
NBS TECHNICAL NOTE 861

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

# A Survey for the Collection of Professional Opinion on Selected Fire Protection Engineering Topics

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.
[2] Part of the Center for Radiation Research.
[3] Located at Boulder, Colorado 80302.
[4] Part of the Center for Building Technology.

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Gregory A. Harrison and James L. Houser

Center for Fire Research
Institute for Applied Technology
U.S. National Bureau of Standards
Washington, D.C. 20234

t. Technical note no. 861

U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, *Secretary*
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

Issued March 1975

Library of Congress Catalog Card Number: 75-600001

National Bureau of Standards Technical Note 861

Nat. Bur. Stand. (U.S.), Tech. Note 861, 30 pages (March 1975)

CODEN: NBTNAE

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1975

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
(Order by SD Catalog No. C13.46:861). Price 80 cents.

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# A SURVEY FOR THE COLLECTION OF PROFESSIONAL OPINION ON SELECTED FIRE PROTECTION ENGINEERING TOPICS

Gregory A. Harrison
National Bureau of Standards, Washington, D.C.

and

James L. Houser
Gypsum Association, Chicago, Illinois

A questionnaire survey on selected fire protection engineering topics was sent to 422 persons from every state and major city in the United States and, also, parts of Canada. The surveyed included architects, engineers, insurance and government representatives, academics, and fire services personnel. One hundred and eighty six questionnaires were returned, a 46.2% return rate. This return rate is more than double the National average on survey returns. The questionnaire covered topics such as the adequacy of the term "noncombustible" as contained in the National Fire Protection Association's National Fire Code, hazards of fire loading concepts, code regulation and enforcement, furnishings, sprinkler systems and smoke detectors. In addition to the questionnaire data, many of the surveyed took the time to write in various unsolicited comments.

Although this survey does not represent a statistical study approach, it is the best effort to date to gather and document the current professional thinking on fire protection matters. When the data permitted, obvious and significant group thought ideas and patterns are documented. The objective of this survey is to collect and document professional opinions on selected fire protection engineering topics for the purpose of determining current professional thinking, and indications of future trends of thought.

Key words: Building construction; detectors; flame spread; furnishings; interior finishes; noncombustible; smoke development; sprinklers; survey.

## 1. SURVEY PROCEDURE

A questionnaire was prepared and sent to 422 selected persons from every state and major city in the United States and parts of Canada. The returned questionnaires were first categorized according to group specialties, e.g., architect, fire service, insurance, etc. The questionnaire data was then tabulated into tables for display and analysis purposes. Finally, the results were formally recorded.

## 2. SURVEY LIMITATIONS

A survey involves communication and full communication occurs only when one person receives both the same intellectual message and the same emotion that the other person sent and felt. Although it is not necessary for the "receiver" to agree with the message content, it is necessary for him to understand the total message meaning.[1] Hence, an inherent survey limitation is whether or not the surveyed really understood the message of a particular question. It can not be ascertained how serious this limitation is, but its existance is acknowledged.

Another possible survey limitation is the lack of common premise on which the questions were answered. For example, it is possible that some code officials and architects, may have responded to certain questions with code restrictions in mind, whereas, an academic or fire service individual may have responded with the idea in mind that "this is what I would like to see done." Specifically, perhaps the building code official may wish to favor a fire load concept with regards to furnishings, but responds negatively because he does not do so in reality.

Other sources of acknowledged error include semantics, inferred meanings, and individual biases toward selected fire protection systems and/or hazards.

In spite of certain inherent weaknesses, it is felt that the results of this survey reflect the thinking and thought patterns of a significant number of professionals in the field of fire protection and fire safety. Although this survey does not reflect an in-depth study on a statistically valid approach, it does represent the best effort to date to collect, analyze and interpret the collective thinking of a large number of professionals. The survey did produce results that illustrated that there exists well defined chains of thought with consistent patterns. Where possible, these are identified.

## 3. INTRODUCTION

There has been a growing awareness in the fire protection profession of the problems associated with the use of the three-part definition of the term "noncombustible" as contained in the National Fire Protection Association's National Fire Code. The BOCA Basic Building Code, the Southern Standard Building Code and the American Insurance Association National Building Code uses this three part definition. The ICBO Uniform Building Code incorporates only the first two parts of the three part definition.

It is becoming increasingly evident that virtually every segment of the construction, regulatory and fire service concerns are questioning the adequacy of the aforementioned definition that uses a test for "surface burning characteristics" (flame spread) to describe noncombustibility.

[1]Newman, W. H., Summer, C. E. and Warren, E. K., The Process of Management, 3rd Ed., Prentice-Hall, Englewood Cliffs, New Jersey, 1972.

