

## **CIB - ASTM - ISO - RILEM 3rd International Symposium on**

# **Applications of the Performance Concept in Building**

**9-12 Dec. 1996, Tel-Aviv, Israel**

- [The Role of the Performance Concept in Future Developments on the European Construction Market](#)
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This International Symposium marked the close of Rachel Becker's decade of distinguished service as Coordinator of W60. CIB and most especially all those who have been involved in this active and productive Commission thank her warmly for the leadership and inspiration which she has provided throughout a period which she characterises below as being "a sufficiently long period for one person."

In what follows she looks back at the Symposium.

Her Report is followed by one of the Opening Keynote addresses given by Mr. James Gross and by the Honorary Speech by Dr. D.K.J. Tommel, a Parliamentary Under-Secretary in the Dutch Government who is responsible at Cabinet Level for monitoring the coordination of the different aspects of construction policy.

As the Performance Concept provides a flexible and technically non-prescriptive framework for building design and construction, its application and implementation throughout the building process is of growing interest world-wide. It is now well accepted that the performance language and tools can become the basis for harmonization and globalization of the building market, and be a means for eliminating barriers to trade. Endeavours in implementing this approach are being carried out in many countries. This was recognized by CIB Commission W60, and the other Commissions who took part in the organization of the Symposium, CIB TG11, ASTM E06, ISO TC59/SC3, and RILEM 140TSL, that it is prime time for a joint international event, that will be devoted mainly to the exposition of research and building projects in which the performance concept was applied.

The Symposium was organized by the National Building Research Institute of the Faculty of Civil Engineering, Technion, Haifa, Israel, from 9th to 12th December 1996, and chaired by the outgoing Coordinator of W60, Assoc. Prof. Rachel Becker. It attracted around 120 participants from 25 countries, with an excellent mix of all the most competent professionals, including members of academia, researchers from public and private institutes, government and code officials, practicing designers and industry members. In the course of presenting papers and posters and taking an active part in the four-day programme, many new acquaintances and friendships were made, and the basis for some future collaboration in research was established.

On Sunday, the evening before the beginning of the Symposium, all those who had arrived sufficiently early met for cocktails, to revive old friendships and to sow the seeds for making new ones.

## **The Scientific Programme**

The scientific programme began on Monday with the official opening ceremony and consisted of 64 oral presentations and 31 posters. It opened with three Keynotes, which clarified the significant roles of Human Requirements, Architectural Design and Building Physics in the application of the performance concept in building. Seven Themes then followed, given over to the various stages and phases of the building process. Each session commenced with an invited Keynote, followed by seven oral presentations. Two Honorary Speeches and three Keynotes closed the Symposium, establishing some additional horizons and a future perspective for further application of the approach in the developing global building market, and pointing at the gaps in knowledge that still have to be bridged by international research.

There were 31 Posters at the Symposium which demonstrated once again how effective this simple means is for getting the message over.

Some of the main conclusions of the Symposium were that there is much world-wide enthusiasm in applying the performance concept throughout the entire building process. It is genuinely believed that this is the right approach to ensure a free and flexible building market. In reality there is some diversity in the level of knowledge development and actual experience with the application during the various stages. The concept is widely applied nowadays during the processes of standards development, evaluation of innovations, detailing and construction of quality buildings, and Post Occupancy Evaluations. For these to be accomplished with a higher degree of accuracy, there are still some performance test methods and scientifically based evaluation tools that need development, and others that require refinement. The main areas calling for more extensive research are in the development of tools for evaluation and analysis of durability and prediction of life-expectancy. Application of the concept in building codes is starting to take place. However, due to lack of experience and knowledge, many building officials tend to prefer the old-fashioned "deemed to satisfy" approach. It is clear that the two approaches should, in the meantime, go on side by side.

Another field of activity where the performance approach is widely applied is in the development of performance integrated Computer Aided Architectural Design tools. In the meantime these tools are used for the sake of research and consultation. It seems that some additional research and collaboration are required in order to establish the adequate design platform. That is, a platform that will equip the practising designers with a computerized continuous tool for the various design stages, starting with the lee front conceptual and preliminary phases up to the detailed design and costing.

The building phase in which the application of the approach is still lagging behind is project initiation. Some new methodologies and procedures have been developed, mainly in The Netherlands, for substituting the conventional client/builder relations by others that are more amenable to application of the performance approach. However, much has still to be done in order to overcome the uncertainty associated with the process, that stems from the lack of rigorous means for evaluating the final product's performance. There are also juridic and managerial problems that need further elaboration which means that this area properly belongs under the title of experimental applications.

