BUILDING RESEARCH WORLD WIDE

Limited Proceedings of the Eighth CIB Triennial Congress, Oslo, June 1980

Volume 1d

Discussion

Edited by
Norwegian Building Research Institute

RECHERCHE MONDIALE DU BÂTIMENT

Actes du 8ème Congrès Triennal du CIB, Oslo, juin 1980
Volume 1d

Discussions

Edité par
Institut Norvégien de Recherche du Bâtiment

BUILDING RESEARCH WORLD WIDE

Proceedings of the Eighth CIB Triennial Congress, Oslo, June 1980

Volume 1d

Discussion

Edited by
Norwegian Building Research Institute

CIB vol. 1 D

ISBN 82-536-0115-8
ISBN 82- 3 38141-7 (Vol. 1 d)

OPPLAG: 750

Nikolai Olsens trykkeri a.s, Kolbotn

PREFACE

This volume 1d is the completion of the proceedings from the 8 CIB Congress held in Oslo 16 to 19 of June 1980.
It contains all contributions, an edited account of the discussions and some few delayed papers.
The Congress Secretariat is very gratefull to the authors and the participants in discussions for their written contributions. All instructions for typing have been followed loyally. This has enabled us to produce the proceedings in a simple but quick and reasonable way.
We are also very grateful to Congress-Service for assistance in arranging the congress and to swissair for their organization of travels for the holders of fellowship granted by NORAD, SAREC, Swedish Council for Building Research and Danish Building Research Institute.

PREFACE

Ce volume est la somme des travaux du 8ème Congrès CIB, tenu à Oslo du 16 au 19 juin 1980. Il contient tous les exposés, un compte-rendu des discussions et quelques documents arrivés en retard.
Le Secrétariat du Congrès est très reconnaissant à tous les auteurs et participants aux discussions de leurs contributions écrites. Toutes les instructions concernant la forme des manucrits ont été fidèlement suivies. Cela nous a permis de présenter les travaux d'une facon simple, mais rapide et raisonnable.
Nous sommes aussi très reconnaissant a swissair et Congress-Service de leur assistance joint à des voyages des boursiers et d'accomplassement du congrès.
Notre gratitude includons NORAD, SAREC, Conceille Suedois de Recherche du Batiment et Institut Danois de Recherche du Batiment pour les bourses.

CONTENTS
Volum 1 D

SECTION

1

Opening of Congress, plenary session
Chairman: V. Kasalicky

Overture du Congrès
Président: V. Kasalicky

OPENING STATEMENT

Mrs. Inger Louise Valle, Norwegian Minister of Local Government and Labour

Ladies and Gentlemen,

It is a pleasure for me to welcome you all to Norway, and to have the opportunity to address you here for the opening of your congress. I feel this as a natural contact, since my Ministry is responsible for housing and building, and has throughout the post-war period had a very close contact with our Norwegian building research, and has made use of its results.

I understand from the programme of your congress that you are this time putting much weight on research for and in that majority of the worlds countries which are not yet highly industrialized. These countries have different conditions from most of the industrialized countries not only as regards level of industrialization, but also as to climate, living habits, availibility of materials, pricerelations and many other features. In this way I understand that your programme will serve to underline that building research in each country should be undertaken on the basis of the situation and the conditions prevailing in that country. I think this is an important principle.

This leads me to mention a couple of examples of important research results of our Norwegian building researchers, where I think they have been in the front-line just because they have used their resources on research which applies to our specific needs and conditions. I know that the international building research community has over the last few years contributed considerably to the work on energy saving in buildings, and that one of the working commissions of your organization has done important work in this field. It is in this connection interesting to note that already in the 1950's Norwegian housebuilding had shift to a much higher thermal insulation standard than before, and that this came through largely as a result of a close collaboration between building research and public authorities. This applied particularly to timberhouses, which make out about three quarter of our housebuilding. In fact a book written by your president Mr. Lundby and your keynote speaker on the building envelop professor Granum, became classical in this connection, and came in a number of issues. Another problem in our cold climate is that we have had to dig deep to place our water and sewerage conduits below the frozen earth in the winter. This costs work and money. Recently our Building Research Institute has developed techniques which enable us at least in a number of cases to place the conduits much nearer the surface and accordingly to save money.

But in spite of the specifics of building research of each country, I am convinced that much can be gained by international collaboration in building research. In fact international collaboration in the field of housing and building needs researchers. If the building habits of European Countries are copied in tropical countries, you will neither meet the needs of the people there nor use the resources in an economical way. The researcher should be a person who goes down to the basic facts and finds out how needs could be covered and how production factors could be combined to get the best result. For this purpose you need as well your housing sociology as your basic technical knowledge, and in all cases the scientific approach. This scientific approach is a thing which can be transferred from one part of the world to another, if it is based on an open mind which tries really to understand the conditions of other people. My Ministry has had collaboration with the building research as well in studies and exchange of experience carried out within the United Nations system as in development assistance. I hope this collaboration can be developed further, as well in bilateral connections as between the CIB and the United Nations' work on human settlements questions. I think it is interesting and encouraging in this connection to note that the United Nations' Centre for Human Settlements has got as its executive director a man with a solid research background from a developing country.

It is with considerable interest that I have noted that one of your technical sessions will deal with solutions for sanitation problems by dry and non-water-borne systems and by infiltration. It may be that in the first instance this seems to be of greatest interest to the developing countries where water shortage is normally more acute than in the industrialized countries. But if good solutions could be developed in the developing countries in this field, I would not be surprised if they could later be brought back to the industrialized countries for application there. The fact that in normal cases at least some 50 000 liters water are used to bring out to the ocean or to a purification plant about 100 kilo of firm material from the human wastes of a household, seems to call for alternative solutions. This is so much more so as the water has in many cases to be lead over very long distances, and as there should be possibilities to make use of the wastes instead of having them as a nuisance. In your technical session 4 B you will hear that there are people at our agricultural university who have taken up this challenge.

On the whole I can easily see that you have a lot of difficult, interesting and challenging problems ahead of you, as well here at your congress as in your further work at home and in CIB as an organization. I am looking forward to meet you again tomorrow evening at the reception which I will have the pleasure to host, and there to exchange views with some of you.

With these words I have the pleasure to declare the 8th CIB congress officially opened.

OPENING OF THE EIGHTH CIB CONGRESS

Mr. Sven Erik Lundby, President of CIB

Ministers, Ladies and Gentlemen,

I am happy to see all of you here for the Congress, and I wish you heartily welcome.

During the period ending with this Congress and General Assembly, our organization celebrated its silver jubilee. At that occasion honorary memberships were bestowed upon Mr. Blachère, France and Professor Červenka, Czechoslovakia, and when I mention this now, it is to repeat our thanks to them.

When founded in 1953, CIB was the logical development of CIDB, which had dealt more restrictedly with building documentation, following the ECE Conference on this theme in 1949. CIB was founded in close co-operation with ECE, and was given consultative status within UN. A person who took active part in the deliberations at that time, and who in fact put the wording on paper is our guest to-day: Mr. Ben Reiner, former secretary of ECE.

This is not time for looking over the shoulder. Let me, however, shortly comment the three years which now are at an end, without going into details, as done in the report of the Board for the coming General Assembly.

The Board and Committees of CIB have had an active period. By meeting in Nairobi and New Delhi the Programme Committee has shown that CIB does not want to be one-centered and limited to the problems of the industrialized world.

With Prof. Dr. Gyula Sebestyén in the chair of the Secretary General since May, a period of uncertainty and difficulties is overcome. I take the opportunity here to wish him heartily welcome, and am happy to leave the coming President such an outstanding personality in charge of CIB daily affairs. At the same time I repeat my warm thanks to our Deputy Secretary General for his devoted service during a difficult time. Without Chris Pollington's loyalty and hard work, and the assistance of the staff, CIB affairs should have been in a very bad shape.

Tasks which have had to wait, should now be finished. I am particularly aware of our responsibilities versus our French speaking members, and sincerely hope that CIB now shall serve them as they may expect.

The Board report states regarding membership that "decline is halted", and that there is a "modest upturn in membership". Good promotional material and efforts by the Secretariat should strengthen this trend. To-day CIB's total membership is close to 200, with 40 of the main building research and documentation organizations as full members.

The General Assembly will be invited to support full membership of industrial members, giving them voting rights and access to high offices. Such members could not only be huge construction companies with large research divisions, like those the CIB Board met in Japan, but also more modest enterprises with a clear research profile.

This Wednesday we hope to have a discussion on the future of those members within CIB, and those who are interested are welcome to join.

Let me then move to some major issues:

Parallell to the efforts of UN, as concluded at the Habitat Conference in Vancouver 1976, our Past President took the lead in reorientating CIB activities towards important global problems and the needs of the Third World. It was his feeling, when his period ended, that more should have been achieved.

I must admit, my feeling is somewhat the same. Nevertheless, what he planted, now seems to be growing. Mostly because of the devoted efforts of our Programme Committee under Nils Antoni, some of our ideas are ripening, and we are much more aware of our responsibilities versus our members in developing countries.

A document of interest is the joint Protocol by the UN Centre for Human Settlements (UNCHS) and the CIB Programme Committee after the Nairobi meeting, a protocol which with minor changes afterwards has been approved by the Board. If the Centre so wishes, we are prepared to sign this protocol, to lend it some formal importance too. This protocol states more precisely some of the fields and concrete tasks where CIB efforts may be of special interest for the Habitat Centre.

CIB clearly sits on personal and institutional resources of great value if motivated and mobilized in the right way.

To move from declarations to actions the General Assembly will be asked to decide upon a Developing Countries Fund (DCF) within CIB.

CIB will, if agreed upon, give the basic contribution and hopefully have som extra-budgetary support from members or institutions. This fund will give the Board an opportunity to facilitate the participation by elected officers of important meetings, and hopefully have some extra-budgetary support from members or institutions. This fund will give the Board an opportunity to facilitate the participation by elected officers of important meetings, and hopefully also open the way for a CIB liaison officer in Nairobi, or a similar arrangement.

The General Assembly also will be asked to support a proposal for a second Vice-President, to ensure that a Vice-President or the President is representing one of the developing countries.

Without some firm steps now taken, CIB may face a credibility gap in relation to the Third World. I am, however, happy to note, that our members in developing countries to-day look at CIB with confidence, and that they are convinced not only of our good will, but also of our determination to offer some humble contribution.

Mobilizing our vast research resources around the world, we could assist members in developing countries with information needed, to solve their national building problems: to develop indigenous building techniques based on local resources, non waterborne sanitation systems and other technical solutions. We could give support to the upgrading of squatter settlement, assist in developing suitable building codes and regulations and raise the level of management competence. This on the conditions of our members in the developing world, and as defined by them.

