

The President's Conference on

**FIRE
PREVENTION**



*Report of the Committee on
Building Construction,
Operation, and Protection*

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“The serious losses in life and property resulting annually from fires cause me deep concern. I am sure that such unnecessary waste can be reduced. The substantial progress made in the science of fire prevention and fire protection in this country during the past forty years convinces me that the means are available for limiting this unnecessary destruction.”

Harry S. Truman

A. HISTORY

Fire has been a major problem ever since this country was founded. Both in peace and war it has been responsible for widespread destruction, needless loss of life, and dislocation of business activity. Even in colonial times it was a matter of real concern, as is evidenced by early legislation against the use of thatched roofs and chimneys made of mud-daubed sticks. The Indians were not slow to take advantage of the vulnerability of the construction used by the early settlers, and their flaming arrows all too frequently found their mark.

History fails to show, however, that knowledge of how to build so as to reduce the hazards of fire kept pace with the rapid increase of congested areas, where large quantities of combustible goods were manufactured, stored, and sold, and where people lived. Firefighting appliances were primitive in type, and little legislation existed to regulate construction or to require proper precautions against the start and spread of fire. As a consequence, an appalling amount of destruction has been recorded, made up in large part of the sum of many individual fires, but punctuated here and there by conflagrations.

New York had conflagrations involving large areas in 1833, 1839, and 1845; San Francisco in 1849, 1850, and 1851; Chicago was devastated in 1871, and Boston in 1872. Since those dates, Paterson, Baltimore, San Francisco, Chelsea, Salem, Fall River, Atlanta, and many smaller places have been visited by fire which swept uncontrolled through large areas of dwellings, business buildings, and factories.

During World War II the principal damage to cities and communities was by fire. In the devastated parts of London, as well as in Germany, it is reported that destruction by fire was five times as great as that by high-explosive bombs; and in Japan the destruction by fire was still more effective and complete.

While there have been improvements in recent years in construction methods and regulations, particularly in the larger cities, there are still many communities that can be destroyed today and await only the proper combination of circumstances involving time, place, force of wind, occupancy conditions, and ignition. The alertness of our public firefighting services is an important factor in interrupting dangerous combinations of circumstances.

B. THE PROBLEM

Statistics show a property loss that has been rising steadily since 1934, with a peak in 1946, and an annual toll over that period of thousands of deaths from fire.

Certainly the failure to reduce the number of, and total damage from, fires cannot be blamed on any lack of technical knowledge. The principles of fire prevention, as practiced by our better building designers and fire protection engineers, have been known for many years.

Since all this technical information is available, what then is the explanation for the high annual fire and life loss cited? The conclusion seems to be inescapable that it results partly from failure of owners and managers of buildings to apply this information; partly from their failure to assume responsibility for the safety of the occupants; partly from willful disregard or ignorance of the fundamentals of fire protection; partly from ignorance of building laws; partly from inadequacy of laws and facilities provided for their enforcement; but to a greater degree the high annual loss is due to ordinary ignorance, carelessness, and negligence.

Even through proper safeguards are incorporated in the design and construction of buildings, and they are erected to conform to established and accepted standards and codes, and the buildings is of slow burning or fire resistive construction, serious danger of loss of life and property may still be present. The degree of that danger depends largely on the consideration given to safety in operation, to maintenance of the structure and of its service equipment, and on the character, quantity and arrangement of the materials present, and the conditions or operations to which they are exposed.

In order that a fire may not involve too much too quickly, and that there may be opportunity for its control and extinguishment, it is proper to place suitable limits on the height and area of buildings. It is especially important, in the occupancy of either new or old buildings, to isolate by fire walls or fire resistant barriers those special hazards of fire that attend the storage or presence of such materials as flammable liquids, gases, dusts, or other readily ignitable substances, or operations involving these materials.

Important though structural and operating conditions may be, the proper degree of protection of life and property requires that effective means of fire extinguishment be provided, commensurate with the conditions of occupancy.

For efficiency of protection, fires must be extinguished while they are still small. When it becomes necessary to use heavy hose streams, it is certain that some fundamental measure for fire prevention and control has been omitted or has not been effectively utilized.

C. FIRE LOSSES

Although the appalling waste of lives is the cumulative total of a great number of small fires, the large annual property losses are mainly due to a small number of large fires. The major causes of such fires are readily identified. Of 585,000 fires reported by the National Fire Protection Association in 1945, 491,000 could be classified as being due to known and specific causes. That association classifies "large fires" as those involving property losses over \$250,000. In 1940, which was an average year, there were 34 in this class; but in 1946 there were 187 large-loss fires.

In 1946, over 50 percent of the large-loss fires was outstandingly the result of inferior building construction. Only 6 large-loss fires occurred in fire resistive buildings. In 81 fires, the fire areas were excessive; and unprotected vertical openings, stairwells, and elevators were important factors in the spread of fire in 71 cases. Other factors in the vertical spread of fire in 90

buildings, involving large losses, were unprotected vents and lack of fire stopping in concealed spaces. In 8 cases, ducts for air-conditioning systems and ventilation were important factors.

Exposure or spread of fire to adjoining buildings was involved in 22 of the 187 large fires. The flammability of contents, coupled with congested storage conditions, was a major factor in 102 of 166 structural fires classified as “large fires.”

Neither automatic sprinkler protection nor automatic fire detecting systems were installed in 125 of the 154 cases where such protection was applicable.

Delayed discovery was evidenced in 87 cases, and delayed transmission of alarm in 117 cases. Without immediate notification of fire, it is obvious that even the best-equipped public fire departments are severely handicapped in their job of rescue and extinguishment.

The large-loss fires accounted for more than one-fifth of the total fire loss in 1946. The smaller fires reflect the same general pattern as to the construction, occupancy, and protection deficiencies.

D. RESPONSIBILITY

The primary responsibility for the prevention of life and property rests with the owners and managers of the premises. It is their duty to provide the necessary safeguards against fire for the occupants and the admitted public. Secondary, but equally important, is the responsibility of governmental authority in instituting and enforcing building codes and ordinances, not only for the construction and protection of the premises, but also for safety in operation and maintenance of buildings and equipment.

The public itself is responsible for the protection of property and lives of others, as well as for its own safety, and must be ever conscious of the importance of fire safety and should constantly act in conformity with this principle.

The continues increase in loss of life and property leads to the inescapable conclusion that those charged with this responsibility have been both careless and negligent.

E. PUBLIC REGULATION

Although the American public cries out against “regimentation” and cherishes freedom of action, the pursuit of selfish freedom has been an important factor in our economic fire waste and mounting loss of life.

Our fire losses have long since been recognized as a national problem, and the adoption of more severe regulations, as well as their proper enforcement, is therefore unavoidable if the welfare of the public is to be safeguarded.

Any comprehensive study of present conditions will reveal the difficulties involved in preparing laws and regulations to cope with the situation. As will be described in this report, of those codes and standards which have thus far been adopted, too many are obsolete, too many are subjective to evasions, and uniformity is lacking.

There is need for the adoption, through enabling legislation, of uniform building codes, regulations, and fire prevention ordinances that will establish requirements for safety of operations and proper maintenance of structures and of their service and fire protective equipment. The enabling legislation should provide for the proper adoption, by reference, of recognized national standards.

Codes and ordinances are of limited value unless they embrace adequate power to enforce compliance, including the right of retroactive action for the correction of certain conditions found especially dangerous to the occupants or detrimental to the public welfare, and unless there is an adequate staff to enforce them.