## **Professional Visits**

On Tuesday participants and their accompanying persons split into the three full-day professional visits, that included some interesting recently constructed building projects such as the Supreme Court and Mormon University in Jerusalem, the Teffen Industrial Park, the New Copernaum Church, the Schneider Children's Hospital and the Solar Tower of the Weitzman Institute. The organizers were so eager to expose their world-wide guests to the Israeli construction projects, that even the Old City of Jerusalem was left out of the Jerusalem tour, and many participants had to use the weekend before or after the Symposium to compensate for this.

Wednesday and Thursday were again working days. Despite the competing attraction of good weather and the magnificent sea shore across the Dan-Panorama Hotel, where the Symposium took place,

attendance at the sessions was excellent and interaction between the professionals continued throughout the whole day.

Dr. D.K.J. Tommel, Parliamentary Under-Secretary for VROM, The Netherlands, was the Honorary Guest of the Symposium, and participated in the gala dinner on Wednesday evening. His contribution is reproduced on page...As the Symposium took place during the week of Hanukah, a Jewish historical holiday, the evening started with the ceremony of lighting the Hanukiah (the eight candle & seven Menorah), accompanied with Hanukah Songs by the Symposium Choir that had been assembled on the spot. During the dinner, a special tribute was paid to the most distinguished participant at this Symposium, Prof. Gerard Blachère, who may be considered one of the founders and forerunners of the Performance Concept in Building. Assoc. Prof. Christer Sjostrom, President of CIB, and Assoc. Prof. Rachel Becker have endowed Prof. Blachère with the CIB Shield, bearing the inscription: 'The International Council for Building Research, Studies and Documentation honors the unique contribution by Gerard Blachère to furthering the worldwide frontiers of building science in The Performance Concept in Building'.

## **New Coordinator for W60**

On Sunday after the Symposium, W60 held a Commission Meeting at the National Building Research Institute in Haifa. Rachél Becker, the outgoing Coordinator, chaired the first part of the Session. She summarized briefly the decade of her acting as Coordinator, thanked all members and CIB Secretariat for the hand they had given in producing the Workshops, Symposium and Reports during this period, and formally announced the end of her term of duty, stating 'ten years are a sufficiently long period for one person. After this Symposium it is only natural that somebody else will take it from here and lead the Commission for the next decade or so'. She suggested to nominate Ir. George K.I. Ang, Deputy Director of Design and Engineering, Government Building Agency, The Netherlands, as the new Coordinator, and this was unanimously accepted. The rest of the meeting was chaired by Ir. Ang and was devoted to defining the W60 work programme for the next few years.



**Rachel Becker**



## **The Role of the Performance Concept in Future Developments on the European Construction Market**

by Dr. D.K.J. Tommel, Parliamentary Under Secretary, Ministry of Housing, Physical Planning & Environment, The Netherlands

This Symposium has been devoted to the application of the performance concept in the construction industry. I have been asked in particular to highlight the future European developments in this connection.

After a brief introduction to construction policy in the Netherlands, I shall look first at the European construction market in general. Then I should like to say something about performance contracts also in relation to European policy. I will close by drawing a few conclusions and stating a few ambitions for the future.

### **Construction Policy in the Netherlands**

Let me first of all say something about construction policy in the Netherlands and my role in this.

Central government in the Netherlands in the past took upon itself a coordinating role with regard to the construction industry. This has taken shape in the form of a coordinated construction policy and a coordinating member of the Government for the construction industry, which is one of the items in my portfolio at the moment.

Primary responsibility for construction policy in fact rests with the members of the government who are responsible for the different aspects of this policy.

When policy is being devised in several places at once a need arises for coordination. This is done to avoid inconsistencies and to spot gaps. The central aim is to promote a smoothly running construction process in the broadest sense of the word. The operation of market forces is taken as a point of departure; only if the results of this fall short when judged on efficiency, effectiveness and/or fairness is there a reason for government intervention.

At Cabinet level I am responsible for monitoring the coordination of the different aspects of construction policy and I draw attention within the Cabinet to the construction branch if the consequences of general policy justify this branch of industry being addressed more closely.

The Netherlands Government takes the view that the construction sector is an extremely important one, though it is not to be regarded as an exceptional sector. The importance of the sector is related to its economic significance and to the role the sector plays in building what society wants. Besides this important macro-economic function, a smoothly functioning construction sector plays an essential role in implementing government policy, for one thing in the field of spatial planning, public housing, the environment and infrastructure. But the construction industry is also a sector like any other. It has to sustain itself in an open market economy; in other words without the support or protection of the Government. Government policy in the Netherlands aims at strengthening the structure of the economy in its full breadth and thus for the construction industry as well. The aim is to ensure that the sector is optimally equipped to sustain itself in the international field of market forces. That brings me to the second theme: the European dimension.

