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Please note

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A great deal is said today about the performance concept and performance codes and specifications for building. The purpose of the proposals and discussions is quite clear -- to promote the practice of specifying materials, components and equipment in terms of what they are required to do rather than specify a particular kind or brand. It is hoped that in this way the greatest possible opportunity will be given to all potential suppliers to compete, that there will be greater incentive for innovation, and that in the end better or cheaper ways of building will result.

It appears to be taken for granted by the more outspoken proponents of these ideas that there will be no difficulty in establishing suitable statements of performance requirements. There is much discussion about evaluating materials or components as to their ability to perform; but there is surprisingly little about the fundamental problem of establishing what will be required in terms of the properties of individual components that will ensure the building as a whole has the desired characteristics.

Performance Approach

There can be little quarrel with the performance approach in principle. It does, however, make demands in practice that are not readily satisfied by existing knowledge and frequently require evaluation procedures that are both long and costly. It is much easier to specify a wood frame wall than to describe the limiting performance characteristics of all acceptable alternative walls. For one thing, economics may already have restricted the choice, so that the procedure of admitting all possible solutions as a principle becomes unnecessarily complex and usually quite impracticable.

It is often overlooked in such discussions that a requirement, performance or otherwise, in a contract document will be of little value unless there is an acceptable way of determining if and when it has been fulfilled. It is one thing to inform the supplier that the buyer will accept any wall having the same general fire resistance properties as a brick wall; it is quite another to define unambiguously the properties of the brick wall that are to be duplicated and how those of competing constructions are to be measured. In any case, it must already have been decided that the brick wall is adequate.

Remarkable advances in science and technology generally have created the optimistic view that "all things are possible," and encouraged an exaggerated idea of the comprehensiveness of knowledge about quite ordinary things like building materials and components. It would come as a great surprise to most people to know that no one is yet able to measure the properties of a particular asphalt or to predict with any certainty the durability of the products made from it except by observing and recording the way they stand up to years of service.

Testing

Testing is naturally the panacea supposed to resolve all problems of prediction. It is true that it is the principal tool the designer has at his disposal to improve his ability to assess or predict. He may set out tests that he has himself devised, but more commonly he will select from among standard tests already available.

There are difficulties associated with either course. A choice must first be made as to the particular conditions under which the performance of the component will be examined. The procedures to be adopted must then be practical in respect of both time and money. They must also be reproducible, so that if carried out on different products, in different places, at different times, the results can be directly compared just as if they had all been done in the same laboratory. These essentially practical requirements inevitably influence the conditions of the test and thus the extent to which it represents real conditions of use.

There is always a major question -- whether the right factors are included in the proper combination to represent critical conditions best reflecting probable performance. Many, for example, have sprayed water on faulty walls and windows and have failed to demonstrate rain leakage. They do not realize that water and wind pressure are usually involved together. This presents a very real difficulty, the full implications of which are seldom appreciated except by those with first hand experience in field and laboratory.

The extent to which a particular test appears to represent a real situation -- in size, completeness of representation of factors and time -- is usually a measure of the lack of understanding of the interplay of various factors influencing the final result. If the more critical factors and their combinations are known, the tests can be simplified by devising procedures that will examine only these factors. Such tests may, however, bear little resemblance to the real situation. When knowledge is adequate, prediction may be possible without any tests whatever.

When the designer devises his own tests, he has the advantage of being able to represent the specific conditions of his particular design. He cannot avoid the risk, however, of not including all the more critical factors and their combinations. As his new tests will probably not have been used before, he will have no prior experience on which to lean and must wait until the supplier completes the tests on his product in the interests of the specific contract involved. There is also little probability that they will be suitable or usable for other situations.

Standard Tests

Clearly, if a standard method of test can be devised, accepted, and regularly used, a much more orderly and less costly approach becomes at once possible. Different laboratories may then produce test results that can be compared at any time with confidence. In this way manufacturers and others can determine in advance the performance of their product as measured by the particular standard test method designated for it. A great deal of useless testing and retesting, using a variety of unstandardized methods, will thus be avoided.

A significant compromise must usually be made in order to gain this advantage. The method of test cannot on the one hand be "standard" and at the same time provide an entirely adequate basis for evaluation of performance for all possible situations. In all such standard tests it is necessary to select a particular set of test conditions. For example, the standard test for leakage through windows will be basically one made under a set of conditions that permits comparison of test results for different windows; yet it may not necessarily be the same set of conditions to which the window is to be exposed in service. The final step of predicting performance in situ on the basis of interpreting standard test results must still be faced.

Judgement and Tests

It will always be necessary to take into account the differences between standard test conditions and those pertaining to a particular job application. This is a task for the expert. When knowledge from tests is inadequate, it becomes necessary to rely upon experience and judgement. It may be necessary in some situations to carry out further testing of a special kind, despite the problems with specially devised tests that have already been suggested. The adequacy of this approach will be limited by the ability of those responsible to anticipate the relevant conditions that will finally exist and to simulate them adequately for the purposes of the test. This too requires knowledge combined with the exercise of the best judgement of a competent professional in the field. With such aids it should be possible to provide improved prediction of in situ performance, as compared with the empirical solutions upon which reliance has had to be placed in the past.

Performance Criteria

Some standard tests are essential if designers are to have even the simplest of yardsticks against which to judge how building components will perform. The test method by itself will be of little use. It must be supplemented by guidelines as to range of values between which test results should lie for satisfactory performance. Final decision on the use to which they are put, aided by such guidelines, will always remain the responsibility of the designer. Only with such standard test methods, supplemented by expert judgement, can the "performance concept" begin to have any real meaning.