Governmental authority should be empowered by law to examine, approve, and regulate operations and changes in occupancy or use of buildings, with provisions for inspection by competent fire prevention and protection experts. The infliction of penalties may be necessary to effect corrective measures.

The requirement of annual licenses for places of public assembly, supported by inspection service, is an effective means for the control of operations to prevent abuses in fire safety matters.

Safety of life and limb is so compelling a consideration that inconvenience and expense are not sufficient reasons for failing to take reasonable measures that will bring buildings up to modern standards. The possible loss of buildings that provide shelter and the means of livelihood for many people is another powerful reason why action should be taken in the public interest.

Pending complete or extensive code revision, which it is recognized is a time-consuming process, consideration should be given to immediate adoption of what might be termed emergency legislation dealing with the correction of deficiencies in existing buildings.

THE REPORT

It is the purpose of this report to call attention to the important items of construction, operation, and protection that are contributing factors to loss of life and property, and to suggest measures for the improvement of conditions.

1. CONSTRUCTION

a. ***Building design and planning.*** - It has been well said that fire safety begins in the designer's office. This observation may well be expanded to state that unless adequate fire safety is established there, it may never be fully obtained, since the cost of installing safety features, although relatively minor at the time of construction of the building, may be so prohibitive at a later date as to permit only partial compliance with generally accepted standards.

Building practice is now so advanced a science that there is little excuse for erecting buildings that are deficient in any safety precautions. Structural design has progressed to the point where the safety of the building, from the strength standpoint, is taken for granted by the occupant. He has an equal right to assume that fire hazards in his building have either been eliminated or controlled.

Nor should compliance with existing obsolete code requirements be offered as justification for failure to build up to modern standards. The competent designer is well acquainted with these standards, and safe construction should be his moral, if not legal, responsibility. The owner's responsibility to the occupants of his building should not permit the designer's advice to be disregarded. The records show quite clearly that the buildings in which the major losses of life by fire have occurred have fallen short, in one or more respects, of generally accepted standards.

Stated simply, the basic principles of design of buildings for fire safety consist essentially of (1) the planning and construction of the building so as to minimize the chances of fire starting in the first instance, or of spreading beyond the point of origin, (2) the providing of sufficient and adequate exitways, so that occupants can be quickly and safely evacuated if the need arises, (3) provision for the prompt discovery and reporting of fires and the necessary facilities for their extinguishment, and (4) attention to details that will minimize the hazards of smoke and noxious gases.

Like accidents, fires do not just happen. In the final analysis, the cause can generally be traced to ignorance, carelessness, or negligence on the part of the individual. In designing the building to minimize the chances of fire starting, attention must be directed toward eliminating as many of these potential danger spots as is humanly possible. A study of the cause of fire will indicate the most promising points of attack. To mention but a few, the heating system should be adequate so as not to be readily overtaxed; clearance of furnaces, fire places, chimneys, smoke pipes, and ducts from combustible materials should be sufficient to avoid one frequent cause of fires; chimneys and incinerators should be carefully built to contain the gases and flame; buildings should have ample spacing from neighboring buildings to avoid exposure fires, and where this cannot be accomplished, exterior opening should be protected, if necessary, to prevent entrance of fire; electrical wiring should not be exposed and should be designed to avoid overloading; flammable liquids should be isolated; roofs should be resistant to sparks and flying brands; and so on down the list. Attention to these obvious danger spots will aid materially in reducing the chances for fires to start. The human equation, however, is always present; and as a defense against this, dependence must continue to be placed on constant vigilance and supervision, and on the cooperation of owners, management, tenants, and enforcing officials in carrying out fundamental rules of housekeeping.

No mention has been made of the materials of construction of the building, in this phase of the discussion, for the reason that, except possibly in the case of a building struck by lightning, or in exposure fires, discussed elsewhere, fires do not usually start in the materials of the structure, but rather in some added component, such as the wiring or heating system, or in the contents of the building. True enough, certain types of construction may promote fire more readily than others; but even here it has been found possible to apply protective measures, such as in the flameproofing of tents. The ideal condition would be that in which the materials of construction and the contents of the building were incombustible; but that, of course, is impractical for obvious reasons. Moreover, the records show that in many of the fires involving large loss of life, the actual burning of the building itself accounted for but few, if any, of the deaths – smoke, toxic gases, and panic being the primary causes.

b. ***Barriers to spread of fire.*** – Assuming that fires will continue to start in buildings, an important step in the design is to insure that barriers are provided to prevent the fire from spreading either in a horizontal or vertical direction or through concealed spaces. In rooms the partitions and self-closing doors should form the barrier to horizontal spread of fire. As to larger areas, it is customary in building codes to limit the area within fire resistive enclosures, the limits being partially determined by the nature of the occupancy and use, the type of construction, and by the extent of the fire protective measures provided. This practice limits the amount of combustibles exposed to any fire, permits more effective action by the fire department, and limits the number of people who may be exposed to the fire, thus improving their chances for getting out. Where it is necessary to have excessively large areas, as in mass production industries, and fire resistive division walls are undesirable or impracticable, a strong barrier to the spread of fire is afforded by automatic sprinklers in areas where there is a continuity of combustibles.

With respect to barriers to vertical spread, the simple rule is that no opportunity should be afforded for fire, smoke, or gases to spread from story to story. This means that all vertical openings, such as stairways and elevator shafts, should be enclosed in fire resistive walls, and that openings in such enclosures should be provided with doors of a standard approved type that will close automatically and tightly. Likewise, all openings around pipes, ducts, and conveyors which might permit the passage of smoke or gases should be properly closed. It is important to remember that many lives have been lost by asphyxiation from such causes, on floors considerably removed from the one on which the fire occurred. Considerable progress has been made in the study of venting of gases by mechanical means. The storage or use of certain kinds of hazardous materials, such as films, records, and highly combustible, flammable, or explosive materials, may require complete isolation or special separation from other occupancies. Special attention should be given to the venting of such spaces.

c. ***Concealed spaces.*** – Among the primary causes of loss of life and property from fire has been the ability of the fire to spread through concealed spaces in the structure, such as within partitions and walls, underneath or within floors, and above hung ceilings. It should be a basic principle of design that all concealed spaces between studs and joists, behind paneling and wainscoting, at eaves, above hung ceilings, and beneath floor finishes should be effectively fire-stopped with suitable material. Again, it should be remembered that it is not necessary for actual flame to spread through such spaces, as heated gases will accomplish the same effect.

d. ***Exitways.*** – If the buildings or their contents burn, they may be replaced, but not so with human lives. Insufficient or inadequately protected exitways may well be placed at the top of the list of causes of loss of life from fires. This was certainly true in many of the spectacular fires of record. Yet the fundamental principles of exitway design have been available for many years in recognized standards on this subject, which are under constant study to effect improvement in their recommendations. Once again it may be pointed out that our great fire losses are due not so much to a lack of information as to a disregard of fundamentals.

Expressed briefly, the basic principle of exitway design is that at least two safe and separate means of exit should always be conveniently available. If given freedom of operation, the competent designer would need no further guide, since all other code requirements on this subject are but detailed specifications that tell how the desired result should be obtained. The basic principle itself is filled with meaning. The requirement of “two safe means of exit” is a minimum. Additional exits must be supplied if the persons accommodated per exit exceed a certain number, which depends on the kind of occupancy and relative fire danger. The word “safe” implies that the exitway (stairway, for example) should be in an enclosure of adequate fire resistance, including self-closing doors; that the exitway should be free from obstructions, properly lighted, and suitably marked as an exit and have directional signs; that the protected means of exit should be continuous and preferably direct to the street or to some other place of refuge; that the stairway should be of adequate size to accommodate the flow of traffic and suitably proportioned; and that paths (corridors) leading to and from the stairway should protect the occupant from fire. It should also be remembered that smoke and gases may be as hazardous to life as fire itself, and that suitable measures should be taken to keep stairways free from such dangers. The expression “conveniently available” implies that the distance to an exit should not exceed that recommended by generally recognized standards for the given occupancy and fire hazard, and that the stairways should be so located as to minimize the length of dead-end spaces in which persons might be trapped.

