To the Graduate Council:

I am submitting herewith a thesis written by James Thomas Blackmon, Jr., entitled "In the Design and Construction of Fire-Safe Buildings, Who Should Know What?" I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Safety Education and Service.

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# IN THE DESIGN AND CONSTRUCTION OF FIRE-SAFE BUILDINGS, WHO SHOULD KNOW WHAT?

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee

James Thomas Blackmon, Jr.

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Just as it requires a team to design and construct a fire-safe building, it required a team to design and complete this study. This unusual page for a Master's thesis is required to tender appreciation for the guidance by all of the unseen faces who participated in this study. Especial thanks are offered to the eighteen dedicated professionals of the Codes and Standards Committee of the American Institute of Architects who possessed the perseverence to examine and comment on both questionnaires; to T. V. Tiedeman, Assistant Director of the Codes and Regulations Center of the American Institute of Architects, for his ability to encourage by listening and his ability to motivate by informative letters; and to Dr. Warren J. Huffman, major professor, a dedicated education professional who also knows how to encourage by listening and to encourage by speaking softly.

Last, but certainly not least, many thank you's are extended to the twenty-one professional East Tennessee Fire Fighters, the twenty-one professionals of the National Fire Protection Association and the thirty-two professional engineers who participated in this study. Here's hoping we have furthered the cause of fire safety.



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## ABSTRACT

This study was undertaken for the purpose of gathering 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 (architects and engineers), construction contractors, building officials, fire prevention specialists, and building trade vocational education instructors. The aforementioned groups were assumed to be members of the building industry because buildings are not designed and constructed except through team effort. The motivation for the study was America Burning—The Report of the National Commission on Fire Prevention and Control. The Commission report, in addition to outlining our nation's fire problems, alleged that certain members of the building industry were designing and constructing unsafe buildings and, therefore, were not fulfilling their responsibilities.

This study began with the assumption that even if the Commission charges were true, most members of the building industry would want to find ways to rectify the situation and with the further assumption that the industry needed to register the opinions of experts involved in day to day design and construction. It was believed that the industry needed to know who should know what, which code should govern, and how the respondents perceived what was the most important category of fire as related to buildings.

These questions were answered by submitting statements concerning buildings and fires to four panels of experts—a group of architects,

a group of engineers, a group of professional firemen, and a group of fire prevention education specialists. These experts rendered opinions regarding: (1) the relevancy of each statement to building design and construction, (2) an opinion concerning who in the industry should know the information contained in each statement, and (3) which code—building or fire prevention—should regulate the information in each statement.

The resulting opinions established a documented compilation of statements concerning fires and buildings even though the information contained in each statement was not tested to determine whether the statement was fact, opinion, theory, or fiction. The study further revealed that the fire-oriented members of the industry might be communicating with themselves rather than with the industry as a whole. Architects and in-house engineers working for a large industrial manufacturer seemed to have different fire protection viewpoints. A substantial number of members from the building industry were willing to spend several hours to render opinions and make comments concerning the study.

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# CHAPTER I

## THE PROBLEM

The United States, the most technologically advanced nation in the world, held the dubious honor of leading the rest of the free world in per capita deaths and property loss from fire, according to the 1973 report of the National Commission on Fire Prevention and Control.[1] The death rate per million population was nearly twice that of the closest contender, second ranking Canada. The United States exceeded Canada by one third in per capita economic losses. Table I-1 summarizes the price this country pays each year because of uncontrolled fire.[2]

TABLE I-1

ESTIMATED ANNUAL U.S. FIRE COSTS

| Category | Losses |
|---|---|
| Death | 12,000 human lives |
| Physical and psychological scars | 300,000 human lives |
| Property loss | $2.7 billion |
| Fire department operations | 2.5 billion |
| Burn injury treatment | 1.0 billion |
| Insurance industry operating costs | 1.9 billion |
| Productivity loss | 3.3 billion |

Based on 1972 data.

[1] National Commission on Fire Prevention and Control, America Burning—The Report of the National Commission on Fire Prevention and Control (Washington: Government Printing Office, 1973).

[2] Ibid., p. 2.

The four major causes of the fire problem were listed as follows:

1. Indifference on the part of people.
2. Ignorance on the part of people.
3. Economic problems which stand in the way of fire prevention investment.
4. Lack of understanding of fire threat, seemingly, accounting for low priority given to fire protection matters.[3]

The report stated that "designers of buildings generally give minimal attention to fire safety in the buildings that they design. They are content, as are their clients, to meet the minimal safety standards of the local building code. Often both assume that the codes provide completely adequate measures rather than minimal ones. . . . Product designers, too, give little thought to possible toxic or fire aggravating effects should their products become involved in fire."[4] A cause listed by the Commission for this unenthusiastic attention to building fire safety was the absence of training in the principles of fire safety received by building designers.[5]

In all states including Tennessee, registered engineers and architects dealing with the public and engaged in building design and construction were required to refrain from engaging in any engineering and architectural design for which they were not competent.[6] Therefore,

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[3]Ibid., pp. 2 and 3.

[4]Ibid., pp. 3 and 4.

[5]Ibid., p. 77.

[6]Tennessee State Board of Architectural and Engineering Examiner, 1970 Roster (Nashville: Tennessee State Board, January, 1970), p. 86.

for a national commission to state that a lawfully responsible segment of the population gave only minimal attention and thought to matters of fire safety was cause for concern.

Methods for fire safety evaluation in building design and construction appeared to be a neglected part of the educational process for architects, engineers, building officials, professional fire fighters, and building trade vocational education instructors. This apparent lack of training helped to provide a rationale for the past actions of people responsible for design and construction of buildings.

While it appeared inconceivable that the education of all segments of the building industry had been neglected, that was not really important. The question was, how could the situation be rectified? One way of doing this would be to gather the opinions of selected segments of the building industry to determine those areas of knowledge most in need of improvement. Then, those responsible for such matters could prepare the necessary educational programs. A conviction that the building industry could help to mitigate the nation's fire losses was the foundation upon which this study was planned.

## I. PURPOSE OF THE STUDY

The purpose of the study 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 (architects and engineers), construction

contractors, building officials, fire prevention specialists, and building trade vocational education instructors.

## II. RATIONALE FOR THE STUDY

It was believed that development of such study areas would be useful at the university, junior college, and technical school levels, as well as for continuing education programs for practitioners. Further, the Federal Fire Prevention and Control Act of 1974 authorized the National Fire Prevention and Control Administration to review, evaluate, and suggest improvements to state and local fire prevention and building codes, and the building industry would be directly affected by changes to such codes.[7] Thus, the survey afforded a unique opportunity to find out how some members of the building industry perceived a building code and a fire prevention code.

## III. STATEMENT OF THE PROBLEM

A basic premise of this study was that during the design and construction phases of a building, five groups are responsible for the safety of the building—the design team, the building contractor, the building official, the fire department fire prevention specialist and, indirectly, the building trades vocational instructor. The essence of the problem was to try to determine which of these groups: (1) should

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[7] U.S., Congress, House, Committee of Conference, Federal Fire Prevention and Control Act of 1974, Conference Report, 93d Cong., 2d Sess., House Report 93-1413 (Washington: Government Printing Office, 1974), p. 11.

have the information contained in each building survey statement, and (2) which code should govern the type of information contained in each statement.

Other factors complicating the problem were: (1) whether the judges, being from different segments of the building industry, held the same building fire safety viewpoint, and (2) which category of fire safety information did the judges deem more important?

## IV. STATEMENT OF HYPOTHESES

Several hypotheses were postulated concerning the views of the groups of judges rendering opinions about the Building Industry Fire Safety Survey. Stated in the null form, these hypotheses were as follows:

Null Hypothesis A—There were no differences of opinion among the four groups of judges concerning which of the five segments of the building industry should have the information contained in the survey statements.

Null Hypothesis B—There were no differences of opinion among the four groups of judges concerning which survey statements belonged in a building code and which belonged in a fire prevention code.

Null Hypothesis C—There were no differences of opinion among the four groups of judges concerning which of the seven broad categories of information took precedence over the other.

## V. BASIC ASSUMPTIONS

Assumption 1. The statements selected for the Initial Questionnaire were considered to be relevant to buildings and fire whether they were factual or not. With the exception of sixteen statements, all statements presented in the questionnaire were abstracted or paraphrased from textbooks, handbooks, correspondence, journal articles, standards books, code books, laws, and magazine articles. When paraphrasing or abstracting factual materials, there is a danger of stating the material out of context. When utilizing magazine articles, there is the possibility of using an opinion or an untested theory. However, for purposes of this study, the idea being examined was whether the material in a statement was relevant or nonrelevant to building design.

Assumption 2. It was not necessary to test statistically the opinions rendered by the American Institute of Architects Codes and Standards Committee concerning whether a fire-safety statement contained in the Initial Questionnaire was relevant or nonrelevant to building design. This committee was composed of fifty practicing architects and consultants from throughout the United States. The average number of years of work experience of the questionnaire respondents was twenty-three years, with a high of fifty years and a low of three years. Their experience covered all major types of construction—hospitals, schools, industrial plants, and public buildings, among others. This committee of building design experts was not asked to state reasons for agreement or disagreement with a statement or why a statement was relevant.

## VI. LIMITATIONS OF THE STUDY

The broadness of the scope of the study was its major limitation. Twenty subject areas in seven broad categories were postulated as being important to the fire safety of a building and an attempt was made to present several statements about each area. Any one of the twenty subject areas would make a good candidate for a study.

## VII. DELIMITATIONS OF THE STUDY

In order to have practical questionnaires, the parameters of this study were as follows:

1. The subject of fire was limited to buildings.
2. The subject was limited to the problems of groups responsible for design and construction of buildings.
3. The selection of the statements for the initial questionnaire utilized a "shotgun" approach.
4. No attempt was made to determine whether a statement was factual or not.
5. The statements for the Building Industry Fire Survey were limited to seventy-five questions, because it was not practical to believe that busy individuals would take the time to answer.
6. Statements for the Building Industry Fire Survey were selected from the Initial Questionnaire.

## VIII. IMPORTANCE OF THE STUDY

Any step which leads toward the reduction of fire or smoke deaths and of resource waste should be judged as a step in the right direction. Statistics of annual national losses attributable to the ravages of fire in terms of death, the living fire victims, injuries, property losses, hospital and medical costs, and the pure waste of our national wealth were frightening in their magnitude. Between the years 1961 and 1972, war in Vietnam caused the death of 45,925 Americans of varying ages; during the same period fire caused the death of 143,550 citizens at home.[8] During its peak year of 1952, poliomyelitis killed one third fewer people that year than did fire, yet the public outcry that something be done about polio resulted in virtual eradication of the disease.[9]

There was apparent agreement in the authoritative literature regarding fire statistics that the leading cause of these frightening data was the lack of fire knowledge on the part of Americans.[10]

Phillips stated in America Burning—The Report of the National Commission on Fire Prevention and Control that "in the first months of the Commission's existence a search was made for data on the American

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[8]National Commission on Fire Prevention, p. 156.

[9]Ibid., p. 4.

[10]U.S., Congress, House, Committee on Science and Astronautics, Subcommittee on Science, Research and Development, Fire Prevention and Control, Hearing, 93d Cong. 1st Sess., July 25, 26, 31; August 1-2, 1973 (Washington: Government Printing Office, 1973), p. 248.

public's knowledge of fire safety principles. Surprisingly the only studies discovered were made after small fire education campaigns. No one had probed our citizen's basic fire knowledge."[11]

Building architects, building design engineers, and building contractors are part of the public, but they have the additional responsibility of designing and constructing homes, schools, factories, and businesses. This responsibility means that they must design these structures to be utilitarian as well as economically feasible. However, Americans have grown to expect—indeed have the right to expect—that building materials and structures have no inherent hazards.[12] Yet the implication was that this segment of the population might not be fulfilling their ultimate responsibility as evidenced by the statements of the Commission and the statistics presented in Table I-1, page 1.

The Commission quotation appearing in the introduction of this study indicated that minimal attention was being given to fire safety in building designs by both the designer and the user. This responsibility requires mutual decisions that should result in joint consideration of such items as potential loss levels (human and dollars), ignition probabilities, conflagration potential and investment cost, among others.[13] If

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[11]National Commission on Fire Prevention, p. 153.

[12]Bureau of National Affairs, "Consumer Product Safety Act," United States Law Week, XLI, No. 16 (October 31, 1972), 41LW57.

[13]L. M. Krasner, "The Feasibility of Quantitatively Analyzing Investments in Loss Prevention Activities" (paper read at the American Institute of Chemical Engineers Meeting, November, 1973), p. 1.

the structure is of a commercial or industrial nature, then additional considerations would include potential losses in market position, goodwill loss through business interruption, and bankruptcy potential which are client decisions.[14] Building designers and builders, to fulfill this responsibility, must have the knowledge to recommend to their clients those alternatives that are open to provide a fire-safe structure.

## IX. DEFINITIONS OF TERMS USED

Accident. An unwanted transfer of energy because of lack of barriers and/or controls, producing injury to persons, property or process.

Builder. Construction contractor.

Building. A structure enclosed with exterior walls or fire walls built, erected, and framed of component structural parts, designed for housing, shelter, enclosure, or support of individuals, animals, chattels, or property of any kind.

Building Code. A compilation of mandatory regulations containing the technical requirements for the design and construction of buildings; consistent with accepted criteria, specific engineering formulae, established performance standards, minimum quality of materials, and testing requirements or on proven acceptable practices; containing minimum requirements to provide reasonable and prudent protection for public health, safety, and welfare.

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[14] Ibid., p. 9.

Building Industry. The team of experts composed of building designers (architects/engineers), builders, building officials, fire prevention specialists, and vocational education instructors that is responsible for the design and construction of fire-safe buildings.

Building Industry Fire Safety Survey. This survey contained seventy-five statements and was answered by four groups of judges—an architect group, an in-house engineering group, a professional fire fighter group, and a fire prevention education specialist group.

Building Official. The officer or authority charged by law with the administration and enforcement of building regulations, or the duly authorized deputy of such officer or authority.

Burn. To cause to undergo combustion and to destroy by fire; or, an injury produced by fire, heat, or a heat-producing agent.

Combustible. Capable of igniting and burning.

Engineer. A person trained in, skilled at, or professionally engaged in a branch of engineering; however, for purposes of this study the term can mean but is not limited to the following disciplines: mechanical, structural, civil, electrical, fire protection, chemical, or industrial.

Fire. A rapid, persistent, chemical reaction that releases heat and light and, as utilized in this paper, is considered uncontrolled. It will usually mean an exothermic combination of a flammable or combustible substance with an oxidizing substance.

Fire Accident. An accident resulting from a fire and/or an accident causing a fire.

Fire Prevention Code. A compilation of mandatory regulations consistent with nationally recognized practices for the reasonable protection of life and property from the hazards of fire and explosion due to storage, use, or handling of hazardous materials, substances, and devices and to minimize hazards to life and property due to fire and panic exclusive of building code regulations.

Fire Prevention Education Specialists. The senior staff of the National Fire Protection Association.

Fire Prevention Specialist. The officer or authority charged by law with the administration and enforcement of fire prevention regulations, or the duly authorized deputy of such officer or authority.

Flammable. Highly combustible and capable of burning with great rapidity.

Initial Questionnaire. This questionnaire contained 315 statements, was answered by the Codes and Standards Committee of The American Institute of Architects and was used as a guide for selecting the seventy-five statements contained in the Building Industry Fire Safety Survey.

Smoke. A suspension in a gas of small liquid or solid particles, the visible portion of smoke. Smoke usually contains carbon monoxide which is a colorless, odorless, tasteless, and poisonous gas formed by incomplete combustion of a combustible or flammable material.

Vocational Education Instructors. Instructors, teachers, or professors who teach special skills in specific occupations (that is, brick laying, sheet metal working, mechanics, carpentry, iron working, electricians, welding, and so forth) at the high school, technical school, junior college, or university level.

## X. ORGANIZATION OF THE STUDY

A brief review of the concept of building codes, a short review of the relationships of people and accidents, a history of fire protection engineering education, and a review of concepts of fire prevention codes are presented in Chapter II. An attempt to explain the approach that was followed as well as the detailed techniques that were employed in conducting this study are presented in Chapter III. The results of the study are presented and discussed in Chapter IV, while Chapter V summarizes and presents the conclusions resulting from the investigation.

# CHAPTER II

## REVIEW OF THE LITERATURE

### I. BUILDING CODES

Hammurabi, a famous king and lawmaker of the era 2100 B.C., issued a written statute that stated the following:

> In the case of collapse of a defective building, the architect is to be put to death if the owner is killed by the accident and the architect's son, if the son of the owner loses his life.[1]

Thus, for over forty centuries, safety of buildings was a matter of concern to the public and especially to engineers and architects. This concern resulted in the development of rules and regulations that came to be called building codes, and every civilized country, both ancient and modern, developed some form of code to regulate construction. The National Commission on Fire Prevention and Control conducted a survey and found that in the United States there existed fourteen thousand local building codes and noted that an earlier commission on urban problems had likened building code jurisdiction in this country to thousands of little kingdoms each having its own way.[2] While presentation of ways to prevent building collapse is the major objective of a building code, this is not the only objective. The presentation of

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[1] Building Codes—Their Scope and Aims (New York: Engineering and Safety Department, American Insurance Association, 1969), p. 3.

[2] National Commission on Fire Prevention and Control, America Burning—The Report of the National Commission on Fire Prevention and Control (Washington: Government Printing Office, 1973), p. 80.

construction requirements intended to prevent fire, restrict its spread, and provide areas of refuge for occupants is another major goal.[3]

The modern building code, when kept revised to incorporate new building technology and when properly enforced, offers to the designer, builder, developer, producer, and consumer, the widest possible choice in both design and material selection within the acceptable limits of established health and safety standards. Such codes should be able to assure every consumer the maximum in structural safety and building economy consistent with approved building construction practices.[4] Building codes should be accepted as desirable vehicles to assist in improvement of the quality of building, including fire safety. The National Commission on Fire Prevention and Control stated, however, that it found that building designers and their clients were content to meet the minimum safety requirements of the local building code.[5]

> The responsibility for codes adoption and codes administration is a primary function of local units of government under the police powers delegated by the state. Unfortunately, these functions have not been fully exercised by local governments or given the importance that they should have in local municipal operations in many instances.[6]

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[3] Building Codes, p. 3.

[4] Daniel M. Taylor, "Part 1: Importance, Function of Building and Housing Codes Established," Southern Building (August, 1973), 6-7.

[5] National Commission on Fire Prevention, pp. 3-4.

[6] Taylor, pp. 5-6.

The situation that existed at the time of this study was that, on the one hand, designers and their clients might be giving minimal attention to the fire safety aspects of the building codes but, on the other hand, a number of local governmental bodies had no code to guide them even though there were at least four modern model building codes that could be easily adopted and adapted to suit local situations. These nationally recognized model building codes were:

1. BOAC Basic Building Code promulgated by the Building Officials and Code Administrators International,
2. National Building Code promulgated by the American Insurance Association,
3. Southern Standard Building Code promulgated by the Southern Standard Building Code Congress, and
4. Uniform Building Code promulgated by the International Conference of Building Officials.[7]

> In many localities the general public has not really understood the benefits of effective codes administration in the total life of the community and, therefore, has not insisted that the locally adopted codes be kept up to date or that such codes be effectively administered.[8]

Thus, it appeared that at least in some communities no building code existed or there was minimal enforcement of an obsolete code. Even in those localities where there was a code, one might find designers and their clients giving only the least attention to the fire safety provisions of the code. These circumstances, therefore, make it apparent that several major factors contributed to the nation's fire losses.

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[7]National Commission on Fire Prevention, p. 79.

[8]Ibid., p. 6.

# II. FIRE PREVENTION CODES

"Typically two-thirds to three-fourths of the provisions of a building code apply to fire safety."[9] However, a building code applies principally to new construction and alterations to the structure itself, with the fire prevention code governing the maintenance of the building including introduction of materials and processes likely to be detrimental to what may be a relatively fire-safe structure.

The building code and fire prevention code complement one another. Fire prevention codes provide regulations for the reasonable protection of life and property from the hazards of fire and explosion due to storage, use, or handling of hazardous materials, substances, and devices.[10] Some fire prevention codes, however, do not cover some features of life safety in buildings when these features are normally considered proper for inclusion in a building code. "For example, requirements as to the number, type and width of exits from a building are normally covered in building codes and, therefore, are not included in a fire prevention code."[11]

As in the case of building codes, several model fire prevention codes were available to assist local officials. These codes were:

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[9]National Commission on Fire Prevention, p. 80.

[10]Gary Wiggins, Southern Standard Fire Prevention Code (Birmingham: Southern Building Code Congress, 1974), preface.

[11]Fire Prevention Code. (New York: Engineering and Safety Department, American Insurance Association, 1965), preface.

1. Basic Fire Prevention Code promulgated by the Building Code Officials and Code Administrators International.
2. Fire Prevention Code promulgated by the Building Code Officials and Code Administrators International.
3. Southern Standard Fire Prevention Code promulgated by the Southern Standard Building Code Congress.
4. Uniform Fire Code promulgated by the International Conference of Building Officials.[12]

The National Fire Protection Association was in the process of developing a fire prevention code that in their words "would cover all aspects of fire protection and prevention." This nationally recognized fire safety standards-making organization stated that this proposed code reflected "a long-standing need of state and local authorities to enact and enforce all types of safety codes."[13] An opinion held by some was that this proposed code would contain a mixture of building standards and fire prevention standards thereby making it complicated to enforce. Further, the document stipulated enforcement by a fire chief or a fire marshall, thus conflicting with the responsibilities of the administrating building officials.[14] This code was to be presented to the membership of the National Fire Protection Association for adoption in May 1975.[15]

As in the case of building codes, some communities did not have a fire prevention code and where one existed there was conflict regarding

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[12]Letter from Warner H. Howe, P.E., Gardner and Howe, Memphis, Tennessee, March, 1974, p. 7.

[13]Proposed Fire Prevention Code (Boston: Fire Prevention Code Committee, National Fire Protection Association, April, 1974), p. ii.

[14]Howe, p. 7.

[15]James H. Riopelle, "Report of the Committee on Fire Prevention Code," Technical Committee Reports (Boston: National Fire Protection Association, 1974), p. 685.

which enforcing authority should have jurisdiction—the fire chief or the building official.[16] Such disputes could be another factor in the nation's fire problem.

## III. PEOPLE AND ACCIDENTS

The Fire Prevention and Control Commission in its discussion of major causes of the fire problems emphasized that they believed that indifference and ignorance on the part of people were two contributing factors to the fire problems.[17] Phillips, while serving as a member of the Commission, presented survey-substantiated data concerning knowledge of fire safety. Commissioner Phillips' limited survey found alarming voids in public fire safety knowledge.[18] Lack of knowledge might better be described as faulty instruction which, in turn, could carry subheadings entitled:

1. No instruction
2. Incomplete instruction.
3. Erroneous instruction.
4. Unenforced instruction.[19]

Heinrich published data based on analysis of industrial accident data covering a period from 1915 to 1929. These data caused him to draw the following conclusions:

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[16]National Commission on Fire Prevention, p. 82.

[17]Ibid., pp. 2-3.

[18]Ibid., p. 154

[19]H. W. Heinrich, Industrial Accident Prevention—A Scientific Approach (New York: McGraw-Hill, 1931), pp. 46-47.

1. 2% of all industrial accidents are unpreventable.
2. 98% are preventable.
3. 88% of the preventable accidents could be classified supervisory in nature which simply means:
   a. Faulty instruction
   b. Inability of the employee
   c. Poor discipline
   d. Lack of concentration
   e. Unsafe practice
   f. Mentally unfit
   g. Physically unfit.
4. 10% of the preventable accidents could be classified as physical in nature, meaning:
   a. Physical hazards
   b. Poor housekeeping
   c. Defective equipment
   d. Unsafe building conditions
   e. Improper working conditions
   f. Improper planning
   g. Improper dress or apparel.[20]

DeReamer in 1957 substantiated Heinrich's findings.[21] Heinrich further introduced the philosophy of property damage accidents in relation to injury accidents. His research indicated a relationship of 1:29:300; that is, for each disabling-type injury there could be expected twenty-nine minor injuries and three hundred no-injury accidents.[22]

Frank E. Bird in his book Damage Control (as cited by Fletcher) presented an analysis of ninety thousand incidents gathered over a seven-year period. Bird's analysis indicated a different ratio, 1:100:500. For each disabling injury there would be an average of one

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[20]Ibid., pp. 46-47.

[21]Russel DeReamer, Modern Safety Practices (New York: John Wiley, 1958), p. 17.