Flame spread, it is reasoned, while certainly a significant factor in the buildup of a fire, is only one parameter associated with the relevant fire hazard of construction materials that should be accessed. Should not the definition include factors such as the ease with which a material will ignite or the rate of its heat release? How severe is the production of smoke and toxic products? Should the current level of fire resistance, be increasing or traded off for detection and suppression systems? Can our codes be changed to performance criteria based on a concept of total fire load? Should the manufacturing of furnishings be regulated?

We solicited answers to these and other questions from more than 400 persons with fire expertise. The response was a significant 46.2%, which is more than double the National average on survey returns.

The sensitivity of certain subjects was quite evident from the various written-in comments. Out of 186 responses, 136 used this opportunity to express themselves with candor on many topics related to fire protection. Some were critical of the survey; others applauded the survey's intent. The majority of unsolicited comments voiced genuine concerns, many of which were unique. A synopsis of the written comments is contained in a separate section of this report.

## 4. GENERAL DISCUSSION

The questionnaire, in its original form, is contained in the Appendix. For purposes of data presentation and brevity, the original questionnaire questions have been reworded to capture their intent or focus and to, hopefully, afford a readable format to the presentation of the survey results. It should be noted that certain questions have been deleted from the compilation of the results because of either insufficient response to same or because the question required a written-in response which is presented in another section of the report.

Analysis of this survey required working with more than 10,000 bits of data.

Table 1

| Group | Total Sent | Effective Distribution | Total Returned | % Returned |
|---|---|---|---|---|
| Academic (A) | 17 | 14 | 8 | 57.1 |
| Building Official (B) | 47 | 47 | 28 | 59.4 |
| General Interest (GI) | 49 | 43 | 22 | 51.2 |
| Fire Service (FS) | 234 | 234 | 101 | 43.2 |
| Federal Government (GOV) | 11 | 11 | 4 | 36.4 |
| Insurance (I) | 14 | 12 | 5 | 41.7 |
| Architech/Engineer (A/E) | 50 | 42 | 19 | 45.2 |
| Total | 422 | 403 | 187 | 46.2 |

## 5. SURVEY RESULTS

The results of the survey are as follows:[2]

Question 1.A Do you use the three part definition of "noncombustibility" as found in the NFPA National Fire Codes (1972-1973) Vol. 4, Section 220?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 2 | 5 | 12 | 56 | 1 | 2 | 10 | 88 |
| No | 4 | 23 | 8 | 32 | 2 | 3 | 5 | 77 |

Comments: Although approximately 50% of the total respondents indicated that they did not use this definition, it is interesting to note that only five building officials out of twenty-eight utilized the definition.

Question 3 Do you consider the definition adequate?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 0 | 11 | 5 | 57 | 1 | 1 | 8 | 83 |
| No | 7 | 17 | 11 | 29 | 3 | 4 | 7 | 78 |

Comments: On a total response basis, 50% accept the definition as being adequate. An examination of the academic, government, insurance, general interest and building official returns show that two-thirds of them do not think that the definition is adequate.

Question 4 In your evaluations of building constructions, do you relate fire load to fire hazard?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 10 | 13 | 70 | 4 | 4 | 10 | 118 |
| No | 0 | 17 | 4 | 22 | 0 | 1 | 8 | 52 |

Comments: An overall ratio considers fuel load in evaluating fire hazard of building construction. The majority of building code officials, however, did not. This is to be expected as building codes do not address themselves to the fuel load concept. The fire service response shows a 3:1 ratio indicating that the fuel load is considered. Perhaps this should be more significant in the thinking of others involved with building fire protection.

[2]In those instances where a specific question response sub-total does not correlate with the total number of returned survey forms for that particular group, it may be assumed that certain individuals refrained from responding to that question.

Question 5.A Is fire load considered in building framing?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 17 | 13 | 56 | 4 | 5 | 13 | 113 |
| No | 3 | 11 | 5 | 31 | 0 | 0 | 5 | 55 |

Comments: An overall 2:1 ratio for this category illustrates concern for fuel loading in building framing.

Question 5.B Is fire load considered in interior finish materials?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 16 | 15 | 81 | 4 | 5 | 10 | 138 |
| No | 0 | 12 | 3 | 11 | 0 | 0 | 8 | 36 |

Comments: Reasonably enough, a high ratio of 4:1 indicated significant concern over fire load in interior finishes. There is a tendency for the categories of building code officials and architect/engineers to conflict with the overall survey response. This may be explained by the fact that building codes do not evaluate interior finishes in terms of overall fire load.

Question 5.C Is fire load considered in building furnishings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 6 | 16 | 72 | 4 | 5 | 8 | 118 |
| No | 0 | 22 | 1 | 19 | 0 | 0 | 9 | 51 |

Comments: The overall ratio of 2:1 compares with question 5.A. However, government, academic, and insurance responses indicated more concern for furnishings, whereas, building code officials and architects showed markedly less concern. This may be because furnishings are not regulated by building codes.

