USER-NEED STUDIES TO IMPROVE BUILDING CODES

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Abstract

The implications of performance, with respect to building codes and architectural practice, are not fully realized. Research, including user-requirement research, is a prime need. These matters are discussed and lead into subject selection, study methods, staff requirements, and other questions relevant to a research program. Examples of user-need research are included.

"User-need" has come to mean, in the author's experience, data and information that replace or supplement the traditional owner's requirements. It means predesign criteria concerning the objectives, activities, special conditions, and demands that a proposed building must satisfy. "Improvement" in building codes connotes an orientation toward performance.

The profound implications of an orientation toward performance have not yet been fully appraised by code-writing agencies nor by specialist groups who would be affected, such as architects. This paper, based on studies for and experience with one model building code which is in wide use, discusses the kind and extent of these implications particularly as they affect architects.

User-need as a subject and user-need studies as a process form an integrated part of the building code approach which results from a performance attitude. Hence a discussion of this attitude and its practical implications is the optimum way of expressing the kind and extent of user-need studies that relate to building code improvement. Not all user-need studies are relevant. It is hoped that the following discussion will clarify the concept of performance and help to define what user-need studies mean with particular reference to code improvement.

The Performance Approach: Meaning and Implications

Converting a building code from specification to performance means more than a clause by clause change. Performance and specification are polar concepts. Therefore, the change to performance transforms the code-writing procedure, the substance of the code, its arrangement, and the means of putting it into effect. Any agency turning to performance must accept a different legal-technical balance in the code, a shift from legal to technical authority, a reordering of jurisdiction, the training and employment of specialist personnel, the development of research facilities, the determination of explicit goals, the restructuring of code form and content, and the acceptance of a code as an 'open' system transcending planning, zoning, building codes and standards.

The architect will be most significantly affected in the area of responsibility. In a real rather than an official sense control will shift to the designer because much of what is now law will become design procedure. The code will be based more on knowledge than on tradition. An important part of the change is to fill gaps in the available knowledge. Some of the largest gaps lie in the field of user-needs, a field which is coming to be of particular interest to architects. Architects will be involved in the information gathering process and setting the standards as well as in the application of these criteria in design.

These developments can be explained by comparing the objectives of the prevailing legal codes that evolved through history with the objectives of codes having a performance orientation. The purpose of legal codes is essentially the same as it was in the 12th century. At that time it was to provide building control with respect to problems that fell outside, or between, the closed professional or trade practice systems. Then as now the architect's concern stopped at the boundaries of his

client's property. He is not concerned with the building next door. Law has always filled this gap. It superimposes control with respect to the hazards to adjoining or adjacent buildings. The mason's concern is the chimney and the carpenter's is the house frame. The gap, or lack of gap, where these components come together is a potential hazard. Here again the law steps in.

The performance attitude, on the other hand, must take these gaps into account. Performance can be thought of as an equation. For example, the performance of an exterior wall can be expressed as an equation of the inside and outside conditions. Designers already assume a performance attitude with respect to thermal comfort. It is merely an extension of this idea to add other characteristics such as sound, light, humidity, and also fire, a matter that the law at present rules upon. There is no reason to divide these subjects between design and law.

Performance raises the question of responsibility. Should these subjects be practice or law? The answer for several reasons must be practice. Design standards must be developed in areas that are now controlled by arbitrary legal rules. This requires a commitment to research and standard-making by those who hitherto have relied very largely on experience or intuition, in design.

The gaps, or what needs to be done, are revealed when the broader framework of knowledge for building performance is set down. Three basic categories of knowledge can be distinguished. These are:

1. Knowledge of the natural environment including climate, soils, and earthquake phenomena.

2. Knowledge of the building fabric including properties of materials, functions related to position and shape of members, and energy use, and

3. Knowledge of the controlled environment or user requirements which include all the predesign criteria based on use, such as live and fire loads in addition to requirements for activity space, privacy, and other related matters.

The impetus for research and selection of subject to fill the gaps in knowledge comes from the performance equation. The inclusion of structural design, including material stresses, in codes provided the incentive to verify the assumptions that had to be used to determine live loads, including loads due to use. When fire resistance was introduced, studies of occupancy fire load were inaugurated. When criteria for ventilation, plumbing fixtures and exits were introduced, consideration had to be given to occupant load.

