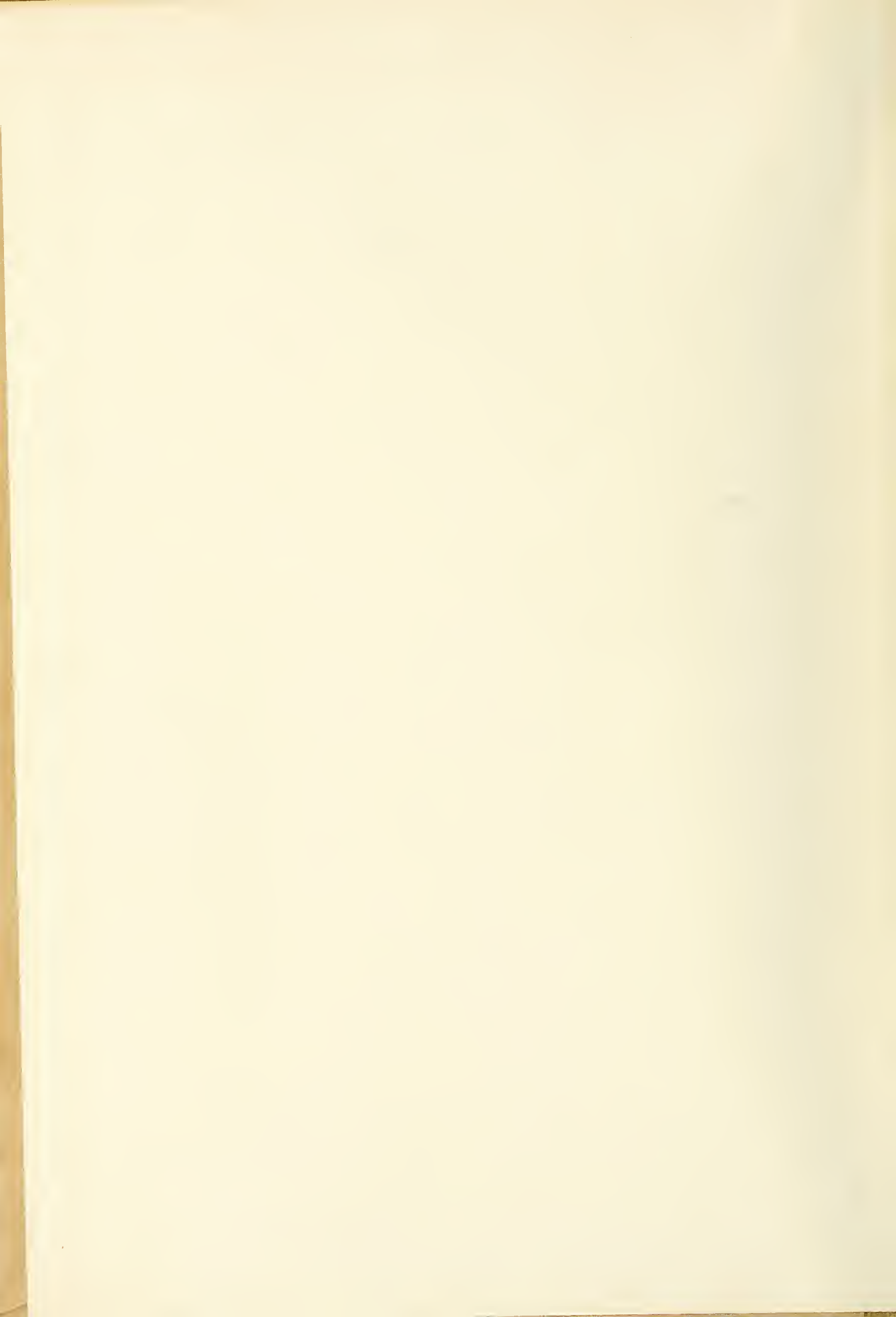


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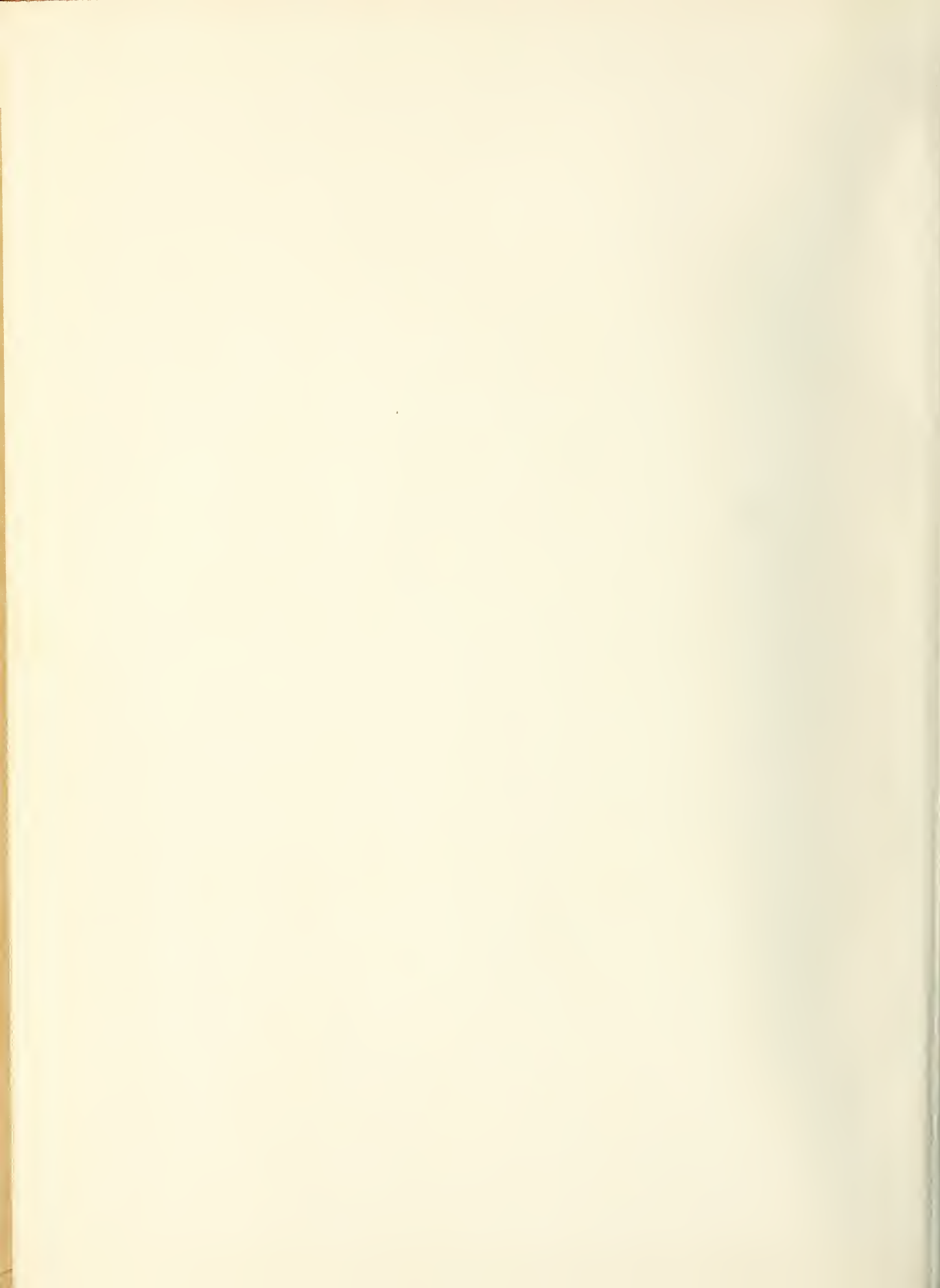


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U. S. DEPARTMENT OF COMMERCE

BUILDING
MATERIALS
AND
STRUCTURES

REPORT BMS19

Preparation and Revision
of Building Codes

by

GEORGE N. THOMPSON



NATIONAL
BUREAU OF STANDARDS



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BUILDING MATERIALS *and* STRUCTURES

REPORT BMS19

Preparation and Revision
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GEORGE N. THOMPSON



ISSUED MAY, 1939

The National Bureau of Standards is a fact-finding organization; it does not "approve" any particular material or method of construction. The technical findings in this series of reports are to be construed accordingly.