Question 6.E Are flame spread ratings considered in your evaluation of building interior finish materials?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 28 | 19 | 94 | 4 | 5 | 17 | 174 |
| No | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

Comments: As expected, this response showed the universal knowledge that the parameter of interior flame spread is one of the most important considerations in building fire safety.

Question 6.F Are flame spread ratings considered in your evaluation of building furnishings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 6 | 8 | 63 | 2 | 3 | 10 | 96 |
| No | 3 | 21 | 7 | 29 | 2 | 2 | 8 | 72 |

Comments: Although there appears to be an even division of the total group opinion on this matter, contrast is evident between the building code officials and the fire services response. This might be explained by the fact that furnishing flame spread rates are not considered from the building code view point, whereas, the fire services response may possibly be indicating their recognition of the furnishing fire hazard with flame spread rates recognized as being a relative measurement parameter thereof. Unfortunately, this question is subject to being answered from more than one common premise with several resultant inferred meanings.

Question 8.K Are smoke and toxic gases considered in building interior finish materials?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 21 | 16 | 87 | 4 | 3 | 7 | 145 |
| No | 0 | 6 | 1 | 7 | 0 | 2 | 11 | 27 |

Comments: As before, a clear majority shows concern for smoke and toxic gases. Any negative response is probably predicated on requirements not in a formal building code.

Question 8.L Are smoke and toxic gases considered in furnishings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 6 | 13 | 72 | 3 | 3 | 10 | 114 |
| No | 0 | 21 | 2 | 21 | 1 | 2 | 8 | 55 |

Comments: An overall group ratio of 2:1 indicates that concern exists for smoke and toxic gases in furnishings. It is interesting to note the reverse trends of fire services and building code officials.

Question 13 Are interior contents more hazardous than the building construction materials?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 23 | 19 | 83 | 3 | 5 | 15 | 155 |
| No | 0 | 3 | 1 | 6 | 0 | 0 | 3 | 13 |

Comments: As expected a high group ratio of 12:1 thought that interior contents are more hazardous than the building construction materials. This response was prevalent in all categories.

Question 14.A Do you favor stronger code regulations governing flame spread rates on floors?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 3 | 12 | 9 | 66 | 2 | 5 | 7 | 104 |
| No | 3 | 3 | 3 | 5 | 0 | 0 | 4 | 18 |
| A/N[3] | 1 | 11 | 6 | 22 | 1 | 0 | 7 | 48 |

Comments: An overall majority indicated that increased code regulation on flame spread rates on floors was desirable. Building officials and architects were somewhat divided and a significant number of respondents indicated that the code was adequate now in this area.

Question $14.A_2$ Do you favor stronger code regulations governing flame spread rates on walls?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 11 | 10 | 66 | 3 | 5 | 6 | 106 |
| No | 2 | 0 | 0 | 3 | 0 | 0 | 3 | 8 |
| A/N | 0 | 15 | 7 | 26 | 0 | 0 | 9 | 56 |

Comments: A 2:1 group ratio existed favoring increased code regulation on flame spread rates on walls. The majority of building officials said it was adequate now and approximately 1/3 of the fire services group said it was adequate now. Fifty-six respondents out of the 168 responding indicated that the code was adequate now.

Question $14.A_3$ Do you favor stronger code regulations governing flame spread rates on ceilings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 10 | 11 | 65 | 3 | 5 | 5 | 104 |
| No | 2 | 0 | 1 | 5 | 0 | 0 | 3 | 11 |
| A/N | 0 | 16 | 5 | 25 | 0 | 0 | 10 | 56 |

Comments: A group ratio of 2:1 favored increased code regulation on ceiling flame spread rates. However, most building officials felt that the code is adequate now.

[3]A/N refers to "adequate now".

Question 14.$A_4$ Do you favor stronger code regulations governing flame spread rates on trim?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 4 | 5 | 40 | 0 | 3 | 2 | 58 |
| No | 2 | 4 | 4 | 10 | 2 | 0 | 6 | 28 |
| A/N | 1 | 18 | 8 | 37 | 1 | 2 | 10 | 77 |

Comments: A clear majority indicated that the building code is adequate now for trim flame spread rates. Building code officials, fire services, and architects appear to be predominately satisfied with the code regulation.

Question 14.$B_1$ Do you favor stronger code regulations governing flammability/combustibility of furniture?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 24 | 18 | 91 | 3 | 5 | 15 | 162 |
| No | 1 | 2 | 1 | 0 | 0 | 0 | 1 | 5 |
| A/N | 0 | 0 | 0 | 4 | 0 | 0 | 2 | 6 |

Comments: An overwhelming support is in evidence for stronger code regulation governing furniture flammability.