Another point sometimes overlooked is that means must be provided to enable firemen to get at the fire. Well designed exits are valuable in this connection. In a recent fire in a building having a single stairway, it was necessary for the firemen to follow the fire up the building by means of this one stairway, instead of attacking from several points at once. In windowless buildings, some provision must be made for access of firemen to stories above the ground. This is particularly important in buildings without sprinklers. Suitable access panels have been provided in some designs for this purpose.

e. ***Installation of fire extinguishing equipment.*** - The installation of fire extinguishing equipment should be considered in the design of all new buildings. Nationally accepted standards covering such equipment are available and should be used. Since these installations require provisions, in some cases, for elevated tanks, fire pumps, and other water supplies and piping, they are frequently difficult of accomplishment after the building is erected. It is important that fire extinguishing equipment be provided during the progress of construction. Any needed supply mains and hydrants should be extended to the site and be available before the start of construction.

f. ***Occupancy and use considerations.*** – Running throughout the whole theory of design of buildings for fire safety is the matter of occupancy and use. Each type of occupancy and use has special characteristics that must be taken into account. It is for this reason that building codes classify occupancies. Thus we may find they may be classified as residential, business, mercantile, institutional, assembly, storage, industrial, and high-hazard. These main classifications may also be subdivided to take account of differences in characteristics. Thus under the institutional classification we may find two major subdivisions; one dealing with people who are harbored for medical or other care or treatment, including hospitals, for example, and another dealing with people who are detained for penal or correctional purposes, which would include prisons and asylums.

Included within these general classifications would be all buildings having similar characteristics, and in which the combustible contents and the fire hazard are comparable. The characteristics take into account the ability of the occupants to evacuate the buildings promptly in case of fire and involve consideration of whether the occupants are young or old, able-bodied or infirm; whether they are asleep or awake during the period of occupancy; whether they have freedom of movement; whether large crowds must be dealt with as in places of assembly; and whether the hazard of panic is present. The bearing which these various considerations have on the design of exitways, the type of construction of the building, the allowable areas between fire resistive walls, and the height of the building is obvious.

Control over the occupancy of buildings is customarily exercised through a certificate of occupancy. This is issued when the building is built and certifies that the building conforms to the provisions of the law under which it was built. The certificate states the purposes for which the building may be used in its several parts, the maximum permissible live loads on the several floors, and sometimes the number of persons that may be accommodated in the several stories. Codes also customarily require that no change in the occupancy classification of a building shall be made until a certificate of occupancy for the new classification shall have been issued. The certificate is of great importance in maintaining lawful conditions and is of value to the owner of the building as evidence that the building conforms to the law under which it was built.

g. ***Fire zoning and exposure.*** – The creation of fire zones or fire districts is a well established method of reducing the hazard of fire spreading from one building to adjoining structures. The probability of a fire assuming conflagration proportions is measured by the amount of fuel available for it to feed upon, and this increases as structures become crowded together in certain districts.

The fire limits should include all closely built mercantile and adjoining manufacturing districts and surrounding blocks on all sides which constitute a particular fire exposure to the district, or within which new construction of a mercantile or manufacturing character is developing. Buildings in fire districts should be restricted to those types of construction that afford an appropriate degree of protection against the spread of fire.

As a further precaution against conflagration, buildings in the fire district, unless adequately separated, should be required to have lot-line exterior walls of a definite fire resistive rating.

Provision should also be made for suitable protection of openings in buildings within the fire district, to prevent the spread of fire from one building to another.

2. BUILDING CODES

a. ***Municipal codes.*** – Thus far, emphasis has been placed upon the responsibilities of designers and owners to make use of well recognized principles. Unfortunately, as has been indicated, these principles are frequently ignored or violated, and so experience has taught the need for legal regulations that would force compliance. The quality of such regulations varies. The effect of building codes regulating new construction is certain to be gradual, applying as new buildings are erected. At the same time, existing buildings usually are not required to be changed adequately to meet modern requirements. Nevertheless, there can be no doubt that modern building regulations, if generally adopted and adequately enforced, would bring about a significant reduction in our national fire losses. Lack of alertness in keeping municipal building codes abreast of technical progress in the science of building construction is illustrated by the following figures from the files of the National Bureau of Standards, covering 3,322 municipalities in 1945:

236 had codes dated from 1942 to 1946.
387 had codes dated from 1937 to 1941.
228 had codes dated from 1932 to 1936.
484 had codes dated from 1927 to 1931.
612 had codes over 20 years old.
33 had codes with no dates.
1,342 had no building codes.

Although figures are not available, it is possible that several hundred of these municipalities are revising their codes, or planning the inauguration of codes, thus improving the situation to some extent. The picture presented is far from satisfactory, however, with reference to the number of municipalities not having codes, and with reference to the number where the code requirements are obviously obsolete. Much good work could be done by local organizations and the responsible public officials if they would investigate their own codes critically and take steps to improve them. Consideration might well be given to the suggestion that the building official be required at stated intervals to review the local code and recommend needed changes therein to the appropriate legislative authority.

Communities have a way of growing. More comprehensive requirements invoked during the process of growth will serve to prevent, at a later date, the existence of fire traps that may become the scenes of disasters such as have recently taken place.

For areas where municipal building regulations do not apply, consideration should be given to the adoption of State requirements, especially in the case of factories, hospitals, schools, and places of public assembly.

b. ***Modernization of codes.*** – Material is not lacking for use in preparing and revising municipal building codes. A great deal of attention has been given to the development of

improved requirements by such organizations as the American Standards Association, the Building Officials Conference of America, the National Board of Fire Underwriters, the National Bureau of Standards, the Pacific Coast Building Officials Conference, the Southern Building Code Congress, and other bodies. The problem is one of selection rather than improvisation. A further constructive step would be the adjustment of remaining differences, so that technical requirements would be the same, so far as is possible. This would tend to prevent confusion in the public mind, would facilitate the free flow of building materials in commerce, and would provide better safety conditions throughout the country.

c. **Uniformity.** – The difficulty of persuading more than 2,000 municipalities to adopt reasonably uniform requirements is admitted, even though the various recommendations mentioned above should be brought into approximate agreement. At present, municipal codes vary widely, not only in technical requirements, but also in size, arrangement, typography, and other features, with the result that extensive study is necessary to determine whether their requirements are adequate or not. While complete uniformity may not be reached in view of varying local conditions, the advantages to be gained point to the need for exploring some method by which reasonable uniformity could be achieved.

d. **Enforcement.** – There is a rather general belief that the mere passing of new laws will be effective in reducing fire losses. Disappointment is likely to follow if adequate provisions is not made for proper enforcement. Law depends on its administration for its effectiveness, and administration depends on the work of the chief administrator and the adequacy of the administrative machinery supplied him.