At the third session of the UN Commission on Human Settlements in New Mexico this year, several delegates stressed the importance of upgrading shelter conditions. "The provision of shelter is only second to food."

I look forward to listen to Minister Thorvald Stoltenberg, a former chairman of the UN North South Commission, and to Governor Göte Svenson, the first chairman of the UN Commission on Human Settlements, and to have views on the UN Habitat approach, the tasks and the role of the Centre in Nairobi, and how CIB can adjust to and support the UN activities.

One step was the Seminar on Building Codes and Regulations for Developing Countries, arranged in Sweden this year by the UNCHS and the Swedish Council for Building Research, and under the auspices of CIB.

Another is the theme of this Congress: Building Research World-Wide, where some of the major problems related to human settlements will be discussed by prominent building experts and research people from all over the world. We are very grateful that this is made possible. To ensure participation by key persons from developing countries, and to give them the support and the encouragement they deserve, DANIDA (Danish International Development Agency), the Swedish Council of Building Research and SAREC (the Swedish Agency for Research Co-operation with Developing Countries), and NORAD (Norwegian Agency for International Development), together have set aside considerable contributions for fellowships for those participants. Besides, we have a contribution from Deutscher Akademischer Austauschdienst. We are all, organizers and participants, really grateful!

I hope that the different sessions by active participation by these experts, shall help us to see problems outside our own circles, adjust to reality, and motivate us to join forces to settle the problems.

I have one fear and should like to issue one warning:

CIB should not completely turn to this sector!

For most members, resources are allocated to solve national problems, and their efforts therefore must be consentrated at home.

CIB should always remain the international organization taking care of these interests, help discuss and solve national and regional problems, be a meetingplace for discussions and exchange of information and experiences, an opportunity to see collegues and learn. The 30 Working Commissions of CIB will remain the backbone of the organization.

It will be a standing order for the Board and the Programme Committee to see to that this work of benefit for all of us, is carried out in the best way. Here I like to thank all our co-ordinators and members of Working Commissions for their interest and devoted work during this period.

I am happy to see a promising reorganization of our activities within the field of building information and documentation. We should not forget that this activity was given high priority by ECE, when countries started the rebuilding process after the war. To-day we have the technical means to organize building documentation services in a really advanced way. This is just as important for west and east, north and south.

A field which should have the greatest attention is energy conservation. A CIB study, which was one of the contributions to the ECE Seminar on Energy Conservation in Ottawa, 1977, showed that around 1/3, or nearly 40%, of the primary energy consumed by 10 countries in Western Europe and Northern America had relation to buildings. Consequently this sector has a great potential for savings, if modern techniques are applied. This is to-day one of the main tasks of building research institutes throughout the world.

The CIB study showed that "the composite ten", which we named the countries included, stood for 1/10 of the world population, but for 1/2 of its primary energy consumption. This question of distribution is far beyond CIB circles, but it is perhaps the core of the problems, and underline the questions raised by the UN North-South Commission.

In its essence this cannot be a question of distribution of fuel. It may as recently pointed out by the Brandt Commission in "North-South: A Programme for Survival" be a question of massive transfer of wealth to the Third World, - not from charity, but from the urgent necessity to head off world economic collapse in the 1980's or 90's.

The main problems of many countries to-day are related to energy, as a resource problem or a financial. Combined with other burdens, the rising energy costs have driven some countries to the brink of bankruptcy. This year developing countries as a group may spend as much as 30% of their export earnings in oil.

Because of the potentials for savings in the building stock, this must remain one of the main tasks for CIB. Its Working Commission 67 has been one of the meeting places to discuss problems and solutions. For instance, an open discussion between experts on experimental houses has taken place, of great benefit for all involved. In this period the second CIB symposium on energy conservation in the built environment took place in Copenhagen.

To-day there is a growing awareness of the need to face the cost and currency problems of many developing countries by reducing transportation and energy consumption in building materials production. It is to-day one of the tasks of CIB to help develop indigenous building materials and techniques for this purpose.

And CIB should continue its collaboration on energy conservation in the built environment of the more developed countries and also adapt the utilization of alternative energy sources, like solar energy, which in essence best is adaptable to housing.

It should be a misuse of time to illustrate CIB activities in all fields. Productivity within the building sector, management and environmental problems, and a series of the classical technical research fields may call upon efforts from all of us. Some of them should have been mentioned, as 1977-80 has been an active period. (As an example: W 14 Fire, with its seminar in Japan).

There is also an obvious task to develop the collaboration between CIB and UN bodies and regional commissions, and between CIB and professional international organizations like ISO, RILEM etc.

From the abundance of interesting questions, different aspects of building research have been chosen as themes of our congresses, some very broad and popular, some more specialized, but all to the point at that stage of development. I hope that Building Research World-Wide can be regarded as a right choise in 1980. The relations between the developing world and the industrialized certainly is one of the most important underlying questions of our time.

I thank the distinguished Minister for welcoming us and stressing the importance of our theme, we look forward to listen to Minister Thorvald Stoltenberg and to Governor Göte Svenson. We look forward to the technical sessions of the Congress too. I wish you all some nice and interesting days in Oslo, and hope that you also will enjoy midsummer life in the north.

REMARKS AT THE OPENING OF THE EIGHTH CIB CONGRESS

Mr. Thorvald Stoltenberg, Norweqian Minister of Defence, former Chairman of the UN North-South Commission

Mr. President, Ladies and Gentlemen,

It is indeed an honour and a pleasure for me to address this Eighth Congress of the International Council for Building Research (CIB). The work of the CIB in bringing together national research organizations in the field of building research is significant not only in the professional sense, but certainly also in the more general sense of increasing international understanding and intensifying the contacts between nations of countries North and South, East and West. It is through such contacts on all levels that we can hope to build a feeling of common global purpose, of mutual responsibility for the future, which is so important for the survival in dignity of mankind.

I have noted with particular interest that this Congress will emphasize the global scope of building research and the needs of developing countries. This line of thinking brings to mind the recently published report of the Brandt Commission entitled "North-South: A program for survival".

As you know, the Brandt Report provides us with a critical analysis of the relationship between industrialized and developing countries, of development problems in relation to security needs, and makes a series of proposals for international action designed to surmount some of the major economic and political problems of our time. I should think it should serve as an inspiration to this Congress that in describing the basically human character of development the Brandt Commission Report lists three elementary needs which must be satisfied for all people. These needs are: health, housing and education. The Report emphasizes that inadequate or nonexistent urban and rural housing in developing countries is intimately linked to such major development problems as high unemployment or underemployment, high birth rates and high infant mortality. The Report also brings out the fact that up to two thirds of the families in major cities in the Third World can not afford the cheapest housing now being built. These facts point to the importance and the overwhelming dimension of the challenge which confronts the field of building research. The contribution which you as professionals in this field can make to the solution of fundamental development problems can not be overestimated.

The counterpart of the interrelationship of issues in economic and social development is the political and economic interdependence of nations. No longer is any nation so large or so powerful that it can withdraw and live its own life in isolation from the rest of the world. The industrialized countries are becoming increasingly dependent on the markets of the Third World for the viability of their economies, just as the developing countries continue to be dependent on the North for the marketing of their commodities, for the acquisition of modern technology and as an additional source of financing for development. Thus it is becoming increasingly clear that North and South have a common interest in the proper management of global interdependence and that it must be possible to overcome the apparent contradiction between self-interest and joint interests. This, to my mind, is what the new international economic order is all about.

Although by nature an optimist, I do not believe that the path ahead is easy. There are fundamental imbalances in the world which have to be redressed before interdependence based on justice and equality can be reached. What we need are basic changes in the world economic structure which will permit the developing countries to pay their own way to development.

There are persuasive arguments in favour of such changes. In the light of the increasing global interdependence the countries of the North also need economic reform to safeguard their prosperity. But we also have to realize that the fundamental questions involved, concern the availability of and the access to economic resources and the redistribution of economic power. We must bear in mind that if we look to history there is little to indicate that nations relinquish power voluntarily. Nor are they ready to do so today.

This is why progress in North/South negotiations has been so slow. Indeed on major issues a stalemate seems to have been reached. Let me in this connection just recall that the most recent of the major North/South negotiations, that is the New Delhi conference on Industrialization in January this year, ended without any agreement.

It is against this background that the initiative launched by the developing countries last year for a new round of global negotiations covering major issues in the fields of raw materials, energy, trade, development and money and financial affairs must be seen. By including energy among the items to be negotiated the developing countries have brought to bear an issue in North/South relations where they hold the power. A decisive question is whether the developing countries as a group will be able to exploit this power to the benefit of the group as a whole.

The preparation of the global negotiations are now under way in the United Nations. The final decisions on the format and the content of the round of global negotiations are to be taken by the Special Session on development and international economic cooperation of the UN Generel Assembly early this fall. The preparations are proceeding slowly and at this point no one can say whether or not it will prove possible to lay the foundations for a successful round of negotiations. For my own part I wish to stress that the initiative taken by the developing countries provide us with an opportunity to bring the process which we call the new international economic order another step forward. Let us hope that we, that is the international community of nations, are ready to seize this opportunity.

This brings me to the conclusion of my remarks. I just said that I regard the new international economic order as a process, that is a process of change and adjustment. I think it would be of benefit to all both for development and security reasons - because to my mind development and security are intimately linked - if we could increase the pace of this process. Sometimes people talk about the new international economic order as if it were a goal which would be achieved at some point in time. I don't believe this is the case. In my opinion - even though progress seems slow - the new order is on its way. It lies in the fact that the peoples of Latin-America, Asia and Africa are on the map, not only politically, but also economically - and increasingly so. Our world is different from the world that was shaped in the 1940s and early 50s. The rules made at that time will not work in the 80s. To my mind, therefore, the choice is not to decide for or against the new order. The choice we have is either to cooperate on a global scale in bringing about the necessary changes or to sit idly by and let events take their own course. We must realize that national interest and common global interests are not by necessity contradictory and that only by bridging the gap between the two can we exploit to the benefit of all the growing interdependence between nations.

Thank you.

SECTION

2

International relations, plenary session
Chairman: K. de Vries

Relations international
Président: K. de VRIES

Report from Section 2, Plenary session:
WORLD-WIDE PROBLEMS AND EFFORTS

Address to the eighth CIB Congress on the Theme "Building Research World-wide": G. Svenson, the first Chairman of the UN Commission on Human Settlement

The Chairman K. de Vries opened the section and introduced Gøte Svenson.