Question 14.$B_2$ Do you favor stronger code regulations governing flammability or combustibility of draperies?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 21 | 17 | 86 | 2 | 3 | 16 | 149 |
| No | 3 | 3 | 1 | 1 | 0 | 2 | 0 | 10 |
| A/N | 0 | 2 | 0 | 9 | 1 | 0 | 2 | 14 |

Comments: An obvious majority indicated that concern exists for stronger code coverage of draperies.

Question 15.$A_1$ Do you favor automatic door closers in apartment buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 20 | 14 | 87 | 3 | 5 | 13 | 149 |
| No | 0 | 1 | 7 | 9 | 0 | 0 | 6 | 23 |

Comments: A ratio of 6:1 felt that automatic door closers is of value in apartment buildings.

Question $15.A_2$ Do you favor automatic door closers in office buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 19 | 14 | 69 | 1 | 3 | 13 | 125 |
| No | 1 | 10 | 7 | 27 | 1 | 2 | 6 | 54 |

Comments: The group response showed less concern for office occupancies and a need for automatic door closers. The ratio from $15.A_1$ was reduced to approximately 2:1.

Question $15.A_3$ Do you favor automatic door closers in high-rise structures?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 22 | 17 | 92 | 1 | 4 | 13 | 156 |
| No | 0 | 7 | 4 | 4 | 1 | 1 | 6 | 23 |

Comments: A high group ratio of 6:1 responded in the affirmative. Of interest here is that the mention of "high-rise" seems to elicit a reaction for more stringent fire safety requirements regardless of the occupancy.

Question $15.B_1$ Do you favor fire suppression systems in apartment buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 11 | 9 | 68 | 0 | 2 | 9 | 104 |
| No | 2 | 3 | 7 | 28 | 2 | 3 | 8 | 53 |

Comments: The group response was a clear majority for fire suppression systems. However, the response of the insurance and architect/engineer concerns differs sharply from the group trend.

Question $15.B_2$ Do you favor fire suppression systems in office buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 12 | 12 | 67 | 0 | 3 | 11 | 109 |
| No | 3 | 3 | 4 | 29 | 2 | 2 | 6 | 49 |

Comments: These results align closely with those of question 15.B.

Question $15.B_3$ Do you favor fire suppression systems in high-rise buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 20 | 11 | 91 | 2 | 4 | 17 | 157 |
| No | 1 | 1 | 5 | 5 | 0 | 1 | 0 | 13 |

Comments: The group responses were almost unanimous. It is interesting to note the full support of architects for fire suppression systems.

Question $15.B_4$ Do you favor fire suppression systems in single family residences?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 2 | 5 | 6 | 19 | 0 | 0 | 1 | 33 |
| No | 5 | 5 | 8 | 77 | 2 | 5 | 16 | 118 |

Comments: A clear majority is evident on this matter.

Question $15.C_1$ Do you favor smoke detectors in apartment buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 15 | 11 | 65 | 3 | 1 | 11 | 112 |
| No | 1 | 3 | 10 | 31 | 0 | 4 | 6 | 55 |

Comments: It is of interest to note that categories "A", "B", "FS", "GOV" and "A/E" basically agree with each other with an opposing trend evident in cateogry "I" and "GI".

Question $15.C_2$ Do you favor smoke detectors in office buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 4 | 11 | 10 | 59 | 0 | 1 | 9 | 94 |
| No | 3 | 4 | 5 | 37 | 2 | 4 | 8 | 63 |

Comments: A lesser concern for smoke detectors in office buildings exists.

Question $15.C_3$ Do you favor smoke detectors in high-rise buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 15 | 12 | 66 | 1 | 0 | 11 | 110 |
| No | 2 | 3 | 3 | 30 | 1 | 5 | 6 | 50 |

Comments: In general, group concern for high-rise smoke detectors compared favorably with data in question $15.C_1$.

Question $15.C_4$ Do you favor smoke detectors in single family residences?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 16 | 8 | 50 | 3 | 2 | 8 | 93 |
| No | 1 | 3 | 7 | 46 | 0 | 3 | 9 | 69 |

Comments: Only a 3:2 ratio exits. Somewhat surprizing was the lack of support by the fire services for home smoke detectors. Strong support is in evidence by the academic, building code officials and government categories.

Question $15.D_1$ Do you favor product of combustion detectors in apartments?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 20 | 11 | 78 | 1 | 4 | 10 | 129 |
| No | 2 | 1 | 3 | 18 | 1 | 1 | 7 | 33 |

Comments: Of interest here is that, although the group response is similar to that for question $15.C_1$, the insurance category response is an exact reversal.

