is accounted for in the design of buildings.

Because of the type of information sought, it should be borne in mind that the data presented reflect what the respondents have chosen to answer, which may not be what they actually do; perhaps their answers might tend towards what they thought should be done. Hence, the validity of the measurements thus obtained is difficult to test, although several checks were considered.
Some questions were included that allowed answers to be compared against those obtained to other questions; but these would at best indicate consistency in the responses from that particular respondent and not his veracity. Another check was made by repeating the same question for the different groups and, as has been shown in Part Four, there is a fair degree of agreement across the groups surveyed, which evidences consistency in their opinions.

The customary way of checking for validity by direct observation of the phenomenon was attempted in two ways. First, by following the decision making process for fire safety in a major project, almost until its submission for approval. Second, despite the reluctance found in some schools of architecture, six schools were visited, meeting with both students (3rd and 4th year) and staff involved, to discuss their attitudes to fire safety in building design and to find out what the students gained from the course. Mention should be made here that a full program of school visits is being arranged, to extend the scope and complement this study, with the consent and support of the RIBA (Letter 1, Appendix 10).
Some further confidence in the findings of this study was provided by the conclusions arrived at in previous research conducted in this area (Section 3, Part 2)

2 FIRE SAFETY AND THE PROFESSION

The survey results have corroborated assertions made in Part One, that fire safety seems to be incorporated into building design mainly because it is seen as a set of legislative requirements which have to be met, if authoritative approval is to be gained. It follows that for the architectural profession, fire safety in building design appears to be reduced to problems of legislation, its implementation and interpretation.

Despite the near concensus in the responses from the architects recognising the relevance of fire safety and indicating their need for a greater awareness, more knowledge and better education; it appears that very few substantial changes have been made to ameliorate attitudes to fire safety, within the profession as a whole, since the days of the Summerland disaster.

Furthermore, since fire safety involves costs considered 'extra' because priorities are placed elsewhere (i.e. it is not considered essential for the functioning of buildings) therefore buildings are designed verbatim et litteratim to legislation, many of the deviations from the 'norm' seem to be more concerned with a reduction of capital expenditure rather than with fire safety provisions.

On the other hand, fire safety in architectural schools, with very few exceptions, seldom seems to go beyond the presentation of legislation. It would appear as if the schools consider to have accomplished their mission once students have been exposed to legislative requirements and shown sets of accepted solutions. A touch of realism is given in some schools by calling in FPO's or BCO's to look into later design schemes, as in real life. The fact that some schools have their fire safety input as part of 'Legal studies' or 'Professional practice' courses is the best indication that, at least for those schools, fire safety is not part of the design problem except for the restrictions it imposes on the 'freedom of design' and the 'extra cost'. The attitude of accepting legislation as 'the answer' to fire safety in building design, has probably resulted in that fire safety research in the schools of this country is a topic almost unheard of.

The above suggests that architects seem to be prepared to be expected to comply with but not to propose solutions for fire safety in the buildings they design, which could be regarded as contrary to the creativity exhibited by the profession in other areas of building design.

A good parallel is provided by structural stability. Like fire considerations, there are strong safety connotations of primary importance attached to structural stability, and for that reason it has also received extensive attention of legislation. But contrary to fire, it seems most unlikely that any architect would define it as a limiting factor to his 'freedom of design', or would complete his designs only then to 'apply' structural requirements to them; quite the opposite, architects seem to have been able to absorb the necessary structural concepts that allow them to design with judgement and communicate with specialist consultants. Unfortunately in fire safety there is no corporate body of consultants like the structural engineers, to whom architects can turn for the analytical quantification of solutions, nor are there corresponding methods of analysis yet available. Moreover, cost arguments may be used to assist in the selection of alternative structural solutions or systems but the provision of stability (i.e. safety) is untouched in such exercises.

3. POSSIBLE CHANGES

The arguments presented above leave very few options open for improvements, short of introducing radical changes in the system. As indicated previously, the integration of fire safety into architectural design seems to be hindered by the lack of knowledge among the profession and the inadequacy of the current legislative system. Many respondents have suggested that the lack of knowledge could be overcome by fire safety education both at school and professional levels. Changes in the structure of current building legislation have also been proposed repeatedly by respondents and more recently, government officials[1] have recast the notion of self-certification and private approval, which appears to have been under consideration a decade ago[2,3]. This indicates two possible outcomes, both dependent upon whether or not the structure of legislation will be changed.

The RIBA-FPA syllabus, reviewed in Section 3.2.1 of Part 1, was intended to fill the gap in fire safety education by introducing the subejct to the schools in 1974. After some 6 years of use, few changes or improvements seem to have been achieved, both the approach and objective of the course remaining stagnant.

Assuming that the format of legislation would not be changed and accepting that the objective of fire safety education is "to enable the building designer to produce designs which will satisfy the requirements of fire authorities, building authorities and insurance companies"[4], as some of the survey results seem to indicate. Then, the model syllabus could provide a starting point, given that it is properly implemented and complemented with the production of guidance and support materials.

Schools could perhaps be asked to dedicate some 10 to 20 lectures in one term and thereafter the topic could be included in all design work as part of the assessment.

For the practitioners a series of short courses and workshops, spread over a period of time and repeated in different cities, could train them in the application of legislation to building design and to become legislation experts. This scheme would perhaps satisfy those interested mainly in gaining authoritative approval; it would also ease the workload of the FPO's and BCO's because legislation would have been applied before submission and therefore approvals would take a shorter time.

Of course, minor changes in legislation would require re-training, otherwise there would be a return to the current situation. In addition, the scheme would not be valid for projects outside the range of solutions contemplated in the legislation, they would have to be dealt with as today. It would seem that in the long run, this scheme would fail to produce any substantial difference or even change with respect to the situation described by the survey.

The other possible outcome would be initiated by the introduction of the proposed changes in legislation.

The proposal that would allow for private inspection and approval of both design projects and buildings (i.e. two stage certification) as a parallel and optional alternative to the official building control, is bound to have profound repercussions in the way buildings are designed and built. There is no doubt that the profession as a whole would welcome such change[5] of practice without direct legislative intervention. Although in some areas of building design (e.g. structure, services) it could be argued that for the final user, the result would be at least as good as the one produced under the present system, for other areas it could prove to be somewhat Damoclean. It appears that fire safety is one such area.

The lack of fire safety knowledge among the profession, and its reliance on legislation and authoritative advice was proven by the survey results. It seems reasonable to conclude that very few architects could be 'competent persons' or candidates to be approved as certifiers for the area of fire safety in buildings.

Perhaps it was recognising this incompetence that the RIBA suggested the necessity of a 'second check' to be required in certifying compliance with structural stability and fire safety[6].

On the other hand, even if fire safety is considered as a specialised aspect of building and thus specialist 'approved persons' would be allowed to 'sub-certify' for a 'head certifier'[7] (i.e. architect). As indicated earlier, fire safety, at least in this country and unlike other areas of building, has not the benefits of a corporate profesisonal body of independent specialists from which such certifiers could be selected. Moreover, fire safety expertise that may exist scattered among the members of the different Institutions might not be necessarily applicable to the specific problems of fire safety in buildings, nor might they be in sufficient number to avoid a monopolistic stiuation. This assertion was suggested by the very few practices (36 out of 233) that indicated that they used the advice of a fire safety consultant (Tables 7-8 and 8-17).

Since all the above shortcomings are unlikely to be corrected overnight, it seems that the so called 'self-certification' for the area of fire safety in buildings appears not to be capable of being implemented in the near future if the current standard is to be maintained. It follows that if the proposed changes are after all passed, then fire safety would have to be left behind and for the most part, dealt with in a similar fashion as today (e.g. official advice and approval) except for the possible redrafting of the format of building legislation.
But if some other proposed changes, e.g. to re-direct fire brigade interest mainly to the industrial sector[8] are also pressed, it might be that the official goodwill advice may not be so readily available any longer.

4. EDUCATIONAL APPROACH

In view of the evidence presented above, it is suggested that the architectural profession should examine its role among the building professions and accept its share of responsibility for an area hitherto neglected but which it can no longer consider isolated from architectural design.

Such reappraisal would inevitably have to be coupled with the need for fire safety education. Which in turn is likely to increase the pressure on the schools to include the subject in a formal and sensible way, as seems to have happened with other topics in the recent past (e.g. services, thermal performance and in general the so called 'science revolution').

In general, there seems to be three possible levels of education for architects, viz: undergraduate, mid-career and post-graduate. It is suggested that fire safety should be offered at all three levels.

a) Schools: courses at this level should aim at providing students with a general conceptual base thereby fire safety would be digested with the background knowledge of the designer as an internal constraint (Figure 1-1 and Section 5.1, Part 1). Since the subject is as relevant as structural stability, it should be introduced in at least two stages from the earliest part of the programme. First, it should be covered by a specific lecture course biased towards life safety, on a compulsory basis and with adequate assessment (as are structural considerations). Second, to identify the implications of design decisions, fire safety should be a permanent feature of all project work, as part of both brief and assessment. As a third stage, it could also be offered as an advanced course in the Honours degree options, as it is being offered currently at the University of Strathclyde.

b) Mid-career: practitioners would also require two stages. First, architects currently in practice would need a course to update or perhaps change their whole conception of the subject, to bring them in line with the schools. For this purpose, it is suggested that a series of courses of short duration (say, weekends) over several months, combined with practical fire safety workshops, repeated in various locations, might be a viable possibility for the busy practitioner. As a second stage, it is suggested that specialist courses should be developed to introduce new techniques, both soft and hardware, relevant to building design. Also at this level, courses should be devised to deepen the expertise in specific areas of interest (e.g. building type).

c) Post-graduate: this would be a specialisation level that could include the MSc/ Diploma course offered by the Department of Fire Safety Engineering at Edinburgh Unviersity. Research degrees should also be encouraged in fire safety topics related to or dependent on architectural design. As indicated earlier, this latter area is a 'new' field for the schools of architecture but not an infertile one. A deeper understanding of the interaction of people and buildings under fire conditions is necessary, so that architects could design buildings primarily for the safety of the occupants.

A framework for fire safety education for the architect was suggested in late 1978[4] reproduced in Table 5-1 below. It included many of the propositions indicated above. Hitherto little notice seems to have been taken of it by either schools or profession. This leads to the conclusion that any attempts to improve fire safety education within the profession will wilt, unless they are endorsed and supported actively, and monitored closely by the professional organisations (e.g. RIBA, ARCUK, SAC) in other words, courses would have to be 'enforced'.

A modular approach to the subject of fire safety engineering has been suggested recently[9]. It provides an overview of the range of fire safety topics from which the topical content for the different levels of education could be extracted. It should be noted that although architects need not have a working knowledge in all the 'modules', at least an awareness of their existence should be expected. Appendix 10 contains a reprint for further reference.

Table 5-1

A Framework for Fire Safety Education for the Architect

Course Concept	Receiver	Giver/Consultant	Result/Implications
1. **Fire Safety Design** The use of fire safety knowledge as a creative design factor. 3-dimensional concepts, fire scenario, studies of interaction. Would not need mathematic or technical skills.	All students of architecture	Fire safety architect	A greater awareness of the choices available to achieve acceptable fire safety.
2. **Design Against Fire** To give a knowledge of the technical and legal requirements for building fire safety.	Optional for both students and practitioners. Architectural technicians.	Fire safety architect OR specialists.	A broad knowledge of current technical design, legislative and insurance requirements. A knowledge of who to ask for advice and when it would be required.
3. **Co-ordination of Fire Safety** The integration of fire safety knowledge into the common design sequence. Development, use and limitations of check lists.	All students of architecture. Architectural managers. Practtioners.	Fire safety architect.	A knowledge of the breadth of fire safety and an ability to identify problems and to know when, how and by whom they can be solved.
4. **Advanced Fire Safety Design** Essentially a postgraduate level course. Emphasis on Fire Safety Evaluation, Systems Analysis, Cost Effectiveness. Analysis of design methods.	Postgraduate students and practitioners. Architectural technicians.	Specialists.	Fire safety architect. Practitioners with a real working knowledge of fire safety and the ability to make rational choices.
5. **Special Courses** Consideration of discrete topics within fire safety. Would require some prior knowledge of technical concepts and/or mathematical skills.	Practitioners and postgraduates. Architectural technicians.	Specialists.	A detailed awareness of particular topics leading to technical expertise.
6. **Fire Safety Workshops** Opportunities for the application of fire safety knowledge to the building design process. New buildings/existing buildings. Would contain elements of 1 and 4 above.	Practitioners.	Various specialists.	A better understanding of the integration of fire safety into building design.

In defining the scope of these fields of education a point emerges that should be of paramount importance. Regardless of the final educational objective to be attained, it should not be based on legislation per se – or else changes in legislation will imply the need for further re-education – but rather it should seek a wider horizon, above and beyond whatever the regulatory system, fostered by the political entity in turn, may be.

It could be anticipated that such educational strategy based on a conceptual approach would encourage architects to have different levels of expertise on the subject but with one major commonality, they would be able to design (or advise on) buildings where fire safety would be the logical sequel of specific design decisions rather than the patchwork produced by the blind 'application' of legislation once designs are near completion.

To develop an educational programme like the one suggested above would require the concurrence of a team of specialists in education, fire safety and architecture. It appears that there is more to the development of a course than the drawing up of an outline or a list of topics, if there is any intention to obtain consistently successful end results.

Indeed, courses should be devised to achieve a predefined and specific degree of proficiency, expressed as an educational objective in terms of skill to be gained or the desired change of behaviour (i.e. what the participant can expect to achieve) taking due account of the backgrounds and qualification of participants. This in turn would dictate not only the choice of the course contents (as a series of steps leading towards the achievement of the prescribed end) but also the method of teaching, the time of dedication, the educational material needed and its design, the selection of the appropriated media and finally, the method and items for the assessment of participants, teacher and course performance.

Moreover, before the courses could be made operative, they would have to be tested and adjusted. The feedback obtained from the original test and successive assessments would provide the best guidance to update and improve the courses.

Bearing in mind all the above considerations, it would seem a non seguitur to try and present here an educational programme for architects in fire safety in the knowledge that it could not embrace all necessary aspects. It is therefore suggested that the Royal Institute of British Architects should support the present proposals by sponsoring their development and ensuring their implementation at the various levels fully.

Part Five References

1. The Future of Building Control
Transcript of the speech by the Secretary of State for the Environment to the National House-Builders Council
London, 10th Dec 1979

2. Atkinson, GA
"Building Law in Western Europe: How Responsibility for Safety and Good Performance is Shared"
Current Paper 6/71
Building Research Station
Watford, 1971

3. Cibula, E
"The Structure of Building Control – an International Comparison"
Current Paper 28/71
Building Research Station
Watford, 1971

4. Marchant, EW
"Design Against Fire: the Role of the Fire Sfaety Architect"
Fire 71 (881) November 1978, p. 294-5

5. The Future of Building Control in England and Wales
Repsonse to the Department of the Environment Consultative Paper BRA 759/23
Royal Institute of British Architects
London, August 1980 (Private document)

6. The Future of Building Control
Observations on the speech by the Secretary of State for the Environment on 10th December 1979
RIBA, 28th January 1980 (private document)

7. The Future of Building Control in England and Wales
(Proposal of Private Circulation) Cmnd. 8179
Department of the Environment
London, 1981

8. Future Fire Policy
A Consutlative Document
Home Office
London 1980, p. 29

9. Rasbash, DJ
"A Modular Approach to the Subject of Fire Safety Engineering"
Fire Safety Journal,3 (1) November 1980, p. 31-40

PART SIX
THE APPENDICES

The first four appendices reproduce the text of the questionnaires as they were sent to the respondents, however the order and format of the pages have been altered and rearranged to simplify their inclusion here.

APPENDIX ONE
SCHOOLS OF ARCHITECTURE QUESTIONNAIRE

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL
Telephone 031-667 1081 ext. 3616

FIRE SAFETY AND THE SCHOOLS OF ARCHITECTURE

Prepared by M A Cerda and E W Marchant.

TO:

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL

RESEARCH PROJECT:
THE APPLICATION OF FIRE SAFETY TO ARCHITECTURAL DESIGN.

One of the objectives of this work is to ascertain the level of fire safety knowledge which exists within the architectural profession both as a taught subject and as working knowledge used by practitioners.

To measure this level of knowledge, four questionnaires are being developed to be distributed, as follows:

1. RIBA recognised Schools of Architecture.
2. Individual practitioners (sample of).
3. Sample of architectural firms (practices).
4. Senior Fire Prevention Officers in local authorities.

The purpose of this questionnaire is to determine:

1. The general attitude of architects towards fire safety at present.
2. The fire safety knowledge/information available and used by the practising architects.
3. Criticisms to fire safety as currently applied by the architectural profession.

M A Cerda

GENERAL INSTRUCTIONS

This questionnaire is designed to take 15 minutes or less to answer. Individual answers will be kept confidential and only general results might be used for future reference.

1. Unless otherwise stated, please tick the box, or boxes, which best fit your own answer. The figures to the right of the boxes are merely an aid for the analysis of the results; please ignore them.

2. At the bottom of most pages, a space is provided for your comments. Please indicate on the left side the number of the relevant question.

3. When you have completed the questionnaire, please unfold the back cover, fold it over the front and glue its corners, or staple the whole booklet. Since the stamp is provided, all you need to do is to drop it into a mail box, the Post Office will do the rest.

Thank you
for your cooperation.

1. *Beside each of the aspects of building design listed below, please indicate the relevance of fire safety:*

1. It makes a positive contribution.
2. It is a constraint.
3. It is just a set of rules for compliance.
4. It has no relevance at all.