To mention but one branch of administration, the building departments of many of our municipalities are decidedly deficient in those things that are necessary to good enforcement of laws. It is a mistake to regard the office of building official as of minor importance. Considering the features of health and safety involved, the complexity of designs submitted for approval, and the volume of construction that goes on each year, the office is one of great responsibility. The administrator should therefore be well qualified for the office. While there are a number of able building officials, it is an unfortunate fact that the salaries paid by many of our municipalities are too low to attract first class administration or to retain them after they have become experienced in their jobs. This condition usually extends throughout the department, and, as a result, most of the building departments are so understaffed as to make it impossible to carry out proper inspection of buildings to determine compliance with the law. A lack of such technical assistance, moreover, is often responsible for failure to modernize the local code. And even though the local code is adequate, its effectiveness is frequently lost because of this defect in the enforcement machinery.

The budgets for such departments should be determined in accordance with the importance or quantity of the work to be performed. Hence, notwithstanding present increased cost of government, attention should be directed toward examining the present composition of local building and fire departments, to see that they are properly staffed and that rates of pay are sufficient to attract and retain first class administrators.

At the present time, the respective functions of the building and fire departments are not adequately defined in many cities, with the result that the possibility of misunderstanding, friction, and evasion of responsibility is always present. When the enforcement of building ordinances, fire prevention ordinances, and the operations of the fire department are not administered by a single authority, the legislative authority should clearly define the duties and responsibilities of the respective agencies.

As a general rule, the enforcement of the provisions of the building code, unless specific exceptions are made, should be the responsibility of the building department. Any exceptions should clearly place the responsibility for their enforcement.

The duties of the fire department should cover the supervision of housekeeping and maintenance of buildings, so far as they pertain to fire prevention; the maintenance of fire extinguishing equipment; the storage of combustibles and inflammables; and the extinguishment of fires.

In any event, the closest cooperation and harmony between the respective enforcement agencies is imperative, and each should report hazardous conditions and violations of law to the official having jurisdiction.

3. DEFICIENCIES IN EXISTING BUILDINGS

a. ***Relative importance.*** – It has already been indicated that life and property loss will probably not be so serious in buildings to be erected in the future, both because of the very gradual increase in the number of such buildings as compared with the total in existence and because the means are at hand for avoiding past mistakes in design and construction. The problem of how to bring existing buildings up to reasonable standards, however, is a very pressing one and calls for vigorous and intelligent action. Fortunately, the legal basis for such action is fairly well established in the principle that public authorities have the power to require the correction of unsafe and unhealthful conditions. This is true even though the buildings concerned complied with the laws in effect at the time of their erection. Wise and effective use of this power requires that only those measures should be demanded that are clearly reasonable and practicable in the light of experience and of modern standards of design and construction. This may mean that existing buildings cannot be brought up to the level of new buildings in all respects, but it opens the way to correction of many hazardous conditions that are indefensible in our present state of knowledge.

b. ***Major deficiencies.*** - Principal points of weakness in existing buildings have been repeatedly demonstrated in actual fires. The presence of open stairways and elevator shafts; the improper disposition or inadequate protection of combustible contents, construction, or interior finish; the lack of adequate means for restricting spread of fire; and the omission of devices that will give prompt notice of excessive temperatures are all familiar features of older types of buildings. Many others could be cited.

Much good could be accomplished through the preparation of a check list of such deficiencies, which could be used in surveys of existing structures with a view to recording their worst

features. Such a list should serve as a useful means of enlisting the attention and cooperation of building owners and, in many cases, should lead to voluntary corrective measures. In fact, education in this and other ways should provide a sound basis for better understanding of the need for improvement and, in many cases, may be expected to bring about changes without the necessity for orders from public authorities.

c. **Corrections .** - Each building owner is on constructive notice as to his obligation under a building code, and many owners will no doubt be willing to make necessary changes in existing buildings, once the necessity for doing so is appreciated. However, no general improvement can be counted upon without enforcement of minimum measures by public authorities. Such measures may take the form of adequate enclosure of elevator shafts; separating banks of elevators into not more than three in the same enclosure; adequate enclosure of stairways; a requirement that doors opening into an exitway shall be self-closing; adding stairways or other means of exit where provision of means of escape is deficient; subdividing excessively large areas; elimination of grills in exitways; closing of movable transoms and substituting wired glass for plain glass in them; avoidance of ventilating systems (natural or mechanical) that exhaust air from assembly or sleeping rooms into exitways; and providing suitable alarm and extinguishment devices. The extent to which such changes will be required will vary with the occupancy, greatest emphasis being placed on improving the protection to those occupancies where people are infirm or are confined, or where sleeping quarters are provided. Especially in need of attention are old hotels in small communities, buildings converted to multi-family occupancy, and farm residences and resort hotels, particularly where they are outside the firefighting zone and are of substandard construction.

4. FIRE PROTECTION

It is unfortunately true that the property owner, all too often, gives little attention to the provision of proper fire protection necessary to safeguard life and prevent economic waste. He relies heavily on the public fire department for the protection of his property and the lives of its occupants. Also, reliance is too often placed on insurance organizations to determine the degree of protection required at any property, and the owner is prone to think in terms of monetary protection and does not consider the possible loss of life and property. Under such conditions, it is easy for the property owner to shirk his responsibility to himself and the community.

Fire prevention and protection, like building design and construction, is a science, and standards have been established that indicate the extent of protection required. The degree of protection is determined by the nature of the occupancy, the type of the construction, and, in some cases, the exposure from nearby structures.

All large fires start from small ones, for which reason it is important that fires be discovered and attacked in their incipiency. When they reach such proportions that it becomes necessary to use heavy hose streams for extinguishment, some fundamental measure for fire prevention and control has been omitted or has not been effectively utilized.

a. ***Hand equipment.*** – In buildings where people are always present, simple hand equipment, for application of water or suitable chemical materials, will enable the extinguishment of most fires with slight loss, if the equipment is conveniently placed and is used intelligently. In fact, fire records indicate that at least half the fires are so extinguished. This equipment includes water and sand pails, carbon dioxide, dry powder, carbon tetrachloride, and other chemical type extinguishers and small hose hand lines.

b. ***Automatic sprinklers.*** – Wherever there is considerable and continuous combustible material present, either in a structure or in its contents, means for the prompt automatic application of water or other extinguisher is a basic consideration.

Automatic sprinkler protection has a long proven record for controlling fires in their incipiency, for limiting property loss, conserving water supplies, and preventing loss of the lives of occupants of buildings and of firemen in fighting fires. Automatic sprinklers may also be applied to offset, in some cases, the danger in existing buildings.

The modern sprinkler system is equipped with an automatic alarm, actuated by the flow of water through the pipes. Thus a sprinkler system serves three purposes. It discovers the fire, applies water promptly, and sounds an alarm. Some alarms are connected electrically to central stations; and within a few minutes after a fire starts, even in unattended properties, the fire department is enroute to the fire.

So efficient is this form of protection that statistics taken from detailed reports of many thousand fires in sprinklered buildings of all occupancy classes over a period of 49 years show that 96 percent of the fires was extinguished or controlled by sprinkler action. Records also indicate that the total losses in such fires were about 10 percent of those in properties without sprinkler protection. To be effective, sprinklers must, of course, be fed by an ample water supply and be properly maintained.

The provision of properly maintained automatic sprinkler protection in many of the older mercantile and general occupancy buildings that line the “Main Streets” of the Nation would bring a material reduction in the national fire waste and reduce the threat of conflagration that exists in many such built-up areas. In many modern buildings of fire resistive construction, including hotels and places of public congregation, automatic sprinkler protection is urgently needed in basements, service and storage areas, incidental mercantile occupancies, and other vulnerable parts, as a safeguard for the lives of occupants.