Question $15.D_2$ Do you favor products of combustion detectors in office buildings?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 5 | 17 | 10 | 72 | 0 | 4 | 11 | 119 |
| No | 2 | 1 | 4 | 24 | 2 | 1 | 6 | 40 |

Comments: Again, when compared to question $15.C_2$, the insurance category responded with a complete reverse trend. Also, in general, the overall response was more positive than that for question $15.C_2$.

Question $15.D_3$ Do you favor product of combustion detectors in high-rises?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 21 | 13 | 84 | 0 | 2 | 13 | 139 |
| No | 1 | 1 | 2 | 12 | 2 | 3 | 4 | 25 |

Comments: Compared to question $15.C_3$, a larger number of respondents indicated preference for products of combustion detectors. However, a reverse trend is evident in the government category.

Question $15.D_4$ Do you favor products of combustion detectors in single family residences?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 7 | 19 | 9 | 59 | 1 | 4 | 6 | 105 |
| No | 0 | 1 | 6 | 37 | 1 | 1 | 11 | 57 |

Comments: Same general response as contained in question $15.C_4$.

Question $15.E_1$ Do you favor elevator recall systems in apartments?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 3 | 12 | 13 | 63 | 1 | 3 | 11 | 106 |
| No | 4 | 2 | 3 | 33 | 2 | 2 | 6 | 52 |

Comments: With the exception of a trend in the government and academic categories, the majority favored elevator recall systems.

Question $15.E_2$ Do you favor elevators recall systems in offices?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 3 | 15 | 15 | 67 | 1 | 3 | 11 | 125 |
| No | 4 | 1 | 1 | 29 | 2 | 2 | 6 | 45 |

Comments: These results are consistent with those of question $15.E_1$.

Question $15.E_3$ Do you favor elevator recall systems in high-rises?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 23 | 16 | 86 | 3 | 5 | 16 | 155 |
| No | 1 | 1 | 1 | 10 | 1 | 0 | 1 | 15 |

Comments: The influence of the term "high-rise", is, again, obvious. The inferred logic as evidenced by the above data does not correlate with the logic of the data for questions $15.E_1$ and $15.E_2$.

Question $15.F_1$ Do you favor pressurized corridors and stairs in apartments?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 3 | 11 | 9 | 62 | 1 | 0 | 6 | 92 |
| No | 4 | 4 | 6 | 34 | 2 | 5 | 11 | 66 |

Comments: A 3:2 group ratio exists for favoring pressurized stairs and corridors in apartments. Reasonable support is in evidence in the fire service and building officials categories. The insurance response appears to support a negative trend toward same.

Question $15.F_2$ Do you favor pressurized corridors and stairs in offices?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 3 | 10 | 12 | 63 | 1 | 0 | 7 | 96 |
| No | 4 | 4 | 4 | 33 | 2 | 5 | 10 | 62 |

Comments: Most consistent with results in question $15.F_1$.

Question $15.F_3$ Do you favor pressurized corridors and stairs in high-rises?

Data:

| | A | B | GI | FS | GOV | I | A/E | Total |
|---|---|---|---|---|---|---|---|---|
| Yes | 6 | 20 | 13 | 86 | 1 | 4 | 12 | 142 |
| No | 1 | 2 | 3 | 10 | 2 | 1 | 5 | 24 |

Comments: With high-rises being considered the turn around is obvious with a resulting 6:1 ratio favoring pressurized stairs and corridors.

Although no formal presentation of data is given for questions 9, 11 and 12, certain overall group trends or tendencies for central values were observable that are noted as follows.[4]

1. Concern for fire load created by furnishings received greater emphasis when compared to building framing and interior finish.
2. Flame spread ratings of interior finish materials was thought to be the prime fire hazard concern.
3. Smoke and toxic gases were thought to be important for both interior finish materials and furnishings.

[4]Many respondents left these questions blank and an analysis of the data available suggested that some respondents used a reversed numbering scheme than that directed by the survey question, e.g., 10 being the least hazardous instead of being the greatest.

4. The group response indicated that the location of interior finish materials on the ceiling represented a greater fire hazard than either on the floor or walls.

5. Gypsum ceilings were rated as being superior to cellulosic and noncombustible ceiling tile with respect to fire hazard potential.

## 6. SYNOPSIS OF NARRATIVE COMMENTS

Of special interest and importance in tabulating the returned survey questionnaires was that out of 186 questionnaires returned, 136 respondents took the time to write in comments expressing their thoughts on a number of topics relevant to fire protection. Most of these comments could be generally categorized as being concerned with:

1. building interior contents, e.g., furniture

2. code regulation and enforcement

3. fuel load concept

4. the adequacy of the noncombustibility definition

5. sprinklers and smoke detection

6. high-rise buildings

7. smoke and toxic gas production in building fires

Because of the volume and consistancy associated with the written comments, it is felt that they are worth recapitulating as being partially representative of the current thinking of persons charged with fire protection responsibilities. Although a synopsis of the comments runs the risk of being viewed as statistically invalid, there existed well defined chains of thought suitable for discussion as follows.