[22]Heinrich, pp. 90-96.

hundred minor injury accidents and five hundred property damage accidents.[23] Further research by Bird, Fletcher, and Douglas indicated that the cost of these property damage accidents ranged from $34.67 to $51.50 per accident.[24]

An accident was defined in Chapter I as an unwanted transfer of energy that produces injury to persons, property, or processes. Fire accidents were defined as accidents resulting from a fire and/or an accident causing a fire. Relating Heinrich's, DeReamer's, Douglas's, Fletcher's, and Bird's studies of industrial accidents to fire accidents, especially those attributable to supervisory causes, one could readily visualize the rationale of the Commission when it expressed the opinion that most fire losses were caused through indifference and ignorance about fire on the part of the people.[25]

Some might suggest that building designers tailor the design of a structure or equipment to mitigate only Heinrich's "physical" accidents, which would fall into the realm covered by a building code. On the other hand, shouldn't the designer be able to suggest ways to his client of mitigating the "supervisory type" accident? The failure to properly evacuate the physically and mentally unfit and the poorly trained individual from a fire location to places of refuge would fall in the category of Heinrich's "supervisory type" accident. The National Fire Protection Association (NFPA) published a standard known as the Life

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[23]J. A. Fletcher, "Total Environmental Control," Risk Management (October, 1971), 9.

[24]Ibid., p. 10. [25]National Commission on Fire Prevention, pp. 2-3.

Safety Code[26] written to guide both designer and client in providing fire-safe methods of exit. Most building codes also discussed this problem, but the NFPA standards were constantly revised to incorporate new techniques. This brief review of accident causes suggests that a designer must have knowledge in several areas other than just architecture or a specific engineering discipline.

## IV. HISTORY OF FIRE PREVENTION EDUCATION

At the time of this writing, only two universities in the United States offered degrees in fire protection engineering—Illinois Institute of Technology and the University of Maryland. The former program was begun in 1903 while the latter was established in 1957. Both these programs were supported by the insurance industry, with the result that most of the few graduates (approximately sixty per year in 1973) of these programs were employed by that industry, while the majority of the remainder went into the fire services. In 1975, few graduate fire protection engineers were employed as designers.[27]

Professor H. E. Hickey, in his testimony before the U.S. House Committee on Science and Astronautics, July 31, 1973, stated

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[26] Life Safety Code (Boston: Committee on Safety to Life, National Fire Protection Association, NFPA 101, 1973), pp. 1-196.

[27] U.S., Congress, House, Committee on Science and Astronautics, Subcommittee on Science, Research and Development, Fire Prevention and Control, Hearing, 93d Cong., 1st Sess., July 25, 26, 31; August 1-2, 1973 (Washington: Government Printing Office, 1973), p. 242.

> . . . the lack of graduate programs designed for fire protection engineering makes it hard to attract highly qualified undergraduate students.[28]

The number of two-year associate degree fire science technology programs for training technicians and fire department fire prevention specialists developed with great rapidity. Favreau estimated that there were approximately 202 programs operating in thirty states with an enrollment of 13,700 during the fall semester of 1971.[29] Kimball reported that two years prior to Favreau's report 8,875 members from 501 fire departments were considered to be enrolled in college courses leading to baccalaureate and associate degrees in fire science technology.[30]

Tennessee in 1975 had three community colleges offering associate degrees in fire science technology. The twenty-five students enrolled during the winter quarter, 1975, at Roane State Community College were employed as members of area municipal fire departments and local industrial plant fire departments.[31]

Hickey seemingly summed up the status of these programs when he observed that existing fire science programs had been designed to provide a means for professionalizing paid fire department personnel

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[28]Ibid., p. 244.

[29]Donald F. Favreau, Fire Service Education 1971: A Survey and Historical Development of Fire Service Education in the United States (Albany, N.Y.: International Fire Administration Institute, 1971), p. 3.

[30]U.S., Congress, Fire Prevention and Control, p. 241.

[31]Statement by J. W. McCormick, Assistant Professor in Fire Science Technology, Roane State Community College, personal interview, January 20, 1975.

within a local and regional area and that the vast majority of these programs were terminal programs.[32]

Jensen reported that graduates from two-year associate programs could fill the demand for technicians, but the rate of fire protection engineering graduates would not fill the demand for design engineers.[33]

One of the difficulties involved in tracing the history of new techniques or programs was in determining where to begin. Vestiges of any topic and its ramifications may be traced back through the years.[34] The literature on the subject of fire protection engineering and fire science technology was sparse, which suggested that fire protection engineering had not yet "arrived" as a separate discipline of engineering. The professional engineering license examinations held in October, 1973, offered fire protection engineering as a discipline for the first time in Tennessee.[35] Such late recognition as a discipline further suggested that fire protection engineering functions were being carried out by engineers in other disciplines. How were these engineers and architects being trained? A review of engineering school catalogs and curricular offerings for schools in Tennessee indicated no such course offerings. At the University of Tennessee in Knoxville only the

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[32]U.S., Congress, Fire Prevention and Control, p. 244.

[33]Rolf Jensen, "Educational Programs in Fire Protection Engineering," Fire Technology, VII, No. 2 (May, 1971), 170-174.

[34]R. J. Suarez, "A Study of the Planning and Scheduling by the Critical Path Method of the Bull Run Steam Plant" (unpublished Master's thesis, The University of Tennessee, 1963), p. 43.

[35]McCormick interview, January 20, 1975.

School of Forestry offered a course in fire protection.[36] Obviously a course in safety education would discuss the subject, but not from a building design viewpoint.[37] From reading the literature, one would gain the impression that American building designers were receiving a substandard education in fire safety.

Bond reported on a document issued by the government of the Isle of Man following the burning in 1973 of a large amusement complex, where fifty persons burned to death. The report purportedly criticized the type education received by architects that allowed a design to be constructed containing a large number of fire safety deficiencies. The report concluded that general safety, including fire safety, appeared to be neglected in architectural education.[38]

However, the University of Edinburgh had implemented prior to the Isle of Man disaster a series of formal postgraduate instruction courses and extramural education programs about the problems of fire and buildings. Their stated purpose was to provide members of the construction professions with a detailed working knowledge of the subject. The first series of lectures resulted in a publication entitled A Complete Guide

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[36]University of Tennessee, 1974/1975 General Catalog, University of Tennessee Record, LXXVII, No. 1 (January, 1974), 100.

[37]H. J. Stack and J. D. Elkow, Education for Safe Living (4th ed.; Englewood Cliffs, N.J.: Prentice-Hall, 1972), pp. 147-171.

[38]Horatio Bond, "Fire Lesson: Design Management," SFPE Bulletin, (January, 1975), 5.

to Fire and Buildings which proved to be an invaluable guide in the preparation of the Initial Questionnaire used in this study.[39]

Florio in his discussion of safety education indicated that three instructional patterns and techniques were commonly used: (1) direct teaching, (2) correlation, and (3) integration.[40]

Direct teaching of safety was normally used in two basic situations: (1) like history or chemistry, it was used in courses concerned exclusively with safety which were distinct subjects in a curriculum; (2) it was used when an instructor of another subject included the material in the regular course.

Correlation involved the use of other curricular areas as vehicles for teaching safety, while integration described a curriculum which revolved around a central theme or objective and related parts of the subject to a whole.[41] An example of integration might be a curriculum in risk management where a total loss control concept was taught.[42]

The evidence indicated that few centers of higher education taught fire protection engineering; therefore, the majority of building designers, construction contractors, building officials, and fire department specialists engaged in the practice of their professions

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[39]E. W. Marchant (ed.), A Complete Guide to Fire and Buildings (Lancaster, Eng.: Medical and Technical Publishing Company, Ltd., 1972), preface.

[40]Aurelio F. Florio, "Safety Education," Encyclopedia of Education, (1971), VIII, 1-6.

[41]Ibid., p. 5.

[42]Fletcher, "Total Environmental Control," p. 10.

must have learned fire protection concepts through the method of correlation and/or integration as undergraduate students or at continuing education seminars—if, indeed, they had learned it at all.

## V. SUMMARY OF CHAPTER II

The major objective of a building code is the preservation of life and property. The construction requirements intended to prevent fire, restrict its spread, and provide areas of refuge for occupants are integral parts of the major goal. The modern building code, when kept revised to incorporate new building technology and when properly enforced, offers the designer, builder, developer, producer, and consumer, the widest possible choice in both design and material selection, within the acceptable limits of established health and safety standards. Such codes should be able to assure every consumer the maximum in structural safety and building economy, consistent with approved building construction practices, the idea being that building codes are desirable vehicles to assist in improving the quality of buildings, including fire safety aspects.

Inadequate protective measures existed in 1975 because designers and their clients gave minimal attention to the fire safety aspects of the building codes and local governmental bodies were not guided by a building code. "Typically two-thirds to three-fourths of the provisions of a building code apply to fire safety."[43] But a building code applies

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[43]National Commission of Fire Prevention, p. 80.

principally to new construction and alterations to the structure itself, with the fire prevention code governing the maintenance of the building including introduction of materials and processes likely to be detrimental to what may be a relatively fire-safe structure.

The literature search revealed that indifference and ignorance on the part of people were two contributing factors to the fire problem. However, this did not relieve the building design and construction team from the responsibility of building fire-safe buildings. Rather, it suggested that a designer must have knowledge in several areas other than architecture or a specific engineering discipline.

Evidence indicated that few centers of higher learning taught fire protection; therefore, the majority of building designers, builders, building officials, and fire department specialists engaged in the practice of their professions must have been learning fire safety concepts by some other method.

The next chapter presents the rationale for the "shotgun" selection of the statement items used in the Initial Questionnaire and the Building Industry Fire Safety Survey, as well as the methods and statistical tests used in gathering the data for this study.

# CHAPTER III

## METHODS AND PROCEDURES

In an awakening world of fire safety consciousness finding the selection of statements on evolved thinking in building fire protection was a difficult task. Although the amount of material in print was not yet vast the existing material available for review became increasingly meaningful. Many of the alternative selections available that could have been used were not, because of the limitations of time on the part of questionnaire respondents and practicality in preparation of the questionnaires used. Selections for the Initial Questionnaire were made with several factors in mind.

First, it was believed that the Initial Questionnaire had to be a real "shotgun" that covered as many areas of fire protection knowledge or opinion as possible. This concept was confirmed by correspondence from the organization that agreed to answer the Initial Questionnaire.

Second, having decided to take the shotgun approach, the problem of reducing the questionnaire to a practical instrument became paramount. Should the document not be broad enough or of sufficient coverage of field, then it would be of little value. Conversely, should the document be too long, then response would likely be meager, again making it meaningless. The approach was to abstract and paraphrase statements that the study planner believed appropriate to ask of one who might have responsibility for fire safety in a new building. The

objective was to provide depth and breadth and diversity of opinion on controversial issues in fire protection. The ability to select the right questions was based on experience rather than on intuition. However, as James Froude, the English historian, once stated, "Experience teaches slowly, and at the cost of mistakes."[1] The writer strived for a minimum of mistakes in this study.

## I. INITIAL QUESTIONNAIRE

The development and completion of the Initial Questionnaire phase of the study required three separate independent steps:

1. To find an organized group of building or fire protection experts or combination of the two willing to spend time evaluating the questionnaire statements.
2. To choose and paraphrase the questionnaire statements.
3. To tabulate the results of the judges' answers and comments.

Step 1. During the first and second quarters of 1974, a literature search was conducted including conversations and correspondence with persons in a position to have knowledge regarding other studies relating to buildings and fires. The purpose of these activities was to ascertain whether prior research of the type contemplated for this study had been

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[1]Tryon Edwards, The New Dictionary of Thoughts (New York: Standard Book Company, 1964), p. 193.

conducted. The individuals contacted in this personal search were associated with such organizations as:

1. American Insurance Association
2. American Institute of Architects
3. Committee on Fire Research, Division of Engineering, National Research Council
4. Department of Fire Protection and Safety Engineering, Illinois Institute of Technology.
5. Department of Fire Protection, University of Maryland
6. Factory Insurance Association
7. Factory Mutual Research Corporation
8. National Fire Protection Association
9. National Society of Professional Engineers
10. Smoke, Fire and Burn Foundation, Inc.
11. Society of Fire Protection Engineers
12. Tennessee Society of Professional Engineers

A second purpose for the personal search was to determine if anyone knew of a group willing to participate in the study by answering the questionnaire. Interest in the project was expressed by all; however, only the American Institute of Architects and the Society of Fire Protection Engineers expressed an indication of willingness to participate. The offer of the Society of Fire Protection was declined after a review of the Society's membership rolls indicated a scarcity of building designers. Further, it was assumed that answers to the questionnaire statements received from the society would have a myopic viewpoint as the primary

prerequisite for membership in the Society was a broad knowledge of fire protection engineering principles.

The offer of the American Institute of Architects Codes and Standards Committee was gratefully accepted even though the possibility existed that their answers might be biased because of the Committee's interest in developing:

1. Recommendations for architectural education programs on fire safety,
2. Guidelines for architectural practitioners on fire safety,
3. Improvements in the "state of the art" relative to courses and programs available to the architect on life safety design and planning at the university, junior college, and technical school levels, continuing education programs and in the areas of architectural examination and registration.

However, the possibility of such bias was considered offset by the Committee's vast experience in and knowledge of building design and construction. The letter of acceptance with a critique of the goals of the proposed study is contained in Appendix A.

Step 2. The critique of the proposed study plan emphasized the point that the Initial Questionnaire must be broad, give sufficient coverage to building design, and not limit the questionnaire to strictly fire protection engineering matters. A shotgun approach was advocated and the committee was cognizant of the necessity for an extremely long questionnaire.

The table of contents of the book A Complete Guide to Buildings and Fire used at the University of Edinburgh[2] and the planning matrix from an international conference sponsored by the General Services Administration on fire safety in high rise buildings provided guidance for the establishment of the broad categories of fire protection used in this study.[3] The high rise building conference indicated five broad categories of fire protection were required for high rise building fire safety. These were: occupant protection, life support systems, fire propagation and movement, fire control and extinguishment, and structural systems.[4] The University of Edinburgh approach was quite similar to the high rise approach but included the categories of reinstatement of fire damaged building structures and fire problems in the many other types of building structures in use. The concepts of what was deemed important to this study are summarized in Table III-1. This table further reflects the specific subject cases believed necessary for a more complete understanding of building fire safety.

Next began the task of selecting statements that would illustrate the twenty specific subject areas. The statements were selected by the process of abstracting or paraphrasing from textbooks, handbooks,

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[2]Eric W. Marchant (ed.), A Complete Guide to Fire and Buildings (Lancaster, Eng.: Medical and Technical Publishing Co., Ltd., 1972), pp. v and vi.

[3]General Services Administration, International Conference on Fire Safety in High-Rise Buildings (Washington: Government Printing Office, 1971), pp. 2-4.

[4]Ibid.

TABLE III-1

BUILDING FIRE SAFETY KNOWLEDGE SUMMARY

| Cateogry | No. of Statements | Broad Category Title | Specific Subject Areas |
|---|---|---|---|
| I | 50 | Fire Problems in Selected Types of Buildings | Different type fire situations (high rise, single story industrial, shopping malls, high rack storage); Combustion Concepts |
| II | 55 | Basic Building Fire Problems | Methods of Structural Protection, Effects of Fire on Structures, Standard Fire Tests, Structural Fire Barriers |
| III | 50 | Building Fires & Electricity | Causes of Electrical Fires, Grounding and Static Electricity, Information from the Electrical Code |
| IV | 35 | Building Life Safety Concepts | Routes of Escape, Life Safety Principles |
| V | 48 | Fire Detection and Suppression | Ways of Extinguishing Fires, Fixed Suppression Systems, Detection Systems |
| VI | 35 | Building Codes & Standards | Reasons and Purposes of Codes and Standards, Heights and Areas |
| VII | 42 | Fire Hazards of Materials | Dusts & Metals, Flammable and Combustible Liquids, Gases, Solids |

decoding the references from which the material was selected may be found in Appendix B. The questionnaire recipients were requested to state whether the information in each statement was relevant to building design and construction and to render an opinion for each statement by stating whether the recipient agreed, tended to agree, was neutral, tended to disagree, or disagreed with each statement.

An original of the questionnaire was mailed to the headquarters of the American Institute of Architects, where sufficient copies were reproduced and mailed to each of the fifty members of the Codes and Standards Committee. Upon completion, the eighteen sets of responses were returned to the study planner for tabulation.

## II. BUILDING INDUSTRY FIRE SAFETY SURVEY

The answers on the Initial Questionnaire were tabulated, and the statements were reassembled into the broad categories indicated in Table III-1, page 34. Ten statements were chosen for each category except Category V, which required fifteen statements. The rationale for the extra five questions was that in the field of fire protection the specific areas of:

1. Ways of extinguishing fires,
2. Fixed suppression systems, and
3. Detection systems

were too important to omit. Selection in all categories was determined by dividing the number of Initial Questionnaire respondents stating that the question was relevant into the number stating the question was

nonrelevant. All 315 Initial Questionnaire statements were treated in this manner with the lowest scores in each category being selected for the new survey.

The seventy-five statement Building Industry Fire Survey was distributed to four organizations with the request that survey recipients in each organization state their beliefs as to (1) who in the building industry should possess the information expressed in the statement, and (2) which code—building or fire protection—should be concerned with the information expressed in the statements. The groups asked to assist in the survey were:

1. The American Institute of Architects' Codes and Standards Committee whose forty architect members come from throughout the United States. (Group response equaled 45 percent.)
2. Fire prevention education specialists of the National Fire Protection Association. (Group response was 84 percent.)
3. Professional fire fighters from Oak Ridge and other adjacent Tennessee communities. (It is to be noted that these twenty-five professional fire fighters were working without financial aid for an associate degree in fire science technology from Roane State Community College. Group response was 84 percent.)
4. An in-house engineering staff employed by a large nonferrous metal producer at offices in a number of locations throughout the United States. (Group response was 92 percent.)

A copy of the entire survey, including instructions for answering, may be found in Appendix C.

# III. STATISTICAL DESIGN

The method for fulfilling the purpose of this study was to solicit opinions from the aforementioned building design specialists (architects and engineers), professional fire fighters, and fire prevention education specialists. The question that automatically came to mind was, "Were there likely to be differences in the opinions of such a diverse group of judges?"

The questionnaire respondents were asked to render an opinion about material which was not quantitative in nature. It is difficult to measure an opinion quantitatively when data cannot be arranged in an orderly manner, therefore, nonparametric techniques were required to measure the degree of correlation between variables in a sample. Kendall's Coefficient of Concordance W was used to test Hypotheses A and C by measuring the degree of correlation between the opinions of the four groups of judges who assisted in this study.[5] This testing method was one of several significance tests that could be used for ranked data. Ranks were established by the study planner from the total number of responses received from a group of judges. Rank 1 was based on the largest number of responses, rank 2 on the second largest, rank 3 on the third largest, with the highest rank corresponding to the lowest number of responses.

The significance of W was tested by determining the probability associated with the occurrence of a judge's response under the null

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[5]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill, 1956), p. 239.

hypothesis.[6] The formula for calculating W was as follows:[7]

$$W = \frac{S}{1/12\ K^2\ (N^3 - N)}$$

where S = sum of squares of the observed deviations from the means of Rj, that is,

$$S = \Sigma\ (Rj - \frac{\Sigma Rj}{N});$$

Rj = sum of the ranks,

K = number of sets of rankings (number of judges),

N = number of responses ranked, and

$1/12\ K^2\ (N^3 - N)$ = maximum possible sum of the squared deviations.

The procedures for testing the significance of the judges' opinions regarding placement of information in a building code or a fire prevention code utilized the ranking methods for White's Rank-Order Test.[8] The test procedure was based upon the ordering of $n_1 + n_2 = n$ observations. A single distribution of n observations was made, and ranks from one to n were assigned to the observations with one representing the highest numerical observation. The two ranks (building and fire prevention codes) were designated $n_1$ and $n_2$ and each was equal to four (representing four groups of observations). The ranks were totaled (T). This calculated T value was used to test the significance at the 5 percent level by comparing it with the T value in White's Rank-Order Table.[9]

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[6]Ibid., p. 237.

[7]Ibid., p. 231.

[8]A. L. Edwards, Statistical Methods for the Behavioral Sciences (New York: Rinehart, 1957), pp. 417-420.

[9]Ibid., p. 340.

## IV. SUMMARY OF CHAPTER III

Perhaps the most difficult task in planning this study was the effort necessary to find willing questionnaire recipients to participate. Just as it takes a team to design and construct a building, so it took a team to design and complete the questionnaires used in this study. This chapter has presented a discussion of the steps required for preparation of the Initial Questionnaire, including the rationale for establishing the broad categories of fire protection. An explanation of the shotgun approach to statement selection was also included. The mechanics of questionnaire preparation were discussed, including an explanation of how the computer was used as an aid to keep track of the statement material.

The Building Industry Fire Safety Survey utilized the answers from the Initial Questionnaire. Here, as in the case of the Initial Questionnaire, the major problem was to find participants. If friends of the study planner had not volunteered and authorized the services of certain members of their organizations, the answers simply would not have been forthcoming.

The chapter included a discussion of the test used to measure the degree of correlation between the opinions of the four groups of judges. Two tests, the Kendall Coefficient of Concordance W and White's Rank-Order Test, were used to accept or reject the three null hypotheses postulated in Chapter I. The findings of the study and general impressions derived therefrom are presented in the next chapter.

# CHAPTER IV

## PRESENTATION AND DISCUSSION OF RESULTS

A summary of the Initial Questionnaire responses by category and by specific subjects is presented in this chapter to give an indication of the magnitude of response given to the Initial Questionnaire. Included is a discussion of the results of the statistical testing of architect, engineer, fire fighter, and fire prevention education specialist responses to the statements contained in the Building Industry Fire Safety Survey.