## **The European Construction Market**

In 1985 the European Commission published its "White Paper on the Completion of the Single Market", under the slogan "Europe 1992". This White Paper gave the go-ahead for around 300 measures whose aim was to create a single European market by 1992. The majority of the 300 measures announced at the time have been converted into legislation by the European Commission. Moreover Brussels has also drawn up proposals to give shape to the social dimension of Europe and Directives have been approved in the environmental field. The European Commission is seeking to achieve more national and international competition and greater equality in national legislation. It is setting itself the aim of eliminating all trade barriers within the common single market.

The building industry, which has traditionally been very much locally and regionally orientated, is increasingly being confronted with the repercussions of the endeavour to create a single European market. No immediate changes are expected for the smaller building contractors, but for the larger companies the situation is different. For them international competition will increase. The national obstacles standing in the way of open competition are being challenged. It is thus that harmonisation of building regulations has also got underway. This harmonisation primarily aims to remove the technical obstacles to the free traffic of construction products. A great number of Directives has been drawn up to achieve this. One of them is the Construction Products Directive which is based on performance criteria. European Directives that have been in force longer relate to an information procedure in the field of standards and technical regulations. Member States are required to notify standards and technical regulations which they are planning to establish to the European Commission. The aim of this procedure is to allow the Commission and the other Member States to ascertain whether those standards and regulations could possibly lead to trade barriers.

Through the harmonisation of European legislation, the accent is increasingly shifting from national to European standards.

In addition, the General Agreement on Tariffs and Trade (GATT) in the Government Procurement Act (GPA) refers to Directives for European Tendering. I shall be reverting to this latter Directive later.

## **From Fragmentation to Cooperation**

That brings me to the subject of your Symposium. Much has already been said here about the performance concept. The concept has been designed to encourage integration in the building process so as to achieve better value for money and to promote innovation. Integration in the construction process has been commanding growing attention in recent years. But the prevailing picture in many countries, including the Netherlands, is that of great fragmentation in the building process.

Now this fragmentation is a phenomenon with a long tradition especially in Western European countries. In the Fourteenth Century, with the advent of the Renaissance, more and more artists were involved in designing buildings. This growing involvement in architecture of people who were not builders resulted in design and building functions being separated. Later in the 18th and 19th Centuries, the phenomenon of subcontracting work became increasingly more common in the construction industry. Then the architect, who was always close to the client and who was increasingly becoming more of an overall consultant, came to look after the interests of the client in the building process as a whole.

In the course of the 20th Century, fragmentation in the building industry proper increased further through subcontracting and the like. The underlying point of departure was that competing on prices was the best way to get value for money. Quality after all was laid down in the Bill of Quantities or specification in the form of product requirements. When it came to value for money, however, the price prevailed over the quality.

It was also found that fragmentation in production led to waste. This applied not only to the building industry but to any industry where subprocesses in the production of goods and services are not properly coordinated. The growing complexity of buildings themselves, however, made it increasingly necessary to integrate design and building.

The current thinking on competitive edge assumes that more attention will be paid to quality. Quality can be promoted through cooperation. The development of a greater competitive edge by providing an integrated building product has become a key concept. "Total Quality Management" is more and more becoming a guide in the production process.

## **Changes**

A number of fundamental changes are needed in the practice of building for the competitive position of the building industry and the reinforcing of trends in Europe. These changes relate notably to the client and the client's position in the building industry.

Clients have to be clients and not directors of the building assignment and the building process. Clients will have to develop forms of tendering and cooperation which mean that main contractors come up with an integral solution to the problem that has been defined. That forces clients to define accurately what end product they require in the preliminary phase. The way in which that end product is brought about is something which clients have to leave to the main contractor(s). Clients will have to gain experience with main contractors in building teams and by means of performance contracts. Clients will also have to endeavour at the same time to combine design, building and maintenance and if necessary financing and exploitation in a single contract.

The supply side will have to behave as entrepreneurs who are prepared to think up and organise integral

solutions to the client's problem in both new building and maintenance. This implies that building contractors will have to cooperate at an early stage so as to be able to offer a single final product and to be able to work together on the basis of integral quality management. Main contractors must be able to supply what the client wants in an integrated way. This will have to be done at an early stage in the planning process. The final product will be the outcome of customised work, on time, at the agreed costs and of a guaranteed quality.

Product-oriented cooperation does not confine itself to joint development of a concept and joint construction. It also relates to joint activities in the field of market analysis, research and development and marketing. Long-term maintenance contracts can also be offered on an integral basis. The major companies in the industry will have to look for ways for distinguishing themselves on the market as an A1 Group. Qualifications and guarantees are the answer.