BUILDING DESIGN ASPECTS	1	2	3	4	
a. Visual/Aesthetic	☐	☐	☐	☐	(6)
b. Environmental	☐	☐	☐	☐	(7)
c. Constructional	☐	☐	☐	☐	(8)
d. Other ______ (*Please specify*)	☐	☐	☐	☐	(9)

Your comments: (10-12)

2. *Please indicate your role with respect to fire safety engineering.*

a. Coordinator ☐ (13.1)

b. Teacher ☐ (13.2)

c. Other (*please specify*) ______ ☐ (13.3)

d. None ☐ (13.4)

3. *Would you describe your present knowledge of fire safety as:*

a. More than adequate ☐ (15.1)

b. Adequate ☐ (15.2)

c. Inadequate ☐ (15.3)

d. Other (*please describe*) ______ ☐ (15.4)

Your comments: (16-18)

4. *Are you satisfied with the fire safety information available at present to the Schools of Architecture?*

NO ☐ (19.2) YES ☐ (19.1)

If not, please say why: (20-25)

5. *Which of the following topics are included in the fire safety course?*

	YES	NO	
a. Risk Assessment	☐	☐	(26)
b. Smoke Control	☐	☐	(27)
c. Escape Route Design	☐	☐	(28)
d. Fire Resistance	☐	☐	(29)
e. Detection Systems	☐	☐	(30)
f. Suppression Systems	☐	☐	(31)
g. Management	☐	☐	(32)
h. Legislation	☐	☐	(33)
i. Other; *(Please describe)*	☐	☐	(34)

6. *It would be most helpful if you could enclose a copy of your fire safety syllabus when returning this questionnaire. Please indicate:*

a. Enclosed ☐ (36.1)

b. Not enclosed ☐ (36.2)

c. Not available ☐ (36.3)

7. *Please indicate, within the parentheses, the number of hours per term given to fire safety during your School course years.*

	TERMS	COURSE YEARS 1	2	3	4	5	
(38)	1	( )	( )	( )	( )	( )	(42)
(43)	2	( )	( )	( )	( )	( )	(47)
(48)	3	( )	( )	( )	( )	( )	(52)

8. *What type of teaching is used?*

	COURSE YEARS 1	2	3	4	5	
a. Formal Lectures	☐	☐	☐	☐	☐	(54)
b. Group Discussions	☐	☐	☐	☐	☐	(55)
c. Tutorials	☐	☐	☐	☐	☐	(56)
d. Occasional Talks	☐	☐	☐	☐	☐	(57)
e. Special Concentrated (Block)	☐	☐	☐	☐	☐	(58)
f. Practical Demonstrations	☐	☐	☐	☐	☐	(59)
g. Project Oriented Discussions	☐	☐	☐	☐	☐	(60)
h. Individual Studio Tutorials	☐	☐	☐	☐	☐	(61)
i. Other (e.g. Visits, *Please specify)* ________	☐	☐	☐	☐	☐	(62)

9. *What method of assessment is used?*

	COURSE YEARS 1	2	3	4	5	
a. Written Examination	☐	☐	☐	☐	☐	(64)
b. Oral Examination	☐	☐	☐	☐	☐	(65)
c. Written Report	☐	☐	☐	☐	☐	(66)
d. Fire Safety Design as Part of Design Project	☐	☐	☐	☐	☐	(67)
e. Other, *please describe.* ________	☐	☐	☐	☐	☐	(68)

10. *Please indicate the status of the fire safety course.*

a. Optional ☐ (70.1)

b. Obligatory ☐ (70.2)

c. Other, *Please specify* ________ ☐ (70.3)

Your comments: . (70-73)

11. *On the following list, please indicate the publications used in your School for fire safety education.*

a. Text Books *Which books?* ______________	☐	(6)
b. Journal Articles *Which Journals?* ______________	☐	(7)
c. Building Regulations	☐	(8)
d. Fire Legislation	☐	(9)
e. Government Department Publications (e.g. DHSS, DOE, etc)	☐	(10)
f. BRE: Digests	☐	(11)
Current Papers	☐	(12)
g. Home Office/Welsh, Scottish Office	☐	(13)
h. Fire Research Station Reports (HMSO)	☐	(14)
i. BSI: Codes	☐	(15)
Standards	☐	(16)
j. Fire Protection Association	☐	(17)
k. Other ______________ *(Please specify)*	☐	(18)

12. *Please tick the people who make a contribution in fire safety education in your School, and indicate the approximate number of hours contributed by each of them.*

"Inside"	Number of Hours		
a. Full Time Lecturer	☐	( )	(20)
b. Part Time Lecturer	☐	( )	(21)
c. Visiting Academic	☐	( )	(22)
"Outside"			
d. Fire Safety Consultant	☐	( )	(23)
e. Fire Brigade Officer	☐	( )	(24)
f. Building Control Officer	☐	( )	(25)
g. Insurance Surveyor	☐	( )	(26)
h. Fire Research Station	☐	( )	(27)
i. Fire Protection Association	☐	( )	(28)
j. Industry/Commerce	☐	( )	(29)
k. Other *(Please specify)*	☐	( )	(30)

13. *What improvements would you suggest to increase the awareness of students in particular and of architects in general, to fire safety problems?* (32-37)

14. *Fire safety problems in building design could be solved more efficiently by:*

a. Additional fire regulations ☐ (39)

b. More scientific research on the fire phenomenon ☐ (40)

c. Architectural design ☐ (41)

d. Engineering design (equipment) ☐ (42)

e Better understanding /education to architects ☐ (43)

f Full enforcement of existing regulations ☐ (44)

Your comments: (45-49)

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.

Letter 1

Professor D.J. Rasbash

FIRE SAFETY KNOWLEDGE AND EDUCATION OF THE ARCHITECT

As briefly described in a previous circular letter, the above topic is one that M A Cerda is pursuing as a research subject. Our objective in this work is to find out the level of fire safety knowledge which exists within the architectural profession both as a taught subject and as a piece of working knowledge as used by practitioners.

To help us get some measure of fire safety knowledge in the profession, we are developing four questionnaires. The first of these is addressed to you as one of the Schools of Architecture staff with responsibility for the subject, and we hope that you will be able to return it before very long. The second questionnaire will also be sent to you but it will be for a colleague of yours who is in full-time practise. I hope that you will be kind enough to ask your colleague to complete it as soon as practicable. A third questionnaire is to be sent to a sample of architectural practises throughout the UK to broaden the data base so that we have a better understanding of the distribution of fire safety knowledge within practice. To complement these three questionaires, a fourth document is being prepared for circulation to Fire Prevention Officers in local authorities. This we hope will give us "the other side of the picture" and therefore eventually we shall be able to identify those parts of the subject of Fire Safety Engineering which are dealt with adequately in Building Design and conversely those parts of the subject not covered adequately. All this will enable us to make proposals on how best to present the topics within Fire Safety Engineering to Building Designers.

E W Marchant

October 1979

University of Edinburgh

Department of Fire Safety Engineering

School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.

Professor D.J. Rasbash

Letter 2

21 November 1979

FIRE SAFETY KNOWLEDGE AND THE ARCHITECT

As you know, we are conducting a survey among Schools of Architecture throughout the UK to measure the fire safety knowledge and information made available to students of architecture. This is all part of the research project titled above.

When carrying out the preliminary analysis of the questionnaires returned from the various Schools, we noticed that no return to date has been received from your School. Perhaps you could spare the few minutes needed to complete the questionnaire as it is of vital importance to the success of our study.

I look forward to hearing from you soon.

Yours sincerely

ERIC W MARCHANT and
MIGUEL A CERDA

PS: I am enclosing a fresh copy of the questionnaire that we circulated for the lectures in Schools in case the first one that was sent out in October has been mislaid and is now hidden from sight.

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.
Professor D.J. Rasbash

Letter 3

March 1980

Dear Colleague

FIRE SAFETY AND THE SCHOOLS OF ARCHITECTURE

At the end of October 1979 we circulated a questionnaire, with the above title, to all Schools of Architecture in the United Kingdom. After sending two reminder letters, one in November 1979 and the other in January 1980, there are still a number of Schools who have not responded.

So that our conclusions can be representative of the fire safety teaching in all the Schools, we are hoping that all the questionnaires will be returned.

At the time of sending this letter we have not received your completed questionnaire and if it has been lost, a fresh copy can be sent on request.

Yours sincerely

EWMarchant

E W MARCHANT
M A CERDA

PS: If you are unable to complete the questionnaire because no fire safety teaching is carried out in your School, it would be good to be certain about this aspect as it will enable us to make our study complete in this part.

APPENDIX TWO
ARCHITECT IN PRACTICE QUESTIONNAIRE

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL
Telephone 031-667 1081 ext. 3616

FIRE SAFETY
AND THE
ARCHITECT IN PRACTICE

Prepared by M A Cerda and E W Marchant.

TO:

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL

RESEARCH PROJECT:

THE APPLICATION OF FIRE SAFETY TO ARCHITECTURAL DESIGN.

One of the objectives of this study is to ascertain the level of fire safety knowledge which exists within the Architectural profession, both as a taught subject and as working knowledge used by practitioners.

Through the medium of questionnaires, we hope to collect the information essential to measure this level of fire safety knowledge. Four questionnaires have been devised and circulated as follows:

1. - RIBA recognised Schools of Architecture.
2. - Sample of individual practitioners.
3. - Sample of architectural firms.
4. - Fire prevention officers in local authorities.

The purpose of this second questionnaire is to provide an indication on the following areas:

1. - The general attitude of architects towards fire safety at present.
2. - The fire safety knowledge/information available to and used by practising architects.
3. - Criticisms to fire safety as currently applied by the Architectural profession.

M A Cerda.

GENERAL INSTRUCTIONS

This questionnaire is designed to take 15 minutes, or less, to answer. Individual answers will be kept confidential and only general results might be used for future reference.

1. Unless otherwise stated, please tick the box, or boxes, which best fit your own answer. The figures to the right of the boxes are merely an aid for the analysis of the results; please ignore them.

2. Since closed-ended questions are somewhat limiting in their freedom of personal response, at the bottom of most pages a space is provided for your comments. Please indicate on the left side the number of the relevant question.

3. When you have completed the questionnaire, please unfold the back cover, fold it over the front and glue its corners, or staple the whole booklet. Since the stamp is provided, all you need to do is to drop it into a mail box, the Post Office will do the rest.

Thank you
for your cooperation.

1. *Please indicate the type of building with which you are most concerned:*

a. Mercantile (e.g. shops, dept stores) ☐ (6)

b. Residential dwellings (e.g. flats, houses) ☐ (7)

c. Hotels ☐ (8)

d. Institutional (e.g. hospitals, nursing homes) ☐ (9)

e. Offices (public or private) ☐ (10)

f. Educational ☐ (11)

g. Sports and leisure ☐ (12)

h. Industrial ☐ (13)

i. Other *(please state)* ☐ (14)

____

Your comments: (15-17)

2. *Would you describe your present knowledge of fire safety as:*

a. More than adequate ☐ (18.1)

b. Adequate ☐ (18.2)

c. Inadequate ☐ (18.3)

d. Other *(please describe)* ☐ (18.4)

____

3. *In which stages of the design process do you consider fire safety as a building parameter?*

a. Inception (brief) ☐ (20)

b. Feasibility (brief) ☐ (21)

c. Spatial design ☐ (22)

d. Materials specification ☐ (23)

e. Performance specification ☐ (24)

f. Constructional design ☐ (25)

g. Working drawings ☐ (26)

h. Maintenance manuals ☐ (27)

i. Other *(please describe)* ☐ (28)

____

4. *In what stage of the design process do you* <u>*first*</u> *consider fire safety as a design component?*

a. Inception (brief) ☐ (30.1)

b. Feasibility (brief) ☐ (30.2)

c. Spatial design ☐ (30.3)

d. Constructional design ☐ (30.4)

e. Working drawings ☐ (30.5)

f. Other *(please describe)* ☐ (30.6)

____

Your comments: (31-33)

5. *Beside each of the aspects of building design listed below, please indicate the relevance that fire safety has:*

ASPECTS OF BUILDING DESIGN.

a. <u>VISUAL/AESTHETIC:</u>

1. It makes a positive contribution ☐ (34.1)
2. It is a constraint ☐ (34.2)
3. It is a set of rules for compliance ☐ (34.3)
4. It has no relevance at all ☐ (34.4)

b. <u>ENVIRONMENTAL:</u>

1. It makes a positive contribution ☐ (35.1)
2. It is a constraint ☐ (35.2)
3. It is a set of rules for compliance ☐ (35.3)
4. It has no relevance at all ☐ (35.4)

c. <u>CONSTRUCTIONAL:</u>

1. It makes a positive contribution ☐ (36.1)
2. It is a constraint ☐ (36.2)
3. It is a set of rules for compliance ☐ (36.3)
4. It has no relevance at all ☐ (36.4)

Your comments: (37-39)

6. *Which of the following list of people, or organisations, do you consult for fire safety advice?*

Please tick and indicate approximately the percentage contributed by each of them.

		Approx %	
a. Central Government Officials e.g. DOE, Home Office, HSE.	☐	( )	(40)
b. Fire Safety Consultant	☐	( )	(41)
c. Fire Brigade Officer	☐	( )	(42)
d. Building Control Officer	☐	( )	(43)
e. Insurance Surveyor	☐	( )	(44)
f. Fire Research Station	☐	( )	(45)
g. Fire Protection Association	☐	( )	(46)
h. Industry/Commerce	☐	( )	(47)
i. Other *(please specify)* ____________	☐	( )	(48)

Your comments: (49-51)

7. *On the following list, please indicate the type of publications used in your practice for fire safety information.*

a. Text Books *Which books?* ____________	☐	(52)
b. Journal Articles *Which Journals?* ____________	☐	(53)
c. Building Regulations	☐	(54)
d. Fire Legislation	☐	(55)
e. Government Department Publications (e.g. DHSS, DOE, etc)	☐	(56)
f. BRE: Digests	☐	(57)
Current Papers	☐	(58)
g. Home Office/Welsh, Scottish Office	☐	(59)
h. Fire Research Station Reports (HMSO)	☐	(60)
i. BSI: Codes	☐	(61)
Standards	☐	(62)
j. Fire Protection Association	☐	(63)
k. Other *(please specify)* ____________	☐	(64)

8. *Your background knowledge on fire safety comes mainly from:*

(Please tick and indicate the approximate percentage)

			approx. %	
a.	School of Architecture	☐	( )	(66)
b.	Specialised short courses	☐	( )	(67)
c.	Occasional Talks/Seminars	☐	( )	(68)
d.	Practical demonstrations	☐	( )	(69)
e.	Previous design experience	☐	( )	(70)
f.	Trade literature	☐	( )	(71)
g.	Other *(please specify)* ______	☐	( )	(72)

Your comments: (73-75)

9. *The following list contains some fire safety topics. In your opinion, please rank these topics according to their relative importance (1 for most important to 11 for least important).*

Fire Safety Topics.

a.	Risk Assessment	( )	(6)
b.	Smoke Control	( )	(7)
c.	Escape Route Design	( )	(8)
d.	Fire Resistance	( )	(9)
e.	Detection Systems	( )	(10)
f.	Suppression Systems	( )	(11)
g.	Management	( )	(12)
h.	Legislation	( )	(13)
i.	Human Behaviour	( )	(14)
j.	Combustion Technology	( )	(15)
k.	Other *(please describe)* ______	( )	(16)

Your comments: (17-19)

10. *Fire safety problems in building design could be solved more efficiently by:*

a. Additional fire regulations ☐ (20)

b. More scientific research on the fire phenomenon ☐ (21)

c. Architectural design ☐ (22)

d. Engineering design (equipment) ☐ (23)

e. Better understanding/education for architects ☐ (24)

f. Full enforcement of existing regulations ☐ (25)

Your comments: (26-28)

11. *Are you satisfied with the fire safety information available at present to practising architects?*

☐ YES (29.1) ☐ NO (29.2)

(30-35)

If not, please say why:

12. *Do you think that architects should have a greater awareness towards fire safety problems?*

YES ☐ (36.1) NO ☐ (36.2)

If yes, how would you suggest that a greater awareness can be achieved? (37-42)

13. *Do you have any further comments or suggestions that you wish to make?* (43-48)

Finally, in order to complete our records, it would be most helpful if you could state:

Name: *Position:*

Address:

Town: *Postcode:*

Telephone:

University of Edinburgh

Department of Fire Safety Engineering

School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.

Professor D.J. Rasbash

Letter 1

1 November 1979

Dear Colleague

FIRE SAFETY AND THE ARCHITECT IN PRACTICE

As mentioned in our previous letter, we are developing four questionnaires and I enclose a copy of the second one which we would like you to give to one of your colleagues who is in full time architectural practice, so that we may fulfil the objectives outlined in page 1 of this second questionnaire.

I hope that you will be able to do this for us and we shall look forward to receiving the questionnaire back from your colleague.

Yours sincerely

DR ERIC W MARCHANT
ARIBA, ARIAS.
and
M A CERDA

PS: If you have returned our first questionnaire by now, thank you very much: we shall undertake to send you a consolidated report in due course.

If you have not been able to return the first questionnaire so far, it would help us a great deal if you could spend the little time required on this and return it to us shortly. Please bear in mind that RIBA (Peter Hollins) is involved with our survey and would like to make it known that we have the encouragement of the RIBA/FPA Committee on Design Against Fire.

APPENDIX THREE
ARCHITECTURAL FIRMS QUESTIONNAIRE

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL
Telephone 031-667 1081 ext. 3616

FIRE SAFETY AND THE ARCHITECTURAL FIRM

Prepared by M A Cerda and E W Marchant.

TO:

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL

RESEARCH PROJECT:

THE APPLICATION OF FIRE SAFETY
TO ARCHITECTURAL DESIGN

One of the objectives of this study is to ascertain the level of fire safety knowledge which exists within the Architectural profession, both as a taught subject and as working knowledge used by practitioners.

Through the medium of questionnaires, we hope to collect the information essential to measure this level of fire safety knowledge. Four questionnaires have been devised and circulated as follows:

1. RIBA recognised Schools of Architecture.
2. Sample of individual practitioners.
3. Sample of architectural practices.
4. Fire Prevention Officers in local authorities.

The purpose of this third questionnaire is to provide an indication on the following areas:

1. The general attitudes towards fire safety at present within the architectural practice.

2. The fire safety knowledge and information available to and used by the Architectural profession.

3. Problems in designing for fire safety within the context of information and knowledge currently available to the practices.

4. Criticisms of fire safety as applied by the Architectural profession.

M.A. Cerda

GENERAL INSTRUCTIONS

This questionnaire is designed to take 20 minutes, or less, to answer. Individual answers will be kept confidential and only general results might be used for future reference.

1. Unless otherwise stated, please tick the box, or boxes, which best fit your own answer. The figures to the right of the boxes are merely an aid for the analysis of the results; please ignore them.