### I. SUMMARY OF INITIAL QUESTIONNAIRE RESPONSES

This questionnaire was distributed to the membership of the American Institute of Architects Codes and Standards Committee—a committee having a membership composed of forty architects and ten consultants living in thirty states and the District of Columbia. This committee was asked to render opinions regarding the validity of the questionnaire statements to building design including the degree of agreement or disagreement with a statement. The committee was not asked to give reasons for agreement or disagreement nor was it asked to give a reason why a statement might be relevant or nonrelevant. A summary of responses, classified by category and subject matter, is presented in Table IV-1. A full tabulation of all Initial Questionnaire responses for each statement is presented in Appendix D. Each question is grouped

TABLE IV-1

SUMMARY OF INITIAL QUESTIONNAIRE RESPONSES

| Category Number | Category and Subject Titles | | Response in Percent A | TTA | N | TTD | D | R | NR |
|---|---|---|---|---|---|---|---|---|---|
| I. | Fire Problems in Selected Types of Buildings | | | | | | | | |
| | 1. Different Type Fire Situations (High Rise, Single-story Industrial, Shopping Malls, High Rack Storage) | 25 Statements | 33.5 | 33.7 | 10.6 | 7.9 | 14.3 | 83.5 | 16.5 |
| | 2. Combustion Concepts | 25 Statements | 22.5 | 18.1 | 39.1 | 8.0 | 12.3 | 49.5 | 50.5 |
| II. | Basic Building Fire Problems | | | | | | | | |
| | 1. Methods of Structural Protection | 10 Statements | 22.4 | 17.2 | 29.3 | 9.8 | 21.3 | 86.8 | 13.2 |
| | 2. Effects of Fire on Structures | 25 Statements | 29.8 | 23.1 | 18.7 | 10.7 | 17.7 | 78.0 | 22.0 |
| | 3. Structural Fire Barriers | 15 Statements | 25.5 | 21.0 | 12.0 | 11.2 | 30.3 | 89.6 | 10.4 |
| III. | Fire and Electricity | | | | | | | | |
| | 1. Causes of Electrical Fires | 20 Statements | 24.1 | 18.8 | 30.8 | 6.7 | 19.6 | 63.9 | 36.1 |
| | 2. Grounding and Static Electricity | 15 Statements | 32.7 | 23.5 | 13.0 | 7.3 | 23.5 | 70.7 | 29.3 |
| | 3. Information from National Electrical Code | 15 Statements | 11.9 | 14.6 | 51.9 | 6.2 | 15.4 | 65.1 | 34.9 |

TABLE IV-1 (continued)

| Category Number | Category and Subject Titles | | Response in Percent A | TTA | N | TTD | D | R | NR |
|---|---|---|---|---|---|---|---|---|---|
| IV. | Building Life Safety Concepts | | | | | | | | |
| | 1. Routes of Escape | 15 Statements | 30.7 | 27.3 | 15.4 | 10.9 | 15.7 | 89.4 | 10.6 |
| | 2. Life Safety Principles | 20 Statements | 38.6 | 28.7 | 11.0 | 6.5 | 15.2 | 82.4 | 17.6 |
| V. | Fire Detection and Suppression | | | | | | | | |
| | 1. Ways of Extinguishing Fires | 10 Statements | 24.4 | 17.1 | 38.1 | 18.5 | 11.9 | 67.2 | 32.8 |
| | 2. Fixed Suppression Systems | 23 Statements | 30.0 | 20.1 | 23.1 | 6.7 | 20.1 | 82.6 | 17.4 |
| | 3. Detection Systems | 15 Statements | 31.0 | 20.3 | 26.2 | 8.1 | 14.4 | 70.1 | 29.9 |
| VI. | Building Codes and Standards | | | | | | | | |
| | 1. Standard Fire Tests | 5 Statements | 34.5 | 36.8 | 12.6 | 4.6 | 11.5 | 88.4 | 11.6 |
| | 2. Heights and Areas | 12 Statements | 32.2 | 29.9 | 13.3 | 5.7 | 18.9 | 80.8 | 19.2 |
| | 3. Reasons and Purposes of Codes and Standards | 25 Statements | 36.9 | 29.6 | 17.1 | 5.9 | 10.5 | 75.0 | 25.0 |
| VII. | Fire Hazards of Materials | | | | | | | | |
| | 1. Dusts and Metals | 10 Statements | 40.9 | 26.9 | 13.5 | 6.4 | 12.3 | 65.2 | 34.8 |
| | 2. Flammable and Combustible Liquids | 14 Statements | 27.3 | 18.8 | 26.5 | 7.8 | 19.6 | 57.0 | 43.0 |

TABLE IV-1 (continued)

| Category Number | Category and Subject Titles | | Response in Percent A | TTA | N | TTD | D | R | NR |
|---|---|---|---|---|---|---|---|---|---|
| VII. | Fire Hazards of Materials (continued) | | | | | | | | |
| | 3. Gases | 5 Statements | 16.3 | 4.7 | 45.3 | 9.3 | 24.4 | 43.3 | 56.7 |
| | 4. Solids | 11 Statements | 33.7 | 22.8 | 25.4 | 7.8 | 10.3 | 43.7 | 56.3 |

Response Legend: A = Agree
TTA = Tend to Agree
N = Neutral, No Opinion, Do Not Know
TTD = Tend to Disagree
D = Disagree
R = Relevant to Building Design
NR = Not Relevant to Building Design

according to category and specific subject area to aid the reader in cross-referencing to the Initial Questionnaire. Table IV-1 and Appendix C will give the reader an indication of the broad shotgun approach used for the Initial Questionnaire which was explained in Chapter III. While no specific statistical design was initially planned to test the answers received for the initial questionnaire, a Chi Square Index Number was computed to rule out the possibility that the answers were the result of chance. The responses were classified according to the broad fire safety categories and relevance to building design in Table IV-2. The computed chi square number of 122.7 was compared with the tabled value where it was found that the probability of receiving a response by chance was greater than 0.001 chances out of 100.[1]

## II. WHO SHOULD KNOW THE INFORMATION CONTAINED IN THE BUILDING INDUSTRY FIRE SAFETY SURVEY STATEMENTS?

In Chapter I, it was assumed that five groups of people have responsibility for the fire-safe design and construction of buildings. These groups were the building design team (architect and/or engineer), the construction contractor, the building official, the fire prevention specialist, and the building trades vocational education instructor. A major question that arose was—Which of these groups should have the

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[1]Sidney Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill, 1956), p. 249.

TABLE IV-2

INITIAL QUESTIONNAIRE RESPONSES CLASSIFIED ACCORDING TO FIRE SAFETY CATEGORIES AND RELEVANCY TO BUILDING DESIGN

| Relevancy to Building Design | Fire Safety Information Categories | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | Total |
| Yes | 465 | 586 | 453 | 436 | 498 | 408 | 297 | 3143 |
| No | 226 | 118 | 230 | 75 | 160 | 122 | 155 | 1086 |
| Total | 691 | 704 | 683 | 511 | 658 | 530 | 452 | 4229 |
| | Expected Numbers, F | | | | | | | |
| Yes | 513.6 | 523.2 | 507.6 | 379.8 | 489 | 393.9 | 335.9 | 3143 |
| No | 177.4 | 180.8 | 175.4 | 131.2 | 169 | 136.1 | 116.1 | 1086 |
| Total | 691.0 | 704.0 | 683.0 | 511.0 | 658 | 530.0 | 452.0 | 4229 |
| | Deviations (f-F) | | | | | | | |
| Yes | -48.6 | +62.8 | -54.6 | +56.2 | +9 | +14.1 | -38.9 | 0.0 |
| No | +48.6 | -62.8 | +54.6 | -56.2 | -9 | -14.1 | +38.9 | 0.0 |

Chi Square $(\chi^2) = \Sigma(f-F)^2/F = 122.7$

Degrees of Freedom (df) = (R - 1)(C-1) = (1)(6) = 6

Tabled Chi Square Value = $(\chi^2)$ .001 = 22.46

information contained in each survey statement? Secondly, did the judges rendering an opinion about "who should know what" hold the same fire safety viewpoint? To test the second question, a hypothesis was postulated using the hypothesis of no differences—the null hypothesis.

In Null Hypothesis A it was stated that: There were no differences of opinion among the four groups of judges concerning which of the five segments of the building industry should have the information contained in the survey statements.

The alternative or research hypothesis was that there were differences of opinion among the judges.

Null Hypothesis A was tested by assigning numerical ranks to the groups responsible for fire-safe building based on the responses received from the four groups of judges. A coefficient of concordance W, utilizing the procedures devised by Kendall and discussed in Chapter III, was calculated. Table IV-3 summarizes the rankings and the results of the calculation. Comparison of the calculated value (S), the sums of the squares of the observed deviations Rj, with the "Table of Critical Values of S in the Kendall Coefficient of Concordance"[2] revealed that the calculated number 88 was slightly less than the table number of 88.4 at a 0.05 level of significance. Since the observed S value of 88 was less than the table value at the 0.05 level of significance, the null hypothesis was accepted.

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[2]Ibid., p. 286.

TABLE IV-3

RANKS ASSIGNED TO GROUPS RESPONSIBLE FOR FIRE SAFE BUILDINGS BASED ON RESPONSES FROM FOUR GROUPS OF JUDGES

| Judging Group | Design Team | Construction Contractor | Building Official | Fire Prevention Specialist | Vocational Education Specialist |
|---|---|---|---|---|---|
| Architect | 3 | 2 | 1 | 4 | 5 |
| Engineer | 1 | 5 | 3 | 2 | 4 |
| Firefighter | 2 | 4 | 3 | 1 | 5 |
| Fire Prevention Ed. Specialist | 2 | 5 | 3 | 1 | 4 |
| Rj | 8 | 16 | 10 | 8 | 18 |
| $Rj - \frac{\Sigma Rj}{N}$ | -4 | 4 | -2 | -4 | 6 |
| $(Rj - \frac{\Sigma Rj}{N})^2$ | 16 | 16 | 4 | 16 | 36 |

$$W = \frac{S}{1/12\ K^2\ (N^3 - N)} = \frac{88}{1/12\ (4)^2\ [(5)^3 - 5]} = \frac{88}{160} = 0.55$$

Tabled coefficient of concordance values = S.05 = 88.4.

The resulting conclusion from the acceptance of the null hypothesis was that there were no differences of opinion among the judges concerning who should know the information contained in the statements. Two things, however, left this open to debate:

1. The W value of 0.55 revealed a moderate degree of correlation[3] which made it apparent that some of the judges were not applying the same criteria judgments to their responses.
2. This view can be substantiated by a comparison of the ranks shown in Table IV-3. The fire fighter and fire protection educational specialist groups had matched rankings in three out of the five areas, while within architect and engineer groups, there were no matched rankings, though there were several areas of agreement with the fire-oriented groups.

The views expressed in 1 and 2 above were substantiated by calculation of a Pearson Rank Coefficient[4] (r') comparing the architects and engineers and the fire-oriented groups. The former had an r' of -0.1 or no correlation while the latter had an r' of 0.983 or almost perfect correlation.

## III. WHICH CODE—BUILDING OR FIRE PREVENTION—SHOULD CONTAIN THE INFORMATION IN THE SURVEY STATEMENT?

The Building Industry Fire Safety Survey afforded a unique opportunity to find out how some members of the building industry

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[3]A. N. Franzblau, A Primer of Statistics for Nonstatisticians (New York: Harcourt, Brace, 1958), p. 81.

[4]A. L. Edwards, Statistical Methods for the Behavioral Sciences (New York: Rinehart, 1957), p. 195.

perceived a building and a fire prevention code. This matter should be of increasing concern to the building industry as the Fire Prevention and Control Act of 1974 is implemented by the National Fire Prevention and Control Administration in the areas of local and state building and fire prevention codes.

As was the case of who should know the fire safety information, did the judges rendering an opinion about building and fire prevention codes hold similar viewpoints? Again, a null hypothesis was postulated.

In Null Hypothesis B it was stated that: There were no differences of opinion among the four groups of judges concerning which survey statement belonged in a building code and which belonged in a fire prevention code. The alternative or research hypothesis was that there would be differences of opinion among the groups doing the judging.

Numerical ranks were assigned to the building code and fire prevention code that were based on the responses received from the four groups of judges. From these rankings a White Rank-Order Test T value was calculated. Refer to Chapter III for a discussion of this test.

Comparison of the calculated T value with the T value in White's Rank-Order Table[5] at the 5 percent level revealed that the calculated value of T was greater than the table value. This fact resulted in the acceptance of Null Hypothesis B. The resulting conclusion from the

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[5]Ibid., p. 515.

acceptance of the null hypothesis was that there were no differences of opinion among the judges.

As in the case of Null Hypothesis A, where study of Table IV-3 revealed a pattern of differences, a study of Table IV-4 will also reveal a pattern of differences.

1. The architects and fire prevention education specialist groups showed a strong preference for the building code (69 percent and 59 percent respectively) over the fire prevention code.
2. However, the engineer and fire fighter groups were almost equal (51 percent to 49 percent) in their preference for a code.

## IV. WAS THERE AN ORDER OF IMPORTANCE FOR THE SEVEN BROAD CATEGORIES OF FIRE SAFETY INFORMATION?

Chapter III contains a discussion of the seven broad categories of fire safety knowledge, the twenty specific subject areas and a rationale for the selection of the material used in both the Initial Questionnaire and in the Building Industry Fire Safety Survey. Table III-1, page 34, contains a summary of the material. These categories of information could be used as the foundation for a fire safety data base. To be useful it would be desirable to determine an order of preference. Therefore, it was of interest to the study planner to determine whether the judges by their responses indicated any order of preference.

Again, as in the case of the groups who need to know, and the building code versus the fire prevention code discussions, did the

TABLE IV-4

BUILDING CODE AND FIRE PREVENTION CODE PREFERENCES SUMMARIZED FROM RESPONSES TO BUILDING INDUSTRY FIRE SAFETY SURVEY

| Respondent Group | Code | Response in % | Ranks | Building Code Ranks $n_1$=4 | Fire Prevention Code Ranks $n_1$=4 |
|---|---|---|---|---|---|
| Architect | Building | 69 | 1 | 1 | |
| Fire Prevention Education Specialist | Building | 59 | 2 | 2 | |
| Engineer | Fire Prevention | 51 | 3.5 | | 3.5 |
| Fire Fighter | Fire Prevention | 51 | 3.5 | | 3.5 |
| Engineer | Building | 49 | 5.5 | 5.5 | |
| Fire Fighter | Building | 49 | 5.5 | 5.5 | |
| Fire Prevention Education Specialist | Fire Prevention | 41 | 7 | | 7 |
| Architect | Fire Prevention | 31 | 8 | | 8 |
| $\Sigma T$ | | | | 14 | 22 |

Tabled rank-order value = T.005 = 10.

judges hold the same fire safety viewpoints? This reservation resulted in Null Hypothesis C where it was stated that: There were no differences of opinion among the four groups of judges concerning which of the seven broad categories took precedence over the others.

Null Hypothesis C was tested by assigning numerical ranks to the information categories based on the responses received from the four groups of judges. A coefficient of concordance W was calculated. Comparison of the calculated value S with the "Table of Critical Values of S in the Kendall Coefficient of Concordance" revealed that the calculated number 160 was considerably less than the table number of 217 at the 0.05 level of significance. Since the calculated value was less than the table value the null hypothesis was accepted.

The resulting conclusion from the acceptance of the null hypothesis was that there were no differences of opinion among the judges concerning whether there was an order of preference for the seven broad categories of information. Further the W value of 0.357 indicated a low degree of correlation.[5] However a study of Table IV-5 reveals only three areas of agreement.

| | | |
|---|---|---|
| Category I | Engineers = 6 | NFPA = 6 |
| Category II | Architects = 1 | NFPA = 1 |
| Category II | Engineers = 2 | Fire fighters = 2 |

In no other category will one find an area of agreement. It was therefore difficult to understand why the Kendall Coefficient indicated

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[5]Franzblau, p. 81.

TABLE IV-5

RANKS ASSIGNED CATEGORIES OF FIRE SAFETY INFORMATION BASED ON THE RESPONSES OF FOUR GROUPS OF JUDGES

| Judging Group | Information Categories | | | | | | |
|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII |
| Architect | 2 | 1 | 6 | 5 | 3 | 4 | 7 |
| Engineer | 6 | 2 | 3 | 7 | 4 | 5 | 1 |
| Fire Fighter | 7 | 2 | 5 | 1 | 6 | 3 | 4 |
| Fire Protection Education Specialist | 6 | 1 | 7 | 4 | 5 | 2 | 3 |
| Rj | 21 | 6 | 21 | 17 | 18 | 14 | 15 |
| $Rj = \frac{\Sigma Rj}{N}$ | 5 | -10 | 5 | 1 | 2 | -2 | -1 |
| $(Rj = \frac{\Sigma Rj}{N})^2$ | 25 | 100 | 25 | 1 | 4 | 4 | 1 |

$$W = \frac{S}{1/12\ (K^2)(N^3 - N)} = \frac{160}{1/12\ (4^2)\left[(7)^3 - 7\right]} = \frac{160}{448} = 0.357$$

Tabled coefficient of concordance value = S.05 = 217.

acceptance of the null hypothesis until a comparison was made between the responses of the architects and engineers and between the fire fighters and the fire protection education groups. There was a noticable difference between the rankings of the architect and engineer groups while there was a slight difference between the fire-oriented groups. When a Pearson Rank coefficient (r') was calculated the results were as follows:

1. Architect and engineer groups. $r' = -0.21$
2. Fire oriented groups. $r' = +0.68$

Therefore, the fire-oriented groups showed a marked degree of correlation while the design-oriented groups showed no correlation. The conclusion was that the high degree of agreement among the fire-oriented groups was compensating for the negligible agreement among the other groups to the point that the other statistical test could lead one to accept the null hypothesis.

# CHAPTER V

# SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## I. SUMMARY

The presentation by the National Commission on Fire Prevention and Control of the fire problem and consequences for this country in terms of human suffering and economic loss prompted this study. The literature search presented in Chapter II confirmed a number of the ideas presented in America Burning—The Report of the National Commission on Fire Prevention and Control regarding the lack of training received by those persons responsible for the design and construction of reasonably fire-safe buildings. Chapter III presented an after-the-fact explanation of the thoughts underlying the selection and grouping of statement items for both the Initial Questionnaire and the Building Industry Fire Safety Survey.

Chapter IV presented the results of the statistical tests which indicated that all three null hypotheses should be accepted. This acceptance of all three hypotheses could lead one to the conclusion that the judges had no differences of opinion, which was hard to believe, especially when approximately 180 people participated in both the Initial Questionnaire and Building Industry Fire Safety Survey. It was only after rank coefficients were calculated that it was found that the fire oriented groups, the professional fire fighters and the National Fire Protection Association fire prevention education specialists, were

seemingly of a common viewpoint. Correlation calculations concerning the views held by the architect and engineer groups indicated an almost total lack of consensus.

## II. CONCLUSIONS

Difficulty was encountered in formulating positive conclusions based on the results of this study. To establish a proper perspective, a reiteration of the purpose of the study was required. The purpose 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 (architects/engineers), construction contractors, building officials, fire prevention specialists, and building trade vocational education instructors.

This statement of purpose was predicated on the assumption that it requires a team of experts to design and construct a fire-safe building (for that matter, any type of building) and that this team is composed of the groups indicated in the purpose statement. To assist in establishing criteria, several segments of the aforementioned team responded to numerous statements. Those who responded from the four groups had divergent opinions regarding what was important in the design and construction of buildings. This divergency resulted in the following conclusions:

1. The fire protection oriented groups, the professional fire fighter and the National Fire Protection Association's fire

protection education specialists had more shared views than were found between the architect and the engineer groups. In other words, the fire-oriented groups were getting their message across to each other.

2. If the survey had been answered by a group of engineers engaged in private practice rather than by a group engaged in the design and construction of industrial occupancies, perhaps there might have been more of a similarity of views between the architects and engineers than was found. The engineers of an in-house staff, with safety being paramount, design for process considerations with the building structure being secondary. Architects and consulting engineers, with safety being paramount, design a building for a client's intended use.
3. The fire safety information compilation contained in Appendix B and Appendix C may represent the first collected and documented list of statements regarding fire safety as related to building design and construction. Even though no attempt was made to determine whether the information contained in a statement was fact, theory, opinion, or fiction, when a statement sounded plausible it was placed in the collection. A group of building design and construction experts attested to the fact that the information was somehow related to building design and four independent groups of judges rendered opinions as to who they believed should have the information, which codes should govern, and which information took precedence over the other.

4. A primary contribution of the study was the proof that the design team segments and the fire protection oriented segments of the building industry were willing to devote time (which means money) to an attempt that might mitigate the nation's fire losses.

## III. RECOMMENDATIONS

This study has located some "where's," "what's," and "who's" about buildings and fires. It is hoped that the building industry will suggest that the various technical societies, schools, and colleges expand upon this limited data base by finding out something about the "why's" and "how's" of building fire safety and "when" the information should be used.

Specifically, it is recommended that the University of Tennessee College of Engineering, School of Architecture, Division of Continuing Education, and Safety Center jointly consider the development of curriculum and courses for:

1. A degree in fire protection and safety engineering.
2. Fire protection courses for the various engineering disciplines and for the architect.
3. Continuing fire safety education courses for the architectural and engineering practitioners (designer and contractor) and building officials.

# SELECTED BIBLIOGRAPHY

## SELECTED BIBLIOGRAPHY


Bahme, C. W. Fire Officers Guide to Extinguishing Systems. Boston: National Fire Protection Association, 1970.

Blake, R. P. (ed.). Industrial Safety. New York: Prentice-Hall, 1946.

Bond, Horatio. "Fire Lesson: Design Management," SFPE Bulletin, LXXV, No. 1, (January, 1975), 1-6.

Brannigan, F. L. Building Construction for the Fire Service. Boston: National Fire Protection Association, 1971.

Bryan, John L. Fire Suppression and Detection Systems. Beverly Hills: Glencoe Press, 1974.

Building Code Committee. "Proposed Code Changes for 1974," Southern Building (July, 1974), 1-76.

Building Codes—Their Scope and Aims. New York: Engineering and Safety Department, American Insurance Association, 1969.

Bureau of National Affairs. "Consumer Product Safety Act," United States Law Week, XLI, No. 16 (October 31, 1972), 41LW57-41LW65.

Copper Life Safety Fire Sprinkler System Handbook. New York: Copper Development Association, 1974.

DeReamer, Russell. Modern Safety Practices. New York: John Wiley, 1958.

Edwards, A. L. Statistical Methods for the Behavioral Sciences. New York: Rinehart, 1957.

Edwards, Tryon. The New Dictionary of Thoughts. New York: Standard Book Company, 1964.

Favreau, Donald F. Fire Service Education 1971: A Survey and Historical Developments of Fire Service Education in the United States. Albany, N.Y.: International Fire Administration Institute, 1971.

Favreau, Donald F. Guidelines for Fire Service Education Programs in Community and Junior Colleges. Washington: American Association of Junior Colleges, 1969.

Fire Prevention Code. New York: Engineering and Safety Department, American Insurance Association, 1965.

Fire Prevention Education. New York: Committee for Fire Prevention Education, New York University Center for Safety Education, 1942.

Fire Protection through Modern Building Codes—Fourth Edition. New York: American Iron and Steel Institute, 1971.

Fletcher, J. A. "Total Environmental Control," Risk Management (October, 1971), 9-15.

Fletcher, J. A. "Total Loss Control," ASSE Journal, XIX, No. 1 (January, 1974), 16-20.

Florio, A. E., and G. T. Stafford. Safety Education. New York: McGraw-Hill, 1969.

Florio, Aurelio E. "Safety Education," Encyclopedia of Education, 1971, VIII, 1-6.

Franzblau, A. N. A Primer of Statistics for Nonstatisticians. New York: Harcourt Brace, 1958.

General Services Administration. Appendix D Interim Guide for Goal Oriented Systems Approach to Building Fire Safety. Washington: Government Printing Office, April, 1972.

General Services Administration. International Conference on Fire Safety in High-Rise Buildings. Washington: Government Printing Office, 1971.

Haessler, W. M. The Extinguishment of Fire. Boston: National Fire Protection Association, 1974.

Handbook of Industrial Loss Prevention. New York: McGraw-Hill, 1967.

Heinrich, H. W. Industrial Accident Prevention—A Scientific Approach. New York: McGraw-Hill, 1931.

Howe, Warner H., P.E. Gardner and Howe, Memphis, Tennessee. Personal correspondence, March 1974.

Jensen, Rolf. "Educational Programs in Fire Protection Engineering," Fire Technology, XII, No. 2 (May, 1971), 170-174.

Johnson, W. G. The Management Oversight and Risk Tree-Mort. Washington: Government Printing Office, 1973.

Kimball, Warren Y. "The Trend in Higher Education for the Fire Service," Fireman, XXXVI, No. 12 (December, 1969), 35-41.

Krasner, L. M. "The Feasibility of Quantitatively Analyzing Investments in Loss Prevention Activities." Paper read at the American Institute of Chemical Engineers Meeting, November, 1973.

Life Safety Code. Boston: Committee on Safety to Life, National Fire Protection Association, NFPA 101, 1973.

Loss Prevention Engineering. Norwood, Mass.: Factory Mutual System, Factory Mutual Engineering Corp., 1974.

Marchant, Eric W. (ed.). A Complete Guide to Fire and Buildings. Lancaster, Eng.: Medical and Technical Publishing Company, Ltd., 1972.

McCormick, John W. Assistant Professor in Fire Science Technology, Roane State Community College. Personal interview, January 20, 1975.

McKoig, T. H. Building Failures. New York: McGraw Hill, 1962.

National Commission on Fire Prevention and Control. America Burning—The Report of the National Commission on Fire Prevention and Control. Washington: Government Printing Office, 1973.

National Electrical Code. Boston: Electrical Code Committee, National Fire Protection Association, NFPA 70, 1971.

National Safety Council. Accident Facts—1973 Edition. Chicago: National Safety Council, July, 1973.

Patton, Richard M. "Systems Protection and Building Codes," Southern Building (December, 1973), 16-17.

Phillips, Anne W. How Safe Are You? Boston: The Smoke, Fire and Burn Foundation, 1974.

Proposed Fire Prevention Code. Boston: Fire Prevention Code Committee, National Fire Protection Association, April, 1974.

Riopelle, J. H. "Report of the Committee on Fire Prevention Code," Technical Committee Reports. Boston: National Fire Protection Association, 1974.

Rosenthal, M. "A Response: Reducing Fire Damage Via Building Codes." Southern Building (December, 1973), 18-19.

A Study of the Fire Problem in Residential High-Rise Buildings. Northfield, Ill.: Rolf Jensen Associates, February 25, 1972.

Shirmer, C. W. "High Rise Fire Protection—Hysteria or Common Sense?" ASSE Journal, XIX, No. 8 (August, 1974), 39-42.

Siegel, Sidney. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw Hill, 1956.

Southern Standard Building Code. Birmingham: Southern Building Code Congress, 1969.

Stack, H. J., and J. D. Elkow. Education for Safe Living. 4th ed. Englewood Cliffs, N.J.: Prentice Hall, 1966.

Strasser, M. K., J. E. Aaron, R. C. Bohn, and J. R. Eales. Fundamentals of Safety Education. 2d ed. New York: Macmillan, 1973.

Suarez, R. J. "A Study of the Planning and Scheduling by the Critical Path Method of the Bull Run Steam Plant." Unpublished Master's thesis, University of Tennessee, 1963.

Taylor, Daniel M. "Part I: Importance, Function of Building, and Housing Codes Established," Southern Building (August, 1973), 6-9.