Gøte Svenson started with a historic wiew of U.N.'s work on human settlement. From Economic Commission for Europe (ECE) where an ECE Housing Sub-Committee was foundet. The creation of the CIB itself in 1953 was a result of iniatives from this committee.
The global level began to a significant extent in the early 60's, when the United Nations Committee and Centre on Housing, Building and Planning was formed (GHBP).

The next step was in 1972 in Stockholm, the United Nations Comference on the Human Euvironment. This led to the United Nations Conference on Human Settlement held in Vancouver in 1976.

He had three major remarks and observations.

First, the understanding of the problems had become wider and more sharply defined from the 1972 Stockholm Conferende on Human Environment to the Habitat Conference in 1976.

Seconly, many if not most of the recommendations for national action at the Habitat Conference are still as valid today.

Thirdly, that we are now entering a new place in which substance and action will have priority over organization and process.

He further described the organization and work of the United Nations Commission and Centre for Human Settlements (UNCHS) and mentioned some of the most relevant sections of the Habitat recommendations.

Two key problems in the building field in developing countries were emphasized as being of special significant.
First, the area of building codes and regulations in developing countries and, secondly the role and countribution of the construction sector itself in national economic and social development.

After Mr. Svensons introduction the members of panel, Mr. Arctander, Denmark, Mr. Mtui, Tanzania, Mr. O. Kyere, Ethiopia and Mr. Kandaswarny, U.S.A. came with coments. Connections between research institutions to awoid costly duplications and emphasizing of the problems in developing countries were some of the main coments.

ADDRESS TO THE EIGHTH CIB CONGRESS ON THE THEME "BUILDING RESEARCH WORLD-WIDE"

Ambassador Göte Svenson, the first Chairman of the UN Commission on Human Settlement

Mr. Chairman,

I have, as one who has for quite a few years been intensively engaged on international work and co-operation in the field of human settlements, been asked to reflect on and review the work of the United Nations, particularly those aspects most relevant to the theme of this eighth CIB Congress on "Building Research World-Wide".

I propose to do so in three parts:

1. The background and development for the present United Nations programmes and institutions;
2. The present organization resources and programme of work and priorities of the United Nations Centre for Human Settlements;
3. Some concluding remarks especially on ways in which this Congress could consider extending CIB activities in developing countries.

BACKGROUND AND DEVELOPMENT OF UNITED NATIONS WORK ON HUMAN SETTLEMENTS

The first United Nations organization to dedicate significant attention and resources to human settlements work was the Economic Commission for Europe (ECE). Under the first ECE Executive Secretary, Gunnar Myrdal, housing was included as a major and integral part of the ECE efforts for the post-war reconstruction and economic development of Europe. At the intergovernmental level, an ECE Housing Sub-Committee was founded.

One of the early initiatives of the ECE Housing Sub-Committee was to recommend and support the creation of the CIB itself in 1953 "to encourage, facilitate and develop international co-operation in building, housing and planning research, studies and documentations". Happily, the ECE officer who was responsible for the housing sector in those days, and who is largely responsible for ECE's pre-eminence and excellence in the field today, is with us at this Congress - Mr. Ben Reiner.

While work was well underway in the ECE throughout the 1950s work at the global level really did not begin to a significant extent until the early 1960s when the United Nations Committee and Centre on Housing, Building and Planning was formed (CHBP). The CHBP was created as part of the UN Department of Economic and Social Affairs, with four principal functions;

1. to provide technical assistance to developing countries in the field of human settlements;
2. to undertake high-priority research projects;
3. to disseminate knowledge and experience through seminars, workshops and publications; and,
4. to co-operate with and assist other UN organizations in carrying out relevant work.

The next most significant step was in 1972 with the convening in Stockholm of the United Nations Conference on the Human Environment. Human settlements was one of the six main subject areas for that conference, which approved:

1. a series of recommendations for action at the national level on human settlements;
2. the creation of an UN Habitat and Human Settlements Foundation which would initially work with the UN Environment Programme (UNEP); and
3. recommendations for international co-operation, including a proposal to hold a Conference/Exposition on Human Settlements in 1976.

With this very brief overview of some of the significant events in the development of international co-operation in the field of human settlements, this brings us to the watershed event, the United Nations Conference on Human Settlements held at Vancouver in 1976.

I had the pleasure and satisfaction to lead the Swedish delegation to the Preparatory Committee Meetings which were held during 1975 to organize the conference and negotiate the proposed Declaration of Principles and the Recommendations for national and international action. The members of that Preparatory Committee, which consisted formally of 56 countries but often had representatives from 80 or more countries, were a remarkably knowledgeable, dedicated and hard-working group. In a series of intensive meetings held over only a 12 month period - from January 1975 to January 1976 - that group prepared a wide-ranging and formidable set of recommendations for action which were not significantly changed at the conference itself.

The intergovernmental Preparatory Committee was assisted by a small but equally dedicated and hard-working secretariat, led by Enrique Penalosa of Columbia. His deputy, Dr. Duccio Turin, was, as many of you know, one of the pioneers in research and studies on the construction sector in developing countries, the results of which are still relevant today to the work of the CIB itself and to the theme of this Eighth CIB Congress on "Building Research World-Wide".

The Habitat Conference was attended by representatives from 137 governments, over 20 United Nations organizations, 13 intergovernmental organizations outside the UN system, and the largest number of non-governmental organizations ever to attend an UN conference. Documentation for the meeting included 20 major background, support and policy papers, 110 national reports, and 250 audio-visual presentations from 123 countries. All in all, it was the most formidable mobilization of policymakers, experts and information in the human settlements field either before or since.

I would like to conclude this introductory section with three major remarks and observations:

First, there are a variety of different ways of measuring the success or significance of an international conference. One way of grasping what in my view was a major achievement of the Habitat Conference is simply to compare the recommendations on human settlements of the 1972 Stockholm Conference on Human Environment with the 64 recommendations for national action which were approved by the Habitat Conference in 1976. Even a cursory comparison of both sets of recommendations will show that in the four years between the two conferences there was a tremendous change in the understanding of the problems of human settlements, that the problems were not simply housing but much more wider, complex and inter-related. The understanding of the problems had become wider and more sharply defined at the same time. What is more important, many different ways of dealing with the problems were also identified and included as an integral part of each of the Habitat recommendations for action. Clearly, a quantum jump had been made by 1976 in our understanding of the problems of human settlements and of ways to deal with them more effectively.

Secondly, I want to make an observation which is similar to the first but opposite to it in tone. It is now four years since the Habitat Conference, and I must note honestly and with considerable regret that many if not most of the 64 recommendations for national action are still as valid today as they were when they were adopted on June 11th, 1976. The problems and needs are still similar, only now they are even more widespread and urgent.

Thirdly, - and this observation is partially an antidote to my second point, in case the challenges implicit in that observation is mistaken as pessimism - I wish to note that we seem to be operating on four year cycles; 1972 - 1976 and 1976 - 1980. So that means this year should signify a change. I think it does. After an

almost inevitable delay after the Habitat Conference in order to firmly establish a new institution in a new location and to overcome the also inevitable early organizational difficulties, I firmly believe that we have been recently moving towards and are now entering a new phase in which substance and action will now have priority over organization and process.

A great deal is happening now in the field of human settlements, and happening quickly in many different places through many different organizations. As only one example, just look at the events in our field for this May and June.

May 6 to 13	-	Third session of the Commission on Human Settlements (Mexico City)
May 7 to 9	-	OECD Conference at Ministerial level on Noice Abatement Policies (Paris)
May 19 to 23	-	ECE Working Party on Housing
May 20 to 30	-	UN Preparatory Committee on the New International Development Strategy (New York) which will consider human settlements for the first time as an integral and important part of the strategy
June 2 to 6	-	Fourth ECE Conference on Urban and Regional Research (Paris)
June 16 to 19	-	Eighth CIB Congress on the theme "Building Research World-Wide" (Oslo)
June 16 to 19	-	ECE Working Party on Urban and Regional Planning (Geneva)
June 23 to 27	-	ECE Working Party on Building (Geneva)
June 23 to 27	-	World Conference on Land Policy (Cambridge, Mass.)

So, in sum, I believe that we do stand poised on the threshold of a new phase and, coincidentally, of a new decade. The review is over and the renewal has begun. We have increasingly effective global and regional UN institutions and programmes in the field of human settlements, and a growing number of colleagues around the world who are ready and willing to work more closely together. In my view, this CIB Congress and General Assembly, and the chosen theme of "Building Research World-Wide", simply could not be more timely in terms of UN progress and the further development of the CIB itself.

THE UNITED NATIONS CENTRE FOR HUMAN SETTLEMENTS

Before turning to some of the questions which this Congress and General Assembly could consider, I will briefly describe the organization and work of the United Nations Commission and Centre for Human Settlements (UNCHS).

After the Habitat Conference in June 1976, it took until December 1977 to negotiate and get General Assembly approval of resolution 32/162 which established the UN Commission and Centre for Human Settlements. It took a further 8 months to appoint the new Executive Director, Dr. Arcot Ramachandran. But, as soon as he took up his post in October 1978, things finally began to move, and quickly. In the 20 months since then, he has among other accomplishments managed to bring together the various staff units and integrate and meld them into a single organization in a new location, Nairobi. He has also convened two successful meetings of the Commission, in April 1979 in Nairobi and May 1980 in Mexico City, and launched an entirely new programme of work and priorities for the biennium 1980-81. In an overview of the organization, I would highlight the following.

First, the intergovernmental body is the 58 member Commission on Human Settlements. The success of the Habitat programme depends a great deal on the number and kind of representation by governments at sessions. The Commission happily remains strong. At the recent session in Mexico City, not only 50 member countries were represented, but an additional 33 countries also sent delegations. Over twenty Ministers participated, with senior policy advisors and human settlements experts having a major in many other delegations. The next session of the Commission is scheduled for April 27th to May 6th, 1981, and will likely be held in the Philippines.

Secondly, the Commission is served by a small secretariat headquartered in Nairobi. The secretariat has a core headquarters staff of around thirty-five principal sections in the secretariat:

- Executive Direction and Management
- Research and Development
- Technical Co-operation
- Information and Documentation
- Administration

The financial resources of the Centre are presently about $ 20 million a year for all activities. The UNCHS receives $ 3.7 million annually from the UN regular budget; has a voluntary fund of just over $ 5 million so far for the implementation of the 1980-81 programme of work; and has a technical co-operation programme with 150 projects in over 70 countries which represents around $ 14 - 15 million annually, with the majority of these funds coming from the UNDP.

One of the questions which used to be raised frequently in the corridors in New York, and is still heard occasionally, is whether developing countries consider human settlements a priority concern. There is no single answer for all countries, but most do now give it much higher priority.