### 6.1. Building Interior Contents

In addition to the overwhelming positive response (155 to 13) to question 13 of the survey, which compared the fire hazard associated with interior contents versus that of the building structural materials, a significant number of participants additionally indicated in writing that interior contents represent the primary building fire hazard and need to be controlled. Of special concern were the observations (especially by Fire Marshalls) of the increase in the use of and unfavorable fire experience associated with, plastic furniture and decor items. Although interior contents were well recognized as being in need of control, the mechanism of control was left open for discussion. However, the clear majority favored

public education and product fire safety standards as a control mechanism in lieu of traditional building code requirements. Although, some respondents suggested that interior contents be controlled by building code regulations, unaminous agreement existed that the enforcement of such regulations would be difficult to impossible and definitely not practical.

### 6.2. Code Regulation and Enforcement

The concensus of the respondents was that todays building codes are adequate, but are in need of an active updating mechanism at the local level, that is, in fact, carried out prior to unfavorable fire experience. Also, it was stated by many that present code enforcement is far too lax or weak and that some sections of code regulations were not practical from an enforcement viewpoint. Several architects noted that the codes lacked coverage with regards to building maintenance and operation and that they felt this was a major factor in building fire experience. An examination of these survey forms, also revealed that these same respondents also indicated that interior contents were the major fire hazard. Several respondents supported the need for a single nation-wide model code.

### 6.3. Fuel Load Concept

The survey questions pertaining to the fuel load concept were deleted from the analysis process because of a general lack of response. This absence of a survey response, coupled with the written comments provides a good indication that there is a lack of understanding and/or widespread resistance to the acceptance of the fuel load concept. Basically, the survey showed that the fuel load concept is not at all understood or accepted by the majority of respondents.

### 6.4. Noncombustibility Definition

The written responses regarding the adequacy of the survey definition for noncombustibility were most consistent. The survey was circulated prior to the suggested changes by American Insurance Association (AIA) using "limited combustibility" and currently being balloted as a tentative change in NFPA. The most cited inadequacies of the current definition include:

1. The noncombustibility definition, as worded, allows the use of certain plastic materials with a flame spread less than or equal to 25. This is unacceptable because of the melt/drip phenomenon, heat release potential and toxic gas and smoke production potential.

2. The absence of criteria in the noncombustibility definition governing the production of smoke and toxic gases.

3. Incorrect grammar and cumbersome readability.

4. ASTM E-84 is not a proper test method or tool for evaluating noncombustibility.

5. Materials which may satisfy the definition were, in fact, combustible as viewed from a practical viewpoint and with respect to relevant fire experience.

Along with the above cited deficiencies were suggestions for improvement. Most notable were the number of respondents (greater than 30) who stated that the ASTM E-84 test method was not being used properly with respect to the noncombustible definition and that it should be replaced by ASTM E-136. Also, a repetition of thought occurred whereby it was indicated that for a material to qualify as being noncombustible, it should not burn or glow at a temperature equal to or less than 1,200°F. One comment stated that a complete dictionary of terms was needed for those engaged in the many facets of the fire protection profession to help ensure efficient and accurate communication.

In essence, the respondents indicated that to be classed as noncombustible, a material should perform under fire conditions like masonry or concrete. It was commonly expressed that a better way to approach the problem was to utilize the concept of heat potential with additional criteria regarding smoke and toxic gas production.

## 6.5. Sprinklers and Detectors

Many favorable comments, mostly by fire marshals, were written on the merits of quick, automatic fire/smoke detection and extinguishment, e.g., smoke detectors and sprinklers. The dominant theme repeated often was that automatic sprinklers should be required for high-rise buildings and nursing homes regardless of construction. In cases where automatic sprinklers were installed, it was generally acknolwedged that code tradeoffs e.g., interior finish requirements, should be encouraged to help create economic incentives for installing automatic sprinklers.

Smoke detection equipment capability was recognized as being highly beneficial, but cost factors were identified as being the primary reason for not installing same. Of secondary importance for not installing smoke detectors was the fear of creating apathy for the smoke detection warnings because of an unreasonable number of false alarms.

## 6.6. High-Rise Buildings

The high-rise fire problem was cited as being the "now" fire problem. The various comments carried a central design philosophy recommendation at its core for high-rise buildings. The suggested design criteria "package" for high-rise buildings contained, as a minimum, the following:

1. Automatic sprinklers

2. Smoke or products-of-combustion detectors

3. Pressurized corridors and stairways

4. Emergency power

5. Central Communications center

A particular high-rise problem mentioned frequently was that concerning vinyl wall coverings and other plastic decor and furnishings.