Tennessee State Board of Architectural and Engineering Examiners. 1970 Roster. Nashville: Tennessee State Board, January, 1970.

Tryon, G. H. NFPA Inspection Manual. Boston: National Fire Protection Association, 1970.

Tryon, G. H., and G. P. McKinnon (eds.). Fire Protection Handbook. 13th ed. Boston: National Fire Protection Association, 1969.

Uniform Building Code. Whittier, Cal.: International Conference of Building Officials, 1973.

U.S. Congress. House. Committee of Conference. Federal Fire Prevention and Control Act of 1974. Conference Report, 93d Cong., 2d Sess., House Report 93-1413. Washington: Government Printing Office, 1974.

U.S. Congress. House. Committee on Science and Astronautics, Subcommittee on Science, Research and Development. Fire Prevention and Control. Hearing, 93d Cong., 1st Sess., July 25, 26, 31; August 1-2, 1973. Washington: Government Printing Office, 1973.

University of Tennessee. 1974/1975 General Catalog, University of Tennessee Record, LXXVII, No. 1 (January, 1974).

What Has Happened Can Happen. Norwood, Mass.: Factory Mutual System, Factory Mutual Engineering Corp., 1974.

Wiggins, Gary. Southern Standard Fire Prevention Code. Birmingham: Southern Building Code Congress, 1974.

# APPENDICES

# APPENDIX A

## AMERICAN INSTITUTE OF ARCHITECTS LETTER

This appendix contains a copy of a letter that gave the encouragement necessary to begin and complete this project.

THE AMERICAN INSTITUTE OF ARCHITECTS

June 27, 1974

Mr. James T. Blackmon, Jr.
Oak Ridge, TN

Dear Mr. Blackmon:

About your proposed master's thesis . . .

I am most interested in your development of a questionnaire of architect/engineer knowledge of fire protection. I wish you well and hope that I may be of assistance. The results of your work should be of great benefit to design professionals, and to the AIA's investigation of the fire-related educational needs of architects and those seeking to become architects.

Since I feel I would not be of much help to you if I avoided making criticism, let me get on with my "assistance."

Provided your initial questionnaire is a real "shotgun" which covers all areas of fire safety knowledge or opinion the following situation can be expected. (If the initial questionnaire is not broad enough and of sufficient coverage of the field, of course, "you blew it.") In response to the questions, the general public will show either consensus or indifference. Experts will have a different response profile. Where the experts internally agree and the sample of the general public internally shows disagreement, there will be a clear indication of public education needs. Where the groups of experts and public both internally agree then current education is probably sufficient. Where experts internally agree to something, and the public internally agrees to the opposite, the situation bears looking into before the "experts" are believed. Obviously something is a awry. When the public shows consensus on an answer and the experts do not, you have pinpointed a controversy among the experts and have not spotted an area where the public can sensibly receive worth while education.

The same sort of situation will exist with the various sorts of engineers and the architects which you chose to study. The forced choice questionnaire properly utilized will be most useful in pointing out "who knows what."

Separation of the results from different types of engineers and architects for analytical purposes will be most important I believe.

One potential problem I see is that you may inadvertently attempt to develop only one "spectrum" or "yard stick." I think several yardsticks of fire related knowledge may be necessary. It seems likely, for example, that a structural engineer needs to know certain basics of fire, a mechanical engineer on the other hand may need a different knowledge base. One presumes that the structural man needs to know protection of structural members very well. The mechanical engineer becomes much more concerned with electrical and fluid-dynamic matters. The extent of shared basic knowledge may not be, and may not need to be significant. I really do not know. The same situation will exist with other engineers, architects, code officials, fire fighters, etc. That the knowledge needed by each of these groups is in fact a subset of the knowledge base of the fire protection engineer is at this point only a presumption and should not be an operational assumption.

I guess that in part I am saying that it may not really be important to the design of a building if the design professional would do something counter-productive if he had a grease fire in his kitchen at home. It matters only that his part of design is cognizant of fire and life safety.

This brings up my first reservation—one with which it is evident you are well aware already. Without yet having seen your initial questionnaire, I fear that it may not be a broad enough "shotgun blast," that your experience as a fire protection engineer may bias the range of questions asked. There is, I believe, a strong possibility that architects and other types of engineers may hold knowledge which is not held by fire protection engineers. This should be querried. To see if this is so, and to prevent a possibly one sided questionnaire (with resultant criticism) I suggest that you encourage architects, engineers and perhaps others to broaden your question range.

My second reservation involves the analysis of the results of your study. Should all go well, your study will point out the strong and weak points in the current knowledge of various sorts of design professionals. Taken alone, however, the study can not be used as the sole source for recommendation on corrective educational programs. You will not, for example, be able to decide from the questionnaire whether or not some sort of knowledge is useful to, or necessary for the design professional, and hence should be included in some sort of curriculum. Also, the questionnaire results probably will not adequately define future educational needs which depend on advances in research and changes in design, construction, and materials.

My reservation is easily dealt with however, if you go into some detail in your thesis to describe the limitations of the questionnaire, and give proper guidance on how it may be applied to the development of fire and life safety educational programs.

Now with the criticism out of my system . . .

Your project effort looks well conceived and looks like it can be successfully accomplished and I would like to help you in any way that I can. Because you have expressed interest in using members of the AIA Codes and Standards Committee as subjects for your questionnaire, and because your work relates closely with the work of the AIA Fire Safety Task Group I am sending a copy of this letter and a copy of the partial draft of your thesis to Jasper Hawkins, Chairman AIA Codes and Standards Committee, and to Peyton Kirven, Chairman of the Fire Safety Task Group so that they may become aware of your work.

Keep up the good work and let me know if I can help.

Truly yours,

/s/ Thomas V. Tiedeman

Thomas V. Tiedeman, Assistant Director
Codes and Regulations Center

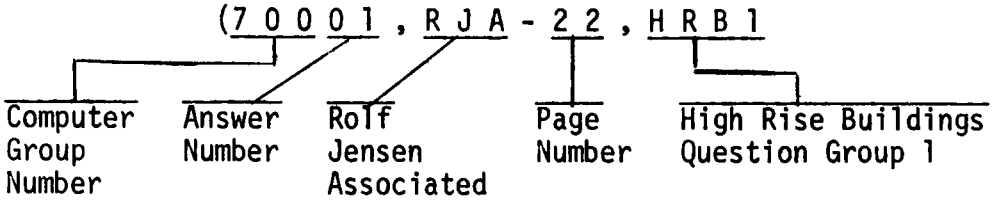
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# APPENDIX B

## COMPLETE INITIAL QUESTIONNAIRE

This appendix contains the transmittal letter, instructions, and the questionnaire which were submitted to the Codes and Standards Committee of the American Institute of Architects.

Each question was paraphrased from published literature and coded in the answer section of each question. The code may be read as follows: (Computer Code Number, Reference Citation and Page Number, Question Category). An example of the Code can be found in Question 1.




A Source Material Decoding Key to all statements in the initial questionnaire may be found in Table B-1.

TABLE B-1

SOURCE MATERIAL DECODING KEY

| Code Initials | Person, Organization, and/or Publication[a] |
|---|---|
| AF | National Safety Council's Accident Facts. |
| AISI | AISI's Fire Protection Through Modern Building Codes. |
| ASSE | ASSE's Journal, Vol. 19, No. 8, 8/74, pp. 39-42. |
| B | Bryan's Fire Suppression and Detection Systems. |
| BL | Blackmon's Unpublished Fire Protection Notions. |
| BR | Brannigan's Building Construction for the Fire Serivce. |
| CLSS | Copper Development Associations Copper Life Safety. |
| CT | National Fire Protection Association's Cooling Tower Standard No. 214. |
| CWB | Bahme's Fire Officer's Guide to Extinguishing Systems. |
| DG | General Services Administration's Interim Guide for Goal Oriented Systems Approach to Building Fire Safety. |
| FMLPD | Factory Mutual System's Loss Prevention Data. |
| FMLPE | Factory Mutual System's Loss Prevention Engineering. |
| FPHB | National Fire Protection Association's Fire Protection Handbook. |
| H | Haessler's The Extinguishment of Fire. |
| HEIN | Henrich's Industrial Accident Prevention. |
| HILP | Factory Mutual System's Handbook of Industrial Loss Prevention. |
| M | Marchant's A Complete Guide to Fire and Buildings. |
| MORT | Johnson's Management Oversight and Risk Tree. |

TABLE B-1 (continued)

| Code Initials | Person, Organization, and/or Publication |
|---|---|
| NCFPC | National Commission on Fire Prevention and Control's America Burning. |
| NEC | National Fire Protection Association's National Electric Code (NFPA 70). |
| NFPAFPC | National Fire Protection Association's Proposed Fire Prevention Code. |
| NFPAIM | National Fire Protection Association's Inspection Manual. |
| PBS | Ault & Bond's Automatic Sprinkler Systems for High Rise Buildings. |
| PHIL | Anne Phillip's How Safe Are You? |
| RJA | Rolf Jensen Associates' |
| SBJJ | Southern Building Code's Proposed Code Changes for 1974. |
| SSBC | Southern Standard Building Code. |
| THM | McKoig's Building Failures. |
| UB | Uniform Building Code. |
| WH | Unpublished Correspondence between W. H. Howe and J. T. Blackmon. |

[a]All persons, organizations, and publications are contained in the bibliography.

Oak Ridge, Tennessee
August 21, 1974

Mr. J. S. Hawkins, Chairman
Codes & Standards Committee
The American Institute of Architects
Washington, D.C. 20006

Dear Mr. Hawkins:

The members of the AIA Codes and Standards Committee are being requested to answer the attached questionnaire because of the Committee's broad expertise in building design, code administration, and fire protection. This particular questionnaire is designed to obtain a measured opinion of what knowledgeable individuals presently involved with building design, think architects and engineers should know about fire problems associated with buildings and building fires. The information provided by this Committee's answers to these questions will be used to develop a second questionnaire for use in determining what other building designers actually know about the subject. The results of this study could be used as a resource by the AIA Task Group on Fire and Life Safety and/or the Society of Fire Protection Engineers in their quest to improve the fire safety education of building design professionals, as recommended by the National Commission on Fire Prevention and Control.[1]

The questions contained in the attached questionnaire were composed from material contained in textbooks, handbooks, building codes, fire protection standards, technical magazine articles, and some personal correspondence and conversations with several nationally recognized building designers and fire protection engineers. The applicability of these questions to the end purpose is my own opinion, based on 22 years experience in an in-house engineering organization (with my own specialty being fire protection and industrial furnace safety) and prior inspection experience with a leading Fire Insurance Company.

As a further explanation for this questionnaire, it is Part I of a University of Tennessee graduate project leading to an M.S. degree in Safety Education.

The motivation for this thesis came from the National Commission Report, "America Burning," Though an excellent report, certain charges directed

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[1]National Commission on Fire Prevention and Control, America Burning—The Report of the National Commission on Fire Prevention and Control (Washington: Government Printing Office, 1973).

at building designers did not appear to me to be completely justified, such as:

a. Building designers are not trained well enough to understand technical reports in fire safety design.

b. Designers give minimal and unenthusiastic attention to fire safety in the buildings they design.

c. Safety for most designers is nothing more than a necessary evil for compliance with local codes.

Though these charges may be true, I feel that the report did not present sufficient evidence. It is my belief that designers do know a great deal about the subject, though to date I am not clear on the specifics. Seemingly, very few schools have formal courses in fire protection, therefore, the primary goal of this study will be an attempt to define the boundaries of fire safety knowledge required of building designers so that eventually some group can establish criteria for guiding us toward the improvement of fire safety in the structures we design.

Part II of the study will be a more refined and much shorter questionnaire based on the results obtained from the questionnaire you are being asked to complete at this time.

My present plan is to resubmit the second questionnaire to you during the second week of October. Your answers will be the basis for scoring a random sampling of some other groups of architects and engineers. (Any suggestions you may have on further sampling will be appreciated.) It is my intention to have the sample population answering the second questionnaire at the same time that the AIA Codes & Standards Committee is answering it. If the second questionnaire can be distributed and returned by around the first week in November, I stand a chance of getting the thesis approved by the University of Tennessee by mid-December.

Please be assured that your time and earnest efforts in completing this and the second questionnaire will be very much appreciated by me. I believe this is a worthwhile project, and from a study of the goals of your Committee, it appears that we are working toward a common goal, that is, improved fire-safe structures. I believe my project can contribute to your work as much as your ideas and suggestions will undoubtedly contribute to mine.

In appreciation,

James T. Blackmon, Jr. P.E.

JTB:vbg
Enclosure
cc: Thesis Committee, University of Tennessee
D. Peter Lund, Exec. Dir., Society of Fire Protection Engrs.

# INSTRUCTIONS

I. These instructions relate to the questionnaire covering the various facets of buildings and building fires. Your opinion concerning each question is solicited. The following statements explain the choices available in completing the questionnaire. Kindly circle the item which most nearly describes your position with regard to each statement on the questionnaire.

(A) I agree with the statement.

(B) I am inclined to agree (with reservations).

(C) I cannot say (have no feeling one way or the other, or the evidence is inconclusive).

(D) I am inclined to disagree (disagree with reservations).

(E) I disagree with the statement.

II. Also, please circle the item that most nearly represents your position regarding the relevance (R) or nonrelevance (NR) of each question, to building design.

III. For purposes of adding credence to the study, it would be appreciated if you would complete the following personal data:

a. Professional Status: _____
*(Licensed Architect; Licensed Engineer—Civil, Electrical, Chemical, Fire Protection, etc.; Building Official; Fire Official; Other—specify)*

b. Number of years experience as participant on a Building Design Team: _____.

c. Major experience in Building Design has been in _____.
*(Residential, commercial, industrial—specify)*

SHEET NO. 1 OF INITIAL QUESTIONNAIRE

| QUESTION | ANSWER |
|---|---|
| 1. In some localities, fires in low rise apartment structures are more severe and more frequent. | A B C D E R NR (70001, RJA-22, HRB1) |
| 2. Open eave or cornice sprinklers are used to prevent fire from coming through windows from exterior fires. | A B C D E R NR (40132, CWB-30, EXT7) |
| 3. Intumescent coatings are some of the most effective and lightweight forms of thermal protection in fire environments. | A B C D E R NR (30101, AISI-169, FHP10) |
| 4. In building fire situations diffusion flame combustion is the prevelant type. | A B C D E R NR (10001, B-1, CC1) |
| 5. Pressurization of stairwells, to exclude smoke when heat sensing devices are installed to shutdown building HVAC fans in the event of fire, should be mandatory. | A B C D E R NR (40030, SBD-19, LS6) |
| 6. The height, area size, and economic size of buildings should be unlimited outside the fire district, provided life safety provisions can be satisfied. | A B C D E R NR (10127, BL, BC5) |
| 7. A fire accident produces injury to persons, property, or processes. | A B C D E R NR (50002, MORT-25, DF2) |
| 8. Building construction consists of all of the elements of the building framing, enclosure, partitioning, and finish materials, including the geometric interrelationship of all of these elements. | A B C D E R NR (20025, DG-19, BBS4) |
| 9. When a flammable gas is above the U.E.L., it is considered to be too lean to burn. | A B C D E R NR (30078, HILP-421, FHP6) |

| QUESTION | ANSWER |
|---|---|
| 10. The primary purpose of a fire detection system is to respond to a fire, to transform the response from the detection device into visual and/or audible signals, warning the building occupants and the emergency response team that combustion is taking place. | A B C D E R NR<br>(60003, B-290, DD1) |
| 11. The major difference between Type V and VI construction is in the fire resistance ratings of exterior bearing and non-bearing walls. | A B C D E R NR<br>(20028, SBJJ-16, BBS6) |
| 12. Building codes should ban the opening of automatic elevator doors at select floors during a fire. | A B C D E R NR<br>(40029, SBD-19, LS6) |
| 13. As residential building height increases, the chance of injury increases while the chance of death decreases. | A B C D E R NR<br>(70002, RJA-22, HRB1) |
| 14. Lightning arrestors are needed for transformers, transmission lines, substations, and rotating machinery. | A B C D E R NR<br>(30019, FMLPE-37-58, EL4) |
| 15. Fires in storage yards, piers, lumber yards, and on the roofs or outer walls of buildings and fires involving vehicles or aircraft may be described as free burning fuel regulated fires. | A B C D E R NR<br>(10007, B-3, CC2) |
| 16. Gaseous extinguishing agents are primarily beneficial against flammable liquid Type B fires, whether or not electrically energized hazards are co-existent. | A B C D E R NR<br>(40108, H-28, EXT2) |
| 17. The three stages of diffusion flame combustion are: incipient, smoldering, and flame. | A B C D E R NR<br>(60008, B-294, DD2) |

| | QUESTION | ANSWER |
|---|---|---|
| 18. | The chief goals of building designers are to plan buildings that serve a given architectural function, as pleasing in appearance as possible, and as inexpensive as possible, so that fire safety becomes, for most designers, nothing more than a necessary compliance with the local building and/or fire prevention code. | A B C D E R NR<br>(10124, NCFPC-72, BC4) |
| 19. | A fire accident interrupts or degrades an activity. | A B C D E R NR<br>(50005, MORT-25, DF5) |
| 20. | When combustible dust suspended in air is ignited, severe explosions may occur. | A B C D E R NR<br>(30084, FBHB-5-49, FHP7) |
| 21. | The combustion requirements of fuel, oxygen, and heat may be graphically shown by the fire triangle. | A B C D E R NR<br>(10012, B-2, CC4) |
| 22. | An internal fire wall requires a three-hour rated automatic closing door on each side of a wall opening. | A B C D E R NR<br>(20039, HILP-7-4, BBS8) |
| 23. | A fire accident is preceded by sequences of planning and operational errors, that failed to adjust to changes in physical or human factors and produced unsafe conditions and/or unsafe acts. | A B C D E R NR<br>(50003, MORT-25, DF3) |
| 24. | Smoke detectors of the ionization and photoelectric types cannot be placed on a drawing prior to construction. Detector placement must be determined in the field using a smoke generator after the building is occupied and operating. | A B C D E R NR<br>(60010, B-383, DD2) |

SHEET NO. 4 OF INITIAL QUESTIONNAIRE

| QUESTION | ANSWER |
|---|---|
| 25. Building codes nationally have achieved a relatively fire-safe high rise residential building. | A B C D E R NR<br>(70003, RJA-23, HRB1) |
| 26. In the design of a building life safety system, the main feature to consider is the length of the path to reach safety. While this is usually related to height, the horizontal distance in a shopping mall or large manufacturing building is equally important. | A B C D E R NR<br>(40014, M-54, LS3) |
| 27. Sodium bicarbonate base and potassium bicarbonate base dry chemical extinguishing agents are very effective against Class B fires whether or not electrically energized hazards are co-existent. | A B C D E R NR<br>(40111, H-28, EXT3) |
| 28. Building codes are not intended to be standards of good practice nor handbooks of construction. | A B C D E R NR<br>(10122, WH-1, BC4) |
| 29. Fire accident is an unwanted transfer of energy resulting from a lack of barriers and/or controls. | A B C D E R NR<br>(50001, MORT-25, DF1) |
| 30. Halon extinguishing systems come as "Package Systems" and are being successfully used in electronic equipment areas both as total flooding and local application situations. | A B C D E R NR<br>(40114, CWB-86, EXT3) |
| 31. Some common ordinary combustible solids are dry wood, paper, cotton, and rayon. | A B C D E R NR<br>(30052, FPHB-5-2, FHP1) |
| 32. Carbon dioxide as a constituent in smoke, usually causes death in a fire. | A B C D E R NR<br>(10019, M-44 |

| | QUESTION | ANSWER |
|---|---|---|
| 33. | The designer is responsible for placement of a building on the owner's property. Inside the fire district, the model codes are specific concerning distances and/or party (fire) walls. However, a more scientific approach would be to limit the radiant energy flux to less than 0.3 calories per square centimeter per second assuming that a fully involved fire in a nonsprinklered area has a radiant flux of approximately 3.5 calories per square centimeter per second. | A B C D E R NR<br>(10106, DG-15, BC2) |
| 34. | A fire that seriously damages a structure in the immediate area of the fire can seriously damage a structure in locations far removed from the fire. | A B C D E R NR<br>(20017, M-167, BBS2) |
| 35. | In a life safety system, a place of refuge is at a person's normal location, with the fire being confined to the area of fire origin and with those occupants exiting to safer areas of building. | A B C D E R NR<br>(40019, M-55, LS4) |
| 36. | It has been estimated that it would require the installation of 18,000 home fire detection systems to save one life. It was also estimated that extensive application would not occur until the cost of protecting the occupants of a dwelling was approximately $100. New places of residence should have detectors installed along with the lights and plumbing. | A B C D E R NR<br>(60012, B-309, DD3) |
| 37. | If a building occupant's reaction time to fire exceeds the fire's critical time, intolerable conditions are reached before reaching safety, and a life is lost. | A B C D E R NR<br>(40008, M-52, LS2) |

| QUESTION | ANSWER |
|---|---|
| 38. In high-rise office structures, suspended ceilings, open areas and centralized HVAC systems cause this type building to be more conducive to fire and smoke spread than the typical residential high-rise building. | A B C D E R NR (70004, RJA-17, HRB1) |
| 39. Many metals have fire hazard properties and nearly all metals will burn under certain conditions. | A B C D E R NR (30085, FPHB-576, FHP7) |
| 40. During the initial phase, fires involving rooms or compartments can be described as air regulated fires. | A B C D E R NR (10008, B-3, CC2) |
| 41. A detection equipment performance summary is as follows: | A B C D E R NR (60009, B-297 and M-84, DD2) |

| Technique | A-Fires | B-Fires | C-Fires | Maintainability | Reliability | Stability |
|---|---|---|---|---|---|---|
| Fixed Temperature | Low | High | Low | High | High | High |
| Rate of Rise | Medium | High | Low | High | Medium | High |
| Rate Compensation | High | High | Low | High | High | High |
| Particulate Matter | High | High | Medium | Medium | Medium | Medium |
| Visible Smoke | High | Low | Medium | Medium | Medium | Medium |
| Ultraviolet | Low | High | High | Medium | Medium | Medium |
| Infrared | Low | High | High | Medium | Medium | Low |
| Laser | No information. Undergoing field trials in England. (A) Optical scattering using beam deflection type laser. (B) Thermal optical using interferometer type laser. | | | | | |

| | |
|---|---|
| 42. A fire accident arises out of the risk in an activity. | A B C D E R NR (50004, MORT-25, DF4) |

| QUESTION | ANSWER |
|---|---|
| 43. The ASTM E119 Test specifies fire resistance criteria for construction elements such as columns, load and non-load bearing walls and partitions, door and window assemblies, floors, and beams. These criteria deal with the stability, insulation properties, and integrity of these elements. | A B C D E R NR (20049, M-115, BBS10) |
| 44. Can the building code trend of allowing reductions in fire-proofing requirements for structural members as well as fire resistance rating of ceilings, walls and floor assemblies, be justified, without guarantees that the sprinkler system will not be shut off at the time of the fire. | A B C D E R NR (40121, CLSS-21, EXT5) |
| 45. The three essential requirements for combustion are: a supply of fuel, a sufficiently high temperature, and an adequate supply of oxygen. | A B C D E R NR (10003, M-19, CC1) |
| 46. The only sound basis for designing a means of escape from a fire is to attempt to locate the positions of all possible sources of outbreak of fire and to predict the courses which might be followed by the fire as it develops at any of these sources, or more particularly, to predict the routes which smoke and hot gases would be likely to take. | A B C D E R NR (40026, M-59, LS6) |
| 47. Detectors may be used as a releasing device and/or for detection alarm service. | A B C D E R NR (60007, B-295, DD2) |
| 48. The primary purpose of a fire wall is to subdivide major monetary values inside of a building and between buildings. | A B C D E R NR (20034, HILP-72, BBS7) |

| | QUESTION | ANSWER |
|---|---|---|
| 49. | The American Insurance Association (AIA), Building Officials Conference of America (BOCA), International Conference of Building Officials (ICBO), and the Southern Building Code Congress (SSBC) publish "Model" building codes and several fire prevention codes suitable for adoption by local governments. These model codes reference portions of the standards of ASTM, ANSI, and NFPA. | A B C D E R NR<br>(10121, FPHB-2-20, BC4) |
| 50. | In apartment buildings, the percentage of deaths and injuries decreases as building construction is improved from frame to fire resistive. | A B C D E R NR<br>(70005, RJA-13, HRB1) |
| 51. | Improper grounding can sometimes be a hazard rather than a safeguard. | A B C D E R NR<br>(30015, HILP-3-11, EL3) |
| 52. | A variation of the local application dry chemical extinguishing systems is called a "Package System" and these "Package Systems" are rated for use on practically any size hazard. | A B C D E R NR<br>(40113, CWB-68, EXT3) |
| 53. | Burning PVC can produce hydrogen chloride. | A B C D E R NR<br>(10022, M-37, CC3) |
| 54. | Fire suppression systems can be of two types - manual or automatic. | A B C D E R NR<br>(40136, DG-31, EXT) |
| 55. | A building of masonry construction with exposed steel members is said to be fire resistive. | A B C D E R NR<br>(20008, FPHB-8-38, BBS3) |
| 56. | Approximately 39 percent of building electrical fire causes are from motors and power-consuming appliances. | A B C D E R NR<br>(30005, AF-22, EL1) |