Some of the most definitive work on user-needs has been done by the American Society Heating, Refrigerating and Air-conditioning Engineers and is represented as information provided in the ASHRAE Guide. The stimulus was to provide more accurate information to solve specific heating, cooling, and other problems. A favourable climate for user-need studies exists where a code-writing agency has a building research wing and where the performance equation is acknowledged. Experience shows that in this case the most familiar and persistent code administration problems are due to ambiguity because occupancy categories, which are predesign criteria, are not definitive with respect to the matters that are regulated. The matters regulated usually need study but by far the greatest problem is to define the specific occupancy situations to which these matters should be applied.

Performance and Research Technique

Performance requires that the system of units used for measuring values is suitable to an equation: each must be in the same terms. Live load, material stresses, and shape factors are all expressed in pounds and inches. Fire load and fire resistance are measured in thermal units, occupancy density is expressed in air changes per hour for ventilation purposes and person per minute in a 22-inch exit unit width for exit purposes. However esoteric one may get about user-needs, particularly of a qualitative kind, it must be remembered that these are of value for building control only if it is possible to find some system of measurement or evaluation so that the condition to be achieved (user-need), the condition to be controlled (the hazard), and the means of control (building or equipment) can be expressed in the same terms for equation purposes.

User-need research is often thought to be closely coupled to research in the social

sciences, but the integral nature of research for performance codes does not support this image. In the examples quoted the need has been for data gathering and the surveys made have involved simple measurements of material things. The live fire and occupant loads in dining rooms, shoe stores, and warehouses differ due to the different social purposes assigned to the spaces. As long as the spaces can be identified by commonly understood terms, however and there is consistency in the values measured over all the spaces that would be known by the same term it is unnecessary and wasteful to study the activities thoroughly to derive any causal relationships.

Social conditions are changing, however, and building nomenclature is becoming meaningless in terms of the hazards and critical situations that the terms have implied. This changing situation provides an opening for social science studies of the hazard factors of human activities, territories, and belongings as related to building use. Social scientists who are interested in and sufficiently knowledgeable about buildings and their use could make a contribution in this area. The objective would be to identify and describe the critical aspects of occupancy so that reference to ambiguous building-type categories could be avoided. This is a valid area for quality appraisal to distinguish phenomena that are qualitatively different.

In the absence of such interest and expertise steps of a more pragmatic kind can be taken as a temporary expedient. The major difficulty with building codes is with fire requirements. The problems of fire, unlike those of structure, and to a lesser extent health, are related to spaces. Fire occurs in a space and the possibility of identifying the cause and controlling it is indirectly proportional to the size of space. If the space is very large, such as a zone in a city, it will contain a wide variety of activities and a corresponding variety of hazards. Because of this variety no general rule can be devised that controls any one hazard. On the other hand, small spaces, such as rooms, are often devoted to a single activity. Here the hazards are easily defined and controlled. A hopeful sign is that, in Canada at least, the trend is toward regulating smaller spaces. This in itself requires more attention to the definition of occupancy and user needs and is therefore a stimulus for research.

A Proposed User-Need Study

One user-need study which has been projected in Canada and suggested for detailed study has to do with the problem of fire in an enclosed space. Specifically the problem concerns the possibility that occupants may be trapped in a room by a fire in that room which cuts off their means of escape. The classic cure for this problem is to require a second door when the space is more than an arbitrary determined size. This rule has been augmented more recently by flame-spread requirements.

Very little study is necessary to realize that being trapped is not directly related to room size. Also, a second door remote from the first tends to be most impractical with long, narrow rooms, configurations where the possibility of being trapped is the greatest. These problems, arising in building code meetings, have stimulated the research wing to make an alternative proposal. This is to formulate the problem in terms of the functions that relate to the problem directly. The result is as follows:

$$\frac{\text{time for occupants to perceive the danger} + \text{time to evacuate the space}}{\text{time for the fire to cut off escape}} = < 1.$$

When this value is less than 1 (a nondimensional number), the situation is safe.

Several things should be noted about the equation. First, the three functions are all in the same terms - time. Second, all the functions are related to activities in the space. A large number of studies of relevant characteristics of human activity would be necessary before this proposal could replace the contemporary method of regulation. Third, this method shows up the current rules in a new light. At present, the basis of flame-spread controls bears no relationship to occupancy. The number of doors required is related to room size. With the suggested method, flame-spread, doors and many other matters become variables in the formula. More doors or sprinklers could offset higher flame spread or there might be intrinsic user's demands that in themselves would satisfy the equation without the need of any further measures. Finally this proposal relates to what would ordinarily be regarded as esoteric occupancy intangibles but it has been put into terms that can be measured and equated even though more than

ordinary reliance will have to be placed on assumptions because of the lack of data.

The author would be glad to exchange information with those who are interested or active in user-requirement research programs specifically oriented toward the development of performance codes.

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