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Foreword

Efficient use of building materials depends not only on accurate knowledge of their characteristics but also on the legal restrictions imposed by public authorities in the interest of safety. If these restrictions do not recognize late developments in design and construction that have been found to be safe, they may cause unnecessary expense, prevent the free exercise of ingenuity in design, and discourage the introduction of new materials and methods.

Under present conditions, most of the preparation and revision of building code requirements is done by local officials or committees. There is available to them a great and growing mass of basic material which must be examined and utilized in the development of local requirements. The selection of necessary features and the combination of them into a series of requirements that will be at once clear and reasonable is a task which makes great demands upon those charged with this responsibility.

This report gives information on useful source material and its use, discusses principles and problems associated with building code requirements, and thus endeavors to indicate a procedure through which full advantage may be taken of developments in the laboratory and in the field, while preserving the primary object of safeguarding the public.

LYMAN J. BRIGGS, *Director.*



Preparation and Revision of Building Codes

by GEORGE N. THOMPSON

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ABSTRACT

Building construction has been subjected for many years to legal control in the interest of safety and health. While there is general agreement on the need for this, specific applications in the form of building codes have been frequently criticized on the grounds of imposing excessive expense and of failing to make adjustments to changing conditions.

The responsibility for preparing or revising building codes usually falls upon local committees. These are called upon to do a great deal of tedious and exacting work. One of their first problems is to determine what source material is available and how they should proceed.

In this discussion, a description is given of how such work is done and useful sources of technical information are indicated. Some of the problems that are encountered by local committees are mentioned, including what basic principles are involved; methods of presentation, arrangement, and numbering; advantages of using national standards and ways of referring to them; methods of recognizing new materials and new methods of construction; extent of delegation of authority to the building official and safeguards against arbitrary action; and other questions of major importance.

An attempt has been made to place committees in possession of sufficient information to proceed in their work with a minimum of lost motion. Not all questions can be answered with finality, since the situation is complicated by the existence of proposals of nearly equal merit and by differing judicial decisions. Such differences will no doubt continue to exist for some time; but they are not of sufficient importance to be allowed to obscure the main objective of providing adequate protection without creating too much of a drag on the building industry. Constructive work in the field of

building-code requirements has been going on continuously for some time and will exert an ever increasing influence. This discussion is offered to supplement such work and as a contribution to the orderly development of good requirements.

I. INTRODUCTION

The need for regulating building construction in the interest of safety and health has been felt in many times and places wherever men have lived under urban conditions. Evidence of this is to be found in the Code of Hammurabi [1],¹ which dealt with conditions in Babylon about 2250 B. C.; in various Roman laws [2]; in Fitz-Elwyne's Assize of Buildings [3], which regulated construction in London in 1189; and in a number of early colonial laws in this country [4]. Early legal restrictions were concerned largely with the hazards of fire and collapse, with health conditions appearing at a comparatively late date. In general, the nature of such laws has broadened with the passage of time so that, in addition to safety and health, they now deal also with some aspects of morals and general welfare.

Requirements, in the form of building codes, have come to be an accepted feature of modern life in all our large cities and in many small ones.

¹ Figures in brackets indicate the literature references at the end of this paper.

Like most restrictive legislation, they have always been the object of some criticism; but this has been intensified in the period since the World War. In 1921 the Senate Committee on Reconstruction and Production issued a report [5] in which it was pointed out that building-code requirements varied widely and were one source of unnecessarily high construction costs. Since that time various writers and speakers have repeated these charges and have also referred to lack of flexibility in dealing with new materials and new methods of construction. Much of this criticism is justified. However, it frequently fails to take into account the great advances that have taken place in codes in recent years, and it constitutes a negative rather than a constructive approach to the problem. In order to effect further improvement, it is necessary to undertake the tedious and exacting task of analyzing present code deficiencies and working out a pattern of requirements that will assure the primary object of safety while giving heed to legitimate economies and necessary adjustments to changing conditions.

In well over 100 cities and towns each year, work is undertaken on the preparation of a local building code, either as a revision of a former document or as preparation of a completely new series of requirements. Usually this work is entrusted to a group of citizens chosen for their special qualifications or interest. The responsibility placed upon them is a heavy one. Utilizing such materials as they can gather, they must proceed to draw up proposed requirements that, if observed, are to assure the safety of building occupants and of those whose customary activities take them into and about buildings. Yet they must keep an eye on the effect which such requirements will have on building costs, since too rigid requirements may so discourage building activity that not enough new construction will be erected to take care of normal needs. Such local groups usually serve without pay and are called upon to contribute a large amount of time and energy as a matter of public service. They undertake their work conscientiously but are often hampered by lack of information about available material and how to use it.

Students of the subject have pointed out that considerable progress could be made through

the adoption of state requirements, leaving local variations at a minimum. This suggestion has met with some favor, but until it is generally accepted the problem of developing complete local requirements and of keeping them up to date will remain.

For some 20 years the National Bureau of Standards has endeavored to provide helpful information on building codes to a large number of local committees and officials. Investigations carried on at the Bureau in regard to strength, fire resistance, and other characteristics of building materials have produced results of direct usefulness in this field. During the period 1921 to 1934, the Bureau supplied the staff and published the reports of the Department of Commerce Building Code Committee. At present, in addition to continued technical research and contact with public officials on building-code problems, the Bureau is cooperating with the Building Code Correlating Committee of the American Standards Association in the continued development of recommended building-code requirements.

These activities have resulted in the accumulation of much material bearing on building-code problems. It has become apparent through correspondence and other contacts that much the same problems occur in each community and that a discussion of some of their more familiar features would serve a useful purpose. The literature on the subject has been enriched in recent years by the writings of Burton, Miller, Stegner, and others. These have made painstaking investigations of fundamental questions and have recorded their conclusions at some length. The literature is scattered, however, and much of it is not readily available. Frequent reference to it will be made in this discussion.

The method of treatment employed here is in large part that of discussion rather than specific recommendation. Great strides have been made in recent years in bringing divergent opinions about building codes into closer agreement, but the time has apparently not yet arrived when it can be said with assurance that some one method of approach is best for all cases. There is a healthy disagreement on such matters as arrangement of topics, ideal requirements versus realistic ones, possibilities of

simplification, and other matters. Those who have followed such controversies over a period of years are aware that variations in codes are diminishing. Some of the alternatives that remain are, however, so closely equal in merit that it is only fair to describe them in detail pending the time when more conclusive evidence is obtainable.