## 6.7. Smoke and Toxic Gases

A large number of the written comments indicated a concern for the smoke and toxic gas production potential associated with building fires, particularly in regards to interior contents and plastic materials. The overall collective essence of all the comments pertaining to smoke and toxic gas production potential of materials was that this problem was not being solved or dealt with in the field and that the production of smoke and toxic gases posed the greatest threat to life safety in building fires. Many suggested that smoke and toxic gas production potential be tied in with the definition of noncombustible which would then discourage certain undesirable materials in new construction.

# APPENDIX

To: Mr. J. L. Houser
National Bureau of Standards
Technical B-66
Washington, D.C. 20234

Printed below is the "Definition of Noncombustibility" as found in National Fire Protection Association's, National Fire Code, 1972-73, Volume 4, Section 220. It is this definition which is referred to in the questions that follow.

"Classification of building types refers to the use of noncombustible material or noncombustible construction, material which, in the form in which it is used, falls in one of the following groups (a) through (c) be accepted. No material shall be classed as noncombustible which is subject to increase in combustibility or flame spread rating beyond the limits herein established, through the effects of age, moisture or other atmospheric condition. Flame spread rating as used herein refers to ratings obtained according to the Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255; Underwriters' Laboratories No. UL 723; American Socity of Testing and Materials, ASTM No. E84, tentative.

(a) Materials no part of which will ignite and burn when subjected to fire.

(b) Materials having a structural base of noncombustible material, as defined in (a), with a surfacing not over 1/8 inch thick which has a flame spread rating not higher than 50.

(c) Materials, other than as described in (a) or (b), having a surface flame spread rating not higher than 25 without evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material in any way would not have a flame spread rating higher than 25 without evidence of continued progressive combustion."

1. (A) We use the above definition without change - Yes___ No___

(B) We use the above definition except for part(s) (a) (b) (c)

(C) If you do not use the NFPA definition, on what basis do you determine noncombustibility?

_____

_____

_____

_____

_____

2. Do you apply the definition when evaluating material to be used in the following constructions?

| | | Yes | No | Not Applicable |
|---|---|---|---|---|
| (A) Type I | Fire Proof | ___ | ___ | _____ |
| (B) Type II | Fire Resistant | ___ | ___ | _____ |
| (C) Type III | Protected Combustible or Heavy Timber | ___ | ___ | _____ |
| (D) Type IV | Noncombustible | ___ | ___ | _____ |
| (E) Type V | Ordinary | ___ | ___ | _____ |
| (F) Type VI | Wood Frame | ___ | ___ | _____ |

3. Do you consider the definition adequate? ___ ___

If not, how would you alter or improve the definition?

A "FIRE LOAD" of building constructions and contents is defined as the quantity of combustible material expressed in its equivalent weight in wood, as pounds per square foot of the gross space.

| | | Yes | No |
|---|---|---|---|
| 4. | In your evaluations of building constructions, do you relate fire load to fire hazard? | ___ | ___ |
| 5. | Are you concerned with the total fire load in: | | |
| | A. Building Framing | ___ | ___ |
| | B. Interior finish materials | ___ | ___ |
| | C. Furnishings | ___ | ___ |
| 6. | Are flame spread ratings considered when you evaluate: | | |
| | D. Building Framing | ___ | ___ |
| | E. Interior finish materials | ___ | ___ |
| | F. Furnishings | ___ | ___ |
| 7. | Are heat release or "flash" points of concern in: | | |
| | G. Building Framing | ___ | ___ |
| | H. Interior finish materials | ___ | ___ |
| | I. Furnishings | ___ | ___ |
| 8. | Are smoke and toxic gas considered in: | | |
| | J. Building Framing | ___ | ___ |
| | K. Interior finish materials | ___ | ___ |
| | L. Furnishings | ___ | ___ |

9. Using a scale of 1 as the least and 10 as the greatest in degree of importance, evaluate items A. through L. in questions 4 through 8 (see page 3) as they apply to the hazards of a construction.

(Note: All could be 10 or 1 or any other number in between.)