One indication of that sense of priority and increasing commitment in developing countries to tackle the problems more effectively is that over 60% of the voluntary contributions made to date to the Habitat Centre come from developing countries. Some major developed countries have not yet contributed, such as France, Japan,

the United Kingdom, the USA and USSR. Together, these countries alone provide over 50% of the regular budget of the UN and usually as much to UN voluntary funds. At present, the UNCHS has less than half the funds required to implement the approved programme of work and priorities for the biennium 1980-81.

Mr. Kandaswamy of the UNCHS will join us on the panel this afternoon and at that time will provide some relevant details on the UNCHS programme of work and priorities, and the results of the recent third session of the Commission in Mexico City.

Before moving to some remarks on the future, I now want to return briefly to what I said earlier about the continuing relevance of many of the Habitat recommendations for national action. As some are directly related to the theme of this Congress, they should be considered. To ensure that we build on the past rather than repeat it, I wish now to cite some of the most relevant sections of the Habitat recommendations:

RELEVANT HABITAT RECOMMENDATIONS FOR NATIONAL ACTION

Settlement Policies and Strategies

Recommendation A 1

"(b) All countries should establish as a matter of urgency a national policy on human settlements, embodying the distribution of population, and related economic and social activities, over the national territory."

(Comment: Such a policy should clearly include priorities for research and development, especially in the building section. What examples do we have today of such policies or research plans. May be we should be addressing ourselves in this sessions also to the need for "building research nation-wide"?)

Recommendation A 3

"(b) A national human settlements policy should concentrate on key issues and provide basic directions for action."

"(c) Such a policy should .....(v) set minimum and maximum standards which should be expressed in qualitative and quantitative terms, based on indigenous values, related to local resources and abilities, capable of evolving over time, and developed with the full participation of all those concerned."

(Comment: There in a single sentence are the main points to be considered when developing a plan and priorities for building research.)

Recommendation A 4

"(b) Human settlements policies should aim to improve the condition of human settlements particulary by promoting a more equitable distribution of the benefits of development among regions, and by making such benefits and public services equally accessible to all groups."

"(c) This can be done through ..... (vi) measures to improve the quality of life of vulnerable groups which have special needs - such as children, the elderly, the handicapped and the disabled. Such measures include provision of basic social services, adequate shelter and social and physical access to facilities."

(Comment: Building research can do a great deal to reduce present architectural barriers for the disabled and to improve the possibilities for future mobility and access. Next year - 1981 - has been designated as the International year for Disabled Persons (IYDP). Can CIB consider special attention to these problems as a contribution to IYDP?)

Settlements Planning

Recommendation B 8

"(b) Settlements must be continuously improved. Renewal and rehabilitiation of existing settlements must be oriented to improving living conditions, functional structures and environmental qualities. The process must respect the rights and aspirations of inhabitants, especially the least advantaged, and preserve the cultural and social values embodied in the existing fabric."

"(c) Special attention should be paid to ..... (i) upgrading and preserving the existing stock through the development and use of low-cost techniques, and the direct involvement of the present inhabitants."

Shelter, Infrastructure and Services

Recommendation C 3

(Comment: Nearly all of the clauses of this recommendation and recommendation C 4 are relevant to the theme of this 8th Congress, as it sets practical goals and guidelines for building research in developing countries.)

"(b) Standards for shelter, infrastructure and services should be compatible with local resources, be evolutionary, realistic, and sufficiently adaptable to local culture and conditions, and be established by appropriate government bodies."

"(c) In particular they should:

(1) Be based on the assessment of felt needs and priorities of the population rather than the adaptation of imported requirements;

(2) Be tested in real life conditions and reflected in public sector programmes which have powerful demonstration effects;

(3) Be evolutionary to accommodate changing needs of society, progress in technology and shifting patterns in the availability of resources;

(4) Conserve scarce resources and reduce the dependence on foreign technologies, resources and materials."

Recommendation C 4

"(b) The choice of designs and technologies for shelter, infrastructures and services should reflect present demands while being able to adapt to future needs and make the best use of local resources and skills and be capable of incremental improvement."

"(c) The solutions arising from such choices should therefore be:

(1) Evolutionary and innovative in character in order to keep pace with national development and the discovery of new techniques and materials;

(2) Based on the best possible use of available local materials and local resources, within a process of constructive rationalization allowing for the effective use of locally existing know-how and unskilled labour in countries with abundant manpower, thereby generating employment and income;

(3) Conceived to utilize traditional techniques suitably adapted to new materials;

(4) Emerging from original indigenous research;

(5) Open to the possibility of harmonizing technical norms to facilitate international co-operation."

Recommendation C 7

"(b) The special importance of the construction industry should be recognized by every nation and the industry should be given the political, financial and technical support it requires to attain the national objectives and the production targets required for human settlements."

"(c) Special attention should be given to:

(1) Establishing performance standards suited to local requirements and capable of being met by local industry;

(2) Simplifying formal procedures so that they can be clearly understood and followed by local entrepreneurs."

Institutions and Management

Recommentation F 7

"(a) In most countries, the lack of adequate knowledge, skills and professional resources is a serious constraint on the policies and programmes."

"(b) The development of research capabilities, and the acquisition and dissemination of knowledge and information on settlements, as an integral part of the settlement development process."

CONCLUDING REMARKS

As is evident from these selected excerpts from the 1976 Habitat recommendations for national action, there is much that remains to be done, and we must now pass from identifying the problems and cataloging ways of dealing with them to actually doing something direct and effective about them.

I would like to put special emphasis on two key problems in the building field in developing countries which have emerged as being of special significance in the discussions at and after the Habitat conference, where immediate action is not only required but possible: first, the area of building codes and regulations in developing countries and, secondly, the role and contribution of the construction sector itself in national economic and social development.

In developing countries, building codes and regulations are too often procedural rather than performance based and are often borrowed from developed countries with little or no modification for local conditions. More often than not, the present codes and regulations are also irrelevant to the situation and needs of the vast majority of the people in developing countries, particularly the 800 million who live at or below the mere subsistence level.

The UNCHS and the Swedish Building Research Council co-sponsored in March of this year a United Nations Seminar of Experts on Building Codes and Regulations in Developing Countries. The Seminar approved ten major recommendations for action which I would recommend to all of you. Copies of the report of the Seminar will be provided at this meeting, and more details on the Seminar conclusions and recommendations will be given during the panel discussions this afternoon.
However, I would add that the establishment or strengthening in developing countries of some type of central agency or institute, like those in Europe, to develop new codes and regulations along the lines proposed at the recent Seminar, and also to encourage, support and perform research in the area of construction and to make the results more widely available to those engaged in construction in developing countries, would contribute immeasurably to alleviating some of the difficulties in this area. The CIB and its member organizations could all contribute substantially to this work, and I hope that solid proposals for doing so will be one of the results of this Congress and General Assembly.

Secondly, the construction sector in too many developing countries has been viewed simply as a service industry, and a too expensive one at that, and its output has been assumed to be dependent upon the demands generated by other sectors considered in national development plans.

Too few efforts have been made to include the construction industry itself in national planning. The national planning departments in developing countries need to know by type, region and year the amount and cost of building and engineering work required of the industry to meet the country's development proposals, and too often they do not. Such knowledge is essential in order to define the demand for the industry's resources in the form of manpower, capital, materials and equipment. This knowledge, in conjunction with an assessment of the industry's available resources, is necessary if the construction sector itself is to develop smoothly with the rest of the economy, and if the overall economic and social objectives and related projects are to be realized. The staging of construction is an additional means by which the industry might be stabilized more and to make construction a continuous rather than a project oriented process. The capacities and contributions of the informal sector in developing countries must also be taken into account. Most of the present shelter in developing countries is built by the people themselves and other resources will simply not be available to change this situation significantly before the end of this century at least.

The role and contribution of the construction sector in human settlements programmes and national economic and social development is one of the two major themes to be discussed in detail at the fourth session of the Commission of Human Settlements scheduled for next April/May in the Philippines. Again, this is a major area where the experience and expertise of the CIB and its member organizations could be effectively applied.

Mr. Chairman, to conclude my remarks, I wish to note with satisfaction that the CIB Board has already considered several ways of increasing CIB efforts in co-operation with the UNCHS. Three particular proposals were considered as being of special priority;

- the establishment of a Working Commission to address itself to the special problems of information faced by the UNCHS;

- the possible appointment of a CIB Officer to carry out CIB work but located at the UNCHS headquarters in Nairobi;

- the development of building codes and regulations adapted to the prevaling socio-economic conditions in developing countries.

Among other points which have emerged from discussions within and outside CIB, and which I hope will be given special consideration this week, I would cite the following seven points:

1. To collect and disseminate to developing countries information on the results and application of relevant resarch programmes.

2. To undertake or sponsor surveys of the state-of-the-art in particular subjects; the use of soil as a building material as one outstanding example where such an effort is now timely.

3. To organize seminars and contribute to training programmes in developing countries.

4. To organize meetings of Working Commissions of special interest to developing countries in easily assessible locations.

5. To assist experts from developing countries to attend CIB meetings.

6. To encourage membership in CIB by organizations and institutes in developing countries through concessionary fees.

7. To assist in the organization and management of institutions for building research in developing countries. The area of institutions and management is one of the top priorities for the UNCHS. Later at this Congress, in Section 8, Mr. Anton Mtui, the Director of the Tanzanian Building Research Unit, will give a key-note address in Plenary on "Building Research Institutions in Developing Countries", using his own institution as a case study. It is a project of special interest to which our hosts and organizers for this Congress, the government of Norway and the Norwegian Building Research Institute, have contributed a great deal.

Mr. Chairman, I will now conclude with this observation. I have attempted in this address to give a summary of the background and development of international co-operation in our field, with a few critical observations as well as a good deal of evidence as to why today it is both necessary and timely to act. We have now come to a crucial threshold at the beginning of a new decade. The CIB, as I have noted above, has a great deal to contribute. This Congress and General Assembly has a unique and timely opportunity to contribute to a renewal and strengthening of CIB itself and to international co-operation on human settlements activities generally. In closing, I wish to congratulate the CIB and the organizers of this Congress for the very pertiment theme they have chosen - "Building Research World-Wide" - and to thank you for giving me this opportunity to address the Congress.

Kandaswarny, U.S.A.

At the outset, Mr. Chairman I would like to convey the best wishes of Dr. Ramachandran, the Executive Direc-

tor of the United Nations Centre for Human Settlements to a succesed meeting of your Congress. I do no have to underscore that the subject matter of discussion at this Meeting is of great interest and relevance to the work of the Centre. Therefore, the Executive Director looks forward with interest to the results of your discussions here, as was emphansized by Ambassador Svenson in this address. We are all aware of the importance of the construction industry as a tool of economic development; the proportion of total employment which is related to construction activities, and the multiplier effects of construction investment in associated industries. We also know what a high proportion of national capital accumulation is represented by buildings and construction works. Consequently even a small percentage saving in building costs, can have a significant impact on national economics particularly in the developing countries, and therefore we consider this factor, a crucial measure to be applied to building research priorities and directions.