II. WHAT THE BUILDING CODE IS

As already indicated, the building code is a collection of legal requirements whose purpose is to protect the safety, health, morals, and general welfare of those in and about buildings. The code attempts to do this by establishing a series of requirements covering such topics as fire protection, strength of materials, light and ventilation, sanitation, exits, and other matters which have been found to need regulation. It sets forth the least that will be acceptable in each instance, leaving the designer or builder to go beyond this as far as he likes. It creates a system of supervision, making it necessary to obtain a permit to undertake work on a building and providing for inspection of the structure by public officials. It usually carries teeth in the form of fines for violation of the code provisions and gives authority to stop the work if necessary in the public interest.

The usual type of building code covers requirements for construction, alteration, demolition, maintenance and repair, and other activities in connection with buildings and certain other structures. Requirements for interior equipment may or may not be included.

Example.—This ordinance provides for all matters concerning the construction, remodeling, alteration, repairing, maintenance, use, moving or removal of buildings and other structures and parts thereof, erected or to be erected in the city; the safety of workers and others during these operations and the safe use of such buildings and structures. [6]

The broad objectives are reflected in the actual requirements. For instance, fire limits are established within which only buildings of certain types of construction may be erected, the object being to restrict the spread of fire in the municipality. Similarly, maximum heights for buildings are given. These are uniform throughout the city for the same type of construction, fire protection being again the de-

termining factor. Requirements concerning alterations touch upon the delicate problem of when old buildings must be brought up to the standards for new ones. The matter of demolition carries with it measures for determining when a building is so unsafe or unsanitary as to justify removal and by what procedure. Provisions for maintenance and repair are bound up with social policies concerned with how far it is expedient to force owners to keep their buildings in conformity with present-day practices. Thus, the contents of the code are something more than a routine statement of technical details. They are, or can be, a dynamic force in shaping the physical character of a community through the standards that are imposed.

III. EXTENT OF CODE REQUIREMENTS

It is well to think of a proposed local building code not as an isolated document of purely local concern but as a part of a network of requirements that extends over the country. There are some 1,500 local building codes and a number of State codes [7]. Although such codes are developed more or less independently under present conditions, they have a common objective and affect the work of professional men and manufacturing concerns far beyond the borders of the political units concerned. The State building codes usually are limited to certain types of buildings and may not apply within the limits of incorporated areas. There are also numerous State laws applying to special occupancies, such as factories and schools. A small number of counties have county building codes.

The pattern of existing requirements is not limited to those forms that have been mentioned but is further extended by zoning ordinances and housing codes. The former, adopted locally in accordance with State enabling acts, regulate the height, use, and area of buildings in different districts, so that the community can develop in an orderly fashion. The latter, more frequently State measures, are concerned with matters of light, ventilation, sanitation, and safety features applying to residential buildings. When housing codes do not exist, these matters are usually contained in building codes. Finally, there are requirements concern-

ing the equipment of buildings, including the plumbing code, the electrical code, the elevator code, and the boiler code. Custom differs as to whether these form chapters of the building code or are separately published and perhaps separately administered. There are local traditions and differences in municipal organization that account for the varying treatment accorded these subjects. Authorities agree that whether they should be included in the building code or not is largely a matter of local policy [8]. They are closely related to the building code even when not an integral part of it.

It may be stated as a general principle that where a State law is in existence, this takes precedence over a municipal ordinance dealing with the same subject, although the ordinance may be more restrictive if this is desired [9].

Example of State code provision illustrating relationship to local code.—This code shall not limit the power of cities, villages and towns to make, or enforce, additional or more stringent regulations, provided the same do not conflict with this code or with any other order of the Industrial Commission. [10]

Example of local building-code provision in same State.—The provisions of this Code shall supplement any laws of the State of Wisconsin relating to buildings. Where requirements of the State Code and the provisions of this Code conflict, the stricter requirements shall govern. [11]

Exceptions to this occur in the case of some home-rule cities where the municipal requirements are specifically put ahead of State laws [12].

With such a multiplicity of measures to safeguard the public, it is obvious that one of the first things for a local committee to do is to establish the place of its project in relation to other legal requirements that apply. This can only be done by assembling and comparing the various documents that have been mentioned. The limiting effects of State laws, the extent to which it is advisable to maintain harmony with existing ordinances, or to absorb them, and the advantages of keeping in step with the requirements of other communities in order to avoid unnecessary confusion are all proper subjects for consideration.

IV. POLICE POWER

The building code derives its justification from the police power. This is the inherent

power of government to protect the people against harmful acts of individuals insofar as matters of safety, health, morals, or the like are concerned [9]. It is a power forming the basis for State acts and municipal ordinances dealing with these matters and is of indefinite extent, although certain limitations concerning its use are to be found in the Federal and State constitutions and in court decisions [13]. Fundamentally, under our system of government, the power resides in the State and may be transmitted to local authorities through enabling acts authorizing the adoption of building requirements or may be conferred upon municipalities when a charter is granted. Although the use of the power has been more narrowly construed at some times than at others, there is an apparent trend toward broadening its application to include many matters falling under the general head of public welfare [13].

In order to have a working knowledge of how the code-making power has come into the hands of the local authorities and what restrictions are placed upon it, it is well to consult the State constitution, any pertinent State enabling acts that confer this power on the municipality, and the provisions of the city charter. The corporation counsel, or other person designated to advise municipal officials on matters of law, is in a position to render skilled assistance in this matter.

V. EFFECT ON COMMUNITY

The influence of the building code on city growth is greater than is ordinarily suspected. The requirements, operating over a period of years, affect the physical character of the community to a marked degree. There are other effects which should be realized. If the requirements are so severe as to impose building costs greater than those prevalent in other cities, new industries may be diverted elsewhere, rents may be increased, and other effects produced. If the permissible building heights and types of construction bear no relation to the city water pressure and efficiency of the fire department, insurance rates may be affected. In a standard method for rating cities for fire-insurance purposes, the quality of the building code and of

its administration is a specific point [14, 15]. If peculiar requirements are made, as is sometimes done, necessitating the use of nonstandard products, manufacturing processes may have to be altered to meet the special requirements of the municipality concerned. Thus, the code can be a beneficent influence guiding the general course of construction in safe channels, or it can be a means of hampering the orderly growth of the community that it is supposed to protect.

VI. TESTS FOR CODES

Building codes, being documents which limit and restrain people in their activities, inevitably are targets for criticism. It is important to know whether such criticism is valid or is frivolous and actuated by other than disinterested motives.

There are certain tests that can be applied to an existing local code which will give some indication of whether it is reasonably adequate or is in need of a thorough overhauling. These tests, together with any complaints that have accumulated, constitute the basis for determination of what action, if any, is necessary.

The age of the code is one indication of its quality, for advances in the building art tend to make provisions obsolete. Doubt is cast upon fully 20 percent of existing codes in this respect, for a recent survey disclosed that 10 percent of such codes are 20 years old or older, while another 10 percent are from 15 to 20 years. Some further investigation is needed before judgment can be rendered on this score, because frequent amendments and supplementary rulings of officials may have brought the code into closer conformity with current practice than the bare figures would indicate. However, these amendments have a tendency to clutter up the code and make it increasingly difficult to understand. A complete overhauling at intervals of not over 10 years, and preferably at somewhat shorter intervals, is desirable.

Looking into the code itself, the next test is whether the contents are reasonably clear and explicit and can be readily located. This applies not only to the wording of individual sections but to the way in which sections are put

together so that they form a logical series of interrelated requirements. Experience with ambiguous provisions has led commentators to emphasize this point [16]. Certainly, if a designer or builder is expected to observe the law, he should be given a fair chance to ascertain what is required. It is equally true that the administrative official should have the backing of a document that leaves little or no room for argument. Ease of reference implies a complete index and adequate cross-referencing wherever necessary.