## **Performance Contracts**

The first thing required to bring about changes on the supply side are different relationships on the construction market. Companies will have to develop a more active market approach. Clients can reinforce this change by putting projects out to tender in a different way. The performance principle and performance contracts offer good opportunities for this. A performance contract is an agreement with a single party on the market who realises an assignment for which he is integrally responsible and liable. This offers clients the opportunity to concentrate on their own core activities. This applies also to central government when it comes to implementing policies on national housing, infrastructure, water management policy and environmental policy.

Around 1991 the National Buildings Agency of my Ministry began working out performance specifications for the quality of central government buildings. From this the National Buildings Agency performance contract arose, which for one thing is based on the application of performance criteria.

The performance principle helps the National Buildings Agency to consistently concentrate on the requirements of the government services that are to be the ultimate users (the clients).

Offering the possibility of an integrated approach to the project provides clients with the chance to concentrate on their own core activities and to consolidate these. As a result the international position of building contractors is strengthened. Innovation, integration and the enhancement of expertise should go hand in hand.

The National Buildings Agency is focusing more and more on defining the final product on the basis of performance criteria rather than on directing the building process. Contractors in the building industry are thus able to offer themselves as firms providing integral solutions to accommodation requirements. This implies early cooperation aiming at integrating the design and building process on the basis of overall quality management. The performance contract has created the opportunity of structuring this cooperation in an innovative way. As a result far-reaching processes of change in the building industry have been brought about through the National Buildings Agency.

## **Innovation**

I have already mentioned on several occasions one of the main objectives of the performance concept: the promotion of innovation. In the past the emphasis was on product and material innovation and this was very much initiated by subcontracting firms for the building industry.

Right now, process innovation as a means of meeting the new requirements is gaining in significance. New ways of organising the building process are being sought so as to offer added value in relation to the sum of the constituent parts. Diverse forms of re-engineering are applied.

For the future more and more is being staked on market innovation. This entails the further development of the supply side for the building industry and building contractors responding in a proactive way. Future wishes in society deriving from new technological developments are highly relevant. New developments in the field of electronics, telecommunications and information technology are having an immense impact on our daily lives. Domotica, office innovation and "Smart Buildings" are concepts that are increasingly becoming a part of these new developments. Safety and comfort will be among the quality requirements set. New openings are being offered through innovations in the field of the environment such as energy conservation, the indoor climate and reducing commuter traffic.

I should like to mention in this connection a number of examples of market innovation which have arisen as a result of proactive enterprise.

In the field of living accommodation and care it has become possible to allow handicapped people and the elderly to live on their own for longer as a result of electronic signalling systems and telecommunications and to enhance their contact with the outside world. Homes are acquiring more and more electronic devices, both for household purposes and to regulate the indoor climate and for telecommunications. This serves to promote comfort but also saves energy. In addition, it is possible by means of teleworking to reduce commuting traffic. Electronic burglar and fire alarms offer a contribution to security without homes having to become fortresses.

In our working lives, part-time work, portable PCs and telephones are giving rise to far-reaching office innovation. The National Buildings Agency, which comes under my Ministry, is trying to respond to these developments with new office concepts. An example of a new office is a standard office building where the different rooms are used efficiently by a series of different members of staff.

## **Social Importance**

It sounds perfectly logical that market parties should have a primacy in market innovation, but that is not always the case. Sometimes it is difficult to resort to market launch, especially if the innovation is aiming at general social goals. In this context I should like to refer to sustainable building and the improvement in working conditions. Here the Government will have to play a stimulating role and do so by setting a good example itself, by offering financial and fiscal support and by legislation and regulations.

In the financial field in the Netherlands there are incentive premiums and fiscal openings in the field of sustainable building. Also in the legislative and regulatory field, new rules have resulted in new market developments. Here again the performance concept is latched onto to the maximum extent possible. Instead of strict regulations indicating how something has to be done we prefer to emphasise ambitions: what has to be achieved. Whereas regulations readily hamper creativity, performance criteria challenge people to innovate.

Thus in the Building Decree in the Netherlands an Energy Performance Standard has been included which has a highly normative impact and serves as the basis for further developments in the field of energy savings. By tightening up this Standard I expect, for example, that solar boilers will become a common feature of newly built dwellings in the Netherlands in a few years' time. For other aspects of sustainable building, too, I plan to include measures in the Building Decree. These will not only have a normative but also a stimulatory role. The Government in this way is fixing the bottom line in the market.

The numerous initiatives that have been taken in response to this show that the market is not entirely indifferent. Bearing in mind environmental criteria, after all, also means more comfort. User requirements contribute to better security and burglary prevention, regulations in the field of working conditions promote continuity of work. In other words, here we are creating win-win situations.