Even in the developed countries, innovation in the construction industry has generally lagged behind the other industrial sectors. Private research and development represents a minute fraction of construction turnover, and government research is often addressed to detailed technical problems rather than to the broad requirements of the industry as a whole. We have also not seen the productivity gains in the building industry that we have seen in other sectors which have made greater research investments and which have been able to take advantage of scientific improvements in areas such as data processing, communications and automation.

It may well be that, because of its very nature, the construction industry will never achieve the efficiencies which can be reached in factory mass-production of manufactured products. Nevertheless, the developed countries still have a long way to go in realizing all the potential benefits of technological innovations open to the building trades. In the developing countries, the situation is somewhat different: industry innovation is badly needed, but it will have to take a form which relies on approximate technology processes rather than an ultra-sophisticated re-ordering of current practices. We see one of the roles of the U.N. Centre as an intermediary in the process of technological transfer - advising the developed countries on what is the most useful of the innovations they have to offer and assisting the developing countries in selecting the most appropriate innovations from amongst those available.

As some of you may be aware, research into construction and infrastructure, and techniques, and dissemination of information on these subjects, are important elements of the Centre's on-going work programme. The technical and geographical scope of the topic is vast, and the resources of the Centre are limited. Therefore, the Centre cannot assume the role of an independent research organization, competing with and duplicating the work of existing agencies. Rather, we see its role as one of identifying high-priority research needs, marshalling resources, providing linkages between research organizations throughout the world, and making the results available to end-users, through the establishment of, an information reference system.

It is in this context, that I would like to explain our current activities and relate them to the type of collaboration and co-operation that can be developed between the Centre and the CIB. As fas as our current work is concerned, we are implementing five programme elements under the general headings of building materials, construction industry, construction technology, standards for infrastructure and services, and information on shelter, and infrastructure. I am, of course, speaking here only of the research activities which we carry out under our regular work programme. In addition, we are undertaking a variety of technical co-operation projects, many of which include a building research element.

Firstly, we are carrying out a study on the development of indigenous construction industries in urban and rural areas. This study will cover the formulation of policy guidelines that would assist Governments in promoting private initiative, and in establishing administrative and technical frameworks, needed to improve the efficiency of the building industry, in the urban and rural areas of developing countries. It will include, statutory regulations appropriate to low-income settlements; measures to generate employment opportunities in the production of building materials; application of suitable technologies in the construction, maintenance and repair of shelter, infrastructure and services; and criteria for design and selection of appropriate building technologies. We propose to organize expert group meetings to provide inputs to these findings and review special technical aspects of the work, and I hope that we shall be able to call on the CIB for assistance in this part of the study.

Secondly, our programme includes a pilot study into innovative technologies for sevices in squatter and rural settlements. This is in conformity with the direction given to the Centre by the Commission on Human Settlements that the upgrading of slums and squatter settlements is to be dealt with as a first priority requirement for action. This study will be related to a series of surveys to be carried out by the regional commissions into (1) the services and infrastructure elements that low-income households generally consider to be of priority need; (2) the standards that have been adopted in settlements upgrading projects and programmes; and (3) the practical results and degree of community acceptance of experi-

ments and innovative technologies in water, lighting, sewerage, waste disposal and energy systems.

As a third exercise, we are looking into the energy requirements of rural settlements and of the urban poor. This stydy will be complementary to various studies of a general nature on energy demands being carried out by many institutions throughout the world. This study will focus on the possibility of using new energy-technology to provide energy services to low-income settlements, and will include (1) qualitative and quantitative information on the use of energy by the urban poor and rural inhabitants, fuels used and demanded (through informal questionnaires and selective observations), and (2) a review of energy supply alternatives based on existing information and innovative methods or devices. An interregional seminar will be convened to review the findings and prepare recommendations.

Fourthly, I must mention the study on energy conservation in building which, following the recommendations of the Seminar on the Impact of Energy Considerations on the Planning and Development of Human Settlements (October 1977), will be undertaken in co-operation with the Economic Commission for Europe and the CIB. The scope of the study will include the potential for energy conservation in buildings, as well as criteria to be used in building design, taking into account efficiency in function, operation and maintenance and the energy required to manufacture the components and building materials.

Finally, in accordance with instructions given to us by the General Assembly, we shall be establishing an international construction resource and information pool on building materials, plants, equipment and tools, to provide information on the availability and sources of building materials, plants, tools and equipment, and to identify potential recipient countries which could most effectively use them. This will be carried out in collaboration with existing building research institutes, professional institutions and relevant non-governmental organizations, with UNCHS assisting in its establishment by the identification and organization of interested participants. There are other research studies under consideration, but these will require additional funding or collaborative inputs from outside sources to make them feasible within the limitations of our current budget.

Finally Mr. Chairman, I wish to comment on the unfortunate duplication of effort which we suffer even in the small amount of research which is undertaken. For too often, research institutions in developing countries with similar conditions recognize the possibilities in a technological innovation and embark on parallel investigations, each not realizing that identical work is already under way elsewhere. If we could strengthen the connections between research institutions into an effective network of information exchange on current activities, and arrange for a discussion on division of labour between the institutions at the national and international levels, we could avoid costly and wasteful duplications and could see, instead, that reasearch efforts complement one another. Institutions which have special skills could share the responsibility for studies, so that each concentrates on its area of strength within an overall research plan.

The Centre and the established research institutions both of the developed and developing countries are in an unmatched position to study together the prospects of such an information network and to assist in drafting work plans for joint research projects. With the Centre as a catalyst and co-ordinating agency, and the CIB members providing the technical expertise, preliminary action could be taken, and I think this would be in the full spirit of the understanding discussed between us.

Arctander, Denmark

My first reachtion is that we have been talking for so many years of such an obvious problem and making so little progress. It is many years ago that in CIB leading circles the question was raised.
How it can be that CIB, an international body, was actually a club of wealthy European and a few more wealthy countries discussion the 3rd desimal of a solution of a refined problem. It became very quichly evident that the reasons were that these countries had among them financial resources to meet, to travel, that they had in these countries the technichal resources to work with their problems. We found it convenient with neighbouring contries to meet frequently.
While in the countries that really had problems ten or ten by ten times as large in housing and building the financial resources to travel abroad were one tenth or less. The number of technichians highly qualified to deal with these problems were also less than one tenth, so you can multiply ten by ten by ten by ten to see how little progress was likely to happen where the problems really were.

The problem now facing us - still facing us - is what CIB and CIB member institutes can do about it? We can not sit here and vote large amount of economic transfer or new economic order in our countries.

What we can do is to discuss how CIB member institutes can act and shat possible CIB as a body of institutes can do. And I'd like to suggest first what we can not do. We can not transfer ressults from successful solutions in industrial countries to non-industrial countries.
It has been done, but they have not solved any problems. What we can transfer is problem-solving methods. We can transfer research principles. We can not walk in

as foreign researchers and go ahead solving problems because we do not know by far enough of the local actual real condition. But we can discuss with friends and colleagues within the development countries which methods we have attached to our own problems. And see whether the same methods would solve problems in their own countries. I am sure they would.

We can not by research solve the housing and building problems of development countries. This needs multi-sided plan attack. Research is part of that and we have seen lots of examples where research have been applied. It is one aspect, the total national housing and building problem, which has given very small result because all the other aspects of the problem are not applied at the same time. Here are planning, financing, land policy, employment, transportation, production materials and so on necessary as integrated parts of a whole plan.

Finally, researchers alone don't solve anything. Only the people can solve the people's problems. It is a question of mobilising the immense efforts which are latent in the countries which have the immense problems. The immensity of the problems is a consequence of the immense number of people, and the immense number of people must be mobiliced to some extent. To participate in solving their own problems will also secure that we are not using fancy and unrealistic methods because they would not swallow such methods.

I think it is necessary for us, researchers and technicians from industrial countries to make it very clear that we are facing different problems where our solutions are no good, and where our methods are probably good. In each of the development countries we are facing actually 3 diffent building worlds.

We are facing the fancy white building blocks in the capital cities. I don't care much about those. We are facing the immense housing problems of the growing urban population which are not solved near the scale of the problem anywhere. If the population growth in an industrial country is 1%, the population growth in many developing countries is 2%. The population growth of the cities in developing countries is 4%. The population growth of the slum and squattered settlements in these cities is 8 or 16% a year.

This problem, the problem of the growing urban population, is a rapidly growing problem, and the measures taken against it by no means the following suit at the scale of the problem.

And the third building world in each of the developing contries is the contryside, which still has the largest population in almost all the developing countries. But it is not a problem of the same urgency as the problem of the growing urban population who move from a culture with a commercial building culture to a slum and sguatter settlement, which is an immense cultural loss where building culture develped through centuries is blowed away in days or weeks where you find no other refined symbol.

Natural healthy solution to building construction problems which you do find in the countryside even with the cheapest and poorest building materials.

This culture lost in a way could in a different shape be recognised in many of the industrial countries in the growth of industrialized cities and industrialized countries.

My lesson is therefore that many of the solutions which may help to develop in developing countries with return and benefit our society in the industrialized countries. And I think this is a solid and good reason for going ahead and do something and go ahead and lern something in the developing countries.

Anton L. Mtui, Tanzania

Standards for shelter must be based on local conditions, adjustable and of help to the poor populations. They must use improved materials and techniques to raise the poor living standard.

J.N. Okyere, Addis Ababa

I would like to limit my remarks to enumerating some of the problems that face building research institutes in Africa, so that members of CIB represented here can know some of the way in which they can provide assistance for the development of building research in Africa. The problems include i) shortage of qualified research personnel due to the attractive countries of service in industry and the private sector, ii) lack of funds to support research programmes including equipment, iii) lack of an adequate base of information on research activities of other institutes both within and outside Africa and in documentation on such activities. In view of these factors and the generally low research capacity there is reason for encourage greater co-operation among Africa countries including the establishment of joint research centres. This view was strongly supported at the meeting of directors of Africans building research instructs organised in institutes, organised in Bujumbura, Burundi from 30. April to 3.May, 1980 by ECA in collaboration with UNCHS, UNEP, UNIDO and the Government of Burundi.

International assistance for the strengthening of building research in Africa should aim to build up the capabilities of research institutes so that they can eventually operate on their own and get efficiently so that they can make a greate impact in the construction industry. Assistance in stoff training, equipping of laboratiories and setting up of operational Information and documentation systems world be greatly appreciated.