| QUESTION | ANSWER |
|---|---|
| 57. Building codes should be changed to prevent use of elevators by building occupants during a fire. | A B C D E R NR (40028, SBD-19, LS6) |
| 58. The economic size, and height and area size of buildings may be unlimited outside the fire district regardless of the building code requirements. | A B C D E R NR (10126, BL-0, BC5) |
| 59. Standby power systems are required for all fire detection systems arranged similarly to exit lights and/or emergency lighting. | A B C D E R NR (60001, B-401, DD3) |
| 60. Even though NEC requires reduction of the individual ampacity of each conductor, where single conductors or multiconductor cables are stacked or bundled in continuous rigid cable supports, additional fire safeguards are necessary. | A B C D E R NR (30034, FMLPD-5-752, EL7) |
| 61. Type III construction is called heavy-timber construction. | A B C D E R NR (20026, UB-113, BBS6) |
| 62. In high-rise buildings, total evacuation in buildings over 25 stories is feasible where the capacity of exits is larger than normal, the building has a partial automatic fire detection system, and a manual fire alarm system. | A B C D E R NR (70006, RJA-T2, HRB2) |
| 63. Prevention is the avoidance of a fire accident and the designer has but limited control over potential fire incidents; therefore, the designer must assume that there is no absolute state of fire-safety and provide a design that will mitigate the severity of the potential fire accident | A B C D E R NR (10103, DG-1, BC1) |

| | QUESTION | ANSWER |
|---|---|---|
| 64. | In planning the life safety system for a building, the designer has five predictable variables to cope with: (1) The characteristics of the occupant, (2) Building design, (3) The technique of protection, (4) The location of the origin of the fire, (5) The location of the people at the time of the discovery of the fire. | A B C D E R NR (40011, M-54, LS3) |
| 65. | Heat detectors operate approximately two minutes ahead of sprinklers. | A B C D E R NR (60013, B-342, DD3) |
| 66. | "Flashover" in a building fire occurs after a small fire is ignited and preheats the combustible surfaces of a room until autoignition occurs. | A B C D E R NR (10010, M-19, CC2) |
| 67. | The following agents have been used to extinguish building fires: water, foam, carbon dioxide, dry chemical, and halogenated agents. | A B C D E R NR (40101, B-18, EXT1) |
| 68. | A disadvantage of reinforced concrete frame construction is that if a severe fire destroys a compartment at the lower floors of a building, incremental collapse can occur. | A B C D E R NR (20014, M-152, BBS4) |
| 69. | The growth of fire is dependent on feedback and positive heat balance. | A B C D E R NR (10013, HILP-4-2, CC5) |
| 70. | The heights and areas of buildings are commonly limited to reduce the economic risk of the insurance company. | A B C D E R NR (10113, BL-0, BC5) |
| 71. | Present day automatic fire detectors respond and transmit signals via pneumatic, electric, hydraulic, or mechanical communications systems. | A B C D E R NR (60004, B-290, DD1) |

| | QUESTION | ANSWER |
|---|---|---|
| 72. | UL and/or FM approved plastic drop-out ceiling panels have been successfully used below sprinkler systems. | A B C D E R NR (30094, BR-162, FHP10) |
| 73. | All types of Class A surface fires can be extinguished by liquid extinguishing agents. | A B C D E R NR (40109, H-28, EXT2) |
| 74. | An escape route consists of three main parts: (1) The horizontal path (the exit access), (2) The path in the exit (vertical or horizontal), (3) The path from the exit to a place of refuge or out-of-doors. | A B C D E R NR (40021, FPHB-8-185, LS5) |
| 75. | The concept of escape time is the relationship between critical time and reaction time with critical time defined as the elapsed time before the products of combustion build to intolerable limits. | A B C D E R NR (40006, M-52, LS2) |
| 76. | The wet sprinkler system is suitable for use in any location. | A B C D E R NR (40119, HILP-1-14, EXT4) |
| 77. | The model building codes list in order of desirability, the following types of construction: (1) Fireproof, (2) Fire Resistive, (3) Noncombustible, (4) Heavy-Timber, (5) Ordinary, (6) Woodframe. | A B C D E R NR (20022, HILP-5-3, BBS2) |
| 78. | At present there are 62 thermal detectors, two flame detectors, 19 products of of combustion smoke detectors, and 31 photoelectric smoke detectors approved by the Underwriters Laboratories. | A B C D E R NR (60015, B-300, DD3) |

| QUESTION | ANSWER |
|---|---|
| 79. The heights and areas of buildings are commonly limited in order to prevent excessive areas subject to a single fire area and thus assure opportunity for occupants to evacuate safely. | A B C D E R NR (10111, DG-41, BC5) |
| 80. Total smoke control in a high-rise building may be accomplished by pressurized stairs, top and bottom ventilated elevators, smoke stopped or top vented service shafts, and HVAC shutdown or 100% exhaust. | A B C D E R NR (70007, RJA-T2, HRB2) |
| 81. Spray-on asbestos fireproofing materials have proved unsatisfactory from a fire standpoint as well as a health standpoint. | A B C D E R NR (30098, BR-262, FHP10) |
| 82. Carbon, carbon monoxide, many compounds rich in carbon and hydrogen, readily oxidizable non-metals such as sulfur and phosphorus, cellulosic substances such as wood and textiles, and many metals such as aluminum, magnesium titanium, zirconium, alkali metals such as sodium and potassium, are the most prevalent reducing agents involved in fires. | A B C D E R NR (10016, B-13, CC4) |
| 83. Hydrogen cyanide is produced from the combustion of wool and silk. | A B C D E R NR (10021, M-45, CC3) |
| 84. Electrical circuits are grounded to limit voltages that are higher than the circuit design voltages. | A B C D E R NR (30013, HILP-3-11, EL3) |
| 85. Building codes should contain provisions to allow the use of heating, ventilating, and air conditioning systems for smoke removal when it is controlled by, or tied to, a building sprinkler waterflow alarm. | A B C D E R NR (40027, ASSE-42, LS6) |
| 86. A Class B fire is a flammable liquid fire. | A B C D E R NR (40104, H-14, EXT1) |

| QUESTION | ANSWER |
|---|---|
| 87. Present day flame detectors operate from ultraviolet, infrared, or visible radiation energy. | A B C D E R NR (60002, B-292, DD1) |
| 88. It has been stated that building codes attempt to prevent a repetition of a disaster which occurred in the past rather than attempting to prevent a "credible" disaster. | A B C D E R NR (10102, BR-19, BC-1) |
| 89. Building codes allow unlimited "Punchthrus" in fire-rated floors for conduit, piping, and cables, provided they are sealed in an approved manner. | A B C D E R NR (20038, BL-0, BBS8) |
| 90. Before manual response can take place, there must be detection, plus an alarm. Detection can be automatic, or human. Manual input can be the traditional fire alarm box or telephone or through a dedicated intercommunication system. | A B C D E R NR (60001, DG-73, DD1) |
| 91. It is impossible to self-ignite a material without an ignition source, even when the whole combustible mixture temperature has been raised to its autoignition temperature. | A B C D E R NR (10011, M-19, CC4) |
| 92. Occupant safety in a zoned building can be accomplished where stairs are not continuous at boundary floors; stair and elevator transfer areas are pressurized; HVAC systems are discontinuous at boundary floors; continuous elevator shafts are pressurized; and service shafts are smoke stopped at boundary floors. | A B C D E R NR (70008, RJA-T2, HRB2) |
| 93. Fire partitions have the same resistance ratings as fire walls. | A B C D E R NR (20036, HILP-7-2, BBS7) |
| 94. Electrical circuits are grounded to limit the maximum potential voltage to ground due to normal voltage. | A B C D E R NR (30014, HILP-3-11, EL3) |

| | QUESTION | ANSWER |
|---|---|---|
| 95. | Ignorance, economy, lapses, carelessness, and unusual occurrences are five major causes for building failures. | A B C D E R NR (10104, THM-4, BC1) |
| 96. | A deluge system is used to protect aircraft hangers, powder plants, transformers, openings through fire walls and other areas requiring large quantities of water. | A B C D E R NR (40129, BL-0, EXT6) |
| 97. | Factors influencing mobility of building occupants are whether they are: confined, incapacitated, incapacitated with assistance, handicapped, infirmed, handicapped with assistance, very old or very young, school age, confined if released, normal adults, and the athlete. | A B C D E R NR (40013, M-54, LS3) |
| 98. | Control of intra-building fires requires limitation of fire characteristics such as the area of fire involvement, the fire severity (the highest level of energy produced from the fire to extinguishment), and the products of combustion produced. | A B C D E R NR (10107, DG-19, BC2) |
| 99. | Fire can cause plastic hinges in a structure to be stressed beyond their elastic limit. | A B C D E R NR (20004, M-155, BBS4) |
| 100. | The reliability factors for sprinkler systems are: (1) Valve supervision, (2) Water flow detection, (3) Proprietary supervision, (4) Central station reporting, (5) Water supplies (out source, in-house storage, pumps, and pump drives), (6) Maintenance, and (7) Remote control of shut-off valves. | A B C D E R NR (40139, DG-34, EXT) |

| QUESTION | ANSWER |
|---|---|
| 101. The following conditions tend to produce static electricity and fires unless protection is provided:<br><br>(1) Paper and cloth on rollers<br>(2) Non-conducting liquids flowing through pipes and hoses<br>(3) Non-conducting liquids falling through air<br>(4) Belts running on pulleys<br>(5) Non-conducting liquids agitated in a tank<br>(6) Non-conducting liquids when air or other gases bubble<br>(7) Gas issuing from a nozzle at high velocity<br>(8) Movement of solid particles such as grain, feed, sugar, etc.<br>(9) Humans working in certain environments, and having very dry skin, wearing rubber soled shoes and clothing of silk, wool, or synthetic textiles, except rayon. | A B C D E R NR<br>(30025, FMLPE-37-53, EL5) |
| 102. In planning a building life safety system, the principal characteristic to consider is the mobility of the occupant. | A B C D E R NR<br>(40012, M-54, LS3) |
| 103. Fire detection devices are substitutes for sprinklers. | A B C D E R NR<br>(60014, BL-0, DD3) |
| 104. Occupant safety can be improved in high-rise buildings by providing two areas of refuge per floor, with at least one-hour fire resistance. Where such areas are provided they would require an air supply for positive pressure and dilution, bottom vented stairs that serve such areas and any elevator serving the refuge area must be top and bottom ventilated. A refute area should not be more than 100 feet from any occupant. | A B C D E R NR<br>(70009, RJA-T2, HRB2) |
| 105. An exit route need only be capable of maintaining a smoke-free atmosphere for the time required for escapees to reach a place of safety. | A B C D E R NR<br>(40025, M-64, LS5) |

| | QUESTION | ANSWER |
|---|---|---|
| 106. | Smoke produced in a fire has been found to consist of very small (aerosol type) particles. As a general rule, particle sizes range between .01 and 10 microns. (Particles less than 5 microns are not visible to the eye.) Smoke detectors sense both the visible and invisible aerosol. | A B C D E R NR (60006, B-292, DD2) |
| 107. | Hydraulically designed sprinkler systems are systems engineered for a specific hazard or occupancy and will, in most instances, result in economic savings through use of smaller pipe sizes than indicated in the standard book (NFPA 13). | A B C D E R NR (40134, BL-0, EXT7) |
| 108. | In the initial stage of burning, fire energies are low and development of the fire is dependent on the characteristics of available combustible surface area and the inherent ignition properties of the immediately adjacent fuel. | A B C D E R NR (10006, DG-20, CC5) |
| 109. | Grounding is particularly important for: armored cable, hazardous locations, temporary wiring, lightning arrestors and transformer cases. | A B C D E R NR (30017, FMLPE-37-59, EL4) |
| 110. | The critical level of energy build-up for transmission of radiant and convected ignition energies across open spaces is approximately 0.6 calories per square centimeter per second. | A B C D E R NR (10002, DG-21, CC1) |
| 111. | The height, area size and economic size of buildings within the fire district are limited by model building codes. | A B C D E R NR (10114, BL-0, BC5) |
| 112. | The behavior of steel or concrete structures subjected to a fire are effected by the restraint effect at the beam and column intersection. | A B C D E R NR (20018, M-167, BBS3) |

| QUESTION | ANSWER |
|---|---|
| 113. Closely grouped cables with combustible insulation under raised floors is a major fire problem in computer room fires. | A B C D E R NR (33038, FMLPD-10-1, EL8) |
| 114. Fuel is the same as a reducing agent in the diffusion flame combustion reaction. | A B C D E R NR (10015, B-12, CC1) |
| 115. The physiological and psychological dangers that can arise from a fire accident are:<br>(1) Products of combustion - smoke, CO, $CO_2$, irritant gases, hydrogen cyanide, sulphur dioxide/hydrogen sulphide mixtures, oxygen depletion.<br>(2) Heat<br>(3) Burns<br>(4) Panic | A B C D E R NR (40003, M-42-50, LS1) |
| 116 In addition to control and/or extinguishment in high-rise buildings, sprinkler systems can enhance occupant safety by alerting a building security center, by sounding local fire/evacuation alarms, and by directly alerting the public fire department. | A B C D E R NR (70010, PBS-A45, HRB2) |
| 117. Deluge systems and preaction systems require the use of heat, smoke, or flame responsive devices for actuation of the system. | A B C D E R NR (40130, CWB-28, EXT6) |
| 118. Building code major emphasis is toward mitigating the supervisory category of fire accident. | A B C D E R NR (10118, BL-0, BC2) |
| 119. Heat detectors function from the laminar and turbulent convection flow of the convection-induced thermal column effect of the diffusion flame phenomenon. | A B C D E R NR (60005, B-292, DD1) |

| | QUESTION | ANSWER |
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| 120. | The Model Codes Standardization Council recommends six types of building construction. The fire resistance for party and/or fire walls in these types of construction is a minimum of four hours. | A B C D E R NR (20031, SBJJ-16, BBS7) |
| 121. | Oxygen and ozone; hydrogen peroxide; the halogens, such as fluorine, chlorine, bromine and iodine; concentrated nitric and sulfuric acids; high valence oxides of heavy metals such as manganese dioxide and lead oxide; nitrates, chlorates, and peroxides; chormates, dichromates, permanganates, hypochlorites and hypobromites are sources of oxygen for fires. | A B C D E R NR (10017, B-12-131, CC3) |
| 122. | Limitation of the fire characteristics of severity and area of fire involvement relates to building construction and occupancy and/or the capability of available suppression systems. | A B C D E R NR (10108, DG-18, BC2) |
| 123. | Wet sprinkler systems automatically detect fire, transmit an alarm, and suppress or extinguish the fire. | A B C D E R NR (40120, HILP-1-11, EXT4) |
| 124. | Heavy timber constructed buildings often have floors of 3-inch plank with a hardwood overlay. This type floor might be expected to have a fire resistance rating of 45 minutes. | A B C D E R NR (20024, HILP-53, BBS4) |
| 125. | In a life safety system, escape means occupants leave the building immediately. | A B C D E R NR (40016, M-55, LS4) |
| 126. | Article 450 of the NEC applies to the installation of transformers, including their location, electrical protection and general fire safeguards. Under certain conditions, fire extinguishing systems are required. | A B C D E R NR (30036, FMLPD-5-752, EL8) |

| | QUESTION | ANSWER |
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| 127. | A solid, liquid, or gas, each has an autoignition temperature. | A B C D E R NR<br>(30075, HILP-4-21, FHP5) |
| 128. | Fire resistive construction alone does not adequately protect occupants, fire fighters or store contents in enclosed shopping malls. | A B C D E R NR<br>(70011, M-230, SM1) |
| 129. | A fire prevention code's major emphasis is directed toward mitigating the physical category of fire accident. | A B C D E R NR<br>(10119, BL-0, BC3) |
| 130. | When a wet system actuates, all heads operate. | A B C D E R NR<br>(40118, CWB-22, EXT4) |
| 131. | Carbon monoxide is formed when there is an excess of oxygen in the fire. | A B C D E R NR<br>(10020, M-44, CC3) |
| 132. | Physical fire accidents are caused by physical hazards, poor housekeeping, defective equipment, unsafe building conditions, or improper planning. | A B C D E R NR<br>(10117, HEIN-46, BC2) |
| 133. | One of the basic principles of fire protection is that the building shall be designed so that all occupants can escape safely in the event of fire. | A B C D E R NR<br>(40001, M-43, LS1) |
| 134. | Steel framing may be fireproofed with water. | A B C D E R NR<br>(30097, BR-267, FHP10) |
| 135. | A better name for Types I and II construction is "fireproof" and "fire-resistive" rather than non-combustible. | A B C D E R NR<br>(20027, SSBC-3-1, BBS6) |

| | QUESTION | ANSWER |
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| 136. | The acceptable level of smoke production by a given building material depends on its position in the building in relation to the probable sequence of fire development in the building, implying that different smoke development ratings at different locations in the building should be allowed. | A B C D E R NR (10024, M-39, CC4) |
| 137. | Limitation of the fire characteristic referred to as "area of fire involvement" can be accomplished by compartmentalization which requires consideration of the probability that the physical form and barriers of the building be sufficiently tight and stable under fire exposure to prevent passage of fire beyond these barriers, the failure of structural elements resulting in collapse of the barriers or collapse of other building elements. | A B C D E R NR (10115, DG-25, BC5) |
| 138. | Unprotected Type IV construction has been called "Main Street-USA" and presents the following problems to a fire department: (1) the structural stability of the masonry wall, (2) the efficiency of the masonry w ll as a barrier to the extension of fire to the next building, (3) the stability of the interior column, girder and beam system, and (4) void spaces which are inherent in Type IV construction and which are usually increased in number by each building alteration. | A B C D E R NR (20030, BR-97, BBS6) |
| 139. | The principle of the "potentially expendable occupant" is that if untenable conditions can be created between an occupant and an exit, that exit does not exist for that occupant, and the designer must provide one. | A B C D E R NR (40015, M-55, LS3) |
| 140. | Sprinkler systems in individual shops with deluge sprinklers to prevent fire spread from shop to shop by radiation should be the rule rather than the exception in shopping malls. | A B C D E R NR (70012, M-226, SM1) |

| | QUESTION | ANSWER |
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| 141. | Discounting process detectors, there are six major groups of detectors available for use in buildings: (1) heat, (2) ionization (smoke and radiation), (3) visible smoke, (4) flame, (5) ultrasonic and laser, and (6) combustion gas. | A B C D E R NR (40135, M-84, EXT7) |
| 142. | Temperature, oxidizing agents, reducing agents, and uninhibited chain reactions are elements of the tetrahedron of fire. | A B C D E R NR (10014, B-11, CC5) |
| 143. | Some solids which are chemicals cannot have a flashpoint. | A B C D E R NR (30062, FPHB-5-15, FHP3) |
| 144. | Building codes should be followed in order that the designer's client may reduce the property insurance premiums. | A B C D E R NR (10125, BL-0, BC4) |
| 145. | Even though ordinary construction has masonry walls, this type construction is often justifiably called "quick burning" construction. | A B C D E R NR (20023, HILP-5-3, BBS3) |
| 146. | Advocates of the life safety sprinkler system state that where the fire suppression system is properly designed, the building will be safe from fire. | A B C D E R NR (40122, SBD-17, EXT5) |
| 147. | If I woke at night and found my bedroom door open and the room half full of thick black smoke, I would get low and stay there and not panic. | A B C D E R NR (40020, PHIL-3, LS4) |
| 148. | Once steady-state combustion is reached in a room fire, the combustion process changes from air regulated to fuel regulated. | A B C D E R NR (10009, B-3, CC2) |

| | QUESTION | ANSWER |
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| 149. | The purpose of a properly enforced building code, legally adopted by an elected governmental body, is not to insure owners and the public a good and perfect job, only a reasonably safe one. | A B C D E R NR (10123, WH-1, BC4) |
| 150. | All materials evaporate: It is the different rates of evaporation of mixtures that is of primary concern to fire protection. | A B C D E R NR (30066, FPHB-5-17, FHP4) |
| 151. | A surface spread of flame test determines the rate of flame propogation over internal building finishes, particularly ceilings. | A B C D E R NR (20047, M-115, BBS10) |
| 152. | A Class A fire is a surface burning fire with fuel consisting of ordinary, usually cellulosic, materials. | A B C D E R NR (40103, H-14, EXT1) |
| 153. | The concept of refuge as related to life safety has been accepted for some time though its practice in this country seems to be restricted to institutional occupancies. | A B C D E R NR (40010, FPHB-8-5, LS2) |
| 154. | The initial appearance of smoke in a shopping mall could very likely initiate a very rapid panic reaction. | A B C D E R NR (70013, M-223, SM1) |
| 155. | A 30 ampere fuse should be used in the ordinary lighting circuit. | A B C D E R NR (30043, NCFPC-159, EL9) |
| 156. | A welded joint structure would collapse only if the temperature at three or more critically stressed points reaches 1022°F. | A B C D E R NR (20012, M-152, BBS2) |

| QUESTION | ANSWER |
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| 157. Occupancy consists of the amount, type, and form of the fuel brought in by the occupants in order to conduct their business, provide for their personal comfort, or other purposes. The designer has an obligation to review the existing fire load condition with clients when remodeling existing structures. | A B C D E R NR (10109, DG-19, BC2) |
| 158. A fire has six identifiable and observable variables which are: input heat, fuel, oxygen, proportioning, mixing, and ignition continuity. | A B C D E R NR (10004, B-5, CC1) |
| 159. To escape a hostile environment is instinctive; therefore, the route from any point in a building, in an ideal situation, should be as short as possible, easily traversed, big enough to accommodate all escapees, and should not contain gases, smoke, or fire. | A B C D E R NR (40004, M-50, LS1) |
| 160. Can a life safety sprinkler system without a guaranteed ample water supply to a functioning system, protect the adjoining property owners, the fire service personnel who will have to cope with the emergency situation, or the owners and designers of the building, especially when the fire resistance requirements have been reduced, more hazardous finishes have been introduced, and additional exit travel has been allowed. | A B C D E R NR (40124, SBJJ-28, EXT5) |
| 161. Only in powder or other finely divided form does aluminum present a special fire problem. | A B C D E R NR (30086, FPHB-5-80, FHP8) |
| 162. An example of an uninhibited chain reaction and activation of energy is when hydrogen and chlorine are mixed in a dark room where it is stable, and then is brought into the sunlight where it becomes explosive. | A B C D E R NR |

| QUESTION | ANSWER |
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| 163. Once the line of escape has been defined, the pathway widths must be calculated. | A B C D E R NR (40024, M-62, LS5) |
| 164. In a shopping mall, life safety is absolutely dependent on the successful operation of fire extinguishing equipment to reduce smoke concentrations during those times when the mall is filled with shoppers. | A B C D E R NR (70014, M-223, SM1) |
| 165. The National Fire Protection Association (NFPA), the American National Standards Institute (ANSI), the American Society of Testing Materials (ASTM) are the predominent consensus promulgators of standards of good practice in the field of fire safety. | A B C D E R NR (10120, FPHB-219, BC4) |
| 166. Unprotected steel 25 feet above a floor may be assumed to be immune to danger of collapse because of fire. | A B C D E R NR (20020, BR-252, BBS5) |
| 167. Classes C and D fires are electrical and combustible metal fires, respectively. | A B C D E R NR (40105, FPHB-18-5, EXT1) |
| 168. Feedback in a fire is dependent on the geometry, ventilation, and thermal characteristics of the fuel adjacent to an ignition source. | A B C D E R NR (10025, HILP-4-2, CC5) |
| 169. Electricity becomes a fire hazard through arcing. | A B C D E R NR (30006, FPHB-9-82, EL2) |
| 170. For any life safety system to be effective the occupants of a building must effect escape during the first phase of fire development, preferably soon after discovery of fire and before smoke, gas, and heat reach toxic or lethal concentrations. | A B C D E R NR (40002, M-43, LS1) |