What might be termed the underlying philosophy of the code as evident in its requirements is also important. If it has been thought necessary to write into the code a great amount of minute directions and specifications, one of two things may have happened: Changes in the art of construction may have forced frequent amendments or may be responsible for complaints that the particular things specified in the code no longer apply. In either case a lack of flexibility of adjustment to new conditions is indicated. On the other hand, if the code is expressed in terms of what is required in the way of strength, fire resistance, and so on, leaving the determination of what will do the job to appropriate tests, a better chance for keeping requirements abreast of changing conditions will have been afforded.

A third way of appraising the code is to examine it for the extent to which national standards have been used. These standards for quality of materials, and in some cases for methods of construction, have been widely accepted and furnish a definite basis for accepting or rejecting proposed elements of construction. When advantage is not taken of these useful devices, a doubt is cast on whether full use has been made of all available methods for keeping the code up to date. One thing that should be watched especially in this connection, however, is the date of the standard used, if this is given. The pages of codes are strewn with dead standards which have long since been superseded by more modern requirements.

Evidence of careless draftsmanship is another cause for holding a code to be in need of revision. Examples of actual errors in codes are the use of the term "feet" for "inches"; two different requirements for the same thing; transposed

column headings in stress tables; and the use of the term "maximum" where "minimum" is meant, or vice versa. Such errors may be patent because of their very absurdity and thus cause little harm, but they cast doubt on the soundness of other provisions and tend to create disrespect for the code as a whole.

If the examination of these general features of the code has resulted in an unfavorable reaction, examination may proceed to details. It will be found that the code contains certain assumptions and estimates which may or may not assure safety. Included will be requirements about live and dead loads, column reduction factors, permissible working stresses, thicknesses of walls, and thicknesses of fire-protective coverings. The less these partake of the character of estimates the more will they satisfy the purpose for which they are intended. To appraise them, it is necessary to compare them with values suggested by outstanding authorities in the building-code field, references to which are available [17].

The attitude of the code toward acceptance of new materials and new methods of construction is important. Innovations are multiplying today and are demanding equal treatment with older materials which have proved their worth. If clear and explicit requirements are lacking in regard to the procedure to be employed, the code is deficient in meeting one of the most pressing problems of building regulation today.

Examination of the features mentioned should give a good idea of whether a few well-selected amendments will accomplish all that is needed or whether the task of preparing a new code should be undertaken.

VII. METHODS OF STARTING NEW CODE

The impetus for code improvement comes from various sources. In the 1,500 communities where a building code of some sort exists the local building official may call attention to its shortcomings. If the official is alert he will observe those points at which the code is not abreast of prevailing practice in other communities or of advances in engineering. He is in a peculiarly good position to observe and

record the shortcomings of the code in its day-by-day operations and to call attention to the need for changes. Sometimes the code is made the object of study by a local group such as the local chapter of a professional society, a civic association, or a business organization such as a local board of trade or real estate board. These bodies are in a position to adopt the initiative where there is no code because of their facilities for study and observation and their contacts with similar bodies in other communities. In whatever way presented, a suggestion that new code requirements are desirable should be accompanied by a well-arranged list of arguments giving the evidence at hand. The local council or other legislative body can then take cognizance of the situation and arrangements can be made for the appointment of a representative committee to proceed with official sanction.

VIII. COMPOSITION OF LOCAL COMMITTEE

The committee which is to prepare a building code should be selected with care. Most productive results are generally held to come from a comparatively small body supplemented, if necessary, by special committees dealing with specific problems [9]. In a large committee, responsibility tends to become diffused and discussion is likely to be prolonged beyond reasonable limits. A body of about seven members has been found to operate efficiently. In larger cities, it is sometimes desirable, in order to give recognition to the great number of groups affected, to establish a sizable group, but in such cases the situation can be met through creation of a comparatively small executive committee empowered to lay out a working plan, make subcommittee assignments, and follow up the work in process.

The composition of the smaller body may well include representatives of the groups which design buildings, of those who are responsible for figuring stresses and strains, of those who do the construction, and of those who finance and manage the completed structures. It should also provide for ascertaining the point of view of the responsible public authorities most concerned.

These general considerations point to the selection of an architect, an engineer, a builder, an owner, the building official (if there is one), and the fire chief. A member of the city planning commission has also been suggested [18] and a master mason or carpenter may also prove indispensable to the work. The numerous legal problems involved may make it advisable to include a lawyer.

From whatever group chosen, members should be expected to bring to the work a broad and sympathetic understanding of the problem before them and should realize that they are acting, not as the jealous conservators of some special point of view, but as representatives of the public in a matter of vital concern. Capacity to work together is one of the qualities that has been emphasized [9].

Since the membership of the committee will normally be busy with their own affairs, it will be necessary to select a competent secretary and to set up a staff and see that the work is pursued with diligence. When this is organized, it is well to establish a progress schedule giving estimated dates when various stages of the work will be completed. This schedule may not be lived up to, but it will provide a definite objective and can be adjusted as time goes on.

EXAMPLE OF PROGRESS SCHEDULE

ACTIVITY	DATE
(1) Organization meeting held and collection of available material started.....	
(2) General method of treatment agreed upon, including arrangement, form, method of numbering, etc.....	
(3) Assignments made to subcommittees or individuals.....	
(4) Subcommittee reports due.....	
(5) Draft of code completed.....	
(6) Public hearings held.....	
(7) Revisions incorporated and code edited.....	
(8) Report submitted with recommendations.....	

Without some such means of measuring accomplishment, the proceedings may drift along for such a period that interest will die down.

IX. STUDY OF CITY NEEDS

Before work on a new code is started, it is well to make a thorough survey to bring out the resources and characteristics of the municipality. This is necessary in order to deal intelligently with such matters as fire limits, building heights, and other matters. The physical lay-out of the city, the nature and location of its industries, the prevailing heights of buildings and their types of construction, the likelihood of severe wind and snowstorms, the efficiency of the fire department, the adequacy of the water-supply system, the number and character of building fires, the qualities of building materials customarily marketed, are all matters deserving of attention. Consideration should also be given to complaints about the existing code, if there is one, and to suggestions for bringing it into harmony with practice elsewhere. By thus appraising the local situation, the committee will be better qualified to pass upon the relative importance of proposals that come before it.

X. COLLECTION OF AVAILABLE MATERIAL

There is a vast amount of material that can be used in the preparation of code requirements. The greater part of this consists of reports of tests, proceedings of engineering societies, and compilations of data of various kinds. Some of this primary material is needed for consultation, but in many cases the basic facts have been assembled and evaluated by competent bodies, so that the tedious process of analyzing a great mass of evidence can be avoided. In cases where a doubt arises or where equally competent bodies disagree, it may be necessary to go back to the primary data and reach an independent conclusion.

The National Bureau of Standards, Washington, D. C., and the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y., are two principal sources of information when material for code use must be accumulated. The Bureau will send on application, copies of its Letter Circular 458, "Publications Relating to Building Regulation," in which are listed its publications containing building-code recommendations, and its Letter

Circular 290, "Publications of the National Bureau of Standards Relating to Building Materials, Building Standards, Home Building," in which are listed publications giving results of tests and other information regarding building materials and methods of construction. The references given are confined to publications of this Bureau, which has long been interested in the development of improved building requirements. They include recommendations prepared by the Department of Commerce Building Code Committee, which functioned in connection with the Bureau for a number of years. The publications themselves must be ordered from the Superintendent of Documents, Washington, D. C., in accordance with directions given.