It is especially unfortunate that property value considerations have often precluded the installation of needed automatic sprinkler protection in many dormitories, hospitals, and homes for children, the aged and infirm, in which the construction is inferior, thereby unduly exposing the lives of the occupants to loss by fire.

c. ***Special extinguishing equipment.*** – There are certain occupancies and hazards that require special extinguishing equipment. These include storage and manufacturing operations involving the use of highly volatile liquids and materials, where the use of plain water is ineffective or undesirable. This extinguishing equipment includes foam, carbon tetrachloride,

carbon dioxide, inert gas, dry powder, and fine water spray, all of which may be manually or automatically controlled, depending upon the conditions involved. Such equipment should be designed and installed according to recognized standards.

d. ***Standpipes and hydrant systems.*** – For multistoried buildings or industrial plants of very large area, a well designed and properly equipped and maintained standpipe system constitutes an effective means for the extinguishment of fire particularly where there is no automatic sprinkler protection. Standpipes are designed for use by fire departments and those trained in handling heavy fire streams. The standpipe system furnishes the most reliable and quickest means of obtaining effective hose streams in the upper stories of high buildings. Some standpipes are supplied by public water or private water supplies; others, particularly for use in very high buildings, are dry and have connections on the street for the use of public fire engines.

In isolated and country areas great reliance is placed on yard hydrants for heavy fire streams, and in many cases these hydrants are the principal fire protection. Where private water supplies are provided for hydrants, standpipes, and sprinklers, hydrants should be used with judgment, particularly by public fire departments, in order not to deplete the water supplies.

Recognized standards for standpipes and hydrant systems are available and should be used.

e. ***Alarm systems.*** – The prompt discovery of fire is a prime requisite of efficient extinguishment and, in most cases, it is of vital importance that immediate steps be taken to warn and evacuate the occupants of a structure and to summon assistance.

A properly designed alarm system can serve both life safety and property protection.

1. ***Public alarms.*** – Public fire alarm systems are provided in all large cities and in many of the smaller communities. While in general the pull boxes on the street are reasonably well located, there is need for more complete utilization of this service, so that the full value of the public fire department can be realized. The public, watchmen, and occupants of buildings should be trained to “Call the Fire Department Before Attacking the Fire.” Convenient means of notification should always be available, particularly at schools, institutions, hospitals, hotels, large apartments, theatres, and all places of public assembly where safety to life is a compelling factor.

2. ***Private alarms.*** – Fire alarm warning systems are an essential precaution in many buildings where safe evacuation of the occupants is a prime consideration, such as in schools, dormitories, and hotels. Warning systems should receive special attention where possibilities for panic exist.

3. ***Fire detecting systems.*** – It is again emphasized that prompt discovery is a prime requisite of efficient extinguishment. Where buildings and areas are equipped with sprinklers, the water-flow alarms can be utilized for discovery, warning, and to summon assistance. For areas not so equipped, automatic fire detecting devices and systems are available for these purposes. They can be used to advantage where conditions do not warrant automatic sprinklers, at properties not constantly attended, and in important areas with combustible construction or contents. These systems are operated by thermostatic or smoke detecting devices.

4. ***Supervisory and central station service.*** – The dependability of all alarms and signaling systems depends upon their maintenance and upon the testing and supervision service,

including those for automatic sprinkler systems and watchman patrol service. Various organizations that maintain central station service for all types of alarms have been established and are available in most cities.

These organizations serve as an important adjunct to the public fire and police departments. This service provides not only the supervision of electric circuits for the alarm and signaling equipment, but also includes a central station with constant attendance, where alarms are immediately transmitted to the fire department. Such organizations maintain runners who are familiar with the premises so protected and respond to all alarms or trouble signals. They inspect and test all equipment at regular intervals. This dependable service is generally desirable at locations involving large values and at all locations where hazards to life is an important factor.

f. ***Watchman service.*** – An important adjunct to the fire protection of a property is the watchman service. The value of the service is no greater than the reliability of the man. For the protection of the owner and the watchman, it is desirable that his rounds be recorded on a standard watchman's clock, unless central station supervisory service is provided.

It should not be overlooked that the normal property, which operates during daylight hours only, is under the absolute and sole supervision of the watchman for as much as two-thirds of the time during the year. Therefore, an active, intelligent, and well trained person should be selected for this job, instead of one who is merely a clock-puncher or who is not far from the unemployment stage.

In addition to providing this service at properties that operate only part-time, it is of utmost importance that recorded watchman service be maintained in buildings occupied by the public at night, such as hotels and hospitals, as well as institutions and dormitories.

g. ***Public protection.*** –

1. ***Fire departments.*** – There is much evidence that the public fire departments, which normally are employed with complete authority over a property when they respond to an alarm, do not always understand or appreciate the effectiveness of the expensive private protection that has been provided by the property owner. Some fire departments are often guilty of closing automatic sprinkler valves upon arrival at the property, when such protection was controlling or at least confining the spread of fire. The public fire department at times is not familiar with the arrangement of the interiors of the building or with the specially hazardous locations where the blind application of water from hose streams could be detrimental to efficient extinguishment. While great strides are being made in the education of public firemen, it behooves all property owners to invite and, where necessary, to insist that the public fire department visit and become familiar with their premises. It is usually a worth while investment to take the necessary time to guide the firemen through the building and explain in detail the hazardous processes, the proper procedure to be followed, and the private protection that has been installed. It is necessary that the owner cooperate with and assist the public fire department before the fire.

2. ***Public water system.*** – Public water systems play an important part in both fire department and private protection. These systems, which are permanent installations, are costly to install, and in many communities they have not kept pace with the building expansion and increased demands for water. Normal improvements have been delayed in the last 5 years by

war and material shortages. Postwar demands for water have increased, rather than decreased. The governmental authorities, as well as the water department operators, whether public or private, have an obligation to the community to maintain adequate water supplies and pressures for firefighting service. Some systems are great sources of income to the municipality, and governing bodies hesitate to make improvements lest they jeopardize this income. They are wary of bond issues, raising of rates or other major expenditures, until an emergency arises.

Excessive charges made by some water departments for the use of public water for automatic sprinklers and other private fire protection have discouraged the installation of such protection. They fear that water from fire protection systems will be wasted or used for domestic purposes. Such fears are for the most part unfounded. Automatic sprinklers actually conserve water supplies, since they attack the fire in its incipiency. Records indicate that 90 percent of all fires in sprinklered properties is extinguished with less than 10 sprinklers and 80 percent with less than 5 sprinklers. The public fire departments must invariably use much larger quantities of water for extinguishment.

If public water officials were better informed as to the function and operation of private protection, they would do more to encourage public water connections for fire service.

5. OPERATIONS AND MAINTENANCE

In addition to good design of buildings and equipment and the provision of adequate protection, effective measures in regard to the operation or use of a property are imperative, in order to reduce our national waste of life and material resources by fire.

There are certain fundamentals in operation and maintenance for fire safety common to all types of buildings and occupancies. These are supervision, organization, education and training of personnel, good housekeeping, precautions against smoking, care and restriction in the use of flammable liquids, open flames and lights; and the maintenance of buildings, service equipment, and fire protective equipment in serviceable and operative condition.

a. **Management supervision.** – The very occurrence of fire is largely influenced by the extent to which the management directs its attention toward fire safety. The instigation of every precaution and safe practice is a measure of the efficiency of management supervision, just as carelessness, poor housekeeping, poor maintenance, and disregard of fire hazards indicate ineffective supervision.