| QUESTION | ANSWER |
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| 171. The ignitors for a building fire accident are: (1) exposure fires from outside of the building; (2) human; (3) failure of equipment and devices; (4) natural disasters; (5) civil commotion and/or wars. The designer has control over placement of the structure and/or its exterior protection and specification of those design criteria, design standards, and approaches directed toward avoiding the generation of ignition sources. | A B C D E R NR (10105, DG-1, BC1) |
| 172. Classes A and B fires can be extinguished by Halon 1301, water, and ammonium phosphate type dry chemical extinguishing agents whether or not electrically energized hazards are co-existent. | A B C D E R NR (40110, H-28, EXT2) |
| 173. The ultimate limit state in a fire is reached where excessive local damage causes deterioration of the material to such an extent that plastic hinges begin to form around the structure, reducing the structure to a mechanism. | A B C D E R NR (20002, M-151, BBS3) |
| 174. A fuel's combustibility is a function of its volatility. | A B C D E R NR (10005, B-2, CC2) |
| 175. The heights and areas of buildings are commonly limited to assure manageable fire situations for public fire departments. | A B C D E R NR (10112, FPHB-8-19, BC5) |
| 176. Because of large undivided volumes and areas, smoke may have unlimited access to people in a shopping mall. | A B C D E R NR (70015, M-223, SM1) |
| 177. Fires can be extinguished by: (1) removal of fuel, (2) reduction of heat, (3) reduction of air, (4) inhibition of flame chain reactions, (5) shock waves, (6) critical vibrations, (7) ion separation (strong electric fields), and various combinations of the above. | A B C D E R NR (40102, H-13, EXT1) |

| QUESTION | ANSWER |
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| 178. Building structures behave differently in a fire, depending on the material, the design method, and the mode of construction adopted. | A B C D E R NR<br>(20006, M-155, BBS1) |
| 179. In a life safety system, slow escape means that occupants leave the building more slowly and need intermediate places of refuge, from which escape is slow and orderly. | A B C D E R NR<br>(40017, M-55, LS4) |
| 180. Temporary wiring is permitted for power and lighting installations for an indefinite period of time. | A B C D E R NR<br>(30032, FMLPD-5-752, EL7) |
| 181. As a fire hazard, the heating of conductors used to convey current is negligible under ordinary circumstances where the NEC has been followed. | A B C D E R NR<br>(30027, FPHB-9-83, EL6) |
| 182. Inside the fire district, the addition of automatic sprinkler systems in a fire resistive structure should result in the reduction of the fire prevention code fire resistance requirements. | A B C D E R NR<br>(20009, BL-0, BBS4) |
| 183. Gaseous extinguishing agents cannot extinguish a Type A surface fire. | A B C D E R NR<br>(40106, H-28, EXT2) |
| 184. Tests conducted by the British on plasterboard, woodfiber insulating board, phenolformaldehyde-faced board, polyurethane foam sandwich, birch plywood, hardboard, PVC-faced hardboard, rigid PVC, chipboard and glassfiber reinforced polyester building materials produced smoke that limited visibility to between two and five meters, indicating that location of exit signs are a function of finish materials rather than travel distance in a given type occupancy. | A B C D E R NR<br>(10023, M-40, CC4) |

| QUESTION | ANSWER |
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| 185. Less than 15 percent of all fire accidents may be classified as physical in nature and/or unpreventable. | A B C D E R NR (10116, HEIN-46, BC2) |
| 186. The horizontal path or exit access has a unit length limit depending upon occupancy and the presence or absence of automatic sprinkler system. | A B C D E R NR (40023, M-61, LS5) |
| 187. Wet life safety sprinkler systems should be mandatory in all apartment buildings, hotels, motels, department stores, and in buildings over 75 feet in height or greater 50,000 sq. ft. of floor area, regardless of occupancy. | A B C D E R NR (40125, NFPAFPC-38, EXT5) |
| 188. Smoke control in shopping malls is of utmost importance as experiments by the British have shown that the smoke from a "small shop" fire traveled 230 feet in 2.5 minutes. Further study indicated that when flashover conditions were reached smoke and heat production increased and the smoke traveled 600 feet in 2.5 minutes. The average travel rate of people is believed to be 115 feet in 2.5 minutes. | A B C D E R NR (70016, M-224, SM1) |
| 189. The major problem with plastic materials is that they breakdown under fire conditions to form undesirable and toxic gas, but on the other hand, so do some conventional and widely accepted building materials. The toxic content of the combustion products and the possible corrosive effect of plastic must be considered when assessing such materials for use in a building. | A B C D E R NR (30090, M-134, FHP8) |
| 190. When in a public building such as a hotel, hospital, or theater, it makes no difference whether one checks for the location of the exits so that one may reach them in the dark and can be confident that a building owner would not lock the doors for security reasons | A B C D E R NR (40009, PHIL-7, LS2) |

| | QUESTION | ANSWER |
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| | because the law will protect him. One also knows that building designers are required by code to provide for safety by providing proper exits. | |
| 191. | Limitation of fire severity requires a review of the fuel and space conditions inside of a building (intra-building) environment). | A B C D E R NR (10110, DG-20, BC2) |
| 192. | The type of floor construction controls the stability of load bearing brickwork during a fire. | A B C D E R NR (20016, M-167, BBS1) |
| 193. | Doors along an exit pathway are classified as amenity doors, security doors, or fire safety doors (fire and/or smoke) | A B C D E R NR (40022, M-63, LS5) |
| 194. | The two main fire safety objectives for any building design are prevention and fire control. | A B C D E R NR (10101, DG-13, BC1) |
| 195. | Article 500 of NFPA 70 specifies electrical equipment for hazardous locations. Is the idea expressed by this article that in some cases hazards may be reduced or hazardous areas limited or eliminated by adequate positive pressure ventilation from a source of clean air in conjunction with effective safeguards against ventilation failure, administratively practical? | A B C D E R NR (40125, NFPAFPC-38, EXT5) |
| 196. | While reinforced concrete frames benefit enormously by their monolithic construction, it is possible that with standard detailing of reinforcing steel and under certain conditions of loading, premature failure may occur during a fire. | A B C D E R NR (20013, M-152, BBS3) |

| QUESTION | ANSWER |
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| 197. The most complicated type sprinkler system is the wet system. | A B C D E R NR<br>(40117, CWB-22, EXT4) |
| 198. The principal automatic response suppression system in use in buildings today is the automatic sprinkler system. | A B C D E R NR<br>(40137, DG-31, EXT ) |
| 199. In a life safety system, an area of refuge is a location where occupants move to a protected area within the building where they may "ride out" the fire or be evacuated over a period of time. | A B C D E R NR<br>(40018, M-55, LS4) |
| 200. A fire in a compartment or in a framework of beams and columns could cause the deflected shape of the beam to be completely reversed if the stiffness of the columns is higher than that of the beams and similarly a reversal of a column's deformation would occur if the beams were stiffer than the columns. | A B C D E R NR<br>(20019, M-169, BBS4) |
| 201. Division 2 locations as designated by the NEC contain a hazard that exists only in the event of rupture of containers, breakdown of a system or failure of protective devices such as ventilating systems. | A B C D E R NR<br>(30049, NFPAIM-128, EL10) |
| 202. The burning of ordinary combustible solids must be preceded by the decomposition of the material into volatile substances since it is the evolved gases which actually ignite. | A B C D E R NR<br>(30060, FPHB-5-5, FHP2) |
| 203. Refuse and laundry chutes even when constructed of non-combustible materials should be enclosed in a shaft. | A B C D E R NR<br>(20045, FPHB-8-158, BBS0) |
| 204. A dry pipe sprinkler system would commonly be used in an area such as an unheated warehouse. | A B C D E R NR<br>(40126, CWB-25, EXT6) |

| | QUESTION | ANSWER |
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| 205. | If a building occupant's reaction time to fire is less than the fire's critical time, he or she will reach life safety before intolerable conditions occur, and a life is saved. | A B C D E R NR (40007, M-52, LS2) |
| 206. | The fact that the structural framing of an unsprinklered building of heavy timber construction will withstand fire exposure for a considerably longer time than will unprotected framing in a metal frame building is an illustration of the high insulating value of wood. | A B C D E R NR (30056, FPHB-5-3, FHP2) |
| 207. | When an escape route from a burning building fails to meet ideal criteria, escape becomes time dependent. | A B C D E R NR (40005, M-52, LS1) |
| 208. | Gaseous extinguishing agents cannot extinguish Type D metal fires. | A B C D E R NR (40107, H-28, EXT2) |
| 209. | Completeness, thermal resistance, and structural integrity are elements in design of building fire barriers. The designer's construction criteria for quality assurance must be explicit to prevent workmanship failures such as failure to install required fire stops, lack of completeness of the barrier at the junctions of floors with exterior walls or interior partitions, with ceilings or slabs, doorways or other openings in the barrier. | A B C D E R NR (20032, DG-25, BBS7) |
| 210. | Class I hazardous locations have atmospheres containing combustible dusts and the equipment is designated Group E, F. and G. | A B C D E R NR (30046, NFPAIM-126, EL10) |
| 211. | The serviceability limit of a building in a fire can be reached if strains or deflections are such that beams, columns, walls, or floors camber excessively. | A B C D E R NR (20002, M-15, BBS2) |

| | QUESTION | ANSWER |
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| 212. | A fire in high rack storage warehouses presents special special problems to firefighters because of: narrow aisles, rack heights, smoke and falling goods that can obstruct aisles. | A B C D E R NR (70018, M-243, HRS1) |
| 213. | The term static electricity is so named because the electron-produced electrical charges cannot escape until enough energy has been developed to cause a spark to jump to some nearby grounded or less highly carged object. | A B C D E R NR (30021, HILP-30-1, EL5) |
| 214. | The only wholly satisfactory method of protecting floor openings at an elevator shaft or stairway is to enclose the shaft with fire resistive walls. | A B C D E R NR (20041, HILP-7-15, BBS9) |
| 215. | A manual response suppression system stands unreactive until detection and alarm occur and there is response to the alarm. | A B C D E R NR (40138, DG-35, EXT ) |
| 216. | The most common grounding methods are water mains, buried rods or plates, and networks at substations. | A B C D E R NR (30018, FMLPE-37-59, EL4) |
| 217. | Since fire, heat, and smoke must follow a relatively circuitous route to move upward, escalator openings do not create an unimpeded vertical flue as does an elevator shaft. | A B C D E R NR (20042, HILP-7-15, BBS9) |
| 218. | Carbon dioxide extinguishing systems can be and are used in similar ways as are local flooding and total flooding Halon and dry chemical systems. The primary drawback to $CO_2$ is its asphyxiation characteristics. | A B C D E R NR (40115, CWB-84, EXT3) |
| 219. | Universal use of NFPA 70 and ANSI C2 (National Electrical Code and National Electrical Safety Code) would virtually eliminate electricity as a source of fire. | A B C D E R NR (30003, BL-0, EL1) |

| QUESTION | ANSWER |
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| 220. The relative stiffness between beams and columns and the degree of fixity between them can drastically alter the deformation characteristics and the additional effects of imposed load can increase or decrease these deformations. | A B C D E R NR<br>(20007, M-155, BBS2) |
| 221. When a sprinkler head fuses to release the air from the dry system, all heads will open. | A B C D E R NR<br>(40127, CWB-25, EXT6) |
| 222. It is the responsibility of the fire inspector to pass on the electrical equipment suitable for a hazardous location after the fire inspector has determined the classification of the area. | A B C D E R NR<br>(30050, NFPAIM-128, EL10) |
| 223. Fire walls can be expected to prevent the passage of fire from one area to another under the most adverse uncontrolled fire conditions. | A B C D E R NR<br>(20033, HILP-7-2, BBS7) |
| 224. Most high rack fires can be controlled by sprinklers inside of the racks in addition to ceiling sprinklers. | A B C D E R NR<br>(70019, M-243, HRS1) |
| 225. Automatic and manually operated fire sprinkler systems go by such names as wet, dry, deluge, preaction, combined dry pipe and preaction, and outside sprinklers for exposure protection. | A B C D E R NR<br>(40116, CWB-22, EXT4) |
| 226. Automatic sprinkler protection is the least expensive method of extinguishing computer room fires after the equipment is de-energized. | A B C D E R NR<br>(30045, BL-0, EL9) |

| | QUESTION | ANSWER |
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| 227. | The life safety sprinkler system assumes a density of water for a given fire loading. If the occupancy changes and subsequently the fire loading increases without an increase in density, is not the code function of protecting adjoining property owners in jeopardy, especially inside the fire district? | A B C D E R NR<br>(40123, SBJJ-28, EXT5) |
| 228. | The standard test to indicate which materials act in a way which will aid combustion or add appreciable heat to a fire is called a combustibility test. | A B C D E R NR<br>(20046, M-115, BSS10) |
| 229. | Some flammable materials react violently on contact with oxidizers. | A B C D E R NR<br>(30082, HILP-4-22, FHP7) |
| 230. | The preaction system requires fusing of sprinkler heads in addition to a detection device for operation. This type system interlocked with the computer provides excellent protection for data acquisition rooms. | A B C D E R NR<br>(40131, BL-0, EXT7) |
| 231. | A serious disadvantage of noncombustible construction is its inability to withstand fire temperatures for more than a few minutes. | A B C D E R NR<br>(20021, HILP-5-2, BBS1) |
| 232. | 61.4 percent of building electrical fires start from wiring and general electrical equipment. | A B C D E R NR<br>(30004, AF-22, EL1) |
| 233. | Upon actuation, a deluge system flows water out of all heads. | A B C D E R NR<br>(40128, CWB-27, EXT6) |
| 234. | Fire partitions serve the same purpose as a fire wall except they do not subdivide major monetary values. | A B C D E R NR<br>(20035, HILP-7-2, BBS7) |

| | QUESTION | ANSWER |
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| 235. | A pin jointed steel structure will collapse if a critically stressed point in the steel reaches 550 degrees centigrade. | A B C D E R NR (20011, M-152, BBS1) |
| 236. | Carbon monoxide has almost the same flammability limits as hydrogen. | A B C D E R NR (30079, HILP-42-1, FHP6) |
| 237. | Methods for protecting against fires caused from static electricity are bonding, grounding, ionization and humidification. | A B C D E R NR (30025, HILP-30-1, EL5) |
| 238. | An attic, basement, or concealed space should not be used as an integral part of a duct system unless it conforms to all of the requirements for ducts. | A B C D E R NR (20043, HILP-10-1, BBS9) |
| 239. | The use of exit corridors as air conditioning plenums is permitted by building codes. | A B C D E R NR (20044, HILP-10-1, BBS9) |
| 240. | Solids derived from animals contain the same chemicals as ordinary combustible solids except they contain a large percentage of protein. Two examples are wool and silk. | A B C D E R NR (30054, FPHB-5-2, FHP1) |
| 241. | With precast frameworks and panel construction, great care should be taken to prevent a "pack of cards" type of disaster, as the fire resistance of this type structure is dependent on the type joint employed. | A B C D E R NR (20015, M-155, BBS5) |
| 242. | The flashpoint of a flammable liquid is the lowest temperature at which it gives off enough vapors to form a flammable mixture with air near the surface of the liquid. | A B C D E R NR (30063, HILP-42-1, FHP3) |

| QUESTION | ANSWER |
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| 243. "Fireproofing" for the steel is more important in a plastic designed building than in a conventional steel structured building. | A B C D E R NR (20010, BR-244, BBS5) |
| 244. Dust-ignition-proof equipment in Class II, Division 2 hazardous locations, including flour handling in bakeries, is required by the NEC and OSHA. | A B C D E R NR (30037, FMLPD-5-752, EL8) |
| 245. Some model building codes do not allow openings in fire walls thereby blocking access to the building by the fire department. | A B C D E R NR (20040, UB-45, BBS8) |
| 246. Approximately 16 percent of all building fires originate from electrical sources. | A B C D E R NR (30001, AF-22, EL1) |
| 247. Ordinary combustible solids are involved in almost every fire. A material of this kind is primarily cellulosic and will not perceptibly flow in its natural state. | A B C D E R NR (30055, FPHB-5-2, FHP1) |
| 248. The high rack storage warehouse, because of the high density of stock, represents a major capital investment and warrants extra expenditure to protect rack area and the building. | A B C D E R NR (70021, M-245, HRS1) |
| 249. The most common types of fire walls are: tied walls, double walls, free standing, and self releasing steel member systems. | A B C D E R NR (20037, HILP-7-4, BBS8) |
| 250. A structure will fail if the imposed fire load causes one of the following conditions to be reached: (1) its serviceability limit; (2) its ultimate limit or limit state of collapse. | A B C D E R NR (20001, M-150, BBS1) |

| QUESTION | ANSWER |
|---|---|
| 251. Fires may be caused by overheating of electrical equipment designed to utilize air circulation when such equipment is placed in locations where air circulation is poor. | A B C D E R NR (30030, FPHB-9-83, EL6) |
| 252. Domestic electric heaters and applicances must have a connection to a receptacle or to a circuit of a rating not less than the rating of the appliance. | A B C D E R NR (30041, NFPAIM-118, EL9) |
| 253. Different mechanisms can form for different structural materials and for different loading conditions and thus the mode of collapse can have many permutations. | A B C D E R NR (20005, M-155, BBS5) |
| 254. Membrane ceilings should not be allowed as a fireproofing method. | A B C D E R NR (30096, BR-267, FHP10) |
| 255. Type IV construction is usually called ordinary construction. | A B C D E R NR (20029, Ub-98, BBS6) |
| 256. The highest temperature required to initiate or cause self sustained combustion in the absence of a spark or flame, is called the autoignition temperature of a substance. | A B C D E R NR (30074, HILP-42-1, FHP5) |
| 257. The fire exposure roof test is concerned with the behavior of a roof when subjected to a fire on the inside of the building. | A B C D E R NR (20048, M-114, BBS10) |
| 258. Variations in the physical state of materials can affect their flash and fi e points, as well as autoignition temperature. | A B C D E R NR (30058, HILP-42-1, FHP2) |
| 259. Fire tests on single structural components have a great value in assessing their behavior in a fire. However, tests are needed | A B C D E R NR (20050, M-117, BBS10) |

| QUESTION | ANSWER |
|---|---|
| to gain knowledge of the behavior of beam and column junctions and complete structure before a complete understanding of the behavior of building structures can be known. | |
| 260. Fire protection and firefighting equipment in the single story building is a function of the general hazard, the surface area and combustible nature of goods and objects, the number of people expected to be within the building, and the degree of risk aversion of the insurance underwriter. | A B C D E R NR (70022, M-212 & BL-0, SSB1) |
| 261. Class II hazardous locations have atmospheres containing flammable vapors or gases and the equipment is classified as Groups A through D. | A B C D E R NR (30047, NFPAIM-126, EL10) |
| 262. Electrical circuits are grounded to limit the voltage through a circuit from exposure to lightning. | A B C D E R NR (30012, HILP-31-1, EL3) |
| 263. The electric arc will ignite only the combustible material in the vicinity. | A B C D E R NR (30007, FPHB-9-82, EL2) |
| 264. The vapors of all flammable liquids are heavier than air. | A B C D E R NR (30068, HILP-42-2, FHP4) |
| 265. 11.9 percent of the total estimated monetary building fire losses originate from electrical sources. | A B C D E R NR (30002, AF-22, EL1) |
| 266. Automatic sprinklers are the basic protection for all indoor flammable-liquid areas. | A B C D E R NR (30073, HILP-42-3, FHP5) |

| QUESTION | ANSWER |
|---|---|
| 267. The lowest temperature at which a liquid in an open container will give off enough vapors to continue to burn, is the fire point of a material. | A B C D E R NR<br>(30065, HILP-42-1, FHP3) |
| 268. Electricity becomes a fire hazard through overheating of electrical equipment. | A B C D E R NR<br>(30011, FPHB-982, EL4) |
| 269. A serious fire occurred in this building. Was this building fire resistive?<br>(1) 11 stories reinforced concrete<br>(2) occupancy: apartments, shops, club<br>(3) hose protected by standpipe, all floors, and automatic sprinklers in one shop on ground floor<br>(4) fire location in club on 11th floor and contained the following:<br>(a) walls, interior finish and partitions contained 12,145 pounds of combustibles<br>(b) ceiling contained 8,448 pounds of combustibles<br>(c) equipment and built-in furnishings contained 11,968 pounds of combustibles<br>(d) furniture totaled 6,080 pounds of combustibles<br>(e) floor covering totaled 5,611 pounds of combustibles<br>(f) total combustible load distributed over 7,000 square feet of floor area was 44,252 pounds. | A B C D E R NR<br>(30095, FMLPD-11-1, FHP9) |
| 270. The major difference between flammable and combustible liquids is the flashpoint. | A B C D E R NR<br>(30061, FP B-5-15, FHP3) |
| 271. OSHA requires compliance with NFPA 70, Article 110-18 and 240-19 regarding arcing. | A B C D E R NR<br>(30009, FMLPD-5-751, EL2) |

| QUESTION | ANSWER |
|---|---|
| 272. In large undivided industrial occupancies if smoke vents are not provided, unrestricted smoke spread occurs with ultimate smoke-lugging of the building. When this occurs a hazard to firefighters develops and they can no longer locate the fire. | A B C D E R NR (70023, M-217, SS1) |
| 273. A flammable liquid's miscibility with water is important since the flash and fire points of a flammable liquid are lowered as the amount of water in the mixture is increased. | A B C D E R NR (30072, HILP-42-2, FHP5) |
| 274. Amorphous solids such as glass are nothing more than liquids of great viscosity. | A B C D E R NR (30053, FPHB-52, FHP1) |
| 275. Most plastics are combustible organic compounds that burn under favorable conditions at a rate similar to wood. | A B C D E R NR (30089, HILP-63-1, FHP8) |
| 276. The vapors from a liquid do not burn, only the liquid itself. | A B C D E R NR (30089, HILP-42-1, FHP3) |
| 277. Fluorescent fixtures, for fire safety, often require additional safeguards not required by the NEC. | A B C D E R NR (30035, FMLPD-5-752, EL7) |
| 278. The flammability limits and explosive range of a material are the same. | A B C D E R NR (30076, HILP-42-1, FHP6) |
| 279. A static electricity spark cannot ignite ordinary combustibles, only flammables such as ether or gasoline. | A B C D E R NR (30022, HILP-30-1, EL5) |
| 280. Ordinary combustible solids consist primarily of carbon, hydrogen, and oxygen with some smaller percentage of nitrogen and other elements. | A B C D E R NR (30051, FPHB-5-2, FHP1) |

| | QUESTION | ANSWER |
|---|---|---|
| 281. | When the NEC limits are exceeded at the time of remodeling a building, or a change in occupancy occurs, the generation of heat can become a problem. | A B C D E R NR (30028, FPHB-9-83, EL6) |
| 282. | Division 1 locations as designated by the NEC contain a hazard that exists continuously, intermittently, or periodically under normal operating conditions, or is likely to exist during repair or maintenance operations. | A B C D E R NR (30048, NFPAIM-128, EL10) |
| 283. | The use of busways is prohibited in all hazardous locations | A B C D E R NR (30033, FMLPD-5-752, EL7) |
| 284. | Smoke vents alone in a large undivided factory building will do little to prevent the spread of fire or cause its suppression. | A B C D E R NR (70024, M-218, SSB1) |
| 285. | When a flammable vapor is below the L.E.L., it is considered to be too rich to burn. | A B C D E R NR (30077, HILP-42-1, FHP6) |
| 286. | Expanded phenolic foam has been found to give a satisfactory performance when used as a partition/core and does not break down under fire conditions in the same undesirable way as does polyurethane foam. | A B C D E R NR (30092, M-135, FHP9) |
| 287. | Materials such as naphthlene and tallow are solids at normal temperatures but assume the characteristics of flammable liquids when melted. | A B C D E R NR (30070, HILP-42-2, FHP4) |
| 288. | The lower the boiling point, the more volatile, and therefore the more hazardous a flammable liquid. | A B C D E R NR (30071, HILP-42-2, FHP5) |

| QUESTION | ANSWER |
|---|---|
| 289. Spontaneous heating of ordinary combustible solids usually does not occur unless the material is contaminated or has been artificially heated. | A B C D E R NR<br>(30059, FPH-5-9, FHP2) |
| 290. The specific gravity of a flammable liquid is important in determining the proper type of fire extinguishing medium and whether overflow drains on open tanks of flammable liquids are required or other special precautions are needed. | A B C D E R NR<br>(30067, HILP-42-2, FHP4) |
| 291. Deposits of combustible dust on beams, machinery and other surfaces are object to flash fires. | A B C D E R NR<br>(30083, FPHB-5-49, FHP7) |
| 292. Gases that will not support combustion are known as inert gases. | A B C D E R NR<br>(30080, FPHB-5-30, FHP6) |
| 293. Can the following building be classified as non-combustible and fire safe?<br>(1) has an aluminum skin located 16" from outer edge of concrete floor<br>(2) is fire stopped with a sheet of aluminum plate inside of two 1" thicknesses of foamed polystyrene<br>(3) the exterior wall is lined with 1" thickness of polystyrene<br>(4) the aforementioned firestops are pierced to permit passage of glass fiber cloth flexible air conditioning ducts. | A B C D E R NR<br>(30094, FMLPD-10-4, FHP9) |