Chana, Tara S., Nairobi, Kenya

Governer Svenson presented a comprehensive historical perspective and scenario and made these major observations. One of these observations was regarding the reminder and following of the UN Habitat recommendations. The International Institute of Environment and Development (IIED) has carried out a post-habitat evaluation of these recommendations three years after Vancouver. This evaluation showed, inter alia, the lack of awareness, adoption and implementation of the habitat recommendations in developing countries.

Question (to the panel): How does the UNCHS (Habitat) reflect upon the effectiveness in the adoption and implementation of the Habitat recommendations by the member states since Vancouver, exp. with regards to the field of building research?

G.C. Mathur, ESCAP, M. Delhi

I am glad that CIB is taking increasing interest in developing countries. For application of results of building research, it is necessary for CIB to give attention to skill-formation in building. This is also necessary in order to improve the capability of the construction industry and to reduce the wastage of resources.

Skill-formation is essential for promoting inprovement of housing and environmental contries largely through self-help.

Training in building trades also needs to be organised due to great demend og skilled manpower in the wake of vast expansion of the construction industry and also on account of migration of skilled workers to gulf countries experiencing building boom.

In many developing countries, women labour is employed for mostly unskilled jobs. In our efforts to improve the lot of women specially during the UN development decade for women, measures should be considered to impact training to women in building trades.

Could CIB consider taking interest in the above for promoting applecation of results of building research?

Hasan Nawab, Islamabad, Pakistan

This is a statement to high-hight the crying need of the developing countries for low-cost housing, where for a common man, even his savings-of a whole life - time is not enough to give him shetter and a roof over his head. This is born out by the enormous member of homeless squatters in many countries. How is it that while in the field of cahcer research, for instance, which is a complite plunge into the unknown, major breakthroughs have been made, there are no hopeful signs in the sphere of low-cost housing research?
The UN fora, especially the Habitat, who have the necessary resources and expertise, should pool and disseminate the research results in such a manner as to enable the low-cost building methods and materials to be used widely and universally.

Dr. S.K. Malhotra, Halifax, Canada

I would like to make a brief comment relating to the theme of this panel discussion.
Formulation of definitions of the problems facing Developing countries in the area of Human settlements and the Development of suitable solutions to these problems, are very important. The solutions have to be appropriate from technical stand point and workable under various applicable environmental constraints including socio-economic conditions.
The panel has articulated these important aspects very well in its deliberations. I would like to add that equally pertinent are efficient and effictive administrative and other linking mechanism for speedy implementation of the developed solutions to the problems.

SUBJECT
SUJET

3A

Resources for construction, availability of materials, with focus on developing countries
Local materials

Chairman: M. MSANGI

Resources pour la contruction, matériaux disponibles en particulier dans les pays en voie de développement. Matériaux locaux

Président: M. MSANGI

Report from Section 3 - Subject 3 A:

RESOURCES FOR CONSTRUCTION, AVAILABILITY OF MATERIALS, WITH FOCUS ON DEVELOPING COUNTRIES. LOCAL MATERIALS.

Key-note speaker: A. Kartahardja

Development of locally produced building materials in developing countries.

Key-note speaker: Albert Kartahardja, Director of the Directorate of Building Research, Indonesia.

First of all allow me to thank the President and the Board of CIB for inviting me to attend this Congress and to present a key-note paper for this session.

Secondly, I thank most sincerely the Governement of Norway for making it possible for me to participate in the Congress.

Last but not least, I congratulate and compliment the Organizing committee for their hospitality and efforts to make this important event not only successful and fruitful, but also pleasant and memorable.

Ladies and Gentlemen,
Before I introduce my paper I must apologize for not submitting a paper that covers also situations and conditions and research undertaken in other parts of the world besides S.E. Asia and Indonesia.

However, after reading the other papers presented for this session and recognizing so many experienced scientists among the audience, I am sure that during the discussions we will learn more about the recent developments in the developing countries in Europe, Afrika, Latin America and Asia and that the outcome of our deliberations will be more relevant to the global situation.

It is universally recognized that success of any building programme depends on the availability of building materials of the right type in the required quantities at the proper time.

It is estimated that in a developing country, 50 - 70 % of the total construction cost of a building is for building materials. Therefore, since the import of building materials and components compared with imports of other materials and commodities can consume a disproportionate share of foreign exchange, the establishment and development of local or domestic indigenous building materials industries is therefore a matter of urgency and importance to increase the national production of building materials.

Some countries have to rely heavily on imports of building materials and in some cases these imports accounted for 14 to 40 per cent of the construction cost of a building.

As an example, in the paper of Mr. O'Rourke figures on the estimated structural and reinforcing steel consumption in Ireland in 1977 are given.

Even if imported materials formed a small share of construction costs in absolute values, the quantum of foreign exchange would easily amount to unacceptable levels if no planned action were taken to replace imports and to develop an efficient domestic building materials industry based on locally available indigenous raw materials.

Therefore, more emphasis is placed on the need for surveys of natural resources. However, priority is often given to surveys to locate valuable raw materials which could be exported while little attention is given to surveys of raw materials for construction. When cement is introduced into a country, it tends progressively to replace other materials, owing to its versitality, ease of handling and urability, although the technology of production is relatively sophisticated. The amount of cement consumed in the construction industry in Ireland is described in the paper of Mr. O'Rourke. A.o. is mentioned "that mortar and plaster accounted for 9 % of the total cement consumed by housing during 1977".

In countries where portland cement is exported and natural pozzolana is found, pozzolana-portland cement or pozzolana-lime cement is produced as a cheaper alternative for blocks and mortars.

Regarding the research on pozzolana, please note the research being undertaken by Dr. Spence and Mr. Allen and also by Mr. Mwamila and Dr. Mlingwa, aid the results of research on fly ash blocks in China reported by Mr. Gu Qihao. Also in Indonesia research has resulted in the production of pozzolana-lime blocks and pozzolana-portland cement as reported by Mr. Ringsholt.

Since first class timber species are export commodities, it is important to promote the use of the second and third class timber species for building and especially for housing construction. To extend the life time and durability of those timber species, seasoning and chemical treatment (preservation) is recommended. Bamboo grows naturally in almost every country in the tropical zone and is used as building material extensively in Indonesia. Bamboo is used in many different ways in the construction of the walls, the roof and the floor of a house.

Although no papers have been submitted on research and development activities on timber, bamboo and lime, I know that there are many activities being done, a.o. in the UNIDO supported project in Indonesia mentioned in the report of Mr. Ringsholt.

Lime is a traditional material which is still being used in developing countries as a component for mortars and plasters and also for whitewashing. Lime can also be used for the manufacture of pozzolana lime blocks, for soil stabilisation and other lime based building materials such as sand-lime bricks and lime cellular concrete.

In developing countries, imported building materials represent a significant percentage of total imports. In Africa, Asia and Latin America, the value of imported building materials ranges from 5 to 8 per cent of the total value of imports.

It is therefore recommended that priority is given to the development of non-traditional and non-conventional building materials based on local resources such as stone, pozzolana, shale, lime, bamboo and timber, as well as agricultural and industrial waste products, one of the possibilities is the production of particle-board.

The establishment of small-scale industrial manufacturing units such as small sawnmills and small non-traditional brick and roofing tile or block plants should be encouraged and promoted. Specially, the feasibility of small-scale production of pozzolana portland cement and pozzolana-lime cement should be studied in those countries where natural pozzolana is found.

Good examples are described in the papers from Messr. Cappelen and Edvardsen, Dr. Ringsholt, Mr. Cu Zihao and Mr. Mwamila and Dr. Mlingwa.

In developing countries labour-intensive technologies have to be developed to overcome among others the problem of unemployment. For that reason it is often appropriate, although not economical, to convert large-scale capital intensive plants from industrialized countries into small-scale labour-intensive plants to be more suitable for developing countries. For example, appropriate technology has to be developed in Indonesia to change a lime kiln producing 100 tons of lime per day into a kiln producing only 10 tons per day. The same has to be done also for a 40 ton Particle Board Plant, Brick Extruders, Concrete Block Machines, etc.

Regarding this it would be interesting to learn more from Mr. Ringsholt on the results of the UNIDO supported Project in Indonesia and I am sure Mr. Cu Zihao can tell us also about the development of the small hollow block machine and the minicranes and derecks.

Governments of developing countries should increase their active role in supporting the development of the small-scale building materials industries by a.o.:

- establishing pilot plants to introduce the production of non-traditional and non-conventional building materials and components;
- setting up demonstration plants to demonstrate improvements and new technologies or techniques in the processing of local indigenous raw materials;
- organising traning in both the technical as well as the managerial aspects of small-scale building materials industries; and
- promoting and giving support to research activities on the production of building materials and components utilising local raw materials and resources.

Only a few developing countries have adopted a comprehensive policy for co-ordinated efforts in the development of the domestic building materials industries.

Long-term targets for these industries and long-term programming of construction activities should be based on surveys of raw materials suitable for the production of building materials and on research in building materials.

In the majority of more developed countries, several specialized research institutions exist and each is concerned with a particular building materials field. In addition, these countries have a national body (or special bodies) for the formulation of research policies and coordination of research activities at the national level. CIB-Secretariat has data available on research organizations in Europe and North America whose activities are closely related to the development of building materials.

The need for systematic collaboration at regional and interregional levels is being increasingly recognized and attempts are being made to undertake and encourage bilateral and multilateral international collaboration particularly in the new field of building materials.

In this connection I would like to refer to the R & D activities on lime-pozzolana cement now being undertaken in many developing countries a.o. in Indonesia, India and Tanzania as explained in the supporting papers of Mr. Mwamila and Dr. Mlingwa of Dr. Spence and Mr. Allen and of Mr. Ringshold. Maybe CIB could explore the possibilities of a TCDC-Project supported by an UN or other International Organization.

To conclude Mr. Chairman, Ladies and Gentlemen, allow me to refer to the summary of my paper, in which I stated that Governments of developing countries should pay adequate attention to the development of the building materials industry which plays a major role in contributing to the success of building programmes

and that it is essential to encourage the use of local rather than imported building materials. And that priority should be given to the development of non-traditional and non-conventional building materials based on locally available and indigenous raw materials and recources including agricultural and industrial waste products. The development and establishment of small-scale and labour-intensive industrial manufacturing units should also be encouraged and supported in order to increase productivity and to improve quality. For that, appropriate technologies for producing building materials should be developed utilising indigenous raw materials and resources.

I thank you for your attention.