2. Since closed-ended questions are somewhat limiting in their freedom of personal response, the inside covers may be used for your comments. Please indicate on the left hand side the number of the relevant question.

3. When you have completed the questionnaire, please unfold the back cover, fold it over the front and staple the whole booklet.

Thank you
for your cooperation.

1. *Please indicate the type of building with which your firm is most concerned:*

- a. Mercantile (e.g. shops, dept. stores) ☐ (6)
- b. Residential dwellings (e.g. flats, houses) ☐ (7)
- c. Hotels ☐ (8)
- d. Institutional (e.g. hospitals, nursing homes) ☐ (9)
- e. Offices (public or private) ☐ (10)
- f. Educational ☐ (11)
- g. Sports and leisure ☐ (12)
- h. Industrial ☐ (13)
- i. Other *(please specify)* ☐ (14)

____

2. *Is there a permanent fire safety adviser or consultant among the members of your firm?*

Yes ☐ (15.1) No ☐ (15.2)

If yes, please specify his/her qualifications.

- a. Architect ☐ (16)
- b. Engineer ☐ (17)
- c. Other ☐ (18)

____

3. *In which stages of the design process is fire safety considered as a building component?*

- a. Inception (brief) ☐ (21)
- b. Feasibility (brief) ☐ (22)
- c. Spatial design ☐ (23)
- d. Materials specification ☐ (24)
- e. Performance specification ☐ (25)
- f. Constructional design ☐ (26)
- g. Working drawings ☐ (27)
- h. Maintenance manuals ☐ (28)
- i. Other *(please describe)* ☐ (29)

____

4. *At what stage of the design process is fire safety first considered as a design parameter?*

- a. Inception (brief) ☐ (31.1)
- b. Feasibility (brief) ☐ (31.2)
- c. Spatial design ☐ (31.3)
- d. Constructional design ☐ (31.4)
- e. Working drawings ☐ (31.5)
- f. Other *(please describe)* ☐ (31.6)

____

5. *Beside each of the aspects of building design listed below, please indicate the relevance that fire safety has:*

ASPECTS OF BUILDING DESIGN

a. VISUAL/AESTHETIC:

1. It makes a positive contribution ☐ (33.1)
2. It is a constraint ☐ (33.2)
3. It is a set of rules for compliance ☐ (33.3)
4. It has no relevance at all ☐ (33.4)

b. ENVIRONMENTAL:

1. It makes a positive contribution ☐ (34.1)
2. It is a constraint ☐ (34.2)
3. It is a set of rules for compliance ☐ (34.3)
4. It has no relevance at all ☐ (34.4)

c. CONSTRUCTIONAL:

1. It makes a positive contribution ☐ (35.1)
2. It is a constraint ☐ (35.2)
3. It is a set of rules for compliance ☐ (35.3)
4. It has no relevance at all ☐ (35.4)

6. *The following list contains some fire safety topics, please rank these topics according to their relative importance to building design. (1 for most important to 11 for least important).*

FIRE SAFETY TOPICS

a.	Risk Assessment	( )	(37)
b.	Smoke Control	( )	(38)
c.	Escape Route Design	( )	(39)
d.	Fire Resistance	( )	(40)
e.	Detection Systems	( )	(41)
f.	Suppression Systems	( )	(42)
g.	Management	( )	(43)
h.	Legislation	( )	(44)
i.	Human Behaviour	( )	(45)
j.	Combustion Technology	( )	(46)
k.	Other *(please describe)* ______________	( )	(47)

7. *Do you think that architects should have a greater awareness towards fire safety problems?*

Yes ☐ (49.1)   No ☐ (49.2)

If yes, how would you suggest that a greater awareness can be achieved? (50-54)

8. *Would you describe the present knowledge of fire safety existing in your firm as:*

a. More than adequate ☐ (55.1)

b. Adequate ☐ (55.2)

c. Inadequate ☐ (55.3)

d. Other *(please describe)* ☐ (55.4)

9 *In general, the fire safety knowledge existing in your firm comes mainly from:*

(Please tick and indicate the approximate percentage)

			approx. %	
a.	School of Architecture	☐	( )	(57)
b.	Specialised short courses	☐	( )	(58)
c.	Occasional Talks/Seminars	☐	( )	(59)
d.	Practical demonstrations	☐	( )	(60)
e.	Previous design experience	☐	( )	(61)
f.	Trade literature	☐	( )	(62)
g.	Other *(please specify)*	☐	( )	(63)

10. *In your opinion, could fire safety problems in building design be solved more efficiently by:*

a. Additional fire regulations ☐ (65)

b. More scientific research on the fire phenomenon ☐ (66)

c. Architectural design ☐ (67)

d. Engineering design (equipment) ☐ (68)

e. Better understanding/education for architects ☐ (69)

f. Full enforcement of existing regulations ☐ (70)

11. *In the following list, which people, or organisations, does your firm consult for fire safety advice?*

(Please tick and indicate approximately the percentage contributed by each of them).

		Approx %	
a. Central Government Officials (e.g. DOE, Home Office, HSE)	☐	( )	(72)
b. Fire Safety Consultant	☐	( )	(73)
c. Fire Brigade Officer	☐	( )	(74)
d. Building Control Officer	☐	( )	(75)
e. Insurance Surveyor	☐	( )	(76)
f. Fire Research Station	☐	( )	(77)
g. Fire Protection Association	☐	( )	(78)
h. Industry/Commerce	☐	( )	(79)
i. Other *(please specify)* ____________	☐	( )	(80)

12. *In general, when you consult any of the organisations listed above for a particular project, in which of the following categories would you place the fire safety advice received?*

a. Of general interest - direct use and applicable to other projects ☐ (6.1)

b. Of particular interest - direct use for project involved ☐ (6.2)

c. Of Limited interest - vague use. Require further information. ☐ (6.3)

d. Other *(please describe)*. ☐ (6.4)

____

13. *On the following list, please indicate the type of publication used in your practice for fire safety information.*

a. Text Books ☐ (8)
Which books? ____________

b. Journal Articles ☐ (9)
Which Journals? ____________

c. Building Regulations ☐ (10)

d. Fire Legislation ☐ (11)

e. Government Department Publications (e.g. DHSS, DOE, etc) ☐ (12)

f. BRE: Digests ☐ (13)

g. BRE: Current Papers ☐ (14)

h. Home Office/Welsh, Scottish Office ☐ (15)

i. Fire Research Station Reports (HMSO) ☐ (16)

j. BSI: Codes ☐ (17)

k. BSI: Standards ☐ (18)

l. Fire Protection Association ☐ (19)

m. Other *(please specify)* ☐ (20)

____

14. *Do you think that the fire safety information available to the architectural profession is sufficient to deal with fire safety problems in building design?*

Yes ☐ (22.1) No ☐ (22.2)

If no, please say:

14.1 *How would you suggest the fire safety information should be presented?* (23-26)

14.2 *What type of additional information would you like to see made available to the Architectural profession?* (27-30)

15. *In your experience, what are the main problems in the application of fire safety to architectural design?* (32-39)

Finally, in order to complete our records, it would be most helpful if you could state:

Name: *Position:*

Address:

Town: *Postcode:*

Telephone:

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.
Professor D.J. Rasbash

Letter 1

January 1980

Dear Colleague

We are conducting a survey to determine, among other things, the level of fire safety knowledge and information which exists within the architectural profession.

The questionnaire attached is the third of the series and is being circulated to the largest architectural practices throughout the UK (i.e. firms with ten or more employees). The distribution list was supplied by the RIBA at our request and the Institute therefore knows of this survey.

Our broad intention in this case is to determine particular ways in which fire safety is applied in the large practices and those conditions which, in the experience of your practice, indicate a satisfactory application of fire safety to building design.

We shall relate this information to that from the other questionnaires, identifying those parts of fire safety engineering which are adequately dealt with in building design and conversely those aspects of the subject not appropriately covered.

All this information will eventually enable us to attempt to make proposals on how best to present the topics within fire safety engineering to building designers and suggest ways to improve its application to architectural design.

The validity of our conclusions in obtaining these goals can be no greater than the validity of the answers given in this document. We therefore hope that you will feel that the trouble involved in carefully answering the questions will be worthwhile in terms of improved conditions that you are helping to devise, and that you will be kind enough to help us in this way.

Finally, we would like to emphasise that the replies to the questionnaires will be treated as highly confidential and will be dealt with in terms of generalisations, not specific cases. The study is part of an independent research project and therefore represents no sectional interest whatever.

We should be grateful for your co-operation in this study and shall look forward to receiving the reply from you soon.

Yours sincerely

EWMarchant

E W MARCHANT, PhD., RIBA, ARIAS.
M A CERDA , Research Architect.

Letter 2

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL. 031-667 1081 Ext 3616

March 1980

Earlier this year you probably received a copy of our questionnaire "FIRE SAFETY AND THE ARCHITECTURAL FIRM" but to date we have not had this returned from you.
We very much hope that this reminder will encourage you to spare the time to fill in the questionnaire and return it to us as soon as possible.

Another copy of the questionnaire could be sent to you if required.
We cannot over emphasise the vital importance that your contribution will make to the success of our project.

Thank you.

APPENDIX FOUR
FIRE PREVENTION OFFICERS QUESTIONNAIRE

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL
Telephone 031-667 1081 ext. 3616

FIRE SAFETY
AND THE
Fire Prevention Officer

Prepared by M A Cerda and E W Marchant.

TO:

Department of Fire Safety Engineering
University of Edinburgh
The King's Buildings
Edinburgh EH9 3JL

RESEARCH PROJECT:

THE APPLICATION OF FIRE SAFETY
TO ARCHITECTURAL DESIGN.

One of the objectives of this study is to ascertain the level of fire safety knowledge which exists within the Architectural profession, both as a taught subject and as working knowledge used by practitioners.

Through the medium of questionnaires, we hope to collect the information essential to measure this level of fire safety knowledge. Four questionnaires have been devised and circulated as follows:

1. RIBA recognised Schools of Architecture.
2. Sample of individual practitioners.
3. Sample of architectural firms.
4. Fire Prevention Officers in local authorities.

The purpose of this fourth questionnaire is to provide an indication on the following areas:

1. The general attitude of architects towards fire safety at present, and Fire Prevention Departments' views of their rôle.

2. The fire safety knowledge and information available to and used by the Architectural profession.

3. Problems and criticisms of fire safety as currently applied by the Architectural profession.

M A Cerda

GENERAL INSTRUCTIONS

This questionnaire is designed to take 20 minutes, or less, to answer. Individual answers will be kept confidential and only general results might be used for future reference.

1. Unless otherwise stated, please tick the box, or boxes, which best fit your own answer. The figures to the right of the boxes are merely an aid for the analysis of the results; please ignore them.

2. Since closed-ended questions are somewhat limiting in their freedom of personal response, at the bottom of some pages a space is provided for your comments. Please indicated on the left side the number of the relevant question.

3. When you have completed the questionnaire, please unfold the back cover, fold it over the front and staple the whole booklet. Since the stamp is provided, all you need to do is to drop it into a mail box, the Post Office will do the rest.

Thank you
for your cooperation.

1. *In general, do you think that the present fire safety knowledge existing among the architectural profession is adequate for them to achieve acceptable design solutions?*

Yes ☐ **(6.1)** **No** ☐ **(6.2)**

If no, please say in what ways you would suggest this knowledge could be increased for both practising architects and students of architecture. **(7-11)**

2. *Are you, or is your Brigade, involved in fire safety education in any School of Architecture?*

Yes ☐ **(13.1)** **No** ☐ **(13.2)**

If no, please proceed to question 3.

If yes, please indicate: **(14-15)**

2.1 *In which School?* ____________________

2.2 *For how many hours per year is your contribution?*

2.3 *What type of contribution is it?*

(Please tick and indicate approximate number of hours).

a.	Lectures	☐	( )	(16)
b.	Occasional talks	☐	( )	(17)
c.	Group discussions	☐	( )	(18)
d.	Project work revision	☐	( )	(19)
e.	Practical demonstrations	☐	( )	(20)
f.	Other *(please describe)*	☐	( )	(21)

____

3. *The following list contains some fire safety topics In your opinion, please rank these topics according to their relative importance for fire safety in buildings. (1 for most important to 11 for least important).*

Fire Safety Topics.

a. Risk Assessment	( )	(23)
b. Smoke Control	( )	(24)
c. Escape Route Design	( )	(25)
d. Fire Resistance	( )	(26)
e. Detection Systems	( )	(27)
f. Suppression Systems	( )	(28)
g. Management	( )	(29)
h. Legislation	( )	(30)
i. Human Behaviour	( )	(31)
j. Combustion Technology	( )	(32)
k. Other *(please describe)* ________________	( )	(33)

4. *Beside each of the aspects of building design listed below, please indicate the relevance that fire safety has:*

ASPECTS OF BUILDING DESIGN.

a. VISUAL/AESTHETIC:

1. It makes a positive contribution	☐	(35.1)
2. It is a constraint	☐	(35.2)
3. It is a set of rules for compliance	☐	(35.3)
4. It has no relevance at all	☐	(35.4)

b. ENVIRONMENTAL:

1. It makes a positive contribution	☐	(36.1)
2. It is a constraint	☐	(36.2)
3. It is a set of rules for compliance	☐	(36.3)
4. It has no relevance at all	☐	(36.4)

c. CONSTRUCTIONAL:

1. It makes a positive contribution	☐	(37.1)
2. It is a constraint	☐	(37.2)
3. It is a set of rules for compliance	☐	(37.3)
4. It has no relevance at all	☐	(37.4)

5. *In which of the following stages of the building design process would you suggest to architects to first seek fire safety advice?*

a. Inception (brief) ☐ (39.1)

b. Feasibility (brief) ☐ (39.2)

c. Preliminary design ☐ (39.3)

d. Constructional design ☐ (39.4)

e. Working drawings ☐ (39.5)

f. Other *(please describe)* ☐ (39.6)

____

6. *Generally, when new building projects are submitted for your comments, would you say that the majority are mostly presented at:*

a. Early stage of design
(Before any definite plans are made) ☐ (41.1)

b. Intermediate stage
(Scheme design, plans not fully developed) ☐ (41.2)

c. Advanced stage
(Detailed plans almost completed) ☐ (41.3)

d. Too late stage
(Plans completed, ready for approval submission) ☐ (41.4)

7. *Besides you as a Fire Prevention Officer, which other people or organisations are most commonly consulted for fire safety advice in your area?*

a. Central Government officials
(eg. DOE, Home Office, HSE) ☐ (43)

b. Fire Safety Consultant ☐ (44)

c. Building Control Officer ☐ (45)

d. Insurance Surveyor ☐ (46)

e. Fire Research Station ☐ (47)

f. Fire Protection Association ☐ (48)

g. Industry/Commerce ☐ (49)

h. Other *(please specify)* ☐ (50)

____

Your comments (51-53)

8. *In your experience, what are the main problems in the application of fire safety to architectural design?* **(54-58)**

9. *In your opinion, could fire safety problems be solved more efficiently by:*

a. Additional fire regulations	☐	**(59)**
b. More scientific research on the fire phenomenon	☐	**(60)**
c. Better constructional design	☐	**(61)**
d. Engineering design (equipment)	☐	**(62)**
e. Better understanding/education of architects	☐	**(63)**
f. Full enforcement of existing regulations	☐	**(64)**

Your comments: **(65-67)**

10. *Do you think that the fire safety information available to the architectural profession is sufficient for them to deal with fire safety problems in building design?*

Yes ☐ **(68.1)** **No** ☐ **(68.2)**

If no, please say: **(69-71)**

10.1. *How would you suggest the fire safety information should be presented?*

10.2. *What type of additional information would you like to see made available to the architectural profession?* **(72-74)**

11. *Do you think that architects should have a greater awareness towards fire safety problems?*

Yes ☐ **(75.1)** **No** ☐ **(75.2)**

If yes, how would you suggest that a greater awareness can be achieved? **(76-80)**

12. *Are you satisfied with the present relationship between your department and the architects in practice?*

Yes ☐ (6.1) No ☐ (6.2)

If yes, proceed to question No 13.

12.1 If no, please say why (7-9)

12.2 What would you suggest to improve this relationship? (10-12)

13. *When confronted with special fire safety problems (e.g. beyond the scope of regulations, either in size, type or complexity), to whom do you refer for advice?*

a. Home Office ☐ (14)

b. Other FP Department ☐ (15)

c. Fire Research Station ☐ (16)

d. Health and Safety Executive ☐ (17)

e. Building Control ☐ (18)

f. Other, *(please describe)* ☐ (19)

____

Your comments: (20-22)

14. *To deal with fire safety problems and cases, would you describe the fire safety knowledge existing in your Fire Prevention Department as a whole, as:*

a. **More than sufficient** ☐ **(23)**

b. **Sufficient** ☐ **(24)**

c. **Insufficient** ☐ **(25)**

d. **Other** *(please specify)* ☐ **(26)**

____

Your comments **(27-29)**

15. *Do you have any further comments or suggestions that you wish to make?* *(30-34)*

Finally, in order to complete our records, it would be most helpful if you could state:

Name: *Position:*

Address:

Town: *Postcode:*

Telephone:

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.
Professor D.J. Rasbash

Letter 1

30 November 1979

To All Chief Fire Officers/Firemasters, for the attention of the Senior Fire Prevention Officer.

Dear Sir

We are conducting a survey to determine, among other things, the level of fire safety knowledge and information which exists within the architectural profession.

The questionnaire attached is the fourth of the series and is being circulated to all Senior Fire Prevention Officers in Local Authorities throughout the UK. Our broad intention in this case is to assess those conditions which, in your experience, indicate a satisfactory application of fire safety to building design - "the other side of the story".

We shall then relate this information to that from the other questionnaires, identifying those parts of fire safety engineering which are adequately dealt with in building design and conversely those aspects of the subject not appropriately covered.

All this information will eventually enable us to attempt to make proposals on how best to present the topics within fire safety engineering to building designers and suggest ways to improve its application to architectural design.

The validity of our conclusions in obtaining these goals can be no greater than the validity of the answers given in this document. We therefore hope that you will feel that the trouble involved in carefully answering the questions will be worthwhile in terms of improved conditions that you are helping to devise, and that you will be kind enough to help us in this way.