| QUESTION | ANSWER |
|---|---|
| 294. Oxidizing materials, such as chlorates, nitrates and peroxides from which oxygen is easily released by heat or chemical action, can stimulate combustion in inorganic matter. | A B C D E R NR<br>(30081, HILP-42-2, FHP7) |
| 295. Three articles of the NEC and two articles of the NESC relate to arcing; however, only two of the NEC articles require protection against the fire hazard. | A B C D E R NR<br>(30010, NEC-17-236, EL2) |
| 296. The term single story building includes industrial buildings, for both manufacture and storage, schools, shops, supermarkets, churches, swellings, restaurants, cinemas, theaters, dance halls, sports arenas, and nursing homes to name a few. Such buildings may be considered hollow rectangular blocks pierced with holes for doors and windows which house activities with low to high fire hazards. Such buildings may have unlimited floor areas and may not require by code any fire protection systems. | A B C D E R NR<br>(70025, M-213, SSB1) |
| 297. Circuits are considered adequately protected against overheating by use of the proper size overcurrent protective device such as a fuse or circuit breaker. | A B C D E R NR<br>(30042, NFPAIM-118, EL9) |
| 298. A building constructed with concrete floors, wall, and ceiling can continue to be described as non-combustible when to these features have been added wood partitions and trim, plastic panels, plastic insulation and plastic covering on the wall. | A B C D E R NR<br>(30093, FMLPD-10-4, FHP9) |

| | QUESTION | ANSWER |
|---|---|---|
| 299. | If a circuit is not purposely grounded, current will seek a path from the point of failure to the earth and any combustible material through which the current flows may become overheated and ignite. | A B C D E R NR (30020, HILP-31-1, EL4) |
| 300. | Polyurethane foam is a material which has very good thermal insulation properties but will burn readily when exposed to fire. | A B C D E R NR (30091, M-135, FHP9) |
| 301. | Fusing of the metal conductor during an arcing situation cannot cause a fire. | A B C D E R NR (30008, FPHB-982, EL2) |
| 302. | If an electric toaster caught fire one could extinguish with water. | A B C D E R NR (30044, PHIL-15, EL9) |
| 303. | Dissimilar metal in contact with each other in the presence of moisture act similarly to an electric storage battery. | A B C D E R NR (30088, FPHB-584, FHP8) |
| 304. | Aluminum building siding will burn. | A B C D E R NR (30087, FPHB-580, FHP8) |
| 305. | When an electrical conductor carries a current, heat is generated in direct proportion to the resistance of the conductor and to the square of the current. | A B C D E R NR (30026, FPHB-982, EL6) |
| 306. | Overheating of electrical conductors becomes a hazard through deterioration of insulation on the conductor and the excess heat generated. | A B C D E R NR (30029, FPHB-983, EL6) |

| QUESTION | ANSWER |
|---|---|
| 307. Lightning arrestors are required on each ungrounded service conductor on the supply side of service equipment under 600 volts. | A B C D E R NR (30031, FMLPD-5-752, EL7) |
| 308. Article 645 of the NEC applies to data processing equipment, power supply wiring, equipment interconnecting wiring and grounding of data processing systems. Because of increasing dependence on this type equipment shouldn't the NFPA standard for Electronic/Data Processing Equipment be made a mandatory portion of Article 645? | A B C D E R NR (30039, NEC-418, EL8) |
| 309. Ventilation outlets to collect vapors from flammable liquids are required to be located near the floor. | A B C D E R NR (30069, HILP-42-2, FHP4) |
| 310. Grounding of circuits supplying power to locations such as hospital operating rooms may not be desirable. | A B C D E R NR (30016, HILP-31-1, EL3) |
| 311. Static electricity can be prevented. | A B C D E R NR (30023, HILP-30-1, EL5) |
| 312. Water cooling towers can become dry enough to require automatic deluge sprinkler systems. | A B C D E R NR (40133, CT-214, EXT7) |
| 313. The fire load in a high rack storage warehouse per unit area of floor is increased in direct proportion to the height of storage of goods. | A B C D E R NR (70017, M-239, HRS1) |
| 314. High rack storage fire hazards do not expose as a usual rule large numbers of people. | A B C D E R NR (70020, M-237, HRS1) |

| QUESTION | ANSWER |
| --- | --- |
| 315. The moisture content of ordinary solid combustibles affects the ignition and burning rate. | A B C D E R NR<br>(30057, FPHB-56, FHP2) |

# APPENDIX C

## COMPLETE BUILDING INDUSTRY FIRE SAFETY SURVEY

This appendix contains the instruction sheet and questionnaire distributed to the American Institute of Architects (AIA) Codes and Standards Committee, the Senior Staff of the National Fire Protection Association, a group of Professional Firemen who are working towards an Associate Degree in Fire Science Technology at Roane State Community College (Harriman, Tennessee) and the nationwide "in house" engineering staff of a major nonferrous metal manufacturer.

The survey form contains statement selected by the AIA Codes and Standards Committee from the 315 item Initial Questionnaire (Appendix B). These 75 questions were believed by the committee to be the most relevent to fire and buildings. The number enclosed in parenthesis after each question signifies the original statement number in the Initial Questionnaire. The reader may wish to refer to Table B-1, page 72 in Appendix B to decode the source material contained in the parentheses following the original statement number.

SHEET NO. 1 OF BUILDING INDUSTRY FIRE SAFETY SURVEY

INSTRUCTIONS

In an effort to gather data which could be used to establish appropriate educational programs, your opinion is solicited as to who in the building industry should possess comprehensive knowledge of fire safety.

The statements included in the attached survey information were considered by a committee of building designers to be in some manner relevant to fire and buildings.

Please indicate in the appropriate column(s) the group(s) whom you believe should possess the stated knowledge. (Columns 1-5)

Columns 6 and 7 relate to Building Codes and Fire Prevention Codes. Your opinion is solicited as to which of these codes might incorporate requirements based upon the information contained in each of the statements.

To Answer Items 1-75

Please indicate in the appropriate column(s), 1-5, the group(s) in the Building Industry whom you believe should have knowledge of the information contained in the statement.

1. Building Design Team (Arch./Eng.)
2. Construction Contractor
3. Building Code Official
4. Fire Department Specialist
5. Vocational Education Instructor

Also, the type code to which the information is most applicable.

6. Building Code
7. Fire Prevention Code

Please Check applicable profession below which most closely corresponds to your own.

| | | | |
|---|---|---|---|
| Architect | ____ | Fire Dept. Specialist | ____ |
| Engineer | ____ | Voc. Educ. Instructor | ____ |
| Contractor | ____ | Other_____ | ____ |
| Building Code Official | ____ | | |

SHEET NO. 2 OF BUILDING INDUSTRY FIRE SAFETY SURVEY

*TO ANSWER ITEMS 1-75: Please indicate which of the following you think should know the information contained in the statement.*

*1. Building Design Team (Arch./Eng.)* *2. Construction Contractor*
*3. Building Code Administrator* *4. Fire Department Specialist*
*5. Vocational Education Instructor, and Code to which information most applicable*
*6. Building Code* *7. Fire Prevention Code*

I. FIRE PROBLEMS IN SELECTED TYPES OF BUILDINGS *1 2 3 4 5 6 7*

1. A method of total smoke control in a building requires the combined use of pressurized stairs, top and bottom vented elevator shafts, top vented service shafts, and shutdown of HVAC system. (80, RJA-T2)

2. Fire safety of the occupants in a high-rise building can be improved by providing two one-hour fire resistive areas of refuge on each floor equipped with positive pressure dilution ventilation. (104, RJA-T2).

3. Because of the large undivided building areas and volumes, people in shopping malls could be subjected to smoke exposure. (176, M-223).

4. In large undivided factory buildings smoke vents can do little do suppress or prevent the spread of fire. (284, M-218)

5. High-rise office structures are more conducive to fire and smoke spread than the typical high-rise residential building. (38, RJA-17)

6. Fire resistive construction in enclosed shopping malls does not adequately protect occupants, shoppers, fire fighters, and building contents from the spread of fire. (128, M-230)

7. During the initial stage of burning, when fire energies are low, the further development of the fire is dependent on the characteristics of the available combustible fuel surface area and the inherent ignition properties of the immediately adjacent fuel. (108, DG-20)

8. Building codes allow materials with different smoke development classifications to be installed at different locations in a building. (136, M-39)

9. "Flashover" occurs when a small fire preheats the combustible surfaces in a room to the point of autoignition. (66, M-39)

10. During the initial phase, fires located inside of rooms or compartments can be described as fuel regulated fires. (40, B-3)

II. BASIC BUILDING FIRE PROBLEMS

11. Noncombustible refuse and laundry chutes should be enclosed in noncombustible shafts. (203, FPHB-8-158)

12. Failure to install fire stops, lack of barrier completeness at junctions of floors and ceilings and other partitions are failures which can contribute to the spread of smoke, heat, and flame during a building fire. (209, DG-25)

13. Building codes do not allow unlimited "punchthrus" in fire-rated floors to accommodate conduit, piping and cables. (89, BL-0)

14. An attic, basement, or concealed space should not be used as an integral part of a duct system unless it conforms to the combustibility requirements for ducts. (238, HILP-10-1)

15. Fire partitions do not have the same fire resistance ratings as fire walls. (93, HILP-7-2)

16. The use of exit corridors as air conditioning plenums is not restricted by building codes. (239, HILP-10-1)

17. Internal fire walls require three-hour rated automatic closing doors on each side of a wall opening. (22, HILP-7-4)

18. Unprotected steel 25 feet and higher above a floor cannot be assumed to be immune to danger of collapse during or because of a fire. (166, BR-252)

19. Fire walls can be expected to prevent the passage of fire from one area to another under the most adverse uncontrolled fire conditions. (223, HILP-7-2)

20. Steel framing can be permanently fireproofed with water. (134, BR-267)

III. BUILDING FIRES AND ELECTRICITY

21. Air-cooled electrical equipment placed in poorly ventilated locations may cause fires as a result of overheating. (251, FPHB-9-83)

22. Circuits are considered to be adequately protected against overheating by using over-current devices sized in accordance with NFPA Standard No. 70. (297, NFPAIM-118)

23. Universal use of NFPA #70 and ANSI, C2 (National Electrical and National Electrical Safety Code) could virtually eliminate electricity as a source of fire. (219, BL-0)

24. Automatic sprinkler protection is the least expensive method of extinguishing computer room fires, assuming automatic electrical deenergizing equipment for the computer is functioning. (226, BL-0)

25. Electrical grounding is particularly important in armored cable, hazardous locations, temporary wiring, lighting arrestors and transformer cases. (109, FMLPE-37-59)

26. One of the reasons for grounding electric circuits is to limit voltages that are higher than circuit design voltages. (84, HILP-3-11)

27. It is not always desirable to ground circuits supplying power to locations such as hospital operating rooms. (310, HILP-31-1)

28. For fire safety, fluorescent light fixtures often require additional safeguards not required by the National Electrical Code. (277, FMLPD-5-752)

29. Temporary wiring is permitted for power and lighting installations for definite periods of time. (180, FMLPD-5-752)

30. Closely grouped cables with combustible insulation is a major fire problem when located under raised computer room floors. (113, FMLPD-10-1)

IV. BUILDING LIFE SAFETY CONCEPTS

31. Pressurization of stairwells and utilization of heat sensing devices and/or sprinkler systems to shutdown HVAC fans in the event of fire should be a mandatory provision of a building code. (5, SBD-19)

32. The unit length of an exit access is limited, depending upon building occupancy, and the presence or absence of an automatic sprinkler system. (186, M-61)

33. Building Codes should contain provisions to allow the use of HVAC systems for smoke removal where the HVAC system is interlocked with the building sprinkler water flow alarm. (85, ASSE 42)

34. Building Codes should require that design of an elevator system include provisions to prevent the opening of doors on select floors during a fire. (12, SBD-19)

35. In a life safety system, "escape" means occupants leave the building immediately. (125, M-55)

36. In a life safety system, an area of refuge is an intermediate protected area in the building where occupants may "ride out" the fire or be evacuated over a period of time. (199-M55)

37. In an ideal situation, the route from any point in a burning building should be as short as possible, easily traversed, large enough to accommodate all escapees, and be free of gases, smoke, or fire. (159, M-50)

38. In shopping malls, large single-story industrial buildings, and high-rise buildings, the length of the horizontal path to safety is the paramount design feature for a building life safety system. (26, M-54)

39. One of the basic principles of fire protection is that a building shall be designed so that all occupants can escape safely in event of a fire. (133, M-43)

40. One life safety system concept is that a person's normal location in a building is a place of refuge; that the fire is contained at the origin and only those persons at the area of fire origin are required to leave for a safe location. (35, M-55)

V. FIRE DETECTION AND SUPPRESSION

41. A manual-response-suppression-system is unusable until there is a response to the alarm. (215, DG-35)

42. The eight types of commercially available smoke and/or heat detection devices do not function equally well on Classes A, B, and C fires and all approved types are not equal in maintainability, reliability, and stability. (41, B-297 & M-84)

43. Classes C and D fires are called "electrical" and "combustible metal" fires, respectively. (167, FPHB-18-5)

44. The permanent location for ionization or photoelectric type smoke detectors cannot be finalized on drawings prior to construction, but must be determined in the field using a smoke generator after the building is occupied and operating. (24, B-383)

45. The following extinguishing agents have been used to extinguish fires in buildings: water, foam, carbon dioxide, dry chemical, and halogenated agents. (67, B-18)

46. New places of residence should have smoke and/or heat detectors installed in much the same way as lighting and plumbing systems. (36, B-309)

47. Fixed package "Halon" extinguishing systems are being successfully used to extinguish fires in electronic equipment areas both in total flooding and in local application situations. (30, CWB-86)

48. Standby power is required for all smoke and/or heat detection systems arranged similarly to standby power systems for exit lights and/or emergency lighting. (59, B-401)

49. A Class "A" fire is defined as a surface burning fire fueled with ordinary, usually cellulosic, materials. (152, H-14)

50. Smoke and heat detectors can be used as releasing devices in addition to alarm service. (47, B-295)

51. Eave or cornice sprinklers are used to prevent exterior fires from spreading inward through windows. (2, CWB-30)

52. Sprinkler systems automatically detect fires and transmit alarms, in addition to suppressing or extinguishing the fire. (123, HILP-1-11)

53. When a wet-type sprinkler system actuates, all heads do not normally discharge water simultaneously. (130, CWB-22)

54. A wet-type sprinkler system is not suitable for use in all type buildings. (76, HILP-1-14)

55. A dry pipe sprinkler system would commonly be used in an area such as un unheated warehouse. (204, CWB-25)

VI. BUILDING CODES AND STANDARDS

56. The heights and areas of buildings are commonly limited to assure manageable fire situations for public fire departments. (175, FPHB-8-19)

57. ASTM E119 Test Criteria deals with the stability, insulation, properties and integrity of columns, walls, partitions, windows, floors and beams. (43, M-115)

58. There are presently four model building codes and several model fire prevention codes that utilize portions of the standards of ANSI, ASTM, and NFPA. (49, FPHB-2-20)

59. The fire-exposure-roof-test is concerned with the behavior of a roof when subjected to an external building fire. (257, M-114)

60. A surface spread-of-flame test determines the rate of flame propogation over internal building finishes, particularly ceilings. (151, M-115)

61. Limitation of the areas of fire involvement in a building can sometimes be accomplished by compartmentalization. (137, DT-251)

62. There should be no limitations to building heights, area subject to a single fire, or to the property economic value subject to a single fire provided life safety requirements can be satisfied. (6, BL-01)

63. The heights and areas of buildings are commonly limited to prevent excessive floor areas subject to a single fire accident. (79, DT-311)

64. The two primary fire safety objectives for any building design are prevention and control. (194, DT-131)

65. Limiting the severity and area of fire involvement is directly related to the type of building construction, building occupancy, and/or the capability of available building suppression and/or barrier systems. (122, DT-101)

VII. FIRE HAZARDS OF MATERIALS

66. Inert gases will not support combustion. (292, NFPAHB-5301)

67. When dust that is suspended in air is ignited, severe explosions can occur. (20, NFPAHB-5491)

68. Ventilation outlets to collect flammable liquid vapors should not always be required to be located near the floor. (309, HILP-4221)

69. Automatic sprinklers are the basic protection for indoor areas utilizing or storing flammable liquids. (266, HILP-4231)

70. The moisture content of ordinary solid combustibles affects the ignition and burning rate. (315, NFPAHB-561)

71. The flammability limits and explosive range of gas are the same. (278, HILP-4211)

72. The high insulating value of wood is demonstrated by the fact that structural framing built of heavy timber will withstand fire exposure for a considerably longer time period than will exposed metal framing. (206, FPHB-5-3)

73. The flashpoint of a flammable liquid is the lowest temperature at which it gives off enough vapors to form a flammable mixture with air near the surface of the liquid. (242, HILP-42-1)

74. Many metals have fire hazard properties and nearly all metals will burn under certain conditions. (39, FPHB-5-76)

75. Because many building materials and expecially plastics break down under fire conditions, the toxic content and corrosive effect of the products of combustion must be considered when assessing such materials for use in a building. (189, M-134)

# APPENDIX D

## TABULATIONS OF OPINIONS FROM INITIAL QUESTIONNAIRE

This appendix contains tabulations of the opinions rendered on the Initial Questionnaire. The opinions are tabulated in seven tables numbered D-1 through D-7. Each table represents one of the seven broad categories of building fire safety.

TABLE D-1

FIRE PROBLEMS IN SELECTED TYPES OF BUILDINGS

| Question Number | | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| ↑ | 128* | 15 | 3 | -- | -- | -- | 16 | -- |
| | 212 | 13 | 4 | -- | -- | -- | 12 | 2 |
| | 314 | 13 | 3 | -- | -- | 1 | 10 | 4 |
| | 154 | 12 | 5 | 1 | -- | -- | 12 | 4 |
| | 248 | 10 | 3 | 2 | 2 | -- | 8 | 7 |
| | 50 | 9 | 5 | 3 | -- | 1 | 14 | 1 |
| | 1 | 8 | 6 | 3 | 1 | -- | 12 | 3 |
| | 116 | 12 | 4 | 1 | 1 | -- | 11 | 3 |
| | 284* | 7 | 8 | -- | 3 | -- | 15 | 1 |
| | 140 | 2 | 5 | 3 | 2 | 6 | 12 | 3 |
| | 272 | 5 | 7 | 3 | 1 | 1 | 11 | 4 |
| | 313 | 6 | 4 | 5 | 1 | 1 | 10 | 4 |
| | 188 | 2 | 6 | 7 | 1 | 1 | 11 | 3 |
| | 92 | 4 | 9 | 2 | 1 | 2 | 14 | 1 |
| | 104* | 3 | 11 | 2 | 1 | 1 | 14 | -- |
| | 164 | 3 | 6 | 2 | 3 | 4 | 11 | 1 |
| | 260 | 6 | 5 | 2 | -- | 4 | 10 | 4 |
| | 25 | 4 | 9 | 1 | 1 | 3 | 11 | 4 |
| | 38* | 4 | 7 | 1 | 3 | 3 | 13 | -- |
| | 80* | 2 | 10 | 1 | 4 | 1 | 13 | -- |
| | 176* | 6 | 11 | 1 | -- | -- | 15 | -- |
| | 224 | 6 | 8 | 1 | 1 | 1 | 10 | 4 |
| | 13 | -- | 1 | 3 | 4 | 10 | 11 | 3 |
| | 62 | -- | 2 | 2 | 3 | 11 | 14 | 1 |
| ↓ | 296 | -- | 2 | 1 | 2 | 12 | 12 | 3 |
| ↑ | 108* | 13 | 4 | 1 | 1 | -- | 11 | 3 |
| | 45 | 16 | -- | 1 | 1 | -- | 10 | 5 |

Different Types of Buildings

TABLE D-1 (continued)

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| ↑ | | | | | | | | |
| | 40* | 8 | 6 | 3 | 1 | -- | 11 | 2 |
| | 66* | 8 | 6 | 2 | -- | 2 | 10 | 4 |
| | 168 | 3 | 7 | 7 | 1 | -- | 8 | 2 |
| | 174 | 5 | 6 | 3 | 1 | 2 | 8 | 7 |
| | 32 | 3 | 6 | -- | 3 | 6 | 5 | 9 |
| | 53 | 7 | 2 | 7 | -- | 2 | 8 | 3 |
| | 110 | -- | 1 | 16 | -- | 1 | -- | 13 |
| | 162 | 1 | 2 | 13 | 1 | 1 | 2 | 8 |
| | 69 | 1 | 2 | 11 | 2 | 2 | 6 | 7 |
| Combustion | 142 | 1 | 2 | 12 | 1 | 2 | 1 | 12 |
| | 83 | 1 | -- | 15 | -- | 2 | 4 | 8 |
| | 121 | 1 | 4 | 12 | -- | 1 | 1 | 11 |
| | 114 | -- | 3 | 12 | 2 | 2 | 2 | 10 |
| | 82 | 4 | -- | 10 | -- | 4 | 6 | 8 |
| | 4 | 1 | 5 | 9 | 2 | -- | 9 | 2 |
| | 184 | 1 | 5 | 9 | 1 | 1 | 9 | 3 |
| | 21 | 7 | 1 | 7 | 2 | -- | 8 | 7 |
| | 158 | 6 | 6 | 4 | -- | 2 | 10 | 5 |
| | 15 | 7 | 2 | 4 | 2 | 3 | 9 | 4 |
| | 148 | 4 | 4 | 6 | 3 | 1 | 4 | 11 |
| | 136* | 3 | 3 | 4 | 3 | 5 | 9 | 6 |
| | 91 | -- | 3 | 3 | 5 | 7 | 7 | 7 |
| ↓ | 131 | -- | 1 | 4 | 4 | 9 | 5 | 9 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-2

BASIC BUILDING FIRE PROBLEMS

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Methods of Structural Fire Protection | 300 | 10 | 2 | 2 | 1 | 2 | 12 | 1 |
| | 298 | 4 | 5 | -- | 2 | 6 | 14 | 1 |
| | 293 | 1 | 2 | 3 | -- | 11 | 6 | 5 |
| | 134* | 7 | 5 | 1 | -- | 5 | 15 | 1 |
| | 81 | 4 | 3 | 2 | 5 | 4 | 13 | 1 |
| | 3 | 4 | 5 | 6 | -- | 3 | 14 | 1 |
| | 72 | 3 | 2 | 11 | 2 | -- | 12 | 1 |
| | 286 | 1 | 2 | 13 | 1 | -- | 5 | 1 |
| | 269 | 3 | 1 | 8 | 4 | 1 | 7 | 3 |
| | 254 | 2 | 3 | 5 | 2 | 5 | 14 | 2 |
| Effects of Fire on Structures | 8 | 14 | 2 | 1 | -- | -- | 11 | 3 |
| | 178 | 12 | 3 | -- | 2 | -- | 14 | 1 |
| | 241 | 9 | 6 | 1 | 1 | -- | 13 | 2 |
| | 192 | 7 | 4 | 3 | -- | 3 | 12 | 4 |
| | 220 | 5 | 6 | 5 | 1 | -- | 11 | 4 |
| | 231 | 6 | 3 | 1 | 3 | 4 | 14 | 1 |
| | 124 | 4 | 8 | 3 | 2 | 1 | 14 | 1 |
| | 182 | 6 | 5 | -- | 3 | 3 | 14 | 1 |
| | 253 | 5 | 6 | 6 | -- | -- | 6 | 7 |
| | 77 | 7 | 3 | 1 | 2 | 5 | 13 | 1 |
| | 250 | 4 | 5 | 5 | 1 | 2 | 8 | 6 |
| | 211 | 7 | 2 | 4 | 1 | 3 | 10 | 4 |
| | 145 | 5 | 3 | 2 | 3 | 5 | 10 | 5 |
| | 99 | 6 | 4 | 7 | -- | 1 | 11 | 2 |
| | 200 | 5 | 4 | 5 | 1 | 2 | 8 | 5 |
| | 166* | 4 | 4 | 3 | -- | 7 | 13 | -- |
| | 243 | 3 | 4 | 4 | 1 | 5 | 13 | 1 |

TABLE D-2 (continued)