It is necessary that management closely supervise all operations and personnel and be particularly attentive to elimination of fire hazards. The instigation and successful consummation of a fire safety program, incorporating those features specified in this report, is urged. Attentive supervision of the procedures established is necessary.

b. **Personnel training.** – The training and education of the personnel in fire protection principles and practices are essential parts of a fire safety program. In a large organization, a separate department may well be established, in charge of a qualified fire protection expert, to

whom should be delegated the necessary responsibility and authority to direct and enforce necessary fire safety measures.

In smaller organizations, the magnitude and scope of the training program will be correspondingly less. Department heads, after themselves being trained, may be utilized to train other employees. Qualified persons may be brought in from the outside for lectures and short courses.

Such a program may be developed by the holding of periodic instructive meetings and lectures, and by the use of visual education, bulletin board notices, instruction sheets, pay-roll envelope stuffers, and well-placed signs designating location of fire protection equipment, exits, building service controls, and areas or rooms of special hazard, etc. Education and interest in fire protection may be augmented by simulating competitive interest among employees, holding contests, issuing prizes, and using suggestion boxes. Public address systems, where provided, may be utilized for broadcasting of fire safety messages.

Personnel training should include instruction in proper procedures in case of fire. The importance of notifying the public fire department as soon as fire is discovered should be stressed. During periods of alteration and repair, the workmen, whether employees of the property or outside contractors, should be bound by the established regulations at any property. The importance of carefulness and good housekeeping should be impressed upon all employees.

The organization and training of a plant fire brigade should be a part of the personnel program. Thorough training and instruction are needed in the location, care, and handling of firefighting equipment, method of firefighting, safeguarding of undamaged property, and in assisting occupants to evacuate the premises. Members should have full knowledge of the operation of all fire protection equipment. It is important that all watchmen be included in training programs and be given special instructions for proper emergency procedures when in sole charge of the premises.

The number of persons in the brigade and the scope of their training and duties will depend upon the nature of the occupancy, magnitude of the premises, total number of employees and periods worked, existence of special hazards, and availability of outside aid. Regular drills should be held to maintain the efficiency of the brigade.

c. ***Training of the public.*** – A comprehensive program of fire safety education is needed for the public, in order that each individual citizen may become informed and appreciate his responsibility in fire safety to himself, his associates, and the community at large. Favorable public opinion and cooperation, based on a sound educational program, is essential, and local agencies should lend their efforts to this end.

For the safety of the premises and of the admitted public, certain safe practices should be followed. It is generally desirable that smoking be curtailed and by all means not done in bed, whether in a hotel or in one's own home. All fire protective equipment, such as extinguishers, hose lines, and fire alarm boxes, etc., should be so located as to be both visible and accessible.

This can be accomplished by the use of notices, signs, and posters. Where public address systems or radios are available, safety messages can be transmitted.

Responsible management can accomplish much in training the public, including its customers, by encouraging them to observe the safety features it has established for its premises.

d. ***Building maintenance.*** – It is important that a building be maintained in good repair, and that protective features incorporated in the design and construction of the building not be impaired or destroyed by building alterations, ornamentations, changes in occupancy, etc. The major structural parts of the building, such as a framework, floors, roof, walls, and enclosures for floor openings should be maintained in good repair, and the fire resistant character not adversely altered. Where wired glass windows, fire shutters, or outside sprinklers are provided as protection against exposure, it is desirable that they should not be removed unless the exposure is removed. This protection should be kept in good repair.

Fire doors in division walls and partitions, and stairway and elevator doors, are important features for retarding the spread of fire and for the protection of the occupants. The functions of these doors are not only to confine fire to its area of origin, but also to retard the fire's spread by elimination of draft, and to afford safe passage and refuge for the occupants.

e. ***Service equipment.*** – The various items of service equipment provided in a building are likely causes of fire if they are not properly installed or are poorly maintained, overloaded, or otherwise abused.

1. ***Heating equipment.*** – The heating facilities for buildings or manufacturing equipment contribute to the hazards of fire and accordingly need careful and competent supervision. Sources of trouble include obstructed, defective, or dirty chimneys and flues, improper combustion of fuel, inadequate ventilation, poorly located fuel tanks, oil leaks, improper maintenance of combustion safeguards, combustibles stored too near to boilers, furnaces, and steam pipes, and the use of combustible containers for ashes.

Other devices employing open flames or glowing metal are used inadvisedly near flammable materials, liquids, and gases. Unless the use of this equipment is carefully supervised and maintained, the hazard of fire and explosion is appreciable.

As evidenced by the number and seriousness of the fires involving the operation of kerosene or range oil heaters and stoves, particularly in dwellings, camps, barracks, and on the farm, greater realization of the hazard and greater care in operation are needed.

2. ***Electrical equipment.*** – The uses of electricity are so diversified that fires attributed to failure of electrical equipment or to faulty installations have been outstanding for many years in the list of causes.

All electrical equipment should receive the best of maintenance, and due regard should be given to the standards adopted and incorporated in the National Electrical Code. The use of temporary wiring during alterations is a frequent source of trouble and should be reduced to a minimum. Such wiring should be replaced with a permanent installation as quickly as possible. The improper use of fuses and the overloading of circuits deserve careful attention.

Electrical equipment should receive frequent inspection by competent persons. It is also important that electrical power be controlled by central switches, which can be opened when power is not in use. The use of warning or pilot lights and thermostatic controls is desirable on all electrically heated devices.

3. *Air conditioning.* – By the nature of the design of an air conditioning system incorporating ducts, it may readily be the means of conveying fire or smoke throughout a building, resulting in considerable property loss or even loss of life by creating a panic among the occupants. Dust accumulating in ducts, plenum chambers, and on filters is conducive to fire and capable of evolving considerable quantities of smoke when burning.

In addition to providing safeguards and protective equipment in the design and installation of air conditioning equipment, it is necessary that proper maintenance and cleanliness of the equipment be given attention. Clean ducts and clean filters will mean the absence of fuel for a fire within an air conditioning system, and proper maintenance of the mechanical, electrical, refrigeration, and heating equipment of the system will reduce causes of fires.

4. *Miscellaneous service equipment.* – Refrigerating equipment, elevators, escalators, and other miscellaneous service equipment require careful servicing and maintenance by competent men. Housekeeping features are also important. Waste and rubbish accumulations in the bottoms of elevator shafts, and lint and grease accumulations on the walls and elevator guides, are means for the quick vertical spread of fire and smoke. Leaks of refrigerant may be dangerous, and in buildings of public assembly the use of nonflammable and nontoxic refrigerants is recommended.

f. *Fire-protective equipment.* – The proper maintenance of fire protective equipment is essential. Equipment should always be available and in operative condition. Good operating condition can best be assured by frequent inspection and tests.

Distribution of water from automatic sprinklers should not be obstructed by high-piled merchandise, partitions, decks, and large tables. Sprinklers should not be removed or omitted because they are considered unsightly. Fear of water damage to contents or to electrical installations from accidental operation is generally unfounded. At each property, some trained and responsible person should be designated to inspect and supervise all fire protective equipment.

The establishment of a self-inspection service has proved to be a most valuable effective means of guarding property against fire and maintaining a high standard of maintenance and safety. Written reports of all inspections should be submitted to responsible management, and prompt action taken to correct all faulty conditions. Chemical extinguishers and other first aid fire extinguishing equipment must be accessible and clearly visible to the occupants.

Effective supervision of valves, alarms, and water supplies is available through central office supervisory service companies, and this service is generally more effectual than local supervision.

Fire alarm and fire detecting (or thermostat) systems of all types require frequent testing and inspection. The systems supervised by a central station agency insure quicker response by public fire departments; but it is usually advisable to have local alarm bells also.