The American Standards Association will supply on request copies of CB30, "Information on Sources of Material for Use in Preparing and Revising Local Building Codes" and CB25, "Building Code Arrangement." The first of these is a carefully selected list of references, including both governmental and nongovernmental publications. It is arranged according to principal topics found in a building code. Directions for obtaining specific items, including addresses of publishing organizations and prices, are given. The second is an approved list of main headings for a building code, together with suggested subheadings indicative of the range of subject matter. From time to time specific recommendations will also be issued by sectional committees operating under the procedure of this Association. These will provide definite ways of dealing with a number of matters for which examples drawn from existing codes are given in this discussion by way of illustration. Inquiry at the time a given local code is in process will disclose what recommendations are available.

A few well-selected building codes should also be obtained, preferably from municipalities of comparable size and geographical location. These will provide a background of contemporary practice but should not necessarily be regarded as models to be followed.

It will be found that, if a start is made along the lines mentioned, one thing will lead to another and that a comprehensive collection of useful material will soon be established. This

can then be indexed and examined by the committee staff. Summary reports on principal features can be prepared for the information of the committee members.

XI. METHODS OF PREPARING CODE

There are several courses open in the preparation of requirements, each having certain advantages and disadvantages.

In former days the impulse has frequently been followed to copy the code of another city, perhaps with some minor alterations to bring it into better conformity to local conditions. This method is pleasant and easy. It is not recommended, however, for several reasons. The code thus copied may contain errors which will be perpetuated. The chances are that its supposed adaptability to the community concerned is more apparent than real. It has been characterized as a dangerous procedure which will very likely be regretted later on [9].

Even more undesirable is the practice of combining requirements from various codes. Unless done with the utmost care it is almost certain to result in overlapping and duplication, sometimes of a ludicrous nature, and in inconsistencies of policy.

Another method of approach is to utilize some one of the several recommended sets of regulations that have been drawn up by organizations of fire underwriters or building officials, making modifications to meet the local situation. For smaller municipalities which are not able to provide the necessary funds and personnel for complete local action, this has a number of advantages. By utilizing this material, such municipalities are in a sense having the services of the experienced talent which prepared them and at little or no expense. All the research and discussion necessary to reach a balanced judgment have already been done. As against this, however, the alert observer will note that the model codes do not agree in a number of respects, raising the problem of which is best for the particular conditions in his own community.

The more generally favored way to go about the work has been to build up a set of requirements, making use of all available material. This requires organization of the committee so

that special subjects are assigned to subcommittees or individuals best qualified to deal with them. It also means that arrangements must be made for careful editing of the various proposals that are brought in so that they harmonize when put together.

Some of the labor of editing will be saved if agreement is reached at the outset on methods of phraseology. For instance, the wording of mandatory requirements, of exceptions, and of variations from the general rule may be agreed upon in advance. An approved method is as follows: "General rules should be stated first, followed by any modifications to the general rule which may be included. The words 'provided that' where only one modification occurs, followed by 'provided further' when there is more than one modification, should precede such modifications. In a few instances it may be found convenient, where there are exceptions to which a rule does not apply, to use a clause starting with the word 'except' preceding the general rule." [19]

The arrangement of tabular matter and method of providing headings may be standardized. From all this will come a set of instructions which can be reduced to writing and distributed to subcommittees working more or less independently on their special problems.

XII. USE OF CONSULTANT

Selecting the right kind of material and putting it in coherent form is not an easy matter. The committee will very likely feel the need for expert advice. It may also desire to be relieved of much technical detail and thus have more time to devote to matters of general policy. Employment of a consultant accomplishes these ends. The competent consultant is able to provide expert craftsmanship in the wording of provisions, a viewpoint unaffected by local prejudices and rivalries, and a specialized knowledge that enables him to distinguish between workable and unworkable requirements. His experience in other cities makes it possible for him to anticipate many of the questions that will inevitably arise and to be ready with a reasonable solution which conserves time and energy in the code-making process.

XIII. CODE ARRANGEMENT

A great deal of thought has been devoted to the best way to arrange the numerous topics customarily found in building codes. The matter has been discussed at length in meetings of building officials [20, 21] and has constituted the subject of a report issued by the Department of Commerce Building Code Committee [9]. While there are two contrasting schools of thought, the methods sponsored by them represent a considerable reduction from the varieties of arrangement that were employed some years ago. Whether any fusion of these two main systems is possible, or whether one will eventually crowd out the other is not clear at the present time. There are obvious advantages in having all requirements appear in the same places and with the same general method of treatment in all codes, but for the present, it is only fair to record that both methods have given satisfaction.

One method makes of the code a series of miniature codes, each concerned with a particular occupancy. Thus, one chapter may deal with dwellings, another with office buildings, a third with factories, and so on. As far as possible, everything pertaining to the particular occupancy is given in the chapter so headed, but as a practical matter certain other chapters that apply to all occupancies must be added. These include requirements for administration, as well as engineering requirements relating to strength of materials which would, of course, not change with occupancy.

The other method lists main headings according to subject matter rather than by occupancies. The chapters deal with fire resistance, exits, light and ventilation, and so on. It allows for considerable compression since several occupancies will frequently have the same requirements and it is not necessary to repeat these requirements in successive chapters.

One universal method would be desirable but is not yet here. There is greater agreement on arrangement of main topics than on further details. The Building Code Correlating Committee of the American Standards Association and the Department of Commerce Building Code Committee have approved substantially the same main order [22, 9]. The following list

of chapters shows the main headings used under this method, which is a slight modification and condensation of the form sponsored by the Department of Commerce Building Code Committee, the changes appearing in the form approved by the Building Code Correlating Committee of the American Standards Association.

1. Administration.
2. Definitions (including classifications).
3. General building restrictions.
4. Special occupancy requirements.
5. Light and ventilation.
6. Means of egress.
7. Loads.
8. Construction requirements.
9. Fire protection and fire resistance.
10. Chimneys and heating appliances.
11. Fire-extinguishing equipment.
12. Precautions during building operations.
13. Signs and billboards.
14. Electrical.
15. Elevators.
16. Plumbing.

By consulting the code recommended by the Pacific Coast Building Officials Conference [23] and that recommended by the National Board of Fire Underwriters [24], it will be possible to see how more-or-less typical examples of the two methods described appear in actual recommended requirements.

Whichever method is chosen, arrangements for a thorough alphabetical index and for adequate cross-referencing of sections requiring such treatment will be of great assistance to the user [9]. This is a detail too often neglected. When properly done, it often goes far to remove the difficulties resulting from illogical arrangement. The lack of a good index is responsible for much difficulty in ascertaining what is actually required.

Closely linked with the problem of arrangement is that of numbering the articles and sections. The numbering system needs to be such as to permit locating provisions readily and it should lend itself to insertion of new requirements without dislocating the system. A decimal system was employed in the recommended arrangement issued by the Department of Commerce Building Code Committee [9]. A modification of this has been employed in the code of New York City which went into effect on January 1, 1938. In this, each number to the right of a decimal point is a subdivision of

the item just to the left. For example, section 8.3.1.6 is the sixth item in the first subdivision of the third section of article 8. As the numbers between decimal points may be increased indefinitely, a great degree of flexibility is obtained. On the other hand, the system is somewhat hard for the average person to grasp at first.