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Effects of Fire on Structures | 55 | 4 | 6 | 1 | 3 | 6 | 12 | 1 |
| | 196 | 2 | 4 | 1 | 5 | 2 | 11 | 1 |
| | 173 | 2 | 6 | 1 | 5 | 3 | 8 | 7 |
| | 112 | 6 | 4 | 3 | 1 | 4 | 11 | 4 |
| | 34 | 3 | 6 | 4 | 2 | 3 | 8 | 6 |
| | 235 | -- | 3 | 9 | -- | 5 | 9 | 4 |
| | 156 | 1 | -- | 8 | 4 | 4 | 10 | 6 |
| | 68 | 1 | 2 | 2 | 5 | 8 | 12 | 1 |
| Fire | 209* | 14 | -- | 2 | -- | 1 | 13 | 1 |
| | 203* | 13 | 4 | -- | -- | -- | 15 | -- |
| | 214 | 10 | 3 | 1 | 2 | 1 | 13 | 1 |
| | 238* | 7 | 9 | -- | 1 | -- | 15 | -- |
| | 223* | 2 | 8 | -- | 4 | 3 | 14 | 1 |
| Structural Barriers | 120 | 2 | 3 | 6 | 1 | 6 | 11 | 1 |
| | 239* | 1 | 4 | 2 | 2 | 8 | 14 | -- |
| | 22* | 6 | 1 | 3 | 3 | 5 | 15 | -- |
| | 89* | 6 | 3 | 3 | 2 | 4 | 15 | -- |
| | 249 | -- | 3 | 6 | 2 | 6 | 9 | 5 |
| | 245 | 2 | 2 | 2 | 3 | 7 | 12 | 3 |
| | 217 | -- | 2 | 2 | 4 | 9 | 13 | 1 |
| | 234 | 2 | 3 | 2 | 1 | 10 | 9 | 5 |
| | 93 | 2 | 3 | 1 | 2 | 10 | 15 | -- |
| | 48 | 1 | 1 | 2 | 3 | 11 | 9 | 5 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-3

BUILDING FIRES AND ELECTRICITY

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Causes of Electrical Fires | 297* | 10 | 5 | -- | 1 | 1 | 13 | 1 |
| | 252 | 9 | 2 | 2 | 1 | 1 | 11 | 2 |
| | 251* | 9 | 6 | 1 | 2 | -- | 11 | 4 |
| | 306 | 8 | 6 | 1 | -- | 2 | 11 | 4 |
| | 169 | 8 | 6 | 3 | 1 | -- | 10 | 2 |
| | 263 | 6 | 5 | 3 | -- | 2 | 8 | 6 |
| | 232 | 3 | 3 | 9 | 1 | 1 | 6 | 6 |
| | 305 | 5 | 3 | 6 | 1 | 2 | 9 | 6 |
| | 295 | -- | 2 | 13 | 1 | 1 | 5 | 7 |
| | 271 | 1 | 2 | 13 | -- | 1 | 5 | 7 |
| | 246 | 1 | -- | 13 | 1 | 1 | 4 | 7 |
| | 265 | 1 | -- | 13 | 1 | 1 | 2 | 9 |
| | 56 | 2 | 3 | 11 | -- | 2 | 8 | 6 |
| | 226* | 4 | 1 | 4 | 1 | 9 | 12 | 4 |
| | 281 | 6 | 7 | 3 | 1 | -- | 9 | 5 |
| | 181 | 5 | 7 | 1 | 2 | 2 | 11 | 4 |
| | 219* | 1 | 4 | 2 | 4 | 6 | 11 | 2 |
| | 301 | 1 | -- | 5 | 2 | 9 | 10 | 4 |
| | 302 | 2 | 2 | -- | 2 | 11 | 5 | 9 |
| | 155 | -- | -- | 2 | 1 | 15 | 16 | 5 |
| Elec. Grounding & Static Elec. | 109* | 12 | 4 | 2 | 2 | -- | 11 | 3 |
| | 237 | 9 | 6 | 1 | 1 | -- | 13 | 2 |
| | 216 | 9 | 6 | 1 | -- | 1 | 10 | 4 |
| | 299 | 7 | 6 | 1 | 1 | 2 | 13 | 2 |
| | 311 | 5 | 7 | -- | 2 | 3 | 11 | 4 |
| | 268 | 9 | 3 | 3 | 1 | 1 | 10 | 5 |
| | 51 | 9 | 4 | 4 | -- | 1 | 13 | 2 |

TABLE D-3 (continued)

| Question Number | | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Elec. Grouping & Static Elec. | 213 | 6 | 4 | 6 | -- | 1 | 3 | 10 |
| | 84* | 1 | 1 | 4 | 1 | 11 | 13 | 5 |
| | 101 | 4 | 3 | 4 | -- | 4 | 6 | 7 |
| | 279 | 2 | 6 | 1 | 2 | 6 | 9 | 7 |
| | 14 | 6 | 4 | 2 | 3 | 3 | 9 | 5 |
| | 262 | 3 | 4 | -- | 2 | 8 | 10 | 5 |
| | 94 | 1 | 1 | 3 | 3 | 10 | 12 | 2 |
| | 310* | 2 | 2 | 2 | 1 | 10 | 14 | 2 |
| Information from National Electrical Code | 180* | -- | 2 | 1 | -- | 14 | 12 | 3 |
| | 283 | 5 | 2 | 7 | 1 | 2 | 9 | 3 |
| | 113* | 4 | 4 | 7 | 1 | 2 | 13 | -- |
| | 308 | 4 | -- | 11 | -- | 2 | 8 | 3 |
| | 244 | 4 | 4 | 10 | -- | -- | 7 | 6 |
| | 126 | 2 | 5 | 10 | 1 | 1 | 11 | 2 |
| | 282 | 2 | -- | 12 | 2 | 1 | 5 | 5 |
| | 261 | 1 | 2 | 12 | 1 | 2 | 5 | 6 |
| | 201 | 1 | 2 | 13 | -- | 1 | 5 | 9 |
| | 210 | 1 | 1 | 13 | -- | 2 | 5 | 5 |
| | 60 | 1 | 3 | 11 | 3 | -- | 7 | 5 |
| | 307 | 1 | 1 | 10 | 2 | 3 | 7 | 6 |
| | 222 | 2 | 6 | 4 | 3 | 2 | 9 | 4 |
| | 195 | 1 | 4 | 8 | -- | 3 | 8 | 4 |
| | 277* | 2 | 2 | 6 | 2 | 5 | 10 | 4 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-4

BUILDING LIFE SAFETY CONCEPTS

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Routes of Escape | 5* | 9 | 7 | 1 | 1 | -- | 15 | -- |
| | 74 | 13 | 2 | 2 | 1 | -- | 13 | 2 |
| | 186* | 8 | 4 | 2 | -- | 3 | 15 | -- |
| | 12* | 7 | 7 | -- | 3 | 1 | 15 | 2 |
| | 163 | 8 | 6 | 2 | 2 | -- | 12 | 2 |
| | 44 | 6 | 4 | 4 | 2 | 3 | 11 | 2 |
| | 187 | 5 | 5 | 3 | 1 | 3 | 13 | -- |
| | 227 | 3 | 6 | 6 | 3 | -- | 13 | -- |
| | 193 | 4 | 7 | 1 | -- | 5 | 12 | 2 |
| | 57 | 7 | 7 | 1 | 2 | 3 | 15 | 1 |
| | 105 | 3 | 7 | 1 | 5 | 2 | 14 | 1 |
| | 160 | 1 | 2 | 7 | 2 | 6 | 9 | 3 |
| | 146 | 4 | 4 | 2 | 2 | 5 | 11 | 5 |
| | 46 | 3 | 1 | 6 | 3 | 4 | 12 | 2 |
| | 85* | 1 | 4 | 3 | 3 | 7 | 13 | 1 |
| Life Safety Principles | 115 | 13 | 5 | -- | -- | -- | 8 | 6 |
| | 159* | 15 | 3 | -- | -- | -- | 14 | 1 |
| | 207 | 8 | 8 | -- | 1 | -- | 11 | 3 |
| | 37 | 7 | 9 | 1 | -- | 1 | 12 | 4 |
| | 199* | 15 | 2 | -- | -- | -- | 16 | -- |
| | 170 | 9 | 6 | 2 | 1 | -- | 13 | -- |
| | 133* | 10 | 2 | 2 | -- | 3 | 14 | -- |
| | 75 | 6 | 6 | 4 | 1 | 1 | 9 | 4 |
| | 205 | 5 | 7 | 2 | 1 | 2 | 11 | 4 |
| | 26* | 11 | 3 | 2 | 1 | 1 | 14 | 1 |
| | 64 | 3 | 9 | 3 | 1 | 2 | 15 | 1 |
| | 97 | 11 | 6 | 2 | -- | -- | 13 | 3 |

TABLE D-4 (continued)

| Question Number | | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| ↑ Life Safety Principles ↓ | 139 | 2 | 8 | 6 | -- | 2 | 10 | 2 |
| | 35* | 4 | 7 | 4 | 2 | 1 | 14 | -- |
| | 179 | 8 | 4 | 1 | 2 | 2 | 11 | 4 |
| | 153 | 3 | 5 | 3 | 4 | 3 | 14 | 2 |
| | 102 | 5 | 4 | 2 | 5 | 1 | 13 | 1 |
| | 147 | 2 | 4 | -- | 2 | 10 | 3 | 13 |
| | 125* | -- | 3 | 1 | 3 | 11 | 15 | 1 |
| | 190 | -- | 1 | 2 | -- | 14 | 13 | 2 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-5

FIRE DETECTION AND SUPPRESSION

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Ways to Extinguish Fires | 67* | 13 | 3 | 1 | 1 | -- | 10 | 4 |
| | 167* | 6 | 2 | 9 | -- | 1 | 10 | 1 |
| | 152* | 4 | 4 | 5 | 2 | 3 | 10 | 5 |
| | 86 | 6 | 1 | 9 | -- | 2 | 13 | 2 |
| | 73 | 3 | 3 | 4 | 5 | 3 | 11 | 3 |
| | 208 | 1 | 1 | 12 | 2 | 1 | 6 | 4 |
| | 16 | 3 | 5 | 7 | 1 | 2 | 7 | 5 |
| | 177 | 5 | 7 | 3 | 2 | -- | 8 | 7 |
| | 183 | 1 | 2 | 8 | 2 | 4 | 7 | 7 |
| | 172 | 1 | 2 | 9 | -- | 5 | 8 | 6 |
| Fixed Suppression Systems | 215* | 11 | 4 | 2 | -- | -- | 13 | 2 |
| | 198 | 12 | 4 | -- | 1 | -- | 11 | 4 |
| | 204* | 12 | 2 | 1 | 1 | 1 | 13 | 2 |
| | 54 | 10 | 6 | 6 | -- | 1 | 12 | 2 |
| | 221 | 1 | 5 | -- | 1 | 10 | 11 | 2 |
| | 225 | 9 | 7 | 1 | -- | -- | 10 | 5 |
| | 130* | 2 | 1 | 1 | 2 | 12 | 14 | 1 |
| | 76* | -- | 1 | -- | 2 | 16 | 16 | -- |
| | 197 | 1 | 1 | 3 | 2 | 10 | 10 | 3 |
| | 107 | 6 | 3 | 6 | 1 | -- | 10 | 2 |
| | 52 | -- | 1 | 11 | 3 | 3 | 10 | 1 |
| | 30* | 4 | 1 | 11 | 2 | -- | 12 | -- |
| | 100 | 6 | 2 | 5 | -- | 2 | 8 | 2 |
| | 27 | 4 | 5 | 8 | 1 | -- | 11 | 3 |
| | 141 | 4 | 9 | 3 | -- | 1 | 14 | -- |
| | 218 | 2 | 6 | 5 | 2 | 2 | 8 | 5 |
| | 123* | 7 | 7 | 1 | 2 | 1 | 14 | -- |

TABLE D-5 (continued)

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| | 117 | 7 | 6 | 3 | 1 | 1 | 11 | 2 |
| | 96 | 5 | 2 | 5 | 2 | 4 | 12 | 3 |
| | 233 | 9 | 3 | 2 | -- | 3 | 11 | 3 |
| | 230 | 2 | 1 | 8 | 2 | 4 | 8 | 5 |
| | 312 | 4 | 1 | 6 | 1 | 5 | 9 | 4 |
| ↓ | 2* | 1 | 3 | 5 | 2 | 9 | 13 | 4 |
| | 10 | 17 | 1 | -- | -- | -- | 15 | 1 |
| ↑ | 47* | 12 | 5 | -- | -- | 1 | 16 | -- |
| | 90 | 10 | 7 | 1 | -- | -- | 8 | 6 |
| | 36* | 11 | 7 | -- | -- | -- | 16 | -- |
| | 17 | 7 | 4 | 6 | 1 | -- | 5 | 7 |
| | 106 | 5 | 2 | 7 | 4 | -- | 6 | 7 |
| | 65 | 2 | 2 | 8 | 2 | 4 | 7 | 5 |
| | 78 | -- | 2 | 16 | -- | -- | 1 | 13 |
| | 119 | -- | 6 | 12 | 1 | -- | 1 | 10 |
| | 41* | 5 | 3 | 8 | 1 | 1 | 10 | 1 |
| | 71 | 6 | 7 | 1 | 2 | 2 | 8 | 5 |
| | 87 | 3 | 2 | 7 | 2 | 4 | 9 | 5 |
| | 59* | 5 | 6 | 1 | 1 | 5 | 15 | -- |
| | 24* | -- | -- | 2 | 6 | 10 | 15 | -- |
| ↓ | 103 | 1 | 1 | 2 | 2 | 12 | 11 | 1 |

Detection Devices

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-6

BUILDING CODES AND STANDARDS

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Standard Bldg. Mtl. | 151* | 6 | 11 | 1 | -- | -- | 13 | 1 |
| | 259 | 11 | 4 | 1 | 1 | -- | 12 | 3 |
| | 43* | 5 | 9 | 3 | -- | 1 | 14 | -- |
| | 228 | 6 | 6 | 2 | 2 | 1 | 11 | 2 |
| | 257 | 2 | 2 | 4 | 1 | 8 | 11 | 2 |
| Heights & Areas | 79* | 10 | 7 | -- | -- | 1 | 16 | -- |
| | 58 | -- | -- | 2 | 3 | 3 | 14 | 2 |
| | 137* | 8 | 7 | 2 | -- | -- | 14 | 1 |
| | 70 | 3 | 2 | 1 | 2 | 10 | 6 | 14 |
| | 175* | 6 | 5 | 1 | 1 | 4 | 14 | 1 |
| | 61 | 8 | 4 | 4 | -- | 1 | 11 | 3 |
| | 255 | 8 | 2 | 3 | -- | 3 | 12 | 2 |
| | 138 | 4 | 7 | 4 | 1 | 2 | 11 | 3 |
| | 6* | 7 | 5 | -- | -- | 6 | 16 | -- |
| | 111 | 4 | 5 | 2 | 2 | 5 | 12 | 3 |
| | 11 | 4 | 3 | 5 | 2 | 2 | 11 | 2 |
| | 135 | 6 | 4 | 4 | 1 | 3 | 10 | 4 |
| Codes & Standards | 49* | 14 | 4 | -- | -- | -- | 14 | 1 |
| | 151 | 6 | 11 | 1 | 1 | -- | 13 | 1 |
| | 122* | 11 | 6 | 1 | -- | -- | 13 | 1 |
| | 191 | 10 | 6 | 3 | -- | -- | 13 | 2 |
| | 149 | 11 | 5 | 2 | -- | -- | 12 | 3 |
| | 63 | 4 | 11 | 1 | 1 | -- | 12 | 2 |
| | 171 | 9 | 6 | 2 | -- | 1 | 13 | 2 |
| | 28 | 13 | 4 | -- | -- | 1 | 12 | 4 |
| | 259 | 11 | 4 | 1 | 1 | -- | 12 | 3 |
| | 98 | 8 | 5 | 4 | 1 | -- | 11 | 3 |

TABLE D-6 (continued)

| Question Number | | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| ↑ Reasons and Purposes for ↓ | 144 | 2 | 2 | 1 | 1 | 12 | 8 | 7 |
| | 132 | 4 | 9 | 1 | 2 | -- | 10 | 5 |
| | 43 | 5 | 9 | 3 | -- | 1 | 14 | -- |
| | 157 | 8 | 5 | 2 | 2 | 1 | 12 | 2 |
| | 165 | 8 | 5 | 2 | 2 | 1 | 10 | 3 |
| | 88 | 7 | 4 | 2 | 3 | 2 | 8 | 6 |
| | 95 | 7 | 4 | 5 | -- | 2 | 6 | 10 |
| | 194* | 9 | 2 | -- | 1 | 2 | 13 | -- |
| | 228 | 6 | 6 | 2 | 2 | 1 | 11 | 2 |
| | 129 | 2 | 7 | 5 | 2 | 2 | 10 | 3 |
| | 257* | 2 | 2 | 4 | 1 | 8 | 11 | 2 |
| | 18 | 2 | 6 | 3 | 3 | 4 | 7 | 6 |
| | 185 | 2 | 3 | 8 | 1 | 1 | 2 | 8 |
| | 118 | -- | 3 | 8 | 1 | 6 | 5 | 7 |
| | 33 | 1 | 1 | 14 | 1 | 1 | 7 | 4 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

TABLE D-7

FIRE HAZARDS OF MATERIALS

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Dusts and Metals | 20* | 18 | -- | -- | -- | -- | 12 | 3 |
| | 189* | 12 | 4 | 1 | -- | -- | 13 | 1 |
| | 39* | 8 | 6 | -- | 4 | -- | 14 | 1 |
| | 291 | 6 | 9 | 1 | -- | 1 | 10 | 5 |
| | 229 | 9 | 5 | 3 | -- | -- | 9 | 5 |
| | 303 | 4 | 8 | 1 | 1 | 2 | 4 | 9 |
| | 304 | 6 | 3 | 1 | 3 | 4 | 8 | 6 |
| | 161 | 3 | 6 | 4 | 1 | 4 | 8 | 5 |
| | 294 | 3 | 1 | 9 | 1 | 2 | 6 | 7 |
| | 275 | 1 | 4 | 3 | 1 | 8 | 8 | 7 |
| Flammable & Combustible Liquids | 288 | 16 | 2 | 3 | -- | 2 | 7 | 7 |
| | 276 | -- | -- | 1 | 4 | 12 | 8 | 6 |
| | 242* | 6 | 5 | 4 | 1 | 1 | 9 | 5 |
| | 287 | 6 | 5 | 5 | -- | 1 | 6 | 7 |
| | 267 | 4 | 2 | 7 | 1 | 3 | 7 | 7 |
| | 150 | 1 | 5 | 7 | 2 | 3 | 7 | 7 |
| | 290 | 4 | 3 | 8 | -- | 2 | 7 | 6 |
| | 273 | 3 | 4 | 8 | -- | 2 | 7 | 6 |
| | 270 | 5 | 5 | 4 | 1 | 2 | 7 | 6 |
| | 309* | 6 | 5 | 1 | 3 | 2 | 14 | 1 |
| | 127 | 7 | 4 | 4 | 2 | 1 | 8 | 5 |
| | 264 | 4 | 2 | 4 | 1 | 6 | 8 | 7 |
| | 256 | 5 | 3 | 5 | 1 | 3 | 6 | 8 |
| | 266* | -- | 1 | 4 | 3 | 8 | 9 | 5 |
| | 292* | 10 | 3 | 1 | 1 | 2 | 7 | 7 |
| | 285 | 1 | -- | 13 | 2 | 1 | 4 | 7 |
| | 236 | -- | 1 | 9 | 1 | 6 | 4 | 7 |

TABLE D-7 (continued)

| | Question Number | Agree | Tend to Agree | No Opinion | Tend to Disagree | Disagree | Relevant | Nonrelevant |
|---|---|---|---|---|---|---|---|---|
| Burning Characteristics of Solids | Gases 9 | 3 | -- | 11 | 1 | 3 | 4 | 6 |
| | † 278* | -- | -- | 5 | 3 | 9 | 7 | 7 |
| | 315* | 13 | 3 | 1 | -- | -- | 9 | 6 |
| | 31 | 13 | 4 | -- | 1 | -- | 8 | 5 |
| | 258 | 9 | 5 | 2 | -- | 1 | 8 | 7 |
| | 206* | 8 | 3 | 1 | 3 | 2 | 11 | 4 |
| | 202 | 5 | 5 | 2 | 3 | 3 | 4 | 10 |
| | 143 | 1 | -- | 11 | 3 | 3 | 4 | 9 |
| | 280 | 5 | 5 | 5 | 1 | 1 | 4 | 10 |
| | 289 | 2 | 7 | 6 | -- | 2 | 4 | 9 |
| | 247 | 3 | 6 | 5 | 2 | 3 | 8 | 9 |
| | 240 | 3 | 4 | 8 | 2 | -- | 5 | 10 |
| | 274 | 3 | 2 | 8 | -- | 5 | 4 | 10 |

Numbers represent total number of opinions rendered per Initial Questionnaire statement.

*Denotes statement appears on Building Industry Fire Safety Survey.

# APPENDIX E

## SUMMARIES OF OPINIONS FROM THE BUILDING INDUSTRY FIRE SAFETY SURVEY

This appendix contains summaries of opinions rendered by the four groups of judges on the Building Industry Fire Safety Survey. The opinions are tabulated on four tables numbered E-1 through E-4. Each table represents one group of judges.

TABLE E-1

ARCHITECT RESPONSES CLASSIFIED ACCORDING TO WHO SHOULD HAVE FIRE SAFETY KNOWLEDGE AND TYPE OF CODE CHOICE

| | Who Should Have Knowledge? | | | | | |
|---|---|---|---|---|---|---|
| Type Code | Design Team | Construction Contractor | Building Official | Fire Prevention Specialist | Vocational Education Specialist | Total |
| Building | 255 | 207 | 285 | 179 | 119 | 1045 |
| Fire Prevention | 84 | 159 | 95 | 83 | 58 | 479 |
| Total | 339 | 366 | 380 | 262 | 177 | 1524 |

TABLE E-2

"IN-HOUSE" ENGINEER RESPONSES CLASSIFIED ACCORDING TO WHO SHOULD HAVE FIRE SAFETY KNOWLEDGE AND TYPE OF CODE CHOICE

| | Who Should Have Knowledge? | | | | | |
|---|---|---|---|---|---|---|
| Type Code | Design Team | Construction Contractor | Building Official | Fire Prevention Specialist | Vocational Education Specialist | Total |
| Building | 974 | 365 | 874 | 734 | 445 | 3392 |
| Fire Prevention | 932 | 400 | 836 | 865 | 539 | 3572 |
| Total | 1906 | 765 | 1710 | 1599 | 984 | 6964 |

TABLE E-3

PROFESSIONAL FIREFIGHTER RESPONSES CLASSIFIED ACCORDING TO WHO SHOULD HAVE FIRE SAFETY KNOWLEDGE AND TYPE OF CODE CHOICE

| | Who Should Have Knowledge? | | | | | |
|---|---|---|---|---|---|---|
| Type Code | Design Team | Construction Contractor | Building Official | Fire Prevention Specialist | Vocational Education Specialist | Total |
| Building | 566 | 400 | 484 | 583 | 347 | 2380 |
| Fire Prevention | 539 | 361 | 477 | 744 | 331 | 2452 |
| Total | 1105 | 761 | 961 | 1327 | 678 | 4832 |

TABLE E-4

FIRE PROTECTION EDUCATION SPECIALIST RESPONSES CLASSIFIED ACCORDING TO WHO SHOULD HAVE FIRE SAFETY KNOWLEDGE AND TYPE OF CODE CHOICE

| | Who Should Have Knowledge? | | | | | |
|---|---|---|---|---|---|---|
| Type Code | Design Team | Construction Contractor | Building Official | Fire Prevention Specialist | Vocational Education Specialist | Total |
| Building | 490 | 168 | 480 | 384 | 307 | 1829 |
| Fire Prevention | 237 | 138 | 209 | 418 | 271 | 1273 |
| Total | 727 | 306 | 689 | 802 | 578 | 3102 |

# VITA

James Thomas Blackmon, Jr., was born in Charlotte, North Carolina, in 1926. He attended elementary schools in Roanoke, Virginia, and graduated from Central High School in Charlotte, North Carolina, in 1943 entering the Navy from high school. He received a Bachelor of Science degree in Business Administration from the University of Tennessee in March 1973. He has been employed by Union Carbide Corporation in Oak Ridge, Tennessee, since May 1952.

He is a registered professional engineer; Chairman of the National Fire Protection Association Committee on Ovens and Furnaces; a member of the Tennessee Society of Professional Engineers and the National Society of Professional Engineers; an Associate member of the Society of Fire Protection Engineers, and an Affiliate member of American Society of Safety Engineers.

He is married to the former Mary Alexa Brown of Gresham, South Carolina, and is the father of sons—Michael Earl and Joseph Peter.