Finally, we would like to emphasise that the replies to the questionnaires will be treated as highly confidential and will be dealt with in terms of generalisations, not specific cases. The study is part of an independent research project and therefore represents no sectional interest whatever.

We should be grateful for your co-operation in this study and shall look forward to receiving the reply from you soon.

Yours faithfully

E W MARCHANT
M A CERDA

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.
Professor D.J. Rasbash

Letter 2

February 1980

Dear Sir.

FIRE SAFETY AND THE FIRE PREVENTION OFFICER
(FIRE SAFETY KNOWLEDGE AND THE ARCHITECT)

Sometime ago we circulated all local authority Fire Brigades in the UK with a questionnaire having the above title. The reason for sending this questionnaire was to give us a more complete picture of the fire safety knowledge of the architect. A large proportion of authorities have returned a completed questionnaire, but to date we have not received a reply from yourselves.

If you have not received a questionnaire and would like to help us, a fresh copy is enclosed.

I look forward to receiving your reply.

Yours sincerely

EWMarchant

DR ERIC W MARCHANT
and
M A CERDA

Encl:

University of Edinburgh
Department of Fire Safety Engineering
School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.
Professor D.J. Rasbash

Letter 3

March 1980

Dear Sir

FIRE SAFETY AND THE FIRE PREVENTION OFFICER

Toward the end of 1979 we sent out a questionnaire with the above title, to all Fire Services in England and Wales and to Fire Brigades in Scotland. The response that we have had to this questionnaire has been extremely good but there are still a few brigades who have not had an opportunity to complete the questionnaire and return it to us.

So that our conclusions can be representative of the attitudes of the Fire Prevention Officers in the various Brigades to the problems that face the architectural profession, we are hoping that all the questionnaires will be returned.

At the time of sending this letter, we have not received a completed questionnaire from you: if it has been mislaid, a fresh copy can be sent on request.

We realise that there is nothing official about our request but we hope that because of the importance of the subject, some time can be given to enable our study to be more complete in this part.

Yours faithfully

E W Marchant

E W MARCHANT
M A CERDA

APPENDIX FIVE
VARIABLES COMMON TO QUESTIONNAIRES AND THEIR CODING CATEGORIES

FILE MSTRSPS (CREATION DATE = 28/10/80)

DOCUMENTATION FOR SPSS FILE 'MSTRSPS '

LIST OF THE 4 SUBFILES COMPRISING THE FILE

SCHOOLS N= 34 PRACT N= 31 FIRMS N= 202 FPOS N= 60

DOCUMENTATION FOR THE 118 VARIABLES IN THE FILE 'MSTRSPS '

REL POS	VARIABLE NAME	VARIABLE LABEL	
1	SEQNUM		
2	SUBFILE		
3	CASWGT		
4	CASE		
5	RELEV1	VISUAL-AESTHETIC	
6	RELEV2	ENVIRONMENTAL	
7	RELEV3	CONSTRUCTIONAL	
		MISS	0. NO ANSWER
			1. POSIT CONTRIBUTION
			2. CONSTRAINT
			3. SET OF RULES
			4. IRRELEVANT
			5. COM 1+2
			6. COM2+3
			7. COM1+3
8	CMREL1		
9	CMREL2		
		MISS	0. NO ANSWER
			1. OUT OF GROUP
			2. DIFFICULT QUESTION
			3. FS PART OF DESIGN
			4. DEPENDS ON APPRCH
			5. CONSTR POS CONTR
10	SOLVED1	ADDITIONAL FIRE REGS	
11	SOLVED2	SCIENTIFIC RESEARCH	
12	SOLVED3	CONSTRUCTIONAL DESIGN	
13	SOLVED4	ENGINEERING DESIGN	
14	SOLVED5	UNDERSTANDING-EDUCATION OF ARCH	
15	SOLVED6	FULL ENFORCEMENT OF REGS	
		MISS	0. NO ANSWER
			1. YES

16	CMSOL1			
17	CMSOL2	MISS	0.	NO ANSWER
			1.	OUT OF GROUP
			2.	MK CLIENT AWR NEEDS
			3.	UNDERST&ARCH RESP
			4.	KNWLD RSCH APPL DSGN
			5.	RSCH AT SCHOOLS
			6.	ONE AUTHORITY
			7.	ALL IMPORT
			8.	BTR WRKSH&SITE SUPER
			9.	MR REGS NOT OBSRVD
18	CMSOL3	MISS	0.	NO ANSWER
			1.	SIMPL&IMPROV REGS
			2.	GR LIAISON ARC-FPO
			3.	STDY&APL INFAV DSGN
19	INFAV	INFORMATION AVAILABLE TO PROFESSION		
		MISS	0.	NO ANSWER
			1.	YES
			2.	NO
20	CMINF1			
21	CMINF2			
22	CMINF3			
23	CMINF4	MISS	0.	NO ANSWER
			1.	OUT OF GROUP
			2.	HANDBOOK
			3.	SCATT FRAG INFO
			4.	SIMPLIF ILLUSTR
			5.	BETTER REGS
			6.	MAKE ARCH AWR INF
			7.	LS LEG MR PRINC
			8.	TEACH AIDS
			9.	DESIGN GUIDES
24	CMINF5			
25	CMINF6			
26	CMINF7			
27	CMINF8	MISS	0.	NO ANSWER
			1.	REG UPDATING
			2.	CASE STUDY
			3.	NAT INFO CENTRE
			4.	GENERAL INDEX
			5.	SECT PROF JRNL
			6.	ONE AUTHORITY
			7.	COMP PUB EQUP+MAT
			8.	STATIST BREAKDWN
			9.	COST COMP APRCH

28	PUBLIC1	TEXT BOOKS	
29	PUBLIC2	JOURNAL ARTICLES	
30	PUBLIC3	BLD REGULATIONS	
31	PUBLIC4	FIRE LEGISLATION	
32	PUBLIC5	GVMT DEPT PUBLIC	
33	PUBLIC6	BRE DIGEST	
34	PUBLIC7	BRE CURRENT PAPERS	
35	PUBLIC8	HOME OFFICE WO SO	
36	PUBLIC9	FRS	
37	PUBLIC10	BSI CODES	
38	PUBLIC11	BSI STANDARDS	
39	PUBLIC12	FPA	
40	PUBLIC13	OTHER	
		MISS	0. NO ANSWER
			1. YES
41	KNOW	PRESENT FS KNOWLEDGE	
		MISS	0. NO ANSWER
			1. GT ADEQUATE
			2. ADEQUATE
			3. INADEQUATE
			4. OTHER
			5. COMB1+2
			6. COMB2+3
			7. COMB3+4
			8. COMB1+3
			9. COMB2+4
42	CMKNOW1		
43	CMKNOW2		
44	CMKNOW3		
		MISS	0. NO ANSWER
			1. OUT OF GROUP
			2. QUESTBL FPO EXPERTS
			3. ADEQ TO TEACH
			4. NEED UPDATNG
			5. ADVICE SOUGHT
			6. VARYING INTERP REGS

```
45   ORIKNOW1   ARCHITECTURAL SCHOOL

46   ORIKNOW2   SHORT COURSES

47   ORIKNOW3   TALKS SEMINARS

48   ORIKNOW4   PRACTICAL DEMOS

49   ORIKNOW5   PREV DESIGN EXP

50   ORIKNOW6   TRADE LITERATURE

51   ORIKNOW7   OTHER
                MISS             0. NO ANSWER
                                 1. YES
                                 2. 0-5PCT
                                 3. 6-10PCT
                                 4. 11-30PCT
                                 5. 31-50PCT
                                 6. 51-70PCT
                                 7. 71-90PCT
                                 8. OVER 90PCT

52   CMORIK1

53   CMORIK2
                MISS             0. NO ANSWER
                                 1. OUT OF GROUP
                                 2. PUBLIC ARTCLS
                                 3. CONSULT FPO
                                 4. TEACHING
                                 5. CONSULT ADVISOR
                                 6. OWN INTEREST

54   TOPIC1     RISK ASSESSMENT

55   TOPIC2     SMOKE CONTROL

56   TOPIC3     ESCAPE ROUTE DESIGN

57   TOPIC4     FIRE RESISTANCE

58   TOPIC5     DETECTION SYSTEM

59   TOPIC6     SUPPRESSION SYSTEM

60   TOPIC7     MANAGEMENT

61   TOPIC8     LEGISLATION

62   TOPIC9     HUMAN BEHAVIOUR

63   TOPIC10    COMBUSTION TECHNOLOGY

64   TOPIC11    OTHER
                MISS             0. NO ANSWER
```

65	CMTOP1		
66	CMTOP2		
		MISS	0. NO ANSWER
			1. OUT OF GROUP
			2. DIFFICULT QUESTION
			3. ALL EQUAL
			4. CONSID JOINTLY
			5. DEPENDS PROJECT
67	CONSUL1	CENTRAL GOVERNMENT OFFICIALS	
68	CONSUL2	FIRE SAFETY CONSULT	
69	CONSUL3	FIRE BRIGADE OFFICER	
70	CONSUL4	BLD CONTROL OFFICER	
71	CONSUL5	INSURANCE SURVEYOR	
72	CONSUL6	FIRE RESEARCH STATION	
73	CONSUL7	FIRE PROTECTION ASSOC	
74	CONSUL8	INDUSTRY-COMMERCE	
75	CONSUL9	OTHER	
		MISS	0. NO ANSWER
			1. YES
			2. 0-5PCT
			3. 6-10PCT
			4. 11-30PCT
			5. 31-50PCT
			6. 51-70PCT
			7. 71-90PCT
			8. OVER 90PCT
76	CMCONS1		
77	CMCONS2		
78	CMCONS3		
		MISS	0. NO ANSWER
			1. OUT OF GROUP
			2. DEPENDS ON PRJCT
			3. NOT AWR AVAIL ADV
			4. CONSUL STATUT
			5. BCO NO ADV OR KNOW
			6. FPO FIRST SOURCE

79	GRAWAR	GREATER AWARENESS TO FS PROBLEMS	
		MISS	0. NO ANSWER 1. YES 2. NO
80	SUGRAWR1		
81	SUGRAWR2		
82	SUGRAWR3		
		MISS	0. NO ANSWER 1. G TIME PART SCH CURR 2. MID CAREER EDUC 3. PUBLICITY PROF 4. EMPH JRNLS 5. FIRE SCENES 6. FILMS AV AIDS 7. FRS FSTC DEMOS 8. LIAISON ARCH-FB 9. STDY&APPL INFO AVLBL
83	SGRAWR4		
84	SGRAWR5		
85	SGRAWR6		
		MISS	0. NO ANSWER 1. OUT OF GROUP 2. HANDBOOK 3. MORE PRINC LESS LEGI 4. UNIF&COORD REGS 5. INCONS INTERP REGS 6. CLIENT AWR NEEDS
86	SUG1		
87	SUG2		
88	SUG3		
89	SUG4		
90	SUG5		
91	SUG6		
		MISS	0. NO ANSWER 1. OUT OF GROUP 2. BETTER EDUC PROF 3. RELUCT ACCEPT ADV 4. EARLY CONS&CONSL 5. ONE AUTHORITY 6. INCONS INTERP REGS 7. INFO RE BLD TYPS 8. FLEXIB APPRCH REGS 9. BETTER LIAISON

92	STAGCON1	INCEPTION	
93	STAGCON2	FEASIBILITY	
94	STAGCON3	SPATIAL DESIGN	
95	STAGCON4	MATERIALS SPECS	
96	STAGCON5	PERFORMANCE SPECS	
97	STAGCON6	CONSTRUC DESIGN	
98	STAGCON7	WORK DRAWINGS	
99	STAGCON8	MAINTENANCE MANUAL	
100	STAGCON9	OTHER	
		MISS	0. NO ANSWER
			1. YES
101	STAGFST		
		MISS	0. NO ANSWER
			1. INCEPTION
			2. FEASIBILITY
			3. SPATIAL DESIGN
			4. CONSTRUC DESIGN
			5. WORK DRAWING
			6. OTHER
102	PROBAPL1		
103	PROBAPL2		
104	PROBAPL3		
105	PROBAPL4		
		MISS	0. NO ANSWER
			1. OUT OF GROUP
			2. COHER INTERP REGS
			3. INHIB DSGN FREEDM
			4. COMPLX&FRAG REGS
			5. COST INCID
			6. ARCH NOKNOW&UNDERS
			7. FPO NOKNOW DESIGN

106	PRBAPL5		
107	PRBAPL6		
108	PRBAPL7		
109	PRBAPL8		
		MISS	0. NO ANSWER
			1. MEANS ESCAPE
			2. MATERIALS
			3. CONFLICT BRIEF
			4. BALANCED SOLUTION
			5. CONFLICT OPRTN
			6. CONFLICT PLANN
			7. SMOKE CONTROL
			8. FAIL MAINT PROVIS
			9. RISK ASSESS
110	TYPBLD1	MERCANTILE	
111	TYPBLD2	RESIDENTIAL	
112	TYPBLD3	HOTELS	
113	TYPBLD4	INSTITUTIONAL	
114	TYPBLD5	OFFICES	
115	TYPBLD6	EDUCATIONAL	
116	TYPBLD7	SPORTS LEISURE	
117	TYPBLD8	INDUSTRIAL	
118	TYPBLD9	OTHER	
		MISS	0. NO ANSWER
			1. YES

APPENDIX SIX

TABLES OF RESULTS

SCHOOLS OF ARCHITECTURE

Table 6-1

RELEVANCE OF FIRE SAFETY TO BUILDING DESIGN

SUBFILE		VISUAL AESTHETIC	ENVIRONMENTAL	CONSTRUCTIONAL
SCHOOLS		1	2	3
ABSOLUTE FREQUENCIES				
TOTAL		33	33	32
POSITIVE CONTRIBUTION	1	7	11	12
CONSTRAINT	2	24	15	13
SET OF RULES	3	0	3	5
IRRELEVANT	4	1	1	0
COMBINATION 1+2	5	1	3	2
RELATIVE FREQUENCIES				
TOTAL		100.00	100.00	100.00
POSITIVE CONTRIBUTION	1	21.21	33.33	37.50
CONSTRAINTS	2	72.73	45.45	40.62
SET OF RULES	3	.00	9.09	15.62
IRRELEVANT	4	3.03	3.03	.00
COMBINATION 1+2	5	3.03	9.09	6.25
MODE		2	2	2

Table 6-2

VARIABLE COM1 COMMENTS TO QUESTION 1

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
OUT OF GROUP	1	2	14.3
DIFFICULT QUESTION	2	5	35.7
FS PART OF DESIGN	3	3	21.4
DEPENDS ON APPROACH	4	2	14.3
CONSTRAINT POSIT CONTRIB	5	2	14.3
	TOTAL RESPONSES	14	100.0

20 MISSING CASES 14 VALID CASES

Table 6-3

VARIABLE ROLE ROLE WITH RESPECT TO FIRE SAFETY Q2

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
COORDINATOR	1	6	18.2
TEACHER	2	9	27.3
COMB 1+2	5	13	39.4
COMB 2+3	6	5	15.2
	TOTAL RESPONSES	33	100.0

1 MISSING CASES 33 VALID CASES

Table 6-4

VARIABLE STATUS STATUS OF FS COURSE Q10

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
OPTIONAL	1	2	6.1
OBLIGATORY	2	28	84.8
OTHER	3	3	9.1
	TOTAL RESPONSES	33	100.0

1 MISSING CASES 33 VALID CASES

Table 6-5

GROUP TOPIC FIRE SAFETY TOPICS CONSIDERED AT SCHOOLS

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
RISK ASSESSMENT	TOPIC1	18	8.5	56.2
SMOKE CONTROL	TOPIC2	32	15.0	100.0
ESCAPE ROUTE DESIGN	TOPIC3	32	15.0	100.0
FIRE RESISTANCE	TOPIC4	32	15.0	100.0
DETECTION SYSTEM	TOPIC5	26	12.2	81.2
SUPPRESSION SYSTEM	TOPIC6	25	11.7	78.1
MANAGEMENT	TOPIC7	10	4.7	31.2
LEGISLATION	TOPIC8	31	14.6	96.9
OTHER	TOPIC9	7	3.3	21.9
	TOTAL RESPONSES	213	100.0	665.6

2 MISSING CASES 32 VALID CASES

Table 6-6

VARIABLE KNOW PRESENT FS KNOWLEDGE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
GT ADEQUATE	1	2	6.1
ADEQUATE	2	23	69.7
INADEQUATE	3	6	18.2
COMB1+2	5	1	3.0
COMB2+3	6	1	3.0
	TOTAL RESPONSES	33	100.0

1 MISSING CASES 33 VALID CASES

Table 6-7

VARIABLE COM3 COMMENTS TO QUESTION 3

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
OUT OF GROUP	1	3	42.9
ADEQUATE TO TEACH	3	2	28.6
NEED TOPPING UP	4	1	14.3
ADVICE SOUGHT AS REQ	5	1	14.3
	TOTAL RESPONSES	7	100.0

27 MISSING CASES 7 VALID CASES

Table 6-8

VARIABLE SYL COURSE SYLLABUS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
ENCLOSED	1	9	27.3
NOT ENCLOSED	2	8	24.2
NOT AVAILABLE	3	16	48.5
	TOTAL RESPONSES	33	100.0

1 MISSING CASES 33 VALID CASES

Table 6-9

VARIABLE COM6 COMMENTS TO QUESTION 6

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
OUT OF GROUP	1	2	20.0
SPREAD IN VAR COURSES	2	5	50.0
BASED RIBA-FPA GUIDE	3	3	30.0
	TOTAL RESPONSES	10	100.0

24 MISSING CASES 10 VALID CASES

Table 6-10

VARIABLE INFAV   INFORMATION AVAILABLE TO PROFESSION

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	13	41.9
NO	2	18	58.1
	TOTAL RESPONSES	31	100.0

3 MISSING CASES   31 VALID CASES

Table 6-11

GROUP CMINF   COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	8	27.6	36.4
HANDBOOK	2	7	24.1	31.8
SCATT FRAG INFO	3	5	17.2	22.7
LS LEG MR PRINC	7	4	13.8	18.2
TEACH AIDS	8	5	17.2	22.7
	TOTAL RESPONSES	29	100.0	131.8

12 MISSING CASES   22 VALID CASES

Table 6-12

METHOD OF TEACHING USED IN SCHOOLS.