## **European Developments**

A single European market is leading to greater competition and the answer to this has to be quality, service and innovation. The definition of quality is known to you better than anyone else. In any event it has to do with meeting a demand and providing for a need. The clearer those demands and needs can be defined, the greater the quality that can be produced. The performance concept is an excellent means of communicating on quality. Performance has to do with measurable wishes and requirements, because performance has to be delivered and assessed. For this the parties have to be brought together and agreements have to be made; binding agreements that are measurable and checkable. At the end of the day we all want to avoid the infamous "Camel-nose" effect by setting down everything properly in advance. But we can also end up in a quagmire of agreements and conditions. The fragmentation in the building industry, which has been coupled with increasingly more agreements and requirements, has led to rigidity. Know-how is sharply concentrated in the construction companies while the know-why and the know-what is very much with the designing disciplines. Through changes in the market diverse parties have started thinking of other ways of cooperating, which enables new answers to be given. New questions and new answers are calling upon the innovative capacity of the entire building industry.

The performance principle and the performance contract are tools that can stimulate this innovative behaviour by clustering and challenging all the forces in the building industry. Thinking about new market developments and seeking to integrate the building process requires coordination. At the European Commission diverse Directorates General are concerned with diverse aspects of the building industry. Thought is being given to setting up a coordination centre for the building industry in Brussels to streamline the diverse actions.

What are the prospects of the performance concept in the context of the developments in the European Union?

Frequently European directives on government orders apply when governments and other public agencies select parties on the market. This applies not only with regard to orders relating to the implementation of works, the Works Directive, but also orders aiming at for example the delivery of loose inventory, the Deliveries Directive or the development of housing projects, the Services Directive.

The question of whether, and if so, which Directives are applicable depends on the nature of the assignment and the estimated sum. Thus the Works Directive applies to an order from the National Buildings Agency to a project developer to deliver the project turn-key on the basis of the performance criteria. The project developer is then after all responsible for the development and implementation. When, on the other hand, development alone is awarded to him, the Services Directive is applicable. It is a directive, incidentally, that also applies if the National Buildings Agency itself contracts an architect. In the case of the Services Directive there is a threshold sum of 200,000 Special Drawing Rights (SDR) and in the case of the Works Directive a threshold of 5 million Special Drawing Rights (SDR).

The application of the performance concept does not currently correspond well with the said European Directives. Putting out to tender on the basis of the European Directives is still very much product-oriented.

Competition on quality is being hampered for the time being by the criteria for awarding orders in the Directives which are based either on the lowest price or the most economically attractive offer. Here price, period of building, utilisation costs, return and technical value play a role.

In the Netherlands, too, there are a number of factors hampering the application of the performance principle, such as the fees for architects which are based on the delivery of capacity. Thus more expensive buildings pay.

In the Netherlands we are still at the experimental phase of working with the performance principle. I propose that as soon as we have gained more experience in this domain, we should get in touch with the relevant European agencies to coordinate the application of the performance principle with the said

Directives.

## **Rounding Off**

I have put forward a number of considerations relating to the performance principle as these have emerged in the development phase. It is clear that we still have to gain the requisite experience with this method of cooperating. The key concepts of the performance principle are integration, quality and market innovation.

The suitability for use of a building at all the stages of its life is the guide in applying the principle. The theme that you have been debating in the past few days provides a sound insight into all the stages of the life cycle that play a role in that use. An inspiring cooperation can arise because both client and main contractor focus on this life cycle with a view to the ultimate user.

Integrated building requires good coordination. To be able to deliver quality we have to know what the client wants. And innovation requires scope for creativity.

Competing on quality is not a magic formula. It is a demand made by the market which has to be answered by market innovation in the form of an integrated specification of what is required for the total use of the product to be supplied.

Delivering quality entails quality management. Quality guarantees streamline these processes and enhance client-friendliness. The Institutes responsible for this Symposium together with the National Building Research Institute (NBRI), notably the International Council for Building Research, Studies and Documentation (CIB), the American Society for Testing and Materials (ASTM), and the International Union of Testing and Research Laboratories for Materials and Structures (RILEM) provide the necessary infrastructure for this quality management and quality guarantee. This infrastructure enables the market partners actually to work out the details of their integrated responsibility and liability. This allows clearer agreements to be reached on quality, price and the settlement of disputes.

Experiences in countries with growing competition in the market such as the UK show that companies who have focused on an integrated demand have been in the forefront of developments. Companies that have confined themselves to offering production capacity have been forced to take a back seat.

I think it is of vital importance that the performance principle should be launched on a wide front. This Symposium is making an important international contribution to this. In Europe, too, I expect to see growing interest in the performance principle because it lends a new dimension to competition and the operation of market forces. In that sense I want to do all I can to facilitate the application of the performance principle in the field of the European Tender Directives.