This is the direction the performance concept must take if this valuable indeed, -- essential -- idea is to be fully applied in the building of the future. Without standard performance-type test methods, devised along well-defined lines and based upon all available research results, talk about the performance concept will not be very meaningful. Correspondingly, an appreciation of the significance, and limitations, of standard test results is essential for the designer if he is to know the criteria he must apply before using the results of standard tests in his design procedures.

The performance concept is here to stay. It is to be hoped that it will become more accurately, more widely, and more completely appreciated throughout the building industry. This will come about only if there is a corresponding appreciation of the necessity for measurement of performance, so that results can be communicated to others without any fear of misunderstanding or misinterpretation. All of this means that the need for standard tests on building components, already urgent, will grow steadily with every advance in building technology. The tests will be, in general, laboratory tests, the methods developed in accordance with widely accepted procedures for the writing of standards. Unfortunately, these are not well understood, except by those who have participated in standards writing. An outline of what is involved may therefore help in a general appreciation of the problems attaching to the performance concept.

Preparation of Standard Test Methods

The need for standard methods of test is not peculiar to the building field. It is a common requirement in many branches of modern technology. Despite the variety of things for which standard test methods are required, the procedure for developing them in such a way that they will be generally acceptable has now been well recognized. Clearly some of those involved must be expert in the procedures for conducting the type of test that is being considered, with valid experience in carrying out comparable tests in their own laboratories. It is equally clear that those who are to use the results of the test methods must also be involved in order to ensure that the tests to be devised will give information of practical use to them when accepted for general application.

The need for balancing the two approaches to testing will be evident, as will also the special place occupied by those who represent the producers of the components for which standard tests are to be devised. Accordingly, committees charged with the preparation of standard test methods, in any field but particularly in the building field, are not just random groups of interested participants but most carefully selected experts, balanced in representation so that no single interest group can exercise control. These restraints on membership are so logical and so well understood by all engaged in the writing of standards that they are universally respected.

Once committee members have been selected and the need for a new standard test method has been established, a first meeting is inevitably a sharing of experiences and information about the product involved and possible methods of test. Time is saved by the preparation of a first, very tentative draft method of test by someone with experience enough to essay this difficult task. Thereafter, the draft will be subject to rigorous discussion by all members of the committee, to amendment, and probably to drastic revision before anything like an acceptable version is achieved. This procedure is an educational experience for all who participate, as those who have been engaged in such work know well. Experiences are exchanged, unsuspected difficulties brought to light, and the basis of the criteria to accompany the test method hammered out.

Standards in Canada

It is desirable that those most anxious to see the performance concept advance to a firm place in the over-all building field should themselves participate in the standards-writing process, architects in particular. The work is time consuming. It has to be a voluntary contribution. But the benefits to be derived are invaluable and the experience gained cannot readily be obtained in any other manner. Use of the performance concept would be immeasurably strengthened and enhanced if all those who urge its adoption had some experience in this essential allied activity, that of preparing standard test methods and seeing that the results they give are properly applied.

The development of national standards in Canada comes under the general control and guidance of the Standards Council of Canada. The Council, with its office at 350 Sparks Street in Ottawa, does not write standards either for products or for test methods. It has designated several standards-writing bodies as accredited standards writing organizations. These include: Canadian Standards Association (CSA), Canadian Government Specifications Board (CGSB), Bureau de Normalisation de Québec (BNQ), Underwriters' Laboratories of Canada (ULC), Canadian Gas Association (CGA). Of these, the Canadian Standards Association, with offices at Rexdale Blvd. in Rexdale, Ontario, is the body chiefly involved with standards for the building field. So vast is the field to be covered that CSA relies to some degree on the standards prepared by a unique body, with headquarters in the United States but international in character, the American Society for Testing and Materials. Its headquarters are at 1916 Race Street, Philadelphia, Pa. 19103. Many Canadians take an active part in the work of ASTM, as well as supporting CSA.

Conclusion

When standard tests are accepted by the designer, he can reasonably expect that some will already have been carried out, thus saving time. A further saving is possible when the results of the standard tests can be used for other jobs. The designer must always ask, however, whether the standard test was designed to cover his particular situation. He must, in fact, regard it as a practical way of comparing various materials or components, one that also provides as much useful information as possible from which performance in a particular situation may be judged. Since those who devise the standard test cannot know what a designer has in mind, the designer has a responsibility that he cannot avoid of assessing carefully the validity of the evidence provided by tests in making his selection of the products offered.

There will always be a risk in relying upon test results. The risk is, however, in inverse ratio to the extent of knowledge of the factors involved and the way in which they interact to produce a final result. The more adequate the understanding of what is involved, the easier it will be to make a proper selection of test methods and to interpret their results in the light of a particular situation.

There is no quick and easy way in which performance predictability, so essential in rational design, can be achieved. The person making the prediction must always know as much as possible about the product under review and its use. In short, it is work for an experienced professional, who begins with an adequate background in building science and has accumulated experience and developed judgement to augment his applied science background. It is difficult to avoid the conclusion that the development of professionals, and indeed of a profession of this kind, is far more urgent and will probably be more effective in improving the quality of buildings than many of the currently proposed changes in the construction industry.

This competence is required in many areas of research, in development, marketing and teaching. It must be used to augment and extend present capabilities at all levels. More building science must be introduced in design, and in manufacturing, as well as on the construction site, through training at technical schools and institutes of technology as well as universities.

Not only is a high level of predictability highly desirable in promoting innovation, it is necessary also to keep pace with the changing needs introduced by new materials and new kinds of buildings. Without this capability of prediction it will be very difficult to build more and better buildings at less cost, and the risk will be greater of constructing poorer buildings at greater cost. Without predictability, which is at the heart of the ability to design and evaluate, the performance approach becomes no more than an intellectual exercise.

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