The testing and maintenance of these alarm systems, as well as water flow alarms for sprinkler systems, are the responsibility of the management of the property.

g. ***Operations problems.*** –

1. *Housekeeping.* – Poor housekeeping is one of the most prevalent causes of fire. Good housekeeping is not the mere removal of waste material and rubbish, although this is of prime importance. The elements of good housekeeping also include the arrangement of storage in an orderly fashion, the segregation of hazardous processes and highly flammable materials to prevent undue exposure to other contents, and the avoidance of excessive floor loads and congestion. Small storerooms, janitor closets, pipe, electrical cable, and elevator shafts; basements, attics, and other places occupied infrequently; drug and anesthesia rooms, X-ray film vaults; oil, paint, and solvent storage rooms; mattress and furniture storage rooms, paper-bailing rooms, and repair shops are all areas requiring special attention if good housekeeping is to be maintained.

Surplus or supplemental furniture, machinery, and storage have no place in halls, corridors, stairways, or building exits; for if they do not contribute to the spread of fire, they frequently obstruct the passage and free exit of the building occupants, or impair the action of the firefighting forces.

The insistence on excellent housekeeping and orderly arrangement of contents impress both the employees and the public and has been found to be a profitable procedure.

2. *Smoking and careless use of matches.* – Smoking and the careless use of matches is one of the greatest sources of ignition. In addition, many of the fires attributed to unknown causes are undoubtedly the result of careless smoking and disposition of burning matches. The average smoker seldom realizes the hazards of his habit. Some act with deliberate and selfish disregard of their own safety or that of others.

It is possible for smoking to be done safely, if the smoker uses proper precautions and chooses suitable locations. It is generally desirable that smoking be restricted to safe areas and to places where suitable equipment is provided for the disposal of burned matches and butts.

Control of smoking may be effected by collective cooperation between management, employees' union, and the public in general. Furthermore, the prohibition of smoking in dangerous areas may be enforced by governmental authorities, through the adoption of suitable laws and ordinances. Some cities have instituted such action. For example, New York has been successful in a campaign against smoking in retail stores, as well as other places, through the application of an ordinance against smoking in places of public assembly, coupled with the enforcement of compliance by arrests and fines.

To cope with this smoking problem, it is evident that the public must be educated further regarding the hazard. It has been suggested that manufacturers of matches print on the package

or wrapper a notice of warning or caution relating to the careless disposal of cigarettes and matches. The same precautions should be displayed as part of the printed matter on packs of cigarettes.

3. *Special hazards flammable liquids, and gases.* – In many buildings, there are operations or contents that are more hazardous than the normal or common hazards incidental to all properties in general. These are called “special hazards,” and from the fire protection view point require special and individual attention.

The careless and improper use of flammable liquids and gases, whether in the home, in buildings open to the public, or in manufacturing plants, has resulted in many disastrous fires and much loss of life.

The use of flammable liquids for home dry cleaning, and careless use of gasoline in repair shops and service areas, are extremely dangerous. The substitution of less flammable liquids wherever possible should be encouraged.

Where the use of the more flammable liquids and gases is necessary in hospitals, industrial plants, and shops, the amount of these materials should be limited to the daily needs, with main supplies stored in properly ventilated and isolated tanks, vaults, or buildings.

Areas involving the use of large quantities of flammable liquids, highly flammable materials such as pyroxylin plastics, magnesium, etc., and manufacturing equipment subject to fire or explosion, require isolation from main workrooms and areas housing large groups of people.

It is good practice to “Post” these areas and to warn everyone of the hazards. It is extremely important that all employees engaged in hazardous occupancies be fully instructed of the dangers involved and be trained in proper procedures to meet an emergency.

4. *Flammable fabrics and decorations.* - Long-nap fabrics of a material more flammable than wool, silk, and nylon, and other highly flammable materials, are extremely dangerous as wearing apparel. Celluloid buttons and trimmings and pyroxylin-coated materials are also dangerous. A garment should not be made of material so flammable that, if ignited, the wearer cannot take it off, without getting seriously burned.

Considerable progress has been made in removing garments and trimming of a highly flammable nature from the market. This has been accomplished by enactment of appropriate legislation, and through education by interested technical and business associations.

Flammable draperies, decorations, upholstery, rugs, and bedding have contributed to the spread of fire and the mounting loss of life, particularly in residential buildings. Combustible decorative trim, although part of the building structure, nevertheless falls in the same category. Proxylin-coated upholstery fabrics are extremely hazardous.

Consideration should be given to the flame-proofing of flammable fabrics, decorations, draperies, and clothing, or to avoiding the use of such flammable materials when possible in buildings where the public is admitted, such as hospitals, hotels, theatres, auditoriums, restaurants, and night clubs.

h. **Technical organization aid.** – There are numerous private and public organizations actively engaged in the field of fire prevention and protection, which are in a position to render considerable assistance. Informative printed matter, including comprehensive technical data, is available to all. In addition, many trade associations, as well as technical and business organizations, frequently devote efforts to fire protection.

Insurance companies maintain large technical staffs of experienced engineers to assist property owners and managers as to recommended procedures and improvements. The services of private, practicing, fire protection engineers are also available.

Management should seek information and assistance through these various channels, heed the advice given, and comply with recommendations submitted.

RECOMMENDATIONS

The committee recommends that greater attention be given by designers of buildings to the recognized standards of construction and to strict compliance with established codes and regulations; that governmental officials review the adequacy and extent of existing regulations; that owners and managers of buildings adhere to safe practices and observe standard rule of fire safety; that aggressive action be taken to accelerate the installation of automatic fire protection in new and existing buildings, particularly where safety to life is a compelling factor; and that designers, owners, public officials, and the public in general assume their full obligation for the elimination of fire hazards. Specific measures to this end are recommended as follows:

I. CONSTRUCTION

a. **Planning and design.** – Every effort should be made to arouse owners, architects, and designers to a sense of their responsibility to the occupants of buildings, so that structures are erected with due regard to the fundamentals of fire safety. Special attention should be given to:

1. The selection of construction materials with regard to the height, area, occupancy or use, and the facilities that will be available for fighting fires.

2. The design, so that adequate vertical and horizontal barriers are included, to prevent the spread of fire, smoke, and gases. All vertical shafts should be in fire resistive enclosures, and all entrances to shafts and stair enclosures should be equipped with self-closing doors.

3. Exitways, so that two independent means of exit will always be available and so that the venting of main areas into exitways is avoided.

4. The interior facing materials of walls, ceilings, and exitways, so that they be selected with regard to their ability to resist spread of flame, in keeping with the nature of the occupancy or use of the building.

5. The possibilities of a structure adding to the conflagration hazard in the district.

6. Private fire protection, so that such protection is included in the original design where needed; any needed water supplies are extended to the structure prior to erection operations; and needed protection keeps pace with construction.

b. ***Building codes and fire protection ordinances.*** –

1. Building code and fire protection ordinances should be provided for all cities and large communities. Where existing legislation is obsolete or inadequate, it should be modernized. State laws that involve prohibitive costs for the publication of changes should be amended so that publication is satisfied by posting new regulations in the office of the building inspector, county court house, or post office.

2. Consideration should be given to increased use of State enabling acts permitting municipalities to adopt standards by reference.

3. Legislation should be enacted or laws amended to give building officials reasonable latitude in the approval of new materials or methods of construction. Municipal authorities should ascertain that their building and fire departments are adequately staffed for enforcement, and that the rate of pay will attract and retain qualified administrators.