Example:

- Article VIII Construction
 - Section 800 Workmanship
 - Section 801 Excavations
 - 1. General
 - 2. Support of neighboring buildings and structures
 - (a)
 - (b)
 - (c)

The Building Code Correlating Committee of the American Standards Association has expressed preference for the second method as being somewhat more quickly understood by the average reader.

In a number of municipalities, ordinances on various subjects are brought together in a general code which has a numbering system of its own. In such cases, the building code will naturally conform to the system chosen.

Example:

- Article 8 Construction
 - 8.1 Workmanship
 - 8.1.1 Workmanship on Wood Frame Structures
 - 8.1.2 Workmanship on Welded Structures
 - 8.1.3 Storage of Concrete Materials
 - 8.2 Excavations
 - 8.2.1 Owner
 - 8.2.2 Excavations Affecting Adjoining Property
 - 8.2.2.1 Temporary Support of Adjoining Property

Another system is to number major headings consecutively from one up, main subdivisions being assigned numbers in the hundreds having the first digit the same as that of the major heading, and further subdivision being cared for: first, by increasing the numbers consecutively in the hundred series; then, by a consecutive series of minor numbers; and, finally, by consecutive letters. There are several variations, all employing the same general method.

XIV. PERFORMANCE BASIS

There are several ways of wording requirements. One is to state the exact materials

that must be used for a given purpose, and frequently the exact sizes and other details. If these are used it is assumed that the desired results will be obtained.

Example.—All cast-iron, wrought-iron, or rolled-steel columns, including the lugs and brackets on same, used for vertical supports in the interior of any fireproof building, or used to support any fireproof floor, shall be entirely protected with not less than 4 inches of hard-burned brickwork, terra cotta, concrete, or other fireproof material, without any air space next to the metal, securely applied . . . [25]

Another way is to state the desired results and leave the details out except as they may be cited for illustrative purposes.

Example.—Iron or steel columns shall be protected by material or assemblies having a fire-resistive rating of 4 hours for class one, fireproof structures, and of 3 hours for class two, fire-protected structures (except that interior columns in class two, fire-protected structures for residence purposes may have only 2-hour protection). [26]

The first way is clear and definite, but it makes no allowance for varying resistance of protective materials. The second is clear and definite so far as it goes but throws no light on what materials and thicknesses are acceptable. If accompanied, as it should be, by information in an appendix to the code listing what materials have passed the test, a complete picture is obtained. The particular virtue of this method is that new materials become available for use as soon as they have demonstrated their value under test. With the first method an amendment to the code may be necessary to accomplish this purpose. There is a well-founded principle that it is not reasonable to specify both the required result and the manner in which it should be accomplished. If the latter is given, the result must be assumed while if the former is given, freedom should be left to adopt any legitimate way of achieving it. [27]

Building-code requirements are in a transitional stage today in which more and more emphasis is being placed on performance as demonstrated under standard test. The general principle has been widely endorsed [9, 28, 29] and is finding its way into many recent codes. It is not feasible to word all requirements this way, for no standard test may have been developed in some cases or the subject matter may not lend itself readily to this treat-

ment because there is no established practice to which reference can be made. Nevertheless, it will be found profitable to subject each proposed requirement to analysis to see whether it can be so worded that the end is emphasized and the means to the end offer as great a choice as possible.

XV. USE OF STANDARDS

A large amount of work has been done over a period of years on the development of standards. These standards apply to quality of materials, to methods of test, and in some cases to methods of assembly of materials and performance under conditions of use. They have been developed by committees of national organizations having much better facilities for gathering and evaluating data than any local body can hope to possess. By utilizing them, a local code committee can avail itself of the great amount of painstaking work that has been done elsewhere and can place its requirements on a footing with others that have made use of the same material.

Liberal use of nationally developed standards has been made in many recent building codes, with the result that greater uniformity in requirements has followed. A notable example is the code of Cincinnati, Ohio, where some 75 approved standardized regulations of national technical organizations have been used as a basis for the code [12]. Care should be taken not to assume that the mere adoption of such standards is all that is necessary, however. It has been pointed out that they may not always be readily available or comprehensible to the average builder and that they may not be in as complete form as is necessary for local use [30]. It is necessary to select them with discrimination, make provision for their convenient use by such devices as keeping copies in the municipal office building and indicating how they may be obtained for personal use, and to provide such supplementary matter as may appear desirable after careful study to make them applicable to local conditions.

For quality of building materials, standards are available from several sources. The American Society for Testing Materials, 260 South Broad Street, Philadelphia, Pa., is most promi-

nent among nongovernmental sources. It is a nonprofit organization which issues standards prepared by evenly balanced groups of producers, consumers, and general interests. It also issues "tentative standards," which are felt to need a period of seasoning before they acquire the status of a full standard. Both types of standards are subject to periodical review in the light of increased knowledge. They are in constant use by purchasing agents, specification writers, and others who order building materials. They constitute a convenient and accurate means of definitely identifying the materials which enter into construction.

In some cases, it will be desirable to make use of Federal specifications prepared by the Federal Specifications Executive Committee. These specifications are prepared primarily for the use of government purchasing agencies and to some extent may reflect the special market for which they are written. A list of these specifications and copies of individual specifications may be purchased from the Superintendent of Documents, Washington, D. C.

A series of "Commercial Standards" is issued by the National Bureau of Standards. This series includes a number of standards which are applicable to building construction and codes. These standards are safeguarded by a procedure conducted by the National Bureau of Standards to protect all those directly concerned, are adjusted in public hearings, and issued only after they are accepted in writing by a satisfactory majority of production volume, including distributors and consumer organizations. A list of these standards may be obtained on request from the National Bureau of Standards, Washington, D. C.

Certain "Simplified Practice Recommendations" available from the same Bureau also have a relation to building regulations, particularly in the case of lumber, for which information on basic grades and actual sizes as compared with nominal sizes is given.

Standards of the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y., are also extremely useful in connection with building-code work. For the most part they are standards of practice, setting forth approved conditions for such features of

building construction as exits, elevators, and electrical work. They go into their special subjects in considerable detail, with the result that they are usually adopted as separate documents with appropriate reference in the building code or appear in shortened form in the code with a reference to fuller details in the standard. These standards are prepared by representative committees under careful safeguards that no one interest shall dominate the requirements to the exclusion of fair treatment for others affected. It is these precautions that account for the confidence with which standards of the American Standards Association are used by the public and the respect shown them in the courts.

Another group of standards is that prepared by an organization dedicated to development of improved uses of a particular material or by an association of manufacturers interested in seeing that their product is utilized to the best advantage. Some of these bodies maintain laboratories or contribute to support of research work and all are continually making substantial contributions to knowledge of building materials. Extensive literature is available, and standards and specifications are frequently proposed for consideration of code-making bodies. Addresses of many of the associations from whom material is available will be found in the publication CB30, "Information on Sources of Material for Use in Preparing and Revising Local Building Codes," issued by the American Standards Association.

The problem of ascertaining whether materials actually delivered on the job conform to required standards is handled in different ways in various communities. Sometimes grade marks of manufacturing associations may be demanded in the requirements. Local officials frequently demand that brand marks be applied to local products and check conformance to quality by periodical inspection or test. Information on more extensive application of methods of identification through labeling may be obtained from the National Bureau of Standards, Washington, D. C., and from the Underwriters Laboratories, Inc., 207 East Ohio Street, Chicago, Ill.