	FORMAL LECTUR 1	GROUPS DISCUS 2	TUTOR 3	OCCASL TALKS 4	CONCEN BLOCKS 5	PRACT DEMONS 6	PROJCT DISCUS 7	INDIV STUDIO 8	OTHER 9
ABSOLUTE FREQ									
TOTAL	31	10	22	17	7	7	23	28	16
COURSE YEAR 1	1	0	0	1	0	2	0	0	2
2	3	1	1	3	1	2	0	0	2
3	6	1	3	0	2	2	2	1	5
4	5	1	1	3	2	1	1	2	2
5	0	2	3	0	0	0	2	1	1
ANY 2 YEARS 6	4	2	5	5	2	0	6	8	1
ANY 3 YEARS 7	8	3	4	1	0	0	4	5	2
ANY 4 YEARS 8	2	0	3	3	0	0	5	5	1
ALL YEARS 9	2	0	2	1	0	0	3	6	0
RELATIVE FREQ									
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
COURSE YEAR 1	3.23	.00	.00	5.88	.00	28.57	.00	.00	12.50
2	9.68	10.00	4.55	17.65	14.29	28.57	.00	.00	12.50
3	19.35	10.00	13.64	.00	28.57	28.57	8.70	3.57	31.25
4	16.13	10.00	4.55	17.65	28.57	14.29	4.35	7.14	12.50
5	.00	20.00	13.64	.00	.00	.00	8.70	3.57	6.25
ANY 2 YEARS 6	12.90	20.00	22.73	29.41	28.57	.00	26.09	28.57	6.25
ANY 3 YEARS 7	25.81	30.00	18.18	5.88	.00	.00	17.39	17.86	12.50
ANY 4 YEARS 8	6.45	.00	13.64	17.65	.00	.00	21.74	17.86	6.25
ALL YEARS 9	6.45	.00	9.09	5.88	.00	.00	13.04	21.43	.00
MODE	7	7	6	6	3	1	6	6	3

Table 6-13

METHOD OF ASSESSMENT USED IN SCHOOLS

		WRITTEN EXAMINATN 1	ORAL EXAMINATN 2	WRITTEN REPORT 3	DESIGN PROJECT 4
ABSOLUTE FREQUENCIES					
TOTAL		21	2	16	28
COURSE YEARS	2	3	0	1	0
	3	5	0	4	1
	4	3	0	6	0
	5	0	0	1	2
ANY 2 YEARS	6	6	1	4	7
ANY 3 YEARS	7	2	0	0	8
ANY 4 YEARS	8	2	1	0	8
ALL YEARS	9	0	0	0	2
RELATIVE FREQUENCIES					
TOTAL		100.00	100.00	100.00	100.00
COURSE YEARS	2	14.29	.00	6.25	.00
	3	23.81	.00	25.00	3.57
	4	14.29	.00	37.50	.00
	5	.00	.00	6.25	7.14
ANY 2 YEARS	6	28.57	50.00	25.00	25.00
ANY 3 YEARS	7	9.52	.00	.00	28.57
ANY 3 YEARS	8	9.52	50.00	.00	28.57
ALL YEARS	9	.00	.00	.00	7.14
MODE		6	6	4	7

Table 6-14

VARIABLE COM7 COMMENTS TO QUESTION 7

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	8	66.7	66.7
DIFFICULT TO ASSESS	2	4	33.3	33.3
TOTAL RESPONSES		12	100.0	100.0

22 MISSING CASES 12 VALID CASES

Table 6-15

VARIABLE COM8 COMMENTS TO QUESTION 8

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
PROJECT ORIENTED	2	7	41.2	41.2
VISITS	3	10	58.8	58.8
TOTAL RESPONSES		17	100.0	100.0

17 MISSING CASES 17 VALID CASES

Table 6-16

VARIABLE COM9 COMMENTS TO QUESTION 9

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	1	14.3	14.3
INTEGRATED OTHER ASPECTS	2	2	28.6	28.6
REPORT OR SPECIAL STUDY	3	4	57.1	57.1
TOTAL RESPONSES		7	100.0	100.0

27 MISSING CASES 7 VALID CASES

Table 6-17

GROUP PUBLIC   PUBLICATIONS USED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
TEXT BOOKS	PUBLIC1	20	7.4	62.5
JOURNAL ARTICLES	PUBLIC2	19	7.0	59.4
BLD REGULATIONS	PUBLIC3	31	11.4	96.9
FIRE LEGISLATION	PUBLIC4	26	9.6	81.2
GVMT DEPT PUBLIC	PUBLIC5	20	7.4	62.5
BRE DIGEST	PUBLIC6	24	8.9	75.0
BRE CURRENT PAPERS	PUBLIC7	19	7.0	59.4
HOME OFFICE WO SO	PUBLIC8	11	4.1	34.4
FRS	PUBLIC9	19	7.0	59.4
BSI CODES	PUBLIC10	23	8.5	71.9
BSI STANDARDS	PUBLIC11	20	7.4	62.5
FPA	PUBLIC12	24	8.9	75.0
OTHER	PUBLIC13	15	5.5	46.9
	TOTAL RESPONSES	271	100.0	846.9

2 MISSING CASES   32 VALID CASES

Table 6-18

PEOPLE CONTRIBUTING TO FIRE SAFETY COURSE

	FULL TIME LECTUR 1	PART TIME LECTUR 2	VISITNG ACADEM 3	FIRE SAFETY CONSULT 4	BUILDNG CONTROL OFFICER 5	FIRE BRIGADE OFFICER 6	INSURAN SURVEYR 7	FIRE RESRCH STATION 8	FIRE PROTECT ASSOC 9	INDUSTY COMMERC 10	OTHER 11
ABSOLUTE FREQ											
TOTAL	30	11	2	6	21	13	3	0	1	3	5
YES 1	9	5	1	2	9	6	2	0	1	2	2
L T 6 HRS 2	6	4	1	2	7	6	1	0	0	1	0
6 TO 12 HRS 3	3	2	0	0	3	1	0	0	0	0	1
12 TO 16 HRS 4	7	0	0	0	1	0	0	0	0	0	0
16 TO 20 HRS 5	2	0	0	0	0	0	0	0	0	0	0
20 TO 24 HRS 6	2	0	0	0	0	0	0	0	0	0	1
28 TO 32 HRS 8	0	0	0	0	1	0	0	0	0	0	0
OVER 32 HRS 9	1	0	0	2	0	0	0	0	0	0	1
RELATIVE FREQ											
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	.00	100.00	100.00	100.00
YES 1	30.00	45.45	50.00	33.33	42.86	46.15	66.67	.00	100.00	66.67	40.00
L T 6 HRS 2	20.00	36.36	50.00	33.33	33.33	46.15	33.33	.00	.00	33.33	.00
6 TO 12 HRS 3	10.00	18.18	.00	.00	14.29	7.69	.00	.00	.00	.00	20.00
12 TO 16 HRS 4	23.33	.00	.00	.00	4.76	.00	.00	.00	.00	.00	.00
16 TO 20 HRS 5	6.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
20 TO 24 HRS 6	6.67	.00	.00	.00	.00	.00	.00	.00	.00	.00	20.00
28 TO 32 HRS 8	.00	.00	.00	.00	4.76	.00	.00	.00	.00	.00	.00
OVER 32 HRS 9	3.33	.00	.00	33.33	.00	.00	.00	.00	.00	.00	20.00

Table 6-19

GROUP SUGRAWR

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
GREATER TIME, PART SCH CURR	1	5	15.2
PUBLICITY PROFESSION	3	6	18.2
VISITS FIRE SCENES	5	6	18.2
FILMS, AV AIDS	6	8	24.2
FRS, FSTC, DEMONS	7	8	24.2
TOTAL RESPONSES		33	100.0

Table 6-20

GROUP SGRAWR

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
OUT OF GROUP	1	12	46.2
HANDBOOK	2	8	30.8
MORE PRINC, LESS LEGISL.	3	6	23.1
TOTAL RESPONSES		26	100.0

Table 6-21

GROUP SOLVED   F S PROBLEMS IN BLD DESIGN BETTER SOLVED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
ADDITIONAL FIRE REGS	SOLVED1	1	1.1	3.1
SCIENTIFIC RESEARCH	SOLVED2	18	20.7	56.2
CONSTRUCTIONAL DESIGN	SOLVED3	23	26.4	71.9
ENGINEERING DESIGN	SOLVED4	16	18.4	50.0
UNDERSTANDING-EDUC ARCH	SOLVED5	29	33.3	90.6
	TOTAL RESPONSES	87	100.0	271.9

2 MISSING CASES   32 VALID CASES

Table 6-22

GROUP CMSOLVED COMMENTS TO SOLVED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	3	25.0	27.3
UNDERST&ARCH RESP	3	3	25.0	27.3
RSCH AT SCHOOLS	5	2	16.7	18.2
ALL IMPORT	7	1	8.3	9.1
MR REGS NOT OBSRVD	9	3	25.0	27.3
	TOTAL RESPONSES	12	100.0	109.1

23 MISSING CASES   11 VALID CASES

APPENDIX SEVEN
TABLES OF RESULTS
ARCHITECTS IN PRACTICE

Table 7-1

GROUP TYPEBLD TYPES OF BUILDING MOST CONCERNED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
MERCANTILE	TYPBLD1	7	7.7	23.3
RESIDENTIAL	TYPBLD2	26	28.6	86.7
HOTELS	TYPBLD3	5	5.5	16.7
INSTITUTIONAL	TYPBLD4	9	9.9	30.0
OFFICES	TYPBLD5	11	12.1	36.7
EDUCATIONAL	TYPBLD6	12	13.2	40.0
SPORTS LEISURE	TYPBLD7	7	7.7	23.3
INDUSTRIAL	TYPBLD8	12	13.2	40.0
OTHER	TYPBLD9	2	2.2	6.7
	TOTAL RESPONSES	91	100.0	303.3

1 MISSING CASES 30 VALID CASES

Table 7-2

GROUP STAGCON   STAGES OF DESIGN FIRE SAFETY IS CONSID

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
INCEPTION	STAGCON1	7	6.0	23.3
FEASIBILITY	STAGCON2	17	14.7	56.7
SPATIAL DESIGN	STAGCON3	22	19.0	73.3
MATERIALS SPECS	STAGCON4	20	17.2	66.7
PERFORMANCE SPECS	STAGCON5	11	9.5	36.7
CONSTRUC DESIGN	STAGCON6	18	15.5	60.0
WORK DRAWINGS	STAGCON7	12	10.3	40.0
MAINTENANCE MANUAL	STAGCON8	9	7.8	30.0
	TOTAL RESPONSES	116	100.0	386.7

1 MISSING CASES   30 VALID CASES

Table 7-3

VARIABLE STAGFST   DESIGN STAGE F S FIRST CONSIDERED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
INCEPTION	1	5	21.7
FEASIBILITY	2	7	30.4
SPATIAL DESIGN	3	10	43.5
WORK DRAWING	5	1	4.3
	TOTAL RESPONSES	23	100.0

8 MISSING CASES   23 VALID CASES

Table 7-4

VARIABLE KNOW PRESENT FIRE SAFETY KNOWLEDGE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
ADEQUATE	2	22	73.3
INADEQUATE	3	7	23.3
COMB2+4	9	1	3.3
	TOTAL RESPONSES	30	100.0

1 MISSING CASES 30 VALID CASES

Table 7-5

GROUP COMSTAG COMMENTS TO STAGE OF DESIGN FIRST CONSID

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	3	21.4	25.0
DEPENDS ON SITE	2	3	21.4	25.0
SPATIAL, SHOULD INCEPTION	3	7	50.0	58.3
ESSENTIAL EARLIEST	4	1	7.1	8.3
	TOTAL RESPONSES	14	100.0	116.7

19 MISSING CASES 12 VALID CASES

Table 7-6

GROUP CMRELEV COMMENTS TO RELEVANCE OF F S TOPICS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	1	20.0	25.0
DIFFICULT QUESTION	2	1	20.0	25.0
CONSTR POSITIVE CONTRIB	5	3	60.0	75.0
	TOTAL RESPONSES	5	100.0	125.0

27 MISSING CASES 4 VALID CASES

Table 7-7

RELEVANCE OF FIRE SAFETY TO BUILDING DESIGN

SUBFILE		VISUAL AESTHETIC	ENVIRONMENTAL	CONSTRUCTIONAL
PRACTITIONERS		1	2	3
ABSOLUTE FREQUENCIES				
TOTAL		30	30	30
POSITIVE CONTRIB	1	1	5	7
CONSTRAINT	2	16	11	13
SET OF RULES	3	3	7	5
IRRELEVANT	4	3	2	0
COMBINATION 1+2	5	0	0	1
COMBINATION 2+3	6	6	5	4
COMBINATION 1+3	7	1	0	0
RELATIVE FREQUENCIES				
TOTAL		100.00	100.00	100.00
POSITIVE CONTRIB	1	3.33	16.67	23.33
CONSTRAINT	2	53.33	36.67	43.33
SET OF RULES	3	10.00	23.33	16.67
IRRELEVANT	4	10.00	6.67	.00
COMBINATION 1+2	5	.00	.00	3.33
COMBINATION 2+3	6	20.00	16.67	13.33
COMBINATION 1+3	7	3.33	.00	.00
MODE		2	2	2

Table 7-8

PEOPLE CONSULTED FOR FIRE SAFETY ADVICE

PRACTITIONERS

	CENTRAL GOVERMT OFFICE 1	FIRE SAFETY CONSULT 2	FIRE BRIGADE OFFICER 3	BUILDNG CONTROL OFFICER 4	INSURNC SURVEYR 5	FIRE RESERCH STATION 6	FIRE PROTECT ASSOC 7	INDUSTR COMMERC 8	OTHER 9
ABSOLUTE FREQ									
TOTAL	6	6	28	24	5	6	3	7	3
YES 1	1	2	9	6	1	0	2	2	2
< 5 % 2	3	1	0	0	1	5	1	2	0
6-10 %3	0	1	0	2	2	0	0	1	0
11-30 %4	1	1	2	9	1	1	0	1	1
31-50 %5	1	1	6	7	0	0	0	1	0
51-70 %6	0	0	6	0	0	0	0	0	0
71-90 %7	0	0	2	0	0	0	0	0	0
> 90 % 8	0	0	3	0	0	0	0	0	0
RELATIVE FREQ									
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
YES 1	16.67	33.33	32.14	25.00	20.00	.00	66.67	28.57	66.67
< 5 % 2	50.00	16.67	.00	.00	20.00	83.33	33.33	28.57	.00
6-10 %3	.00	16.67	.00	8.33	40.00	.00	.00	14.29	.00
11-30 %4	16.67	16.67	7.14	37.50	20.00	16.67	.00	14.29	33.33
31-50 %5	16.67	16.67	21.43	29.17	.00	.00	.00	14.29	.00
51-70 %6	.00	.00	21.43	.00	.00	.00	.00	.00	.00
71-90 %7	.00	.00	7.14	.00	.00	.00	.00	.00	.00
> 90 % 8	.00	.00	10.71	.00	.00	.00	.00	.00	.00
MODE	2	1	1	4	3	2	1	1	1

Table 7-9

GROUP PUBLIC PUBLICATIONS USED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
TEXT BOOKS	PUBLIC1	9	5.0	30.0
JOURNAL ARTICLES	PUBLIC2	18	9.9	60.0
BLD REGULATIONS	PUBLIC3	30	16.6	100.0
FIRE LEGISLATION	PUBLIC4	17	9.4	56.7
GVMT DEPT PUBLIC	PUBLIC5	12	6.6	40.0
BRE DIGEST	PUBLIC6	21	11.6	70.0
BRE CURRENT PAPERS	PUBLIC7	12	6.6	40.0
HOME OFFICE (WO, SO)	PUBLIC8	5	2.8	16.7
FIRE RESEARCH STATION	PUBLIC9	10	5.5	33.3
BSI CODES	PUBLIC10	20	11.0	66.7
BSI STANDARDS	PUBLIC11	12	6.6	40.0
FIRE PROTEC ASSOC	PUBLIC12	11	6.1	36.7
OTHER	PUBLIC13	4	2.2	13.3
	TOTAL RESPONSES	181	100.0	603.3

1 MISSING CASES 30 VALID CASES

Table 7-10

ORIGIN OF PRESENT FIRE SAFETY KNOWLEDGE

PRACTITIONERS

		ARCHITECT SCHOOLS 1	SHORT COURSES 2	TALKS SEMINARS 3	PRACTICAL DEMONSTRAT 4	PREVIOUS DESIGN EXP 5	TRADE LITERATURE 6	OTHER 7
ABSOLUTE FREQ								
TOTAL		17	5	12	8	25	20	11
YES	1	3	2	2	1	3	3	4
< 5 %	2	1	0	3	1	0	5	0
6-10 %	3	4	2	4	2	1	5	0
11-30 %	4	6	1	3	2	4	6	4
31-50 %	5	2	0	0	0	7	1	1
51-70 %	6	0	0	0	2	5	0	2
71-90 %	7	1	0	0	0	4	0	0
> 90 %	8	0	0	0	0	1	0	0
RELATIVE FREQ								
TOTAL		100.00	100.00	100.00	100.00	100.00	100.00	100.00
YES	1	17.65	40.00	16.67	12.50	12.00	15.00	36..36
< 5 %	2	5.88	.00	25.00	12.50	.00	25.00	.00
6-10 %	3	23.53	40.00	33.33	25.00	4.00	25.00	.00
11-30 %	4	35.29	20.00	25.00	25.00	16.00	30.00	36.36
31-50 %	5	11.76	.00	.00	.00	28.00	5.00	9,09
51-70 %	6	.00	.00	.00	25.00	20.00	.00	18.18
71-90 %	7	5.88	.00	.00	.00	16.00	.00	.00
> 90 %	8	.00	.00	.00	.00	4.00	.00	.00
MODE		4	1	3	3	5	4	1