4. Provisions should be made in building codes for the issuance of certificates of occupancy, as an aid to maintaining lawful conditions in buildings and as a measure of control to prevent the development of hazardous conditions.

5. When the enforcement of building and fire prevention ordinances and the operations of the fire department are not administered by a single authority, the legislative authority should clearly define the duties and responsibility of the respective agencies.

As a general rule, enforcement of building code requirements, unless specific exceptions are made, should be the responsibility of the building department. The duties of the fire department should cover the supervision of housekeeping and maintenance of buildings, so far as they pertain to fire prevention, the maintenance of fire extinguishing equipment, storage of hazardous materials and liquids, and the extinguishment of fires.

The closest cooperation between the enforcement agencies is imperative, and each should report violations of law and hazardous conditions to the official having jurisdiction.

c. ***Deficiencies in existing buildings.*** – The construction and protection in existing buildings have been responsible for many of the more serious losses to life and property. For correction of the outstanding deficiencies, the following procedure is advised:

1. Exitways should conform with the basic principles of recognized standards, and in places of public assembly exit facilities should conform to standards required for new construction. (See sec. 1d.)

2. Stairways and vertical shafts must be suitably enclosed and protected, and horizontal barriers provided, to prevent the spread of flame, smoke, and gases. (See sec. 1b.) Subdivision of fire areas by fire resistive walls, and tight-fitting fire doors to provide for horizontal exits, should be provided where the hazard to life is severe.

3. In existing institutional or residential buildings (including hospitals and hotels), the doors of individual rooms should be constructed to retard the spread of fire and the gases of combustion. The use of door grilles, movable transoms, or fixed transoms glazed with plain glass should be prohibited. Corridor partition doors and stairway doors should be self-closing and of fire resistive materials.

4. Building owners should provide sufficient private protection for the safety of the structure, and not protection based solely on insurance credits. Where necessary, the financing

of automatic extinguishing equipment and other building construction improvements should be investigated.

5. Governmental authorities are urged to enact and enforce remedial legislation for the correction of hazardous conditions in existing structures where safety to life is a compelling factor.

II. FIRE PROTECTION EQUIPMENT

Fire loss records reveal notable deficiencies in the installation of fire protection, including hand equipment, standpipes, automatic extinguishing equipment, alarms, and water supplies, and attention should be given to the provision of equipment as follows:

a. ***Hand equipment.*** – First aid fire extinguishing equipment (sand and water pails, extinguishers, and small hose) should be provided in every manufacturing, mercantile, and storage occupancy; in every school, hospital, hotel, dormitory, restaurant, institution for care, office building, and place of public assembly or entertainment, whether permanent or temporary.

b. ***Automatic sprinklers.*** – Automatic sprinklers should be installed more generally in all large industrial and mercantile buildings, schools, institution, and places of public assembly that are of combustible construction and in hazardous areas where fire might spread in fire resistive buildings.

c. ***Special extinguishing equipment.*** – Special extinguishing equipment, such as foam, carbon dioxide, fine water spray, and inert gas should be used more generally for the protection of flammable liquids and other specially hazardous materials.

d. ***Standpipe and hydrant systems.*** – Standpipe systems should be provided for public fire department and for private use in buildings of unusual height or area, in accordance with recognized standards.

e. ***Alarm systems.*** –

1. Public fire alarm signaling systems should be expanded, where needed, to locations convenient to all large mercantile and industrial properties and to locations convenient to all schools, hotels, hospitals, public and private institutions for care, and places of public assembly.

2. Suitable fire alarm and warning equipment should be provided in all schools, hotels, hospitals, institutions, and places of public assembly.

3. Supervisory and central station service should be more fully utilized, where available, for all alarm service, including private fire alarms, fire detecting equipment, and automatic sprinkler systems.

f. ***Watchman service.*** – The quality of watchman service should be improved, and more active, intelligent, and well-trained men should be employed for this service. Watchman services should always be recorded. In addition to other protective features, night-watchman service

should be provided in all hotels, hospitals, and institutions where a considerable number of people are sleeping or confined.

g. **Public fire departments.** –

1. Public fire departments should set up at least quarterly inspection schedules for all buildings where there is a potential hazard to life, and should check the operation and condition of all private extinguishing and alarm equipment; the adequacy of public fire alarm boxes for the property; and the storage and handling of flammable liquids; and should insist upon maintenance of excellent housekeeping conditions

2. Building owners should advise public fire departments of any impairment to automatic protection, or of any other unusual conditions that could obstruct or interfere with normal procedures during a fire.

3. Public fire departments should become more familiar with the value and operation of private protection, particularly automatic sprinkler equipment.

h. **Public water.** –

1. Public water officials should review the adequacy of distribution systems and water supplies, and urge responsible officials to instigate the appropriation of funds for needed improvements. Attention is directed to war plants and large residential areas recently erected, particularly areas expanded in outlying districts where normal improvements have been delayed by the war and material shortages.

2. Excessive costs for private fire service connections should be avoided.

III. OPERATIONS AND MAINTENANCE

Attention should be given to certain fundamentals in operation and maintenance for fire safety common to all types of buildings and occupancies. These are supervisions, organization, training of personnel, building and equipment maintenance, housekeeping, smoking, and handling of hazardous materials and flammable liquids. Adherence to these fundamentals will affect the incident of fire.

a. **Suppression.** – The owners and managers of all buildings should set up hard-and-fast rules for fire safety at all structures, and such regulations should be strictly enforced.

b. **Training.** –

1. Measures should be instituted for the personal safety of the admitted public, by the use of signs and other applicable means. All floor men, and elevator and telephone operators, should be given special instructions in procedures to be followed in emergencies.

2. Fire brigades should be organized and drilled, and similar training should be extended to all watchmen and key employees.

c. **Inspections.** - A responsible employee should be delegated to make periodic inspection of all exitways, fire doors, housekeeping, smoking, and fire protective equipment, and of all conditions relating to fire hazards and the safety of the occupants or visiting public. Responsible

management should preferably require written reports and should insist that deficiencies be corrected.

d. ***Building and service equipment maintenance.*** – Competent mechanics should be employed to maintain all structures, including roofs, windows, stair and elevator enclosures, and fire doors, and all heating, lighting, power, air-conditioning, ventilating, refrigeration, and other service equipment, so that structural conditions or equipment will not cause fire or contribute to the spread of fire.

e. ***Flammable liquids and gases.*** –

1. The storage and use of flammable liquids and gases should be arranged according to recognized standards. The use of flammable liquids should be restricted wherever possible, substituting nonflammable or nonexplosive liquids. The use of highly flammable or explosive cleaning fluids in small shops and in the home should be avoided.

2. Where large quantities of flammable liquids and gasses are necessary to operation, as in industrial plants, the maintenance of adequate ventilation, the prevention of ignition, and the installation of special extinguishing equipment should be given careful consideration. Employees in these areas should be fully instructed regarding the hazards involved and the proper procedures to be followed.

f. ***Flammable decorations.*** – The use of flammable decorations, draperies, and highly combustible wall coverings should be avoided in all places of public assembly and where people sleep or are confined, as in hotels, hospitals, and institutions.

g. ***Smoking.*** – The hazard attending promiscuous smoking should be widely advertised. Where smoking is permitted, provision should be made for the safe disposal of butts and matches. “No Smoking” rules should be strictly enforced.

h. ***Housekeeping.*** – The importance of good housekeeping in preventing fires and reducing the extent of fires should be kept forcefully in mind by all persons responsible for the management and operation of buildings, and every means should be employed to acquaint the public with the need for utmost care in accomplishing this necessary end.

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