Pål Cappelen, Norwegian Building Research Institute,
Forskningsveien 3B, Oslo 3 Norway

Roof sheets made of sisial reinforced concrete

Roofing materials is the main problem in developing countries. Sisal reinforced concrete sheets is one alternative. To produce such sheets you need sand, cement, water and sisal. In addition you need some masonry tools, a wooden form and some plastic sheets. The mortar mixture is: 1 part cement : 2 parts sand (w/c = 0.5). A sheet is built up as a laminate with layers of mortar and sisal fibres. Thickness of the sheet is 10 mm. The sheet gets its corrugated shape when moulded on to a wooden form. The sheet is demoulded after one day and stored away for curing. Each sheet is fixed to the roof-battens with two nails. The sheets overlap only in the length-direction. Sideways the gap between the stripes of sheets is covered with a special made profile. The top-ridge is also made from a special profile. From 1 bag of cement 6 m^2 roofing sheets can be produced by two men in one day.

Lin Zhiqun, Architect, Head of the Representative Group of Chinese Academy of Building Research, China

My colleague Mr. Gu Zihao has presented the Congress an article titled "The utilization of local materials in the development of block construction". Now it is my pleasure to give som further briefings on this subject.

During recent years, there has been a bigger increase in housing for 110 million urban inhabitants in our country. The total floor area completed in 1977 was 28 million sq. meters and in 1978, amounted to 37.68 million sq. meters, i.e. 34.5 percent over 1977. In 1979, the figure increased to 62.56 million sq. meters, or 66 percent more than in 1978. So the year 1979 was a year in which the figure of the completed floor area of housing was the highest and its proportion to the total building area was the largest (52 percent) during the past thirty years. We are convinced that with the successful accomplishment of the economic readjustment in our country, the volume of the building construction especially the houses and other buildings will have a more steady increase in a much longer period.

At present, considering the total population number and the growth rate as well as our current housing standards and requirements, our country is no doubt a developing country. According to the practice in our country during the past thirty years and the experience of many other developing countries, in order to keep our building industry continuously developing, we must choose the appropriate techniques as the major method to develop the building industry. More and more people have now recognized that actively developing the block construction which makes use of the industrial wastes and local resources is an important aspect of the appropriate techniques or intermediate techniques.

In China, majority of blocks are used for the internal and external bearing walls of multi-storey buildings, minority for the non-bearing partition walls or as filler blocks between frames. Our blocks can be divided into two kinds of basical size: one is known as "small" size block with a volume as ten times as our standard brick (60 x 120 x 240 mm); Another known as "medium" size block, weighing from tens to more than hundred kg. with an average volume as one hundred times the standard bricks. All the small size blocks are hollow core while the medium size blocks are either hollow core or solid. Generally, in the case of the solid ones, the foaming agent is added to reduce the weight of the blocks. The materials used for making block are mainly two kinds, that is to say, concrete and silicate, including common sand and pebble aggregate concrete, slag or stone chip concrete, pumice and other natural light aggregate concrete as well as fly ash and coal refuse silicate. The concrete blocks are mainly natural cured or steam cured. Silicate blocks are all steam cured without pressure. Various moulding methods are used such as hand-operated moulding, semi-mechanical lever pressing moulding, movable machine moulding on site and fixed machine moulding in factory. With blocks, several million sq. meters of houses have been built in our country. In 1979 only, about 1.5 million sq. meters of building were constructed with blocks as the bearing wall materials. The block building may be built in zones where resistance against an earthquake intensity of 7 is required in the design, the highest of them being 7-storey and the ordinary being 3 to 4-storey. Recently, the block construction is

more and more welcomed in many areas for the considerations as following.

One of the considerations is related to building material resources. As our country has a lot of coal mines, their by-products or the coal refuse amounted to tens-millions tons. Coal is a primary fuel for the power plants in China, consequently their by-product, fly ash is registered about 30 million tons each year. On the other hand, the cultivatable area per capita in China is small, the development of clay brick is not encouraged in some places because the making of clay brick may take up and spoil some cultivatable lands. Therefore, extensively utilizing coal refuse, fly ash and the other by-products to manufacture building products is of magnificent economic profits and is a realizable measure in environmental protection.

After many years of scientific expermiments on fly ash and coal refuse blocks, we have got a definite result in the material properties and structural performance such as the strenght, duration, carbonation and corrosive effect on reinforcement. By making test products and erecting test production lines and test buildings, we have also mastered the foundamental production processes and construction techniques. Based on summing up the experience, a specification for design and construction of small size and medium size block buildings is now being compiled in our country.

When the machinery and equipment for manufacture and construction being compared, it is found that those required by the small size block construction is similar to that required by the brick-concrete construction generally and conventionally employed in our country; Although the industrializing requirements of the medium size block are higher as compared with the brick-concrete construction, the machinery and equipment for its production, transportation as well as lifting and laying are much simplier as compared with the large-panel construction. Therefore, the block construction is adopted to many areas, especially to the medium and small cities in our country.

It is particularly important that the cost of the block construction is equal to and in some places even slightly lower than that of the brick-concrete construction, and the consumptions of cement, steel and lumber are also similar to that of the latter; This makes the block construction more competitive with other systems higher industrialized level such as the large-panel system.

China is vast in territory. In different areas, not only do the natural conditions vary remarkably, but also the economic and technical conditions are quite different. Therefore, we should have various technical ways to meet the development of construction in different areas in the country. In order to find out the techniques suitable to the conditions of our country's own, the Chinese representative group attending the Eighth CIB Congress would like to learn from our colleagues in building industry circles coming from various countries over the world. We are looking forward to the Congress.

Thank you, Mr. President.

Neville Hill, 26- Lingfield Court, Portsmouth POI 2TB, U.K.

My contribution relates to the paper by Cappelen and Edvardsen.

This is a practical and "down to earth" paper. Earth or soil, provided it contains adequate clay size material, requires little energy to convert it into useful buildingmaterial. The same applies to certain types of natural stone. On the other hand, crushed rock aggregate has been converted to a state where it requires an expensive, energy intensive material, Portland cement, to make it utilizable again.

It will become increasingly prohibitive for cost reasons to transport building materials more than short distances. Hence, local materials, close to the location of the building construction, will continue to be used; in rural areas this means soil, natural stone, grass, leaves and pieces of wood. Examples from other developing countries are shown in the slides.

Finally, the small field kiln, shown in these slides taken in West Java, and described in the June 1980 issue of "Appropriate Technology" journal, is the best example I have come across so far and is worth noting as an example for other countries, possibly through TCDC.

Neville Hill, 26, Lingfield Court, Portsmouth POI 2TB, U.K.

My contribution relates to the paper by Spence and Allen.

Potentially, the development of this portable test method for comparing the pozzolanicity of materials is very useful for those working in the field on establishing production of building materials such as lime-pozzolana products. Much work has been done by many laboratories to obtain a simple analytical method but from the evidence I agree that it has to be based on compressive strength, which for blocks is the parameter that is going to be measured in any case.

In the wider context, there are two main reasons for the importance of lime-pozzolana and hence the signifi-

cance of this paper. Firstly, Portland cement is usually an extremely expensive material by the time it reaches distant localities, due mainly to the inappropriate way in which the industry has been allowed to develop in many countries. Also, of course, ASTM Type I or ordinary Portland cement is a civil engineering material and seldom appropriate for rural housing, irrigation, etc. Secondly, pozzolanas occur in many areas such as the Andes, East Africa, South-east Asia etc. as the slides show.

In starting lime-pozzolana block production the simplest hand moulding methods should be used first to access the materials, become used to the process and test market acceptability etc. The slides show such a system and also well planned private factory in West Java which is worth adapting to conditions in other countries.

Finally, if natural pozzolanas are not available there are several simple ways of making artificial pozzolana on a small scale. The slides show the method used by some lime manufacturers in central Java.

Øivind Birkeland, Norwegian Building Research Institute,
Forskningsveien 3B, Oslo 3, Norway.

I only wish to draw your attention to the fact that many countries earlier had a very well developed lime-technique. Wonders have earlier in many countries been done using traditional lime mortar technique.

However, when cement was introduced the cement managed completly to push out lime from the market. The result was that a lot of problems and failures were introduced.

I have only just these questions: Why did this happen? And was it necessary?

Prof. D. Mohan, Central Building Research Institute,
Roorkee (U.P.) India.

My contribution relates to the paper by A. Kartahardja.

Most developing countries are in search of substitutes for traditional building materials such as cement, asbestos and steel which are in short supply as well as are very costly. In many areas such as in Middle East and African countries as well as in far East countries the rural housing is still based on locally available building materials such as clay, thatch, timber and bamboo. The improvements of these materials are also an area of research and development concerning the developing countries.

Among the substitute materials for cement, CBRI (India) has been concentrating on the development of lime pozzolana mixtures, ready to use. In this respect our work on the development of activated lime pozzolana mixtures[1] and rice husk lime sludge based materials[2] could be of interest to other countries. Asbestos sheets can be replaced with either fibre-cement roofing sheets[3] or paper-asphaltic roofing[4] sheets. On both these materials the Institute has done considerable work. The fibres such as woodwool, coir and jute wastes could be used in making low cost and durable roofing sheets.

Various countries are facing shortage of good quality aggregates. At the same time, they are producing waste materials from mining and mineral industries such as in the benefication of zinc, copper, gold and iron ores[5]. These wastes as well as certain other locally available nonconventional aggregates[6] should be evaluated for use in mortar and concrete. Blast Furnace Slag from steel plants and gypsum from fertilizer industries[7] should also find use in developing low cost cementitious materials.

Non-availability of fossil fuel in various developing countries is a big problem[8]. The cost of imported fuels is a great hinderance in the development of building materials industries. As such, use of agricultural wastes could be recommended for burning bricks. This Institute has recently carried out some work on use of rice husk as a fuel in burning bricks and tiles.

Seasoned timber is generally not available and use of unseasoned timber leads to serious problems. The cost of seasoning in steam operated kilns is very high. The CBRI work of development of solar seasoning timber kiln[9] could be of much interest to various countries. One such kiln has been put up by a firm close to Roorke.

References:

1. A new approach to lime-based products; N.G. Dave and S.P. Mehrotra, Consultation: Lime-Pozzolana, 8-9th Dec., 1977, Page 71.

2. A new hydraulic binder from waste lime and rice husk; Part II-typical applications. Arjun Das and S.K. Malhotra, Research and Industry, 22(4), Dec., 1977, 239-42.

3.a) Steel fibre reinforced concrete roofing units; Dinesh Mohan and S.S. Rehsi, Indian Concrete Journal, 51(12), Dec., 1977, 370-73.

b) Woodwool corrugated roofing sheets. S.M. Singh, Research and Industry, 20 (1), March 1975, 10-11.

4. Asphaltic roofing materials; Mohd. Aslam, Civil

Engg. Const. and Public Works, Journal 6(4), 1973, 35-39.