Table 7-11

RANKING OF FIRE SAFETY TOPICS

PRACTITIONERS

ABSOL FREQ	RISK ASSES 1	SMOKE CONTRL 2	ESCAPE DESIGN 3	FIRE RESIST 4	DETECT SYSTEM 5	SUPRES SYSTEM 6	MANGMT 7	LEGISL 8	HUMAN BEHAVR 9	COMBST TECHNL 10
TOTAL	23	25	25	25	25	26	26	23	24	22
1	4	1	10	1	0	0	0	2	1	0
2	5	3	7	4	1	1	0	2	2	1
3	3	5	5	4	2	0	1	0	3	0
4	3	11	1	4	1	0	0	1	2	1
5	2	2	1	8	6	1	2	2	2	0
6	2	2	0	1	7	4	4	2	2	2
7	0	1	0	1	5	6	3	6	3	0
8	1	0	0	2	0	8	4	4	3	3
9	0	0	0	0	2	2	8	0	5	7
10	3	0	1	0	1	4	4	4	1	8
MODE	2	4	1	5	6	8	9	7	9	10

Table 7-12

GROUP CMORIK COMMENTS TO ORIGIN TO F S KNOWLEDGE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	4	21.1	23.5
PUBLICATIONS, ARTCLES	2	6	31.6	35.3
CONSULTING FPOS	3	6	31.6	35.3
TEACHING	4	3	15.8	17.6
TOTAL RESPONSES		19	100.0	111.8

14 MISSING CASES 17 VALID CASES

Table 7-13

GROUP CMTOPIC COMMENTS TO RANKING OF F S TOPICS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	4	57.1	66.7
ALL EQUAL IMPORTANT	3	1	14.3	16.7
CONSIDERED JOINTLY	4	2	28.6	33.3
TOTAL RESPONSES		7	100.0	116.7

25 MISSING CASES 6 VALID CASES

Table 7-14

GROUP SUGG FURTHER COMMENTS AND SUGGESTIONS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	2	25.0	28.6
BETTER EDUCATION PROFESSION	2	1	12.5	14.3
UNDER ONE AUTHORITY	5	1	12.5	14.3
INCONSIST INTERPREP REGS	6	1	12.5	14.3
INFO REFER BLD TYPES	7	1	12.5	14.3
FLEXIBLE APPOARCH REGS	8	2	25.0	28.6
TOTAL RESPONSES		8	100.0	114.3

24 MISSING CASES 7 VALID CASES

Table 7-15

GROUP SOLVED FIRE SAFETY PROBLEMS IN BLD DESIGN

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
ADDITIONAL FIRE REGS	SOLVED1	1	1.7	3.3
SCIENTIFIC RESEARCH	SOLVED2	11	18.3	36.7
CONSTRUCTIONAL DESIGN	SOLVED3	12	20.0	40.0
ENGINEERING DESIGN	SOLVED4	3	5.0	10.0
UNDERSTANDING-EDUC ARCH	SOLVED5	21	35.0	70.0
FULL ENFORCEMENT OF REGS	SOLVED6	12	20.0	40.0
	TOTAL RESPONSES	60	100.0	200.0

1 MISSING CASES 30 VALID CASES

Table 7-16

GROUP CMSOLVED COMMENTS TO SOLVED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	7	46.7	53.8
MAKE CLIENT AWARE NEEDS	2	2	13.3	15.4
UNDERST&ARCH RESP	3	1	6.7	7.7
UNDER ONE AUTHORITY	6	2	13.3	15.4
ALL IMPORTANT	7	1	6.7	7.7
MORE REGS WILL NOT OBSERVED	9	2	13.3	15.4
	TOTAL RESPONSES	15	100.0	115.4

18 MISSING CASES 13 VALID CASES

Table 7-17

VARIABLE INFAV   INFORMATION AVAILABLE TO PROFESSION

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	14	46.7
NO	2	16	53.3
	TOTAL RESPONSES	30	100.0

1 MISSING CASES   30 VALID CASES

Table 7-18

GROUP CMINFAV   COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
CASE STUDY	2	1	25.0
SECTION IN PROF JOURNALS	5	1	25.0
COMPLETE PUBLIC EQUP+MAT	7	1	25.0
COST COMPARISON APRCH	9	1	25.0
	TOTAL RESPONSES	4	100.0

27 MISSING CASES   4 VALID CASES

GROUP CMINF   COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	6	18.2	30.0
HANDBOOK	2	9	27.3	45.0
SCATTERED FRAG INFO	3	6	18.2	30.0
SIMPLIF ILLUSTR	4	4	12.1	20.0
BETTER REGS	5	1	3.0	5.0
MAKE ARCH AWARE INFO	6	5	15.2	25.0
LESS LEGISL, MORE PRINC	7	2	6.1	10.0
	TOTAL RESPONSES	33	100.0	165.0

11 MISSING CASES   20 VALID CASES

Table 7-19

VARIABLE GRAWAR GREATER AWARENESS TO FS PROBLEMS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	25	83.3
NO	2	5	16.7
	TOTAL RESPONSES	30	100.0

1 MISSING CASES 30 VALID CASES

Table 7-20

GROUP SUGRAWR SUGGESTED WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
GREATER TIME, PART SCH CURR	1	7	43.7	63.6
MID-CAREER EDUCATION	2	8	50.0	72.7
PUBLICITY PROFESSION	3	1	6.2	9.1
	TOTAL RESPONSES	16	100.0	145.5

20 MISSING CASES 11 VALID CASES

GROUP SGRAWR MORE WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	15	51.7	68.2
HANDBOOK	2	7	24.1	31.8
MORE PRINC, LESS LEGISL	3	1	3.4	4.5
UNIFIC&COORDINATION REGS	4	3	10.3	13.6
INCONSISTENT INTERPRET REGS	5	1	3.4	4.5
MAKE CLIENT AWARE NEEDS	6	2	6.9	9.1
	TOTAL RESPONSES	29	100.0	131.8

9 MISSING CASES 22 VALID CASES

APPENDIX EIGHT
TABLES OF RESULTS
ARCHITECTURAL FIRMS

Table 8-1

GROUP TYPEBLD TYPES OF BUILDING MOST CONCERNED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
MERCANTILE	TYPBLD1	81	9.6	40.9
RESIDENTIAL	TYPBLD2	116	13.7	58.6
HOTELS	TYPBLD3	45	5.3	22.7
INSTITUTIONAL	TYPBLD4	89	10.5	44.9
OFFICES	TYPBLD5	151	17.9	76.3
EDUCATIONAL	TYPBLD6	105	12.4	53.0
SPORTS LEISURE	TYPBLD7	85	10.1	42.9
INDUSTRIAL	TYPBLD8	134	15.9	67.7
OTHER	TYPBLD9	39	4.6	19.7
	TOTAL RESPONSES	845	100.0	426.8

4 MISSING CASES 198 VALID CASES

Table 8-2

VARIABLE PERMADV   PERMANENT FIRE SAFETY ADVISOR

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	18	9.3
NO	2	176	90.7
	TOTAL RESPONSES	194	100.0

8 MISSING CASES   194 VALID CASES

Table 8-3

GROUP QUADV   QUALIFICATIONS OF ADVISOR

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES
ARCHITECT	QUADV1	11	61.0
ENGINEER	QUADV2	0	0.0
OTHER	QUADV3	7	39.0
	TOTAL RESPONSES	18	100.0

184 MISSING CASES   18 VALID CASES

Table 8-4

GROUP STAGCON STAGES OF DESIGN FIRE SAFETY IS CONSID

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
INCEPTION	STAGCON1	46	6.0	24.7
FEASIBILITY	STAGCON2	119	15.5	64.0
SPATIAL DESIGN	STAGCON3	121	15.7	65.1
MATERIALS SPECS	STAGCON4	114	14.8	61.3
PERFORMANCE SPECS	STAGCON5	88	11.4	47.3
CONSTRUC DESIGN	STAGCON6	115	14.9	61.8
WORK DRAWINGS	STAGCON7	109	14.2	58.6
MAINTENANCE MANUAL	STAGCON8	55	7.1	29.6
OTHER	STAGCON9	3	0.4	1.6
	TOTAL RESPONSES	770	100.0	414.0

16 MISSING CASES 186 VALID CASES

Table 8-5

VARIABLE STAGFST DESIGN STAGE F S FIRST CONSIDERED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
INCEPTION	1	39	25.0	25.0
FEASIBILITY	2	75	48.1	48.1
SPATIAL DESIGN	3	40	25.6	25.6
CONSTRUC DESIGN	4	2	1.3	1.3
	TOTAL RESPONSES	156	100.0	100.0

46 MISSING CASES 156 VALID CASES

Table 8-6

RELEVANCE OF FIRE SAFETY TO BUILDING DESIGN

SUBFILE	VISUAL AESTHETIC	ENVIRONMENTAL	CONSTRUCTIONAL
ARCH FIRMS	1	2	3
ABSOLUTE FREQUENCIES			
TOTAL	181	169	164
POSITIVE CONTRIB 1	5	12	16
CONSTRAINT 2	68	55	41
SET OF RULES 3	50	52	63
IRRELEVANT 4	11	6	2
COMBINATION 1+2 5	4	3	2
COMBINATION 2+3 6	36	34	32
COMBINATION 1+3 7	5	3	1
RELATIVE FREQUENCIES			
TOTAL	100.00	100.00	100.00
POSITIVE CONTRIB 1	2.76	7.10	9.76
CONSTRAINT 2	37.57	32.54	25.00
SET OF RULES 3	27.62	30.77	38.41
IRRELEVANT 4	6.08	3.55	1.22
COMBINATION 1+2 5	2.21	1.78	1.22
COMBINATION 2+3 6	19.89	20.12	19.51
COMBINATION 1+3 7	2.76	1.78	.61
MODE	2	2	3

Table 8-7

RANKING OF FIRE SAFETY TOPICS
==============================
ARCHITECTURAL FIRMS

ABSOL FREQ	RISK ASSES 1	SMOKE CONTRL 2	ESCAPE DESIGN 3	FIRE RESIST 4	DETECT SYSTEM 5	SUPRES SYSTEM 6	MANGMT 7	LEGISL 8	HUMAN BEHAVR 9	COMBST TECHNL 10
TOTAL	159	163	171	178	173	139	153	158	163	154
1	37	7	80	14	2	0	3	21	5	3
2	16	28	53	42	6	0	5	8	14	0
3	17	43	20	41	18	6	1	10	16	4
4	24	40	9	31	24	8	7	17	10	5
5	13	22	6	20	39	18	8	14	18	8
6	16	11	1	12	33	34	13	14	14	11
7	9	4	2	7	24	26	17	11	27	16
8	7	3	0	9	14	16	29	20	22	29
9	10	3	0	1	13	17	40	24	20	23
10	10	2	0	1	0	14	30	19	17	55
MODE	1	3	1	2	5	6	9	9	7	10

Table 8-8

VARIABLE GRAWAR GREATER AWARENESS TO FS PROBLEMS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	114	74.0
NO	2	40	26.0
	TOTAL RESPONSES	154	100.0

48 MISSING CASES 154 VALID CASES

Table 8-9

GROUP SUGRAWR SUGGESTED WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
GREATER TIME, PART SCH CURR	1	46	39.0	50.5
MID-CAREER EDUCATION	2	44	37.3	48.4
PUBLICITY PROFESSION	3	28	23.7	30.8
	TOTAL RESPONSES	118	100.0	129.7

111 MISSING CASES 91 VALID CASES

GROUP SGRAWR MORE WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	75	59.1	67.0
HANDBOOK	2	19	15.0	17.0
MORE PRINCIPLES LESS LEGISL	3	1	0.8	0.9
UNIFIC&COORDINATION REGS	4	23	18.1	20.5
INCONSISTENT INTERPRET REGS	5	9	7.1	8.0
	TOTAL RESPONSES	127	100.0	113.4

90 MISSING CASES 112 VALID CASES

Table 8-10

VARIABLE KNOW PRESENT FIRE SAFETY KNOWLEDGE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
GT ADEQUATE	1	13	8.1
ADEQUATE	2	126	78.3
INADEQUATE	3	15	9.3
OTHER	4	3	1.9
COMB1+2	5	2	1.2
COMB2+3	6	1	0.6
COMB3+4	7	1	0.6
	TOTAL RESPONSES	161	100.0

41 MISSING CASES 161 VALID CASES

Table 8-11

VARIABLE CATADV CATEGORY OF ADVICE RECEIVED Q12

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
GENERAL INTEREST	1	57	31.7
PARTICULAR INTEREST	2	94	52.2
LIMITED INTEREST	3	1	0.6
COMB1+2	5	27	15.0
COMB1+3	8	1	0.6
	TOTAL RESPONSES	180	100.0

22 MISSING CASES 180 VALID CASES

Table 8-12

GROUP CMTOPIC COMMENTS TO RANKING OF F S TOPICS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	4	10.3	12.9
DIFFICULT QUESTION	2	7	17.9	22.6
ALL EQUAL IMPORTANT	3	10	25.6	32.3
CONSIDERED JOINTLY	4	8	20.5	25.8
DEPENDS PROJECT	5	10	25.6	32.3
TOTAL RESPONSES		39	100.0	125.8

171 MISSING CASES 31 VALID CASES

Table 8-13

GROUP CMORIK COMMENTS TO ORIGINE TO FIRE SAFETY KNOWLEDGE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	7	6.6	7.4
PUBLICATIONS, ARTICLES	2	33	31.1	35.1
CONSULTING FPOS	3	35	33.0	37.2
TEACHING	4	4	3.8	4.3
CONSULTING ADVISORS	5	18	17.0	19.1
OWN INTEREST	6	9	8.5	9.6
TOTAL RESPONSES		106	100.0	112.8

108 MISSING CASES 94 VALID CASES

Table 8-14

ORIGIN OF PRESENT FIRE SAFETY KNOWLEDGE

ARCHITECTURAL FIRMS

		ARCHITECT SCHOOLS 1	SHORT COURSES 2	TALKS SEMINARS 3	PRACTICAL DEMONSTRAT 4	PREVIOUS DESIGN EXP 5	TRADE LITERATURE 6	OTHER 7
ABSOLUTE FREQ								
TOTAL		62	27	75	21	156	113	72
YES	1	1	2	8	2	30	14	11
< 5 %	2	16	9	17	9	0	20	2
6-10 %	3	18	11	30	6	2	35	5
11-30 %	4	22	3	18	4	22	34	27
31-50 %	5	4	2	1	0	37	10	17
51-70 %	6	0	0	0	0	40	0	6
71-90 %	7	0	0	1	0	19	0	3
> 90 %	8	1	0	0	0	5	0	1
RELATIVE FREQ								
TOTAL		100.00	100.00	100.00	100.00	100.00	100.00	100.00
YES	1	1.61	7.41	10.67	9.52	19.23	12.39	15.28
< 5 %	2	25.81	33.33	22.67	42.86	.00	17.70	2.78
6-10 %	3	29.03	40.74	40.00	28.57	1.28	30.97	6.94
11-30 %	4	35.48	11.11	24.00	19.05	14.10	30.09	37.50
31-50 %	5	6.45	7.41	1.33	.00	23.72	8.85	23.61
51-70 %	6	.00	.00	.00	.00	25.64	.00	8.33
71-90 %	7	.00	.00	1.33	.00	12.18	.00	4.17
> 90 %	8	1.61	.00	.00	.00	3.21	.00	1.39
MODE		4	3	3	2	6	3	4

Table 8-15

GROUP SOLVED   FIRE SAFETY PROBLEMS IN BLD DESIGN SOLVED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
ADDITIONAL FIRE REGS	SOLVED1	9	3.2	5.8
SCIENTIFIC RESEARCH	SOLVED2	64	22.7	41.3
CONSTRUCTIONAL DESIGN	SOLVED3	45	16.0	29.0
ENGINEERING DESIGN	SOLVED4	22	7.8	14.2
UNDERSTANDING-EDUC ARCH	SOLVED5	104	36.9	67.1
FULL ENFORCEMENT OF REGS	SOLVED6	38	13.5	24.5
	TOTAL RESPONSES	282	100.0	181.9

47 MISSING CASES   155 VALID CASES

Table 8-16

GROUP CMSOLVED   COMMENTS TO SOLVED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
MAKE CLIENT AWARE NEEDS	2	1	33.3
UNDER ONE AUTHORITY	6	1	33.3
ALL IMPORTANT	7	1	33.3
TOTAL RESPONSES		3	100.0

199 MISSING CASES   3 VALID CASES

VARIABLE CMSOL3

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
SIMPLIFIC AND IMPROV REGS	1	5	62.5
GREATER LIAISON ARCH-FPO	2	3	37.5
TOTAL RESPONSES		8	100.0

194 MISSING CASES   8 VALID CASES

Table 8-17

PEOPLE CONSULTED FOR FIRE SAFETY ADVICE

ARCHITECTURAL FIRMS

	CENTRAL GOVERMT OFFICE 1	FIRE SAFETY CONSULT 2	FIRE BRIGADE OFFICER 3	BUILDNG CONTROL OFFICER 4	INSURNC SURVEYR 5	FIRE RESERCH STATION 6	FIRE PROTECT ASSOC 7	INDUSTR COMMERC 8	OTHER 9
ABSOLUTE FREQ									
TOTAL	70	24	159	133	57	71	15	34	13
YES 1	9	3	23	14	10	7	1	3	2
< 5 % 2	18	7	3	12	20	28	7	10	3
6-10 %3	20	8	5	16	19	27	5	16	5
11-30 %4	18	3	25	53	7	8	1	3	0
31-50 %5	3	3	47	33	1	1	1	2	2
51-70 %6	0	0	24	2	0	0	0	0	1
71-90 %7	2	0	28	2	0	0	0	0	0
> 90 % 8	0	0	4	1	0	0	0	0	0
RELATIVE FREQ									
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
YES 1	12.86	12.50	14.47	10.53	17.54	9.86	6.67	8.82	15.38
< 5 % 2	25.71	29.17	1.89	9.02	35.09	39.44	46.67	29.41	23.08
6-10 %3	28.57	33.33	3.14	12.03	33.33	38.03	33.33	47.06	38.46
11-30 %4	25.71	12.50	15.72	39.85	12.28	11.27	6.67	8.82	.00
31-50 %5	4.29	12.50	29.56	24.81	1.75	1.41	6.67	5.88	15.38
51-70 %6	.00	.00	15.09	1.50	.00	.00	.00	.00	7.69
71-90 %7	2.86	.00	17.61	1.50	.00	.00	.00	.00	.00
> 90 % 8	.00	.00	2.52	.75	.00	.00	.00	.00	.00
MODE	3	3	5	4	2	2	2	3	3