All these developments are contributing to creating the conditions for delivering the building quality that clients and users want. And that was where it all started after all.

I shall continue to make every effort for this, both on the national and on the international front, as the coordinating member of Government for the construction industry in the Netherlands.

National traditions and culture of the Host Country are always accorded their rightful place at CIB gatherings. The ceremony of lighting the Hanukiah accompanied by Hanukah Songs by the "Symposium Choir" made a deep impression on all who were there.

Gérard Blachère honoured for his unique contribution to the Performance Concept.

Roger Baldwin, Coordinator of TG8 (above, foreground) and Rachel Becker and Wim Bakens (below, left centre), with a group of participants.



# Developments in the Application of the Performance Concept in Building



by **James G. Gross,**

National Institute of Standards and Technology, Gaithersburg, MD, USA

## 1. Introduction

This presentation provides a summary of the history of the performance concept in building, identification of some problems and limitations to its application and how the performance concept is dependent upon the more traditional prescriptive approach for practical application. It is suggested that now is the time for rapid increases in application because numerous nations of the world are committing themselves to applying the performance concept to building regulation which will permit and encourage application to innovative building design and construction.

Perhaps in the future, now will be viewed as a water shed time in the development and application of the performance concept in building - a time when the world moved from philosophical discussion and limited experimental application to broader and broader usage in both procurement of buildings and in their regulation and control. The performance concept as applied to both regulation and procurement is synergistic. For the first time, we are seeing many countries accelerating on both fronts. It is fitting that this Symposium is organised to share practical application of the concept based upon experience, case studies and significant recent accomplishments.

## 2. Development of the Concept

During the 1960's and early 70's, there were numerous worldwide activities to develop and apply the performance concept in building. Major research efforts were undertaken to understand and develop methodologies and tools for application. Major building programs for housing, educational facilities and office buildings were carried out under the performance vernacular with varying degrees of success. This flurry of activity and interest in many countries led to the joint efforts of RILEM-ASTM-CIB to cooperate in the first international Symposium on the Performance Concept in Buildings held in Philadelphia in May 1972, nearly 25 years ago. The Proceedings were published in two volumes. Volume 1 contains 82 papers published prior to the Symposium [1], and Volume 2 contains opening addresses, rapporteur reports and discussion during the Symposium [2]. Many of the performance leaders of the time were present. Emphasis was on research, concept development and major building procurement programs. Little attention was given to standards development and regulatory application. These proceedings deserve attention today. Much of what was said then is still applicable and very helpful in the implementation of the performance concept.

In 1977, RILEM-ASTM-CIB cosponsored a specialty conference on the Evaluation of the Performance of External Vertical Surfaces of Buildings, i.e. walls and fenestration. Also over the years, the same three Organisations along with some others have sponsored seven international conferences addressing the important performance attributes. "Durability of Building Materials and Components", the last of the series, was held in Stockholm last May.

The second broad-based Performance Concept in Building conference sponsored by the three Organisations was held in Lisbon, Portugal, in the spring of 1982. Three topics were selected to receive in-depth treatment:

- (1) methods of deriving performance requirements and criteria;
- (2) methods of evaluating performance against criteria;
- (3) application of performance concept to rehabilitation.

The third topic was in recognition of an increasing worldwide concern for preservation, rehabilitation and reuse of the existing building stock. As was true in the first cooperative symposium, limited attention was given to regulations. The proceedings were published in two volumes [3] and [4].

Today we begin the third broad-based conference on Application of the Performance Concept in Building cosponsored by CIB, ASTM and RILEM. ISO has joined as a Cosponsor. Emphasis is on practical application, innovation and regulation as applied to the building design and construction process.

### **3. Application Barriers**

The discussion and conclusions from these symposia raise a rhetorical question: "If the performance concept is so widely embraced philosophically, if the approach is so widely accepted intellectually, if the principles are easy to understand, if the methodology removes barriers to innovation, if the performance concept can aid in the production of buildings that perform better at less total cost, why isn't it universally applied? While each of these "ifs" can be answered in the affirmative, let me share some observations about limitations which support the view that the devil is in the details.

#### **Definitions and Terminology**

There are definitions and terminology applicable to the performance concept, given in the ISO performance standards in building [5] [6] and the CIB Publication, Working with the Performance Approach in Building [7] which is still one of the best publications on the subject. Nevertheless, these definitions and terminology are not widely accepted by those who are attempting to apply the concept. The performance concept itself means different things to different people. To some, it is a concept of qualitative aspirations for buildings without a systematic methodology for analysis and verification. For others, it is a concept which requires quantitative analysis and rigorous evaluation that at times discourages those who wish to use the concept when these tools are not available.