A._____ E._____ I._____

B._____ F._____ J._____

C._____ G._____ K._____

D._____ H._____ L._____

10. Assuming that one hour of fire resistance is necessary for each 10 pounds per square foot of fire load, what would you consider as a reasonable maximum allowable fire load per sq. ft. of occupied space that should be permitted in the following:

| | Structure | Contents |
|---|---|---|
| A. Office Buildings, up to 75 feet* | _____psf | _____psf |
| B. Office Buildings, 75 feet or more | _____psf | _____psf |
| C. Apartment Dwellings, up to 75 feet | _____psf | _____psf |
| D. Apartment Dwellings, 75 feet or more | _____psf | _____psf |
| E. Mercantile Occupancies, 75 feet or less | _____psf | _____psf |
| F. Garden type Apartments, 50 feet or less | _____psf | _____psf |
| G. Town or Row Houses (connected single family dwelling units) | _____psf | _____psf |
| H. Detached single family dwellings | _____psf | _____psf |
| I. Public places of assembly such as theaters, night clubs, auditoriums, etc. | _____psf | _____psf |

*75 feet in height, accessible by fire service apparatus, is being used here to differentiate between mid-rise and high-rise buildings.

11. Please rate on a scale of 1 as the least hazardous and 10 as the highest, the following categories that you consider to be potential serious fire hazards.

A. Furnishings _____

1. on floors _____
2. in closets _____
3. in storage rooms _____
4. Other _____

B. Interial finish materials ____

5. on floors _____
6. on walls _____
7. on ceilings _____
8. Other _____

12. With regard to life safety, using 1 as the least hazardous classification and 10 as the highest, please rate the following with regard to life safety:

A. Floor coverings

1. Carpeting _____
2. Wood _____
3. Other _____

B. Wall coverings

1. Vinyl _____
2. Paper _____
3. Paneling _____
4. Paint _____

C. Ceilings

1. Gypsum _____
2. Cellulosic tile _____
3. Noncombustible tile _____

13. Do you consider the interior contents more hazardous than the building construction materials?

| | Yes | No |
|---|---|---|
| | ___ | ___ |

14. As a means to reduce, if not eliminate present day hazards, would you favor stronger code regulations governing:

| | Yes | No | Adequate now |
|---|---|---|---|
| A. Interior flame spread: | | | |
| 1. on floors | ___ | ___ | _____ |
| 2. on walls | ___ | ___ | _____ |
| 3. on ceilings | ___ | ___ | _____ |
| 4. on trim | ___ | ___ | _____ |
| B. Flammability/combustibility of: | | | |
| 1. furniture | ___ | ___ | _____ |
| 2. draperies | ___ | ___ | _____ |

15. Do you favor mandatory requirements in the structures indicated for the equipment listed?

| | 1<br>Apts | 2<br>Offices | 3<br>High-Rise | 4<br>Single Family Residence |
|---|---|---|---|---|
| A. Automatic door closers | ____ | _____ | _____ | _____ |
| B. Fire suppression systems | ____ | _____ | _____ | _____ |
| C. Smoke Detectors | ____ | _____ | _____ | _____ |
| D. Products of Combustion Detectors | ____ | _____ | _____ | _____ |
| E. Elevator recall system | ____ | _____ | _____ | _____ |
| F. Pressurized corridors and stairs | ____ | _____ | _____ | _____ |

We would appreciate any general or specific comments with reference to any questions listed.

SIGNED _____

TITLE _____

CITY _____

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NBS-114A (REV. 7-73)

| U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET | 1. PUBLICATION OR REPORT NO. NBS TN-861 | 2. Gov't Accession No. | 3. Recipient's Accession No. |
|---|---|---|---|

4. TITLE AND SUBTITLE
A SURVEY FOR THE COLLECTION OF PROFESSIONAL OPINION ON SELECTED FIRE PROTECTION ENGINEERING TOPICS

5. Publication Date

6. Performing Organization Code

7. AUTHOR(S)
Gregory A. Harrison and James L. Houser

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.
4903285

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*
same as No. 9

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

A questionnaire survey on selected fire protection engineering topics was sent to 422 persons from every state and major city in the United States and, also, parts of Canada. The surveyed included architects, engineers, insurance and government representatives, academics, and fire services personnel. One hundred and eighty six questionnaires were returned, a 46.2% return rate. This return rate is more than double the National average on survey returns. The questionnaire covered topics such as the adequacy of the term "noncombustible" as contained in the National Fire Protection Association's National Fire Code, hazards of fire loading concepts, code regulation and enforcement, furnishings, sprinkler systems and smoke detectors. In addition to the questionnaire data, many of the surveyed took the time to write in various unsolicited comments.

Although this survey does not represent a statistical study approach, it is the best effort to date to gather and document the current professional thinking on fire protection matters. When the data permitted, obvious and significant group thought ideas and patterns are documented. The objective of this survey is to collect and document professional opinions on selected fire protection engineering topics for the purpose of determining current professional thinking, and indications of future trends of thought.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)* Building construction; detectors; flame spread; furnishings; interior finishes; noncombustible; smoke development; sprinklers; survey.

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[ ] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13
[ ] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT)
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21. NO. OF PAGES
30

20. SECURITY CLASS (THIS PAGE)
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22. Price
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USCOMM-DC 29042-P74

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