Having obtained copies of standards and satisfied itself of their usefulness, the local code

committee is confronted with the problem of how to refer to them. It is obvious that to print them in their entirety in the code would cause that document to assume huge proportions. Since it is impracticable to include them verbatim, the question arises, what is a legal way to make them applicable. The problem has engaged the attention of a number of writers who have discussed the difficulties in various jurisdictions. Burton [31] has suggested a State enabling act authorizing adoption by reference. Miller [29], Irwin [32], and the Committee on Legislation and Administration of the President's Conference on Home Building and Home Ownership [28] have suggested various solutions. Moulton [33] has summarized the various methods that have been employed and has discussed the problem in detail.

The surest way is to refer to the standard by title, number, and year. This avoids the charge that legislative authority is delegated to some outside body.

Example.—Hollow clay tile used for exterior, party, or bearing walls shall be of manufacture and quality at least equal to the "medium class," as prescribed by the Standard Specifications and Tests for Structural Clay Load Bearing Wall Tile (A. S. T. M. Designation C 34-31) of the American Society for Testing Materials.

Since standards are being constantly improved, however, and issued in new editions, a large number of references in the code may soon become obsolete, requiring frequent amendments to keep the code up to date. Attempts have been made to meet this difficulty by saying that the standard, as amended from time to time, shall apply. This is a doubtful expedient.

Another way is to state the fundamental principles that apply and confer power on the building official to make rules and regulations carrying out the intent of the code. The progressive and well-informed official will make national standards the basis of such rulings, and can recognize new editions without recourse to modifying the code itself.

Example.—Quality of Materials. All building materials shall be of a quality to meet the intent of this ordinance, and shall conform to such specifications, consistent with its requirements, as may be promulgated by the superintendent of buildings, or in the absence of such specifications, to well-recognized standards for the materials in question. [35]

A third method is to state fundamental purposes and make the adoption of specified standards *prima facie* evidence of safe practice. This does not require confining the approved standard to any particular edition.

In a few States, there is State legislation empowering municipalities to adopt standards or even complete code requirements directly by reference, with suitable safeguards as to making the standards available in the municipal offices.

Example.—An act relating to the passage of ordinances by cities or counties, and authorizing cities or counties to adopt ordinances relating to building construction, plumbing or electric wiring by reference to published codes on such subjects; provided not less than three printed copies of such code or codes, in book form, have been filed with the clerk.

The People of the State of California do enact as follows: Section 1. Ordinances passed by cities or counties must be posted or published in a newspaper as required by their respective charters or the general laws; provided that ordinances establishing rules and regulations for such matters as the construction of buildings or the installation of plumbing or electric wiring, where such rules and regulations have been published as a code in book form, may adopt such code or portion thereof by reference thereto without further publication or posting, provided not less than three (3) copies of such code have been filed for use and examination by the public in the office of the clerk of such city or county, as the case may be. [36]

The choice of methods will be governed by constitutional limitations and legal precedents in the particular community concerned. In general, it is well to explore the possibilities of the second and third methods with the object of applying one of them so that flexibility of adjustment to changing conditions will be assured. If the legal obstacles are insurmountable, the first method is always available.

XVI. ACCEPTANCE OF NEW MATERIALS AND METHODS

The rapid introduction of new materials and methods of construction presents problems to every municipal building department. To a considerable extent these problems will be anticipated through the use of the performance basis already mentioned. It is necessary to supplement this, however, by some provision which will make it possible to pass upon the new development without unnecessary delay. Various methods are in use, such as approval

by the building official, approval by a local board, or submittal of an amendment to the code.

Examples.—

(1) The Inspector of Buildings shall have full authority to approve or disapprove any device, material or construction proposed to be used in building construction in the city of Minneapolis, not specifically provided for in this ordinance, and may base such approval or disapproval upon the results of satisfactory evidence of competent and impartial tests or investigations conducted by others, or upon the results of satisfactory tests made under his direction. [37]

(2) For the purpose of securing for the public the benefits of new developments in the building industry with respect to construction, materials, processes and methods and appliances to insure public safety, the Board may make or cause to be made at the expense of the promoter or submitter, investigations of new materials or modes of construction, intended for use in the construction of buildings or structures in the city of Wilmington which are not provided for in this ordinance and not prohibited thereby and shall adopt and promulgate rules of practice and regulations setting forth the conditions under which such materials or modes of construction may be used. It shall have the power to make similar investigations at the expense of the promotor or submitter in cases where a recommendation to Council for amendment of this ordinance is contemplated. [38]

Approval depends on appropriate tests or on submittal of evidence that the innovation is in accord with good engineering practice. The approval is accompanied by prescribed conditions of use. In larger cities where it is possible to organize a board, this provides a broader base for judgment than the opinion of the building official. In either case difficulties will be encountered in passing upon radically new types of construction unless standard methods of tests have been developed and facilities are available for having tests made. One of the responsibilities of the local official or board will be to select approved laboratories where tests may be conducted at the expense of the manufacturer and whose reports may be accepted as disinterested and conclusive. The method of acceptance by amendment to the code is a much slower process and may be subject to as much, if not more, danger of political or other influence, than the method of acceptance by an official or board.

This matter of giving adequate attention to new developments in the construction field has been emphasized repeatedly in comments on

building codes [8, 28]. It is one matter deserving of special attention by a local committee.

XVII. RULES AND REGULATIONS

As already indicated, problems are continually cropping up concerning building regulation, and it often happens that the code has no answer for them. If the general principle governing such cases is set forth in the code, however, and power is granted in the code for some person or body to lay down specific conditions which carry out the intent of the code, an awkward situation can be bridged. It would be pleasant if the building official could turn always to a particular page of the code and cite a passage applying exactly to what is proposed. Experience has demonstrated that to expect a code to fulfill this function is a vain hope.

Frequently an interpretation by the building official will meet the situation. Authorities differ on how far this interpretive power should be exercised by the official, and its existence is sometimes based on inference rather than on any specific provision of the code. In other cases, the power is expressly conferred.

*Example.—*Said Building Commissioner shall have full power to interpret any question arising under the provisions of this ordinance relative to the manner of construction or material to be used in the erection, alteration or repair of any building. [39]

As has been indicated, opinion is not unanimous on granting discretion to the building official in the matter of making rules and regulations. The case for it has been ably presented [40, 8, 9] and effective arguments against it or cautions as to restrictions on its use have also been made [16, 41]. There appears to be a trend toward its use, however, in recognition of the many complications that develop in administering a code. Perhaps as fair a statement of the reasoning back of this trend as can be made would be as follows: When matters come up which are plainly new and for which no definite guiding principle is laid down in the code, then an amendment is required; when, however, something comes up which is not exactly covered but which is plainly related to some definite principle already set forth, a ruling by the building official or by a designated board will accomplish the purposes of the code. By

granting specific power to make rulings which merely carry out the intent of the code and do not seek to create new requirements or strained interpretations, a useful administrative process is set up.

Example.—The Board shall have power to adopt rules to secure the intent and purposes of this Code and a proper enforcement of its provisions. The Board shall also have power to make rules and regulations respecting the approval of materials and methods of construction. [42]

Rules serve several useful purposes. They provide the machinery for acceptance of new materials, they facilitate the early acceptance of standards, and they permit a limited amount of variation from the strict letter of the requirements in unusual cases.