Table 8-18

GROUP PUBLIC   PUBLICATIONS USED

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
TEXT BOOKS	PUBLIC1	41	3.6	21.4
JOURNAL ARTICLES	PUBLIC2	97	8.6	50.5
BLD REGULATIONS	PUBLIC3	185	16.3	96.4
FIRE LEGISLATION	PUBLIC4	121	10.7	63.0
GVMT DEPT PUBLIC	PUBLIC5	113	10.0	58.9
BRE DIGEST	PUBLIC6	137	12.1	71.4
BRE CURRENT PAPERS	PUBLIC7	72	6.4	37.5
HOME OFFICE (WO, SO)	PUBLIC8	28	2.5	14.6
FIRE RESEARCH STATION	PUBLIC9	83	7.3	43.2
BSI CODES	PUBLIC10	109	9.6	56.8
BSI STANDARDS	PUBLIC11	100	8.8	52.1
FIRE PROTEC ASSOC	PUBLIC12	28	2.5	14.6
OTHER	PUBLIC13	19	1.7	9.9
	TOTAL RESPONSES	1133	100.0	590.1

10 MISSING CASES   192 VALID CASES

Table 8-19

VARIABLE INFAV   INFORMATION AVAILABLE TO PROFESSION

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	120	70.2
NO	2	51	29.8
	TOTAL RESPONSES	171	100.0

31 MISSING CASES   171 VALID CASES

Table 8-20

GROUP CMINF COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	121	59.3	130.1
HANDBOOK	2	27	13.2	29.0
SCATTERED AND FRAG INFO	3	2	1.0	2.2
SIMPLIF ILLUSTR	4	12	5.9	12.9
BETTER REGS	5	14	6.9	15.1
MAKE ARCH AWARE INFO	6	2	1.0	2.2
LESS LEGISL, MORE PRINC	7	1	0.5	1.1
TEACHING AIDS	8	5	2.5	5.4
DESIGN GUIDES	9	20	9.8	21.5
TOTAL RESPONSES		204	100.0	219.4

109 MISSING CASES 93 VALID CASES

GROUP CMINFAV COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
REG UPDATING	1	46	56.1	78.0
CASE STUDY	2	7	8.5	11.9
GENERAL INDEX	4	2	2.4	3.4
SECTION IN PROF JOURNALS	5	6	7.3	10.2
UNDER ONE AUTHORITY	6	9	11.0	15.3
COMPLETE PUBLIC EQUP+MAT	7	8	9.8	13.6
STATISTICS BREAKDOWN	8	2	2.4	3.4
COST COMPARISON APPROACH	9	2	2.4	3.4
TOTAL RESPONSES		82	100.0	139.0

143 MISSING CASES 59 VALID CASES

Table 8-21

GROUP PRBAPL MORE PROBLEMS IN THE APPLICATION OF F S

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
MEANS ESCAPE	1	41	18.4	35.0
MATERIALS	2	42	18.8	35.9
CONFLICT BRIEF	3	33	14.8	28.2
BALANCED SOLUTION	4	30	13.5	25.6
CONFLICT OPERATION	5	29	13.0	24.8
CONFLICT PLANNING	6	17	7.6	14.5
SMOKE CONTROL	7	10	4.5	8.5
FAILURE MAINTAIN PROVISIONS	8	12	5.4	10.3
RISK ASSESSMENT	9	9	4.0	7.7
	TOTAL RESPONSES	223	100.0	190.6

85 MISSING CASES 117 VALID CASES

Table 8-22

GROUP PROBAPL PROBLEMS IN THE APPLICATION OF F S TO BLD DESIGN

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	66	20.8	40.2
COHERENT INTERPRET REGS	2	92	29.0	56.1
INHIBIT DSGN FREEDOM	3	59	18.6	36.0
COMPLEX&FRAGMENTED REGS	4	28	8.8	.17.1
COST INCIDENCE	5	27	8.5	16.5
ARCH LACK KNOW&UNDERST	6	37	11.7	22.6
FPO NOKNOW OF DESIGN PROCESS	7	8	2.5	4.9
	TOTAL RESPONSES	317	100.0	193.3

38 MISSING CASES 164 VALID CASES

APPENDIX NINE
TABLES OF RESULTS
FIRE PREVENTION OFFICERS

Table 9-1

VARIABLE ADEKNOW   PRESENT KNOWLEDGE IN PROFESSION ADEQUATE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	7	11.7
NO	2	53	88.3
	TOTAL RESPONSES	60	100.0

0 MISSING CASES   60 VALID CASES

Table 9-2

GROUP CMADEK

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	23	28.7	52.3
RELUCT ACCEPT ADV	2	8	10.0	18.2
CHANGE RIBA ATTIT	3	5	6.2	11.4
CHARGE FOR REV	4	2	2.5	4.5
PRJCT REV AT SCH	5	1	1.2	2.3
IMPROV LIAISON	6	11	13.7	25.0
EMPH REQ DSGN STAG	7	13	16.2	29.5
ARCH AWR EFFECT DSG	8	13	16.2	29.5
EMPH PROF JRNLS	9	4	5.0	9.1
TOTAL RESPONSES		80	100.0	181.8

GROUP COMADEK

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
GR TIME SCH CUR	1	37	52.9	84.1
MID CAR EDUC	2	25	35.7	56.8
NO UNDER BASICS	3	8	11.4	18.2
TOTAL RESPONSES		70	100.0	159.1

16 MISSING CASES   44 VALID CASES

Table 9-3

VARIABLE INVEDUC   INVOLVEMENT IN ARCH. EDUCATION

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	20	33.3
NO	2	40	66.7
	TOTAL RESPONSES	60	100.0

0 MISSING CASES   60 VALID CASES

Table 9-4

VARIABLE COM21

CATEGORY LABEL	CODE
ABERDEEN	1
BATH UNIV.	2
BELFAST UNIV.	3
BIRMINGHAM POLY	4
BRIGHTON POLY	5
CAMBRIDGE UNIV	7
CANTERBURY COL	8
DUNDEE COL	11
EDINBURGH H-W	12
GLASGOW UNIV STRATH	15
HULL COL	18
LEICESTER POL	21
LIVERPOOL POL	22
LIVERPOOL UNIV	23
LONDON POL SB	29
MANCHESTER POL	32
NEWCASTLE UNIV	34

Table 9-5

RANKING OF FIRE SAFETY TOPICS

FIRE PREVENTION OFFICERS

ABSOL FREQ	RISK ASSES 1	SMOKE CONTRL 2	ESCAPE DESIGN 3	FIRE RESIST 4	DETECT SYSTEM 5	SUPRES SYSTEM 6	MANGMT 7	LEGISL 8	HUMAN BEHAVR 9
TOTAL	56	53	56	56	56	53	55	56	56
1	15	1	23	2	0	0	2	4	3
2	11	10	14	9	2	0	1	2	2
3	11	7	10	15	3	0	1	2	3
4	5	8	4	9	9	2	4	4	4
5	6	7	2	9	12	4	5	3	4
6	4	14	1	6	6	4	9	1	8
7	1	4	0	6	13	5	10	4	11
8	0	0	2	0	7	13	7	8	6
9	1	0	0	0	4	12	10	15	7
10	2	2	0	0	0	13	6	13	8
MODE	1	6	1	3	7	8	7	9	7

Table 9-6

RELEVANCE OF FIRE SAFETY TO BUILDING DESIGN

SUBFILE		VISUAL AESTHETIC	ENVIRONMENTAL	CONSTRUCTIONAL
FIRE PREV OFFICERS		1	2	3
ABSOLUTE FREQUENCIES				
TOTAL		58	57	57
POSITIVE CONTRIB	1	2	26	30
CONSTRAINT	2	39	18	14
SET OF RULES	3	11	6	9
IRRELEVANT	4	4	4	0
COMBINATION 1+2	5	0	2	2
COMBINATION 2+3	6	1	0	1
COMBINATION 1+3	7	1	1	1
RELATIVE FREQUENCIES				
TOTAL		100.00	100.00	100.00
POSITIVE CONTRIB	1	3.45	45.61	52.63
CONSTRAINT	2	67.24	31.58	24.56
SET OF RULES	3	18.97	10.53	15.79
IRRELEVANT	4	6.90	7.02	.00
COMBINATION 1+2	5	.00	3.51	3.51
COMBINATION 2+3	6	1.72	.00	1.75
COMBINATION 1+3	7	1.72	1.75	1.75
MODE		2	1	1

Table 9-7

VARIABLE STAGADV STAGE OF DESIGN FIRST SOUGHT ADVICE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
INCEPTION	1	10	16.9
FEASIBILITY	2	8	13.6
PRELIM DESIGN	3	36	61.0
WORK DRAWING	5	1	1.7
COMB1+2	7	1	1.7
COMB2+3	8	1	1.7
COMB2+4	9	2	3.4
	TOTAL RESPONSES	59	100.0

1 MISSING CASES 59 VALID CASES

Table 9-8

VARIABLE STAGSUB STAGE OF DESIGN PROJECTS SUBMITTED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
EARLY	1	1	1.7
INTERMEDIATE	2	11	19.0
ADVANCED	3	23	39.7
LATE	4	11	19.0
COMB2+3	6	4	6.9
COMB3+4	7	6	10.3
COMB2+4	8	2	3.4
	TOTAL RESPONSES	58	100.0

2 MISSING CASES 58 VALID CASES

Table 9-9

GROUP CONSUL PEOPLE CONSULTED FOR ADVICE

DICHOTOMY LABEL	COUNT	PCT OF RESPONSES	PCT OF CASES
CENTRAL GOVERNMENT OFFICIALS	26	27.1	44.8
BLD CONTROL OFFICER	55	57.3	94.8
INSURANCE SURVEYOR	7	7.3	12.1
FIRE RESEARCH STATION	4	4.2	6.9
INDUSTRY-COMMERCE	1	1.0	1.7
OTHER	3	3.1	5.2
TOTAL RESPONSES	96	100.0	165.5

2 MISSING CASES 58 VALID CASES

Table 9-10

GROUP CMCONS COMMENTS TO PEOPLE CONSULTED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	19	52.8	65.5
DEPENDS ON PRJCT	2	1	2.8	3.4
NOT AWR AVAIL ADV	3	4	11.1	13.8
CONSUL STATUT	4	8	22.2	27.6
BCO NO ADV OR KNOW	5	2	5.6	6.9
FPO FIRST SOURCE	6	2	5.6	6.9
TOTAL RESPONSES		36	100.0	124.1

31 MISSING CASES 29 VALID CASES

Table 9-11

GROUP PROBAPL PROBLEMS IN THE APPLICATION OF F S

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	39	37.9	73.6
COHER INTERP REGS	2	1	1.0	1.9
INHIB DSGN FREEDM	3	26	25.2	49.1
COST INCID	5	18	17.5	34.0
ARCH NOKNOW&UNDERS	6	19	18.4	35.8
		-------	-----	-----
TOTAL RESPONSES		103	100.0	194.3

7 MISSING CASES 53 VALID CASES

Table 9-12

GROUP PRBAPL MORE PROBLEMS IN THE APPLICATION OF F S

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
MEANS ESCAPE	1	16	29.1	44.4
MATERIALS	2	4	7.3	11.1
CONFLICT BRIEF	3	12	21.8	33.3
BALANCED SOLUTION	4	5	9.1	13.9
CONFLICT OPRTN	5	7	12.7	19.4
CONFLICT PLANN	6	7	12.7	19.4
SMOKE CONTROL	7	2	3.6	5.6
RISK ASSESS	9	2	3.6	5.6
		-------	-----	-----
TOTAL RESPONSES		55	100.0	152.8

24 MISSING CASES 36 VALID CASES

Table 9-13

GROUP SOLVED F S PROBLEMS IN BLD DESIGN BETTER SOLVED

DICHOTOMY LABEL	COUNT	PCT OF RESPONSES	PCT OF CASES
ADDITIONAL FIRE REGS	7	6.3	11.9
SCIENTIFIC RESEARCH	12	10.8	20.3
CONSTRUCTIONAL DESIGN	20	18.0	33.9
ENGINEERING DESIGN	7	6.3	11.9
UNDERSTANDING-EDUCATION OF ARCH	52	46.8	88.1
FULL ENFORCEMENT OF REGS	13	11.7	22.0
TOTAL RESPONSES	111	100.0	188.1

1 MISSING CASES 59 VALID CASES

Table 9-14

GROUP CMSOLVED COMMENTS TO SOLVED

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	28	63.6	87.5
UNDERST&ARCH RESP	3	2	4.5	6.2
KNWLD RSCH APPL DSGN	4	7	15.9	21.9
ALL IMPORT	7	4	9.1	12.5
BTR WRKSH&SITE SUPER	8	2	4.5	6.2
MR REGS NOT OBSRVD	9	1	2.3	3.1
TOTAL RESPONSES		44	100.0	137.5

28 MISSING CASES 32 VALID CASES

VARIABLE CMSOL3

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
SIMPL&IMPROV REGS	1	5	27.8	27.8
GR LIAISON ARC-FPO	2	5	27.8	27.8
STDY&APL INFAV DSGN	3	8	44.4	44.4
TOTAL RESPONSES		18	100.0	100.0

42 MISSING CASES 18 VALID CASES

Table 9-15

VARIABLE INFAV INFORMATION AVAILABLE TO PROFESSION

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
YES	1	45	76.3	76.3
NO	2	14	23.7	23.7
TOTAL RESPONSES		59	100.0	100.0

1 MISSING CASES 59 VALID CASES

Table 9-16

GROUP CMINF COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	21	47.7	77.8
HANDBOOK	2	6	13.6	22.2
SCATT FRAG INFO	3	1	2.3	3.7
SIMPLIF ILLUSTR	4	3	6.8	11.1
MAKE ARCH AWR INF	6	12	27.3	44.4
TEACH AIDS	8	1	2.3	3.7
TOTAL RESPONSES		44	100.0	163.0

33 MISSING CASES 27 VALID CASES

GROUP CMINFAV COMMENTS TO INFORMATION AVAILABLE

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
REG UPDATING	1	4	28.6	36.4
CASE STUDY	2	2	14.3	18.2
NAT INFO CENTRE	3	3	21.4	27.3
GENERAL INDEX	4	3	21.4	27.3
COMP PUB EQUP+MAT	7	2	14.3	18.2
TOTAL RESPONSES		14	100.0	127.3

49 MISSING CASES 11 VALID CASES

Table 9-17

VARIABLE GRAWAR GREATER AWARENESS TO FS PROBLEMS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
YES	1	58	98.3	98.3
NO	2	1	1.7	1.7
TOTAL RESPONSES		59	100.0	100.0

1 MISSING CASES 59 VALID CASES

Table 9-18

GROUP SUGRAWR SUGGESTED WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
G TIME PART SCH CURR	1	32	29.1	58.2
MID CAREER EDUC	2	22	20.0	40.0
PUBLICITY PROF	3	2	1.8	3.6
EMPH JRNLS	4	11	10.0	20.0
FIRE SCENES	5	4	3.6	7.3
FILMS AV AIDS	6	2	1.8	3.6
FRS FSTC DEMOS	7	7	6.4	12.7
LIAISON ARCH-FB	8	9	8.2	16.4
STDY&APPL INFO AVLBL	9	21	19.1	38.2
TOTAL RESPONSES		110	100.0	200.0

5 MISSING CASES 55 VALID CASES

GROUP SGRAWR MORE WAYS TO IMPROVE AWARENESS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	37	88.1	97.4
MORE PRINC LESS LEGI	3	3	7.1	7.9
UNIF&COORD REGS	4	1	2.4	2.6
CLIENT AWR NEEDS	6	1	2.4	2.6
TOTAL RESPONSES		42	100.0	110.5

22 MISSING CASES 38 VALID CASES

Table 9-19

VARIABLE RAPORT PRESENT RELATIONSHIP WITH ARCHITECTS

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
YES	1	42	70.0
NO	2	18	30.0
TOTAL RESPONSES		60	100.0

0 MISSING CASES 60 VALID CASES

Table 9-20

GROUP CMRAPORT

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	21	60.0	87.5
RELUCT ACCEPT ADV	2	12	34.3	50.0
INSUFIC QUAL PERS	3	2	5.7	8.3
TOTAL RESPONSES		35	100.0	145.8

36 MISSING CASES 24 VALID CASES

GROUP COMRAP

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
BTR EDUC PROF	1	8	33.3	42.1
BETTER LIAISON	2	11	45.8	57.9
EARLY CONSULT	3	5	20.8	26.3
TOTAL RESPONSES		24	100.0	126.3

41 MISSING CASES 19 VALID CASES

Table 9-21

GROUP REFADV

DICHOTOMY LABEL	NAME	COUNT	PCT OF RESPONSES	PCT OF CASES
HOME OFFICE	REFADV1	45	22.3	77.6
OTHER FP DEPT	REFADV2	37	18.3	63.8
FRS	REFADV3	50	24.8	86.2
H & S E	REFADV4	31	15.3	53.4
BLD CTRL OFF	REFADV5	22	10.9	37.9
OTHER	REFADV6	17	8.4	29.3
	TOTAL RESPONSES	202	100.0	348.3

2 MISSING CASES 58 VALID CASES

Table 9-22

GROUP CMREFADV

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	17	27.9	45.9
FSTC	2	8	13.1	21.6
DEPENDS ON PROJECT	3	11	18.0	29.7
SDD PLANN DEPT	4	6	9.8	16.2
FPREV TECH MEET	5	5	8.2	13.5
PUBLIC TECH LIT	6	3	4.9	8.1
SPECIAL MANUFAC	7	2	3.3	5.4
MAJORIT ARE USED	8	9	14.8	24.3
	TOTAL RESPONSES	61	100.0	164.9

23 MISSING CASES 37 VALID CASES

Table 9-23

VARIABLE KNOW PRESENT FIRE SAFETY

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES
GT ADEQUATE	1	8	13.6
ADEQUATE	2	43	72.9
INADEQUATE	3	6	10.2
OTHER	4	1	1.7
COMB2+4	9	1	1.7
	TOTAL RESPONSES	59	100.0

1 MISSING CASES 59 VALID CASES

Table 9-24

GROUP COMKNOW

CATEGORY LABEL	CODE	COUNT	PCT OF RESPONSES	PCT OF CASES
OUT OF GROUP	1	22	40.0	59.5
QUESTBL FPO EXPERT	2	12	21.8	32.4
NEED UPDATNG	4	10	18.2	27.0
ADVICE SOUGHT	5	9	16.4	24.3
VARYING INTERP REGS	6	2	3.6	5.4
	TOTAL RESPONSES	55	100.0	148.6

23 MISSING CASES 37 VALID CASES

APPENDIX TEN

MISCELLANEOUS

University of Edinburgh

Department of Fire Safety Engineering

School of Engineering, The King's Buildings, Edinburgh, EH9 3JL.