#### **Performance and Prescriptive Approaches**

Some see the performance concept as opposed to or a non-related alternate approach to prescriptive standards, regulations and specifications. In the minds of some these two ideas are not meant to work together, when in fact, the prescriptive approach is complementary to but subordinate to the performance approach. In order to implement the performance concept, prescriptive descriptions are needed, both for programs of regulation and procurement. In applying the performance concept, prescriptive solutions are evaluated against performance requirements for compliance with user needs. In pre-construction applications, the solution, be it a building or a part thereof, must be expressed in prescriptive terms in order for evaluation and construction to take place. In post-construction situations, the construction itself provides the prescriptive solution for evaluation.

#### **Framework and Taxonomy**

The performance concept is applied to both building procurement and building regulation. In the case of innovative building production (an initiative action), more economical and better performing buildings are expected due to the freedom encouraged in design and construction. In the case of regulation (a permissive action), such as building codes and other control methods, the performance concept is intended to permit innovative construction while still protecting the health, safety and general welfare of society.

It is widely agreed that in the development of performance documents to meet either or both procurement

and regulatory needs, three essential aspects must be considered in writing performance statements.

(1) User Requirement is a **qualitative** statement giving the user need or expectation for the item being addressed. It is a subjective statement of what the product or assembly is intended to do. (Other terms used include user needs, goals, objectives, intent, function, principles.)

(2) Performance Requirement is a **quantitative** statement giving the level of performance required to meet the user needs or expectations for the item being addressed. (Other terms used include criterion and function.)

(3) Evaluation Methods set forth the tests or other information upon which judgement of compliance with the performance requirement is based. It identifies the standards, inspection methods, engineering analysis, calculations, review procedures, historical documentation, test methods (be they laboratory or field, full-scale or less than full-scale, destructive or non-destructive) used in evaluating whether or not the performance requirement has been satisfied. (Other terms used for evaluation include verification, compliance, conformance and tests.)

In addition, there are some useful components but not necessarily essential parts that aid in the implementation of the performance concept and include:

(1) Commentary provides background for the reader and presents the rationale behind the selection of specific user requirements, performance requirements, and the evaluation sections. The commentary is provided for informational purposes.

(2) Deemed to Satisfy Documents supply information on traditional solutions which are deemed to comply with the performance requirement. Deemed to satisfy documents are very helpful in implementing the performance concept, particularly in regulations when traditional solutions have been shown to satisfy the performance requirement and thus should not be subjected to detailed repetitive evaluation and analysis. (Other terms used for these documents include Approved Documents, Codes of Practice, Manuals of Acceptable Practice and Prescriptive Codes.)

(3) Quality Control Manuals are documents that set forth quality control and quality assurance procedures for building products and construction practices. Laboratory accreditation and product certification programs may be included.

(4) Post-Occupancy Evaluation outlines procedures for evaluation of the actual performance of the building in use. Post-occupancy evaluation provides a means of assessing actual performance as compared to predicted performance and feedback for future work. Unfortunately such evaluation is seldom carried out unless performance problems have been identified. Otherwise, post occupancy evaluation is often considered a non-essential expenditure of resources, particularly when the evaluation does not directly benefit the building owner.

Confusion arises when writers of performance statements use different terms for the same meaning and when these essential parts and implementation aids are further broken down or combined in a variety of ways.

### **Knowledge Deficiencies**

Unfortunately, in many cases, user needs or user requirements are not well understood. Different people have different requirements. Cultures, economic capabilities and expectations vary from country to country. The building industry worldwide has neglected human factors research which would assist in filling these gaps.

One of the most difficult technical problems in applying the performance concept has to do with the issue of performance over time. Traditional prescriptive solutions have implied acceptable performance, but

the reliability and associated risk with innovation cannot draw upon history to assure performance over time. This matter is being addressed. In the work of CIB, RILEM and ISO, researchers from around the world are co-operating in an attempt to quantify and standardise performance of whole buildings and components.

Another problem relates to the lack of authoritative information on the economic benefit of innovation both as related to productivity in the workplace and the health and well being of building occupants. There is an increasing awareness, and efforts are under way to quantify these benefits, particularly as they relate to productivity in the workplace. Recently (November 1996), a high level conference, the National Summit on Building Performance, was held in Washington, D.C. to examine the influence of buildings and facilities on workplace productivity. Speakers included Dr. John Gibbons, Assistant to the President of the U.S. for Science and Technology, who said "better constructed and renovated facilities could improve employee productivity 30 percent by the year 2003." Also, a keynote speaker was Lee Iacocca, who was CEO of the Chrysler Corporation when it invested \$1 billion to construct the most advanced automobile technology center in the world which led to major increases in worker productivity.