It is of course possible for such a power to lead to abuses, and it is for this reason that it is often qualified in various ways.

Example.—The Commissioner of Buildings may from time to time adopt rules which, when approved by Council, shall have the force and effect of ordinances. Until other rules shall have been adopted and approved by Council, the recommended provisions of the various approved technical organizations with exceptions and additions as hereinafter specified in this Code, shall be considered as the rules applicable and shall have the force and effect of ordinances, except wherein such rules are not in conformity with other provisions of this Code. The Commissioner of Buildings shall keep at least two copies of all such rules in his office for public reference. [43]

Example.—No rule of the superintendent of buildings shall become effective until two weeks after notice of intention to adopt it shall have been given in the official newspaper and until a public hearing on the same shall have been held. Such rule must be drawn in its proposed form and open to public inspection at the time the notice to adopt is published. Rules adopted and promulgated as herein provided shall have the same force and effect as provisions of this ordinance. [44]

The importance of providing adequate safeguards against arbitrary action have been repeatedly emphasized [40, 29, 16]. Publicity occupies a prominent place, involving such steps as notice of intention to act, public hearings, and making generally available the rule as adopted.

XVIII. PROVISIONS FOR CHANGES IN CODE

Even the most flexible of requirements do not escape the necessity of an occasional over-

hauling to bring them fully abreast of the times. Circumstances arise which were not thought of at the time the code was written and for which no adequate treatment can be accorded except through revision or amendment to the code. Because of inertia, the tendency will be to delay meeting the situation squarely unless there is some definite system set up in the code for its amendment and revision. A method sometimes employed is to write into the code a provision placing upon the building official or board the responsibility for periodical reports to the local legislative body on desirable changes. This may form a part of the customary annual reports or may be a separate feature.

Example.—The Board shall also act in an advisory capacity to the Building Inspector and his assistants and to the Council and shall, from time to time, recommend to the Council such amendments of and additions to this ordinance as it may deem advisable. It shall have power to conduct hearings with respect to proposed amendments of this ordinance before recommending the same to the Council. [45]

The point is that unless some agency is charged with the duty of reporting in this connection, the matter is likely to be put off far beyond the time when action should have been taken.

XIX. ENFORCEMENT

Careful work in preparation of technical requirements may lose much of its effectiveness if subsequent enforcement is weak. To ensure that the code will be intelligently and impartially applied, requirements frequently call for definite qualifications for the building official, such as 5 years' experience as an architect, engineer, or builder. Sometimes city charter provisions have a bearing. Advice should be sought on what can legally be written into the code on this matter.

A man of the requisite experience and character to administer the code deserves protection from pressure that will inevitably arise to make exceptions and grant favors. A civil service system based on merit has been proposed as the most effective way to assure impartial administration [46]. Certainly, the protection of the public should offer a career of dignity and permanence that will attract capable men. Where the merit system does not apply, or cannot be introduced, provision for appointment for a

definite period, such as 5 years, with removal only for cause after a public hearing, may meet the situation.

In small municipalities, the budget may not be sufficient to attract applicants for the position and the volume of building may be insufficient to occupy the entire time of an official. In such cases, it may be better to retain the qualifications mentioned and make arrangements with adjoining municipalities to pool resources with the object of obtaining a good man who can serve all [47]. Some codes also make provision for making use of consulting service in the case of unusual situations.

Example.—The Commissioner shall have the power to engage such expert opinion as he may deem necessary to pass upon unusual technical issues which may arise, subject to the approval of the Common Council. [48]

The technique of enforcement has been discussed in various papers [49, 50, 47] and need not be enlarged upon here. It is pertinent to remark, however, that a good code deserves good administration and that good administration deserves the moral and financial support of the community. It is a mistake to regard the office of building official as of minor importance. Considering the features of safety and health involved and the volume of construction that goes on each year, the office is one of great responsibility. That officials are conscious of this is evidenced by the fact that they have organized professional bodies whose meetings are devoted to serious consideration of administrative problems [51]. Recognition of the importance of the job and of the high caliber of men necessary to enforce requirements adequately and impartially will be forced upon the attention of any committee which has to consider the many technical matters that enter into a building code.

XX. BOARD OF APPEAL

Reference has been made at several points to a board which might exercise certain powers. This is a device which helps to make administration of the code effective by providing a place to which a person aggrieved by the building official's decision may go and state his case without the necessity of slow and expensive

court action. In larger cities, it is common to have such a body. It may be assigned various duties, among which are consideration of applications for variances from the strict terms of the code, if this is authorized by law, and appeals from the building official's interpretations or rulings. Other activities which have been mentioned include passing upon the merits of new materials and making recommendations for amendments to the code. While it may not be considered feasible to establish such a board in small communities, the possibility of creating it should always be considered, for it constitutes a protection against arbitrary action of the local official and provides an orderly way of adjusting the code to new developments.

Example.—Whenever the Building Inspector shall reject or refuse to approve the mode or manner of construction proposed to be followed or materials to be used in the erection or alteration of any such building or structure, or when it is claimed that the provisions of this Code or any of the ordinances relating thereto do not apply, or that an equally good or more desirable form of construction can be employed in any specific case, or when it is claimed that the true intent and meaning of this Code or any of the ordinances and regulations have been misconstrued or wrongly interpreted, the permit applied for having been refused by the Building Inspector, and the owner of such building or structure, or his duly authorized agent, may appeal from the decision of the Building Inspector, in writing, to the Board of Appeal. The Board shall, after hearing the evidence on such appeal, either affirm, modify or reverse the decision of the Building Inspector as to it may seem best under all the circumstances of the case, and their decision shall have the same effect as if it were the decision of the Building Inspector. [52]

XXI. APPENDIX

No matter how well the code is written, there will always be questions about its provisions which can be cleared up to a considerable extent by accompanying explanations and illustrations. These cannot be a part of the legal requirements but they may be offered in an appendix consisting of numbered sections adequately cross-referenced to the corresponding provisions in the code itself. Such appendix matter may consist of brief comment on the reason for the particular provisions concerned, references to test data, examples of how the provisions work out in typical cases, and diagrams showing approved practice. While this adds to the bulk

of the code, it is so useful a method of obtaining compliance through better understanding of requirements that it justifies the additional effort necessary to supply it.

XXII. CONCLUSION

This discussion has touched upon certain aspects of building regulation that are of interest to local committees charged with the responsibility of writing building codes. An effort has been made to provide further information through selected references to articles by persons who have devoted serious study to the subject. It will be apparent from what has been said and from collateral reading that building codes are founded partly upon fact and partly upon opinion. For facts, it is possible to turn to records of laboratory tests and of experience with fires and structural failures. For opinion, it is necessary to resort to study of views expressed by experts whose background qualifies them to speak with authority; such opinion is likely to be better balanced when expressed through the composite judgment of committees.

Present-day building-code committees have the advantage of a great volume of test data, the proceedings of professional and scientific societies and of building officials, as well as recommendations of standardization bodies and national or regional committees. Use of such material in an orderly way is of greater benefit to a community than sporadic campaigns to alter existing requirements under the cloud of some great catastrophe or in response to dissatisfaction with some isolated requirement that is felt to be out of step with the times. An attempt has been made here to indicate the nature of this material and how it may be organized to serve a useful purpose. The treatment has not been exhaustive, for there are other points deserving of consideration. Nevertheless, it is hoped that sufficient information has been presented to enable a local code committee to get its bearings and proceed with confidence in its work.

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