Professor D.J. Rasbash

Letter

8 April 1981

FIRE SAFETY KNOWLEDGE AND THE ARCHITECT

Some eighteen months ago, your colleague who is responsible for fire safety teaching in your School, kindly filled in a questionnaire about the fire safety content of your course for architecture students. This questionnaire, and the three others that we have circulated, have produced a very high rate of response and the results have now been analysed. Our research architect, Miguel Cerda, will be presenting a full report before the end of the Summer term.

I am writing this letter as it has occurred to us that one very important part of the architectural population - the student - has not been approached in this exercise. Naturally, to cover all students by a questionnaire, would not be a very useful exercise. In view of this, RIBA have made available to me an amount of money for travel expenses to visit Schools to discuss fire safety with students, and of course with staff.

I would like to visit your School some time in the Autumn term and would like to know if there are any particular months, weeks, or even days which I should avoid in making my arrangements.

I shall look forward to hearing from you sometime during the Summer term so that I can prepare an overall schedule for the Autumn. A notional programme for a visit is given at the foot of this page.

Yours sincerely

DR ERIC W MARCHANT

<u>Notional programme</u>

1. Brief discussion with member of staff responsible for fire safety.
2. Brief discussion with any number of staff of the School.
3. Discussion about fire safety with students (depending when fire safety appears in the course, it may be best to invite those students who have had such teaching, to this discussion).
4. Lecture: if it is thought sensible, I would be happy to offer a lecture on any topic within Building Fire Safety.

Fire Safety Journal, 3 (1980/81) 31 - 40

A Modular Approach to the Subject of Fire Safety Engineering

D. J. RASBASH

Department of Fire Safety Engineering, University of Edinburgh, The King's Buildings, Edinburgh EH9 3JL (Gt. Britain)

(Received February 1, 1980)

SUMMARY

It is suggested that the subject matter of fire safety engineering be divided into twelve sections. This follows some six years of experience of running an MSc course in the subject. Most of the sections would consist of two parts, a basic part and a more advanced part, and each of these would comprise a module in the subject. It is suggested that most of the basic modules should be common knowledge for all fire safety engineers but a more restricted selection of the advanced modules would be needed for the various specialists in the subject. Ways in which university degrees and other qualifications may be put together using this modular approach are outlined.

1. INTRODUCTION

In this paper a modular approach to the structure of the subject of Fire Safety Engineering is outlined. It is an attempt to encompass within recognisable and reasonable limits a rapidly expanding subject which obtains its data, information and methods from many disciplines and which finds application in many fields. The experience of the author in running the MSc/Diploma course at the University of Edinburgh, which is described briefly in Section 2, is the background to the suggestions made in this paper which are open for comment and discussion in the fire safety world and elsewhere. The form of the subject as defined here has accompanied a request to the University to establish the department permanently when the appeal funds run out in about 1983.

2. STRUCTURE OF THE CURRENT MSc/DIPLOMA AT THE UNIVERSITY OF EDINBURGH

The MSc degree and Diploma in Fire Engineering were launched in October 1974. It has been constituted into four main parts: Fire Science, Fire Protection Engineering, Fire Safety Evaluation, and Fire Safety Management. The course consists of some two hundred hours of lectures, ten laboratory projects, six course work projects and culminates in an examination in June of four three-hour papers. The MSc candidates who are successful are allowed to proceed to a dissertation for presentation by 30 September, the end of the academic year. The MSc degree has been the only one of its kind in the world, although within the last year or so a programme for an MSc degree has been set up by the Worcester College in Massachusetts. There have been two undergraduate degrees of long standing in Fire Engineering at the University of Maryland and at the Illinois Institute of Technology. The main strength of the MSc degree at the University of Edinburgh is that it emphasises the quantitative approach. Thus, the study of Fire Science in the professional fire world is at present very limited and is, indeed, a reflection of the limited knowledge available up until fairly recently. However, research into the science of fire has been active since the war and particularly so in the last decade. The main results of this activity have been incorporated into the Masters Degree. Also, in the last ten years, there has been a strong move towards the quantification of safety, and methods are now being developed for assessing and defining fire safety as a systemic whole. The absorption into teaching and use of these methods has *(a) MSc/Diploma*

The current MSc/Diploma course at the University of Edinburgh comprises about four-fifths of the content of the primary section and about half the content of the secondary section. It is visualised that for a modular approach, some eight to ten primary parts would need to be studied and some four to five of the secondary parts. The selection can depend on the emphasis of the subject, *e.g.*, Fire Science will include Parts 1, 2 and 7; Fire Protection Engineering, Parts 2, 3 and 4; Fire Insurance, Parts 3, 8 and 11; Fire Safety Management, Parts 5, 8, and 10 or 11; Fire Service, Parts 6, 7 and 12. The extra flexibility could give rise to some complexity in setting the examination papers but these difficulties would not be insurmountable. The MSc taken by outside students will have material in which either primary or secondary parts could be presented in modules of one week duration, plus, perhaps, two weeks of laboratory and project work carried out between courses. The total content necessary for an MSc degree could be taken by outside students over a period of some years.

(b) Undergraduate degree

It is visualised that an undergraduate degree would require study in all parts of the subject at primary level. The way in which this may be done and the nature of the accompanying subjects will vary with the teaching organisation concerned. Thus, in order to fit in with the way the other engineering departments in the University of Edinburgh teach their respective subjects, the subject matter might be arranged into two major parts for the second and third years called Fire Safety Engineering 1 and 2, respectively. However, in spite of the fact that much instruction in basic disciplines may not be necessary, as this will be covered by other parts of an engineering degree, it may still not be possible to cover all the subject matter in all the primary modules in the second and third years. In addition there would also be a common first year with other engineering departments (Mathematics 1 and Engineering 1 plus one other subject); Mathematics 2 in the second year, as required for Engineering, and another subject in the third year. The most favoured third year subject would probably be Mechanical Engineering, but Chemical Engineering, Structural Engineering, Electrical Engineering, Building or Statistics, would be useful alternatives. If possible the contents of these latter parts of the course would be arranged to overlap substantially, if not completely, with the parts of the respective subjects taught to undergraduates in other departments in the University. An honours degree would require a further year in which the remainder of the content of the primary parts of the subject and the choice of possibly four or five secondary parts would be taught. There would also be a dissertation.

(c) Joint degrees and options

Other academic departments normally found in universities may be interested in various parts of the subject, as follows: Architecture, 5 and 10; Civil Engineering, 4, 10 and 12; Mechanical Engineering, 2, 3 and 6; Chemical Engineering, 1, 2, 8 and 11; Business Studies, 8; Urban and Regional planning, 5 and 12; Social Science, 5. These parts of the subject may be the basis of options within the above disciplines which may possibly lead to joint courses and joint degrees with a Fire Safety Engineering Department. Indeed, different educational establishments may cooperate in this process. Thus, in the coming Session the Fire Safety Engineering Department in Edinburgh will be arranging a course for undergraduate Architects at the University of Strathclyde (in Glasgow) as well as at the University of Edinburgh.

(d) Specialised part-time studies

As indicated earlier, although there is a great need for expertise on fire safety in industry, commerce, and in other areas, it is normal for this to be required only in special parts of the subject. Thus, a Building Control Officer is unlikely to be called upon frequently to be knowledgeable on details of fire-fighting or even on fire protection systems, while a fire protection systems technician will not need a great deal of information on passive fire safety of buildings and means of escape or even fire brigade methods. The suggested subdivision of the subject into modules should assist in devising specially shaped courses for different demands. It should be emphasised that for this purpose the content of the modules should not be regarded as

REFERENCES

1 Syllabus for Postgraduate Studies in Fire Engineering. University of Edinburgh Department of Fire Safety Engineering.
2 D. J. Rasbash, Fire Safety Journal — A Journal for a New Subject, Editorial, *Fire Safety Journal, 2* (1) January (1980).
3 Regulations and Syllabuses of Examinations, 1980. The Institution of Fire Engineers, 148 New Walk, Leicester LE1 7QB, England.

APPENDIX

SUGGESTED CONTENT OF MODULES FOR FIRE SAFETY ENGINEERING

1. FIRE CHEMISTRY

(a) Primary
Relevant basic organic and inorganic chemistry. Elementary thermodynamics. Thermochemistry of combustion. Adiabatic flame temperatures. Modes of combustion (gas phase and surface). Properties of premixed flames. Flammability and ignitability limits (gases, vapours, dusts and mists). Burning velocity. Properties of diffusion flames. Burke–Schuman model. Flashpoint and firepoint. Auto-ignition. Steady burning of condensed fuels. Effect of heat on common materials. Fire properties of common materials, including thermal sink factors and reactivity. Products of combustion (smoke and toxic gas). Measurement of smoke. Smouldering combustion. Common ignition sources and their heat output characteristics. Mechanism of extinction based on limiting (adiabatic) flame temperatures. Unstable and explosive substances. Oxidation of carbon and the combustion of metals.

(b) Secondary
Basic chemical kinetics. Kinetics of gas phase oxidation. Cool flames. Effect of temperature, pressure, oxygen concentration on combustion. Basic mass transfer. Thermal explosion theory and auto-ignition. Catalytic oxidation, anti oxidants. Extinction mechanisms. Firepoint theory. Inhibition. Quenching. Fire retardance. Design and operation of flame arresters. Thermodynamics and kinetics of explosion and dangerous exothermic reactions. Mechanisms and theories of burning rate for solid state combustion, including smouldering, glowing combustion and burning of metals. Rates of production of smoke and dangerous toxic products at fires. Properties of particulate matter in smoke and their influence on smoke detection methods. Spectral properties of flames and their influence on flame detection methods.

2. FIRE DYNAMICS

(a) Primary
Heat transfer. Radiation, conduction and convection with particular reference to relevant dimensionless groups. Aerodynamics of forced jets and buoyant plumes. Rates of burning of organic materials. Factors affecting spread of fire. Properties of open fires. Size, movement, structure and temperature of flames. Main characteristics of jet fires, pool fires, three-dimensional liquid fires, fireballs, running fires, open flammable cloud fires and fire storms. Properties of enclosed fires, including simple heat balance. Fuel and ventilation controlled fires. Characteristics of flashover. Space separation. Description of fire tests for ignition, spread of fire and heat development. Pressure development in a symmetrical enclosed explosion. Cube root law. Open explosions. Movement of smoke in buoyant columns and through roof vents.

(b) Secondary
Structure of turbulence. Stratified flow. Richardson Number. Movement, control and dispersion of smoke produced by fires and vapour and liquid spillages in enclosed spaces and in the open. Interaction of thermally incompatible liquids. Rollover. Compressible flow. Structure of pressure waves, blast waves and shock waves. Structure and flame propagation theories for laminar and turbulent flames. Detonation. Design of pressure relief and explosion relief. Pressure–time pulses of gas explosions in various enclosures and in the open. Detonation in condensed explosions. Liquid–vapour explosions. Models of burning in enclosures. Theories of flashover. Theory of flame coalescence and fire storms. Properties of flames outside windows. Physical modelling of fires. Quantitative interpretation of fire tests. Production and properties of missiles produced by fire explosions and other forms of energy release.

tection for fires and blast protection for explosions. Limit state method applied to fire resistance. Influence of continuity and restraint.
Resistance of buildings to explosions and to progressive collapse. Repair of structures following fire and explosion damage.

5. INTERACTION BETWEEN FIRE AND PEOPLE

(a) Primary

Effect of human beings on fire occurrence with reference to age, sex, social habits and social economic status. Influence of fire safety education and training on ignition probability and evacuation behaviour. Behaviour of people in fire and other relevant emergency situations. The need for, and the design of, information communication systems for emergency conditions, including audibility of fire alarms and clarity of emergency signs and instructions. Effect of harmful agents produced by fire in producing disorientation during escape and causing injury and/or death. Consideration of the range of physical, psychological and physiological characteristics of typical populations leading to the appropriate choice of the mode of escape. Movement of people in buildings under normal and emergency conditions. Interaction and relative value of the components of escape route design, especially smoke movement and control.

(b) Secondary

Detailed analysis of fire case studies, especially those fires where large numbers of people have been involved. Application of rigorous analytical techniques to simulate escapers' decisions and usefulness of escape routes. Problems of people control in emergencies. After care of escapers and the necessary inter-relationship of all emergency services for rescue and care. Medical study of fire victims, including normal recovery, surgical and psychological cases. Psychometric approach to assessing acceptability of risk. Quantification of human response, error, and reliability. Criteria for devising training programmes for various aspects of fire safety.

6. FIREGROUND OPERATIONS AND APPLIANCES

(a) Primary

*Command and control at fires, other emergency incidents and major disasters: 1. Pre-planning. 2. General control and fireground strategy. 3. Evacuation and rescue. 4. Safety of personnel and public. 5. Breathing apparatus procedures and problems. 6. Ventilation. 7. Salvage and investigation of damage.
*Firefighting vehicles and appliances: 1. Design, construction and operation of firefighting vehicles and appliances. 2. Design, construction and operation of fireboats and other water-borne appliances. 3. Helicopters. 4. Design, construction, operation and performance characteristics of pumps and primers and special pumps.
*Communications: 1. Ways in which calls from the public and other sources are passed to the fire brigade, *e.g.*, the public telephone system, automatic fire alarms, direct lines, etc. 2. Control centres — design and operation. 3. Methods of alerting stations from a central control using land lines: (a) Call out system for unmanned stations, (b) Systems for whole time stations, *e.g.*, direct lines, public address teleprinters, etc. 4. Radio systems: (a) Systems for general communication — control to mobiles, (b) Systems for alerting stations using radio links. 5. Fireground communications: (a) Methods of working, (b) Equipment available.
Planning water supplies for fire risk.
*Fire lifts and escalators. Firefighting services in buildings, *i.e.*, water supplies, hydrants, hose reels, rising mains, foam inlets, etc.

(b) Secondary

Mechanical engineering and ergonomic aspects of fire appliance design.
Hydraulics of water supply systems in cities and at major risks.
Quantitative effectiveness and limitations of different firefighting methods for various fire risk situations, particularly: (a) Fires in buildings, (b) Fires in the open: (i) process plant, (ii) aircraft crash, (iii) forests. (c) Fires in ships.

---

*Taken from the Institution of Fire Engineers' Syllabus for 1980 [3].

types. Fire appliance access. Management structure in non industrial organisations and commerce, relevant fire safety responsibilities of various managers. Responsibility of the building professions for aspects of fire safety and other input to the building design process. Fire safety aspects of construction, maintenance, alteration and demolition of buildings. Implications of the application of legislative and insurance rules to some building types.

(b) Secondary
Application of legislative and quantitative design principles to the various stages of design of simple and complex buildings. The use of various evaluation techniques to aid the analysis of risk (activity) space relationships and the selection of integrated fire safety systems.
Personnel structures in commerce and the role of management. Discussion of problems associated with customers and staff; awareness of maintaining level of training; production of maintenance manuals; problems that may be created by continuing control and enforcement of legislation over combustible contents and change of use and construction of buildings.

11. FSDM OF INDUSTRIAL PROCESSES AND TRANSPORT

(a) Primary
Structure of manufacturing industry. Principles of industrial management. Legislation, *e.g.*, Health and Safety at Work etc. Act. Special fire problems for certain basic industries — including engineering, motor vehicles, electronics, textiles, plastics, rubber, timber, furniture. Appraisal of consequential loss, planning for recovery from fire. National and international legislation for road, rail, air, and sea transport. IMCO, IATA requirements. The Blue Book.

(b) Secondary
Application of quantitative methods to different industrial risks. Study in depth of design and management of fire safety of a number of the following major industrial risk areas:

1. Power generation and nuclear power plant.
2. Chemical and fuel process plant.
3. Offshore gas and oil production platforms.
4. Aircraft and aerospace vehicles.
5. Passenger and merchant ships.
6. Tankers, including liquefied gas tankers.
7. Risk in automated areas and warehouses, including high bay automated warehouses.
8. Forests and agricultural risks.
9. Mines and tunnels.
10. Land surface transport and mass transit systems.

12. FSDM OF CITIES AND COMMUNITIES

(a) Primary
Management and administration of a fire service.
*Administration: 1. Standards of fire cover. 2. Finance and budgeting procedures. 3. Planning of fire stations. 4. Planning of water supplies. 5. Committee rules and chairmanship. 6. Preparation and presentation of committee reports. 7. Press relations. 8. Public relations.
*Personnel: 1. Recruitment procedures. 2. Promotion procedures. 3. Assessment and reporting on staff. 4. Job specifications and descriptions. 5. Industrial relations. 6. Consultitative committees. 7. Safety of personnel. 8. The law relating to employment, industrial relations, and safety.
*Management: 1. The process of decision making. 2. Factors affecting morale. 3. The nature of leadership. 4. Functional leadership. 5. The essentials of good communications. 6. Management tools, *e.g.*, management by objectives, cost benefit analysis, problem analysis, etc. 7. Organisation charts. 8. Job evaluation.
*The law in relation to the Fire Service: 1. The Fire Services Acts 1947 and 1959, and Statutory Instruments made thereunder. 2. The Water Act as applicable for the provision of water for firefighting. 3. The Road Traffic Acts as specifically applicable to the Fire Service. 4. Common Law, the making of Statute Law, the use of delegated legislation. 5. The Fire Service's liability for damage and accidents.

---

*Taken from the Institution of Fire Engineers' Syllabus for 1980 [3].