The report from this conference will be delivered to the U.S. Congress and widely circulated to the U.S. business community.

### **Need for Standards**

Standards are needed to facilitate communication and application of the performance concept. We need performance standards and prescriptive standards. Performance test methods are most often expressed as prescriptive standards which simulate the environment in which the building component will be subjected. Evaluation test standards are most often a detailed prescription of the test method and the specimen to be tested. The detailed prescription is necessary in order to obtain precision and accuracy required for ready comparability and acceptance of the test results.

To aid innovators and evaluators alike there is need for standardisation of the performance requirements for various systems, e.g. wall systems and components of buildings, in order to encourage innovation and to set forth evaluation guides. Such standards should be produced on an international basis to obtain consistent and comparable results.

### **Needs for Education**

Except for conferences and symposia, insufficient attention is given to both formal and informal education of design professionals, manufacturers, standards writers, regulators and owners on the benefit and methods of application of the performance concept. Many educational institutions introduce students to the philosophy of the performance concept but provide little instruction in its application to real problems and real building solutions.

## **4. Recent Developments**

Several recent developments have brought about increased activities in the application of the performance concept.

### **Construction Products Directive**

The Construction Products Directive issued by the European Union in December 1988, explicitly calls for application of the performance concept in the development of European standards for all construction products that are intended to be permanent parts of buildings and civil engineering structures. The six essential performance requirements for construction products include (1) mechanical resistance and stability, (2) safety in case of fire, (3) health hygiene and the environment, (4) safety and use, (5) protection against noise, (6) energy economy and heat retention.

## **CIB TG11 - Performance-Based Building Codes**

Recently CIB, recognising the need for work in the application of the performance concept to building regulations, formed Task Group 11 (TG11), to facilitate the exchange of knowledge and the development of recommendations to aid nations wishing to pursue this direction. TG11 held its first meeting in 1994 and now has held 4 meetings, the latest in September 1996 in Ottawa, Canada. England and Wales implemented a performance-based building regulatory system in 1984 and since that time other nations including Sweden, New Zealand, Australia, and the Netherlands have implemented this approach with varying degrees of success. Canada has developments underway to implement the performance concept in the form of an Objective Based National Building Code in the year 2000. Japan, too, has a mandate to implement a performance based building regulatory system. In the U.S. the organisations which have promulgated three sets of regional model building codes have joined to produce one set for the entire country. A study is underway to develop a performance-based set of model building codes for the country.

### **Standards Development**

ISO TC 59, Building Construction, SC 3 on Functional-User Requirements on Performance in Building Construction, has several working groups developing performance standards. Particularly notable is the development of standards addressing design life of buildings, under Working Group 9. Working Group 10 was established this year to explicitly develop Performance Standards for One- and Two-Family Dwellings. Counterpart activities on dwellings have been established by Standards Australia and in the U.S. by ASTM Committee E-6 on Building Performance with a new subcommittee E6.66, Performance Standards for Dwellings. Also noteworthy is the establishment and work of Subcommittee 4 of ISO TC92, Fire Safety. Working Group 1 of Subcommittee 4 is explicitly devoted to the application of fire safety performance concepts to design objectives.

### **WFTAO Formation**

Most if not all industrialised countries of the world have technical approval organisations for the performance evaluation of innovative building products. In most cases, these organisations evaluate non-standard products, those for which there are no prescriptive standards or specifications. Since 1994, these organisations have met in an International Forum in Brazil, France and South Africa. This past September the World Federation of Technical Assessment Organisations was formed to foster information exchange, cooperation and eventually mutual recognition. This is a significant development.

## **5. Summary**

Much progress has been made since the first joint conference in 1972. In the intervening time, there have been periods when the development of the performance concept and its application has not received much attention. Today we see a resurgence and much progress toward implementation, particularly in the building regulatory systems of the world. Lack of acceptance of the performance concept by the world's building regulatory interests has been a severe constraint to those wishing to apply the concept to the design and construction of buildings. When designers and builders wish to take advantage of the concept in order to apply innovation, they are discouraged by building regulatory systems which prohibit or at a minimum make it very difficult to apply. Today, we see this situation changing rapidly. The emphasis on the development of performance standards in national and international standards organisations also facilitate the application of the concept in both building production and regulation. It is recognised that test standards which simulate performance in a given environment are particularly important to permit regulatory application and to encourage trade even when the test values required in one part of the world are different than in another part of the world. Although progress is excellent, there remain many problems with the application of the performance concept. We look to this Symposium to shed light on many of these so that we might move into the next century with the performance concept better understood and more widely applied to the design, construction and regulation of buildings.

## 6. References

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