5. Utilization of Zinc tailings for making masonry cement. Mohan Rai and V.K. Jain, Cement 13(1), Oct.-Dec., 1979, 6.

6. Precast stone masonry block using red lateritic aggregate; Mohan Rai, Dinesh, Chandra and V.K. Jain, The Indian Concrete Journal 53(12), Dec., 1979, 336.

7.a) A sulphate resisting pozzolanic slag cement; C.A. Taneja and S.K. Malhotra, Cement, 7(2), Jan. 1974, 14-16.

b) Evaluation of suitability of phosphogypsum for use in the preparation of different building materials; C.A. Taneja and Manjeet Singh, Research and Industry, 21(4), 1976, 263-65.

8. Fuel Economy in brick industry; N.C. Majumdar and E.S. Hira Lal, I.S.I. Bull. 27(9), Sept. 1975, 324-28.

9. Solar seasoning Timber Kiln, Y. Singh, CBRI Publication, 1980.

Dr. A.G. Madhava Rao, Structural Engineering Research Centre (SERC), CSIR Campus, Adyar, Madras 600 020, India.

My contribution relates to the paper by Mr. Mwamila & Dr. Mlingwa.

In their paper the authors have said that three-quarters of the Tanzanian land is dominated by lateritic soil. SERC, Madras, has developed a process for the manufacture of building blocks using lateritic soils. Lateritic soil available anywhere can be utilized for the manufacture of good quality building blocks with compressive strength of 50 to 150 kg/cm^2. In the SERC process the main binder used is lime of about 5 to 6 %. The blocks are made using high pressure presses, (not of cinva-ram type) and hot water/steam curing. The blocks have a low water absorbtion of only 12 %. The manufactury process is also of low energy comsumption, high temperature firing is not required for the production of blocks. We have also developed two types of machines for producing these blocks; 1) A manually operated machine with a production capacity of 500 blocks per shift. 2) A semi-automatic machine with a production capacity of 2000 blocks per shift. A low cost house with a plinth area of 25 m^2 built with laterite blocks for walls is performing well for the past 3 years.

SERC has also developed three-dimensional sanitary/service core units in ferrocement for the sites and services scheme of the Madras Metropolitan Development Authority. The units can be precast or cast-in-situ and has a thickness of only 3 cm. The precast core units weight about 1.5 tons and these need no foundations and can be placed on the ground or on 40 cm high pedastals. Other ferrocement units developed by us include small capacity rectangular and cylindrical water tanks, Double-T ferrocement units for roofing, ferrocement gas holders for bio gas plants and ferrocement folded plate, roofing units for low cost houses and ferrocement rafters for roofs.

Dr. Mofid A. Samarai, National Centre for Construction Laboratories, Moosa Bin Nasir Square - Tel-Mohammed-Baghdad, Iraq

My contribution relates to the paper by Mr. Kartahardja.

The author must be complimentet for his fine paper however, in countries like the middle-east and Arabic countries the problems are different in many ways. These countries face great shortage in skilled and unskilled labor which is imported. Hence the policy is not towards industries absorbing labor and unemployment as much as to save labor and push to the production as much building materials as possible. Good suitable raw materials are not always available, mainly due to contaminations with sulphates of aggregates and even soil.

However, with the increase in advanced equipment we face the problem of maintenance and upkeep of these equipments.

As mentioned in the paper coordination between developing countries in the field of research in this field is lacking as much as the gap in their coordination between the industrialized countries and the developing countries. International institutions like the CIB should take active part in this aspect to reduce the repetition in work and research, and making the research activities be known to research establishments in developing countries not after they are finished, but rather when in progress so information could be exchanged and time saved.

W.J. Allen, University of Cambridge, Dept. of Engineering, Trompinton St., Cambridge, England.

My contribution relates to the paper by Mr. Allen.

The paper as presented in the text proposes the use of an accelerated compressive strength test as an index to medium term compressive strength. I wish to relate the practical application of this test to assessing the variability of a pozzolana deposit, and to the quality control of this pozzolana in the field. The pozzolana is a volcanic ash, found in Oldonyo Sambu Ward, Arusha, Tanzania, it is a raw material source for a local lime pozzolana production unit. Samples were taken from across the area of deposition, and at various depths at one location. The activity, in terms of accelerated strength, peaks around a geographical feature indentified as an old lake-bed. There is also a sudden reduction in strength at a depth of 3.5 m. To understand the cause of the variations all samples were examined mineralogically, chemically, and by various physical means. Only surface area as measured by air permeability correlated to accelerated strength. The correlation coefficient rising to 0.86 when samples from the extremes of the deposit are eliminated. The test may be used for quality control purposes if samples can be tested on site. To facilitate this, a hand powered compressive strength testmachine has been developed and is undergoing field trials in Oldonyu Sambu, Arusha.

Surinder Singh, Dept. of Building & Estate Management
University of Singapore, Kent Ridge
Campus, Singapore - 0511

My contribution relates to the paper by Mr. O'Rourke.

It is well known that any information of resources for construction is very useful for various purposes during the different stages of construction. I would therefore like to congratulate Mr. Charles O'Rourke for his paper "The quantifiction of steel and concrete product use, by sector, in the Irish construction industry". The information given is quite useful for planning. In this direction I would like to mention the useful work done at the Central Building Research Institute, Roorkee (U.P.), India, for resources requirement for different types of buildings, number of storeys and specifications. Any body interested in the work can obtain copies from the Director fo the institute.

At the university of Singapore, we had undertaken the investigation for comfortation of resources requirement for commercial buildings ranging from 5 - 50 storeys in denomination of 5 storey. Statistical relationships have been established between the individual material, good size and number of storeys etc. and the results are being presented in Singapore in August 1980. The statistical relationships give results of material requirements to an accuracy of about ± 6 procent. The methodology adopted is rational and can be applied for local conditions. The results have been found to be very useful for approximate cost estimation, selection of economical number of storeys, budgetting of materials etc.

G.C. Mathur, India.

I commend the papers presented in this section. However, I would like to emphasise the need to undertake research and also to propagate extensively improved use of local building materials. This is necessary to improve the durability and performance of houses and buildings made of local materials. I suggest that CIB Working Commisson on "Improved Technology for using local building materials" be set up.

The new working commisson should also devote attention to use of agriculture and industrial wastes that are locally available for construction.

As houses in developing countries are built largely through self-help, it is necessary to devise propagational media/literature to provide know-how to the people to ensure adoption on improved technology for using local materials. This aspect calls for coordinated approach by CIB for the benefit of developing countries.

Thomas Ringsholt, Indonesia.

Summary of presentation:
The author presented several slides illustrating the general development of indigenous building materials and low-cost housing in Indonesia. He presented solutions obtained with the assistance of UNIDOs large-scale building materials project which has been operating since 1974, and outlined future activities in the fields of small-scale building materials industries, rationalization of traditional building technologies and preparations for a national open housing system as prerequisite in future industrialization in housing construction. The socio-economic importance of housing and building materials industries in the overall economy of the country was emphasized.

Prof. D. Mohan, Central Building Research Institute,
Roorkee, India.

I was interested in the comments made by Mr. Cappelen about the use of sisal fibre in roofing sheets. We are using wood wool and coconut core waste for these sheets since fibre is not plentified in India.

Mr. Ziqun from China mentioned the use of medium size concrete blocks equivalent to 100 clay bricks. It is an interesting idea and will increase providing that the weight of such blocks will be rather heavy and

cranes or other lifting derecks will have to be used. We have developed stone blocks 20 x 20 x 10 cm weighing 18 kg and these are equal to six bricks and can be handled by one man. It was also interesting to note that China is making use of fly ash concrete even for structure work. I hope they are using some coating over the reinforcement which tends to corrode under marine environment.

Mr. Kartahardja and Mr. Hill showed some interesting slides on vertical lime kilns in Indonesia with capacity up to 10 tons. These appeared to be rather tall when compared to the same capacity kilns in India. May be the fuel makes the difference which is oil for Indonesia and coal for India.

Dr. Zawde Berhane, P.O. Box 518, Addis Ababa, Ethiopia.

My contribution relates to the paper by Mr. A. Kartahardja.

First of all may I commend the author for his thoughtful consideration of the problems forced by developing countries in their efforts to develop indigenous building materials.

I have one observation and one comment to make. First the observation: the ± (pluss - minus) signs on page 18 in item 7, paragraph one, I think, are not necessary.

Now the comment: in my openion the following should be taken into consideration in the planning and development of indigenous building materials in developing countries:

a) survey on the availability of raw materials,
b) survey on demands of building materials in the specific country,
c) training of building materials production technicians
d) establishment of small-scale production units at appropriate locations in the country,
e) popularization (introduction to the public) of the building materials, and
f) study on the possibilities of exporting of such building materials to neighbouring developing countries (in case there will be surplus of the building materials).

At the same time research on such building materials should be conducted in order to import their essential properties and the results fed to the production units without delay.

Dr. Zawde Berhane, P.O. Box 518, Addis Ababa, Ethiopia.

My contribution relates to the paper by Mr. R.J.S. Spence and Mr. W.J. Allen.

In Fig. 1 a compressive strength of about 2.75 N/mm^2, at a zero age, is indicated. How was this achieved?

Even though the magnitude of the curing temperature is an important factor, one should not neglect the influence of wet or water curing period on the compressive strength of specimens in such investigations.

Secondly in Fig. 4 the ages of test specimens for the lower two curves are given. What was the age of the specimens (when tested) for the upper curve? In both cases (Figs. 1 and 4) the magnitudes of the curing temperatures were not indicated.

SUBJECT
SUJET

3B

Energy conservation: Installations
Heat exchangers, heat pumps, solar panels etc.

Chairman: K. KAMIMURA

Installations pour économie d'énergie
échangeurs de chaleur, pompes de chaleur, panneaux solaires etc.

Président: K.KAMIMURA

Report from Section 3 - Subject 3B:
ENERGY CONSERVATION: INSTALLATIONS, HEAT EXCHANGERS, HEAT PUMPS, SOLAR PANELS ETC.

Key-note speaker: S. Leach

Assistant director Katsuro Kamimura, Building Research Institute, Japan opened the session:

May I have your attention please. I would like to call the session 3B to order. Ladies and gentlemen, since we are a little bit late for the fixed time I would like to begin the session 3B immediately.

My name is Katsuro Kamimura from the Building Research Institute, Japan. And I will serve as chairman of the session 3B of this congress. Mr. Munch-Anderssen right at side of myself is from the staff of the Norwegian Building Research Institute and I ask the favour of his assistance.

According to the program to day I will be responsible for this session, so I would like to ask for your kind cooperation. We sincerely hope that those who are participating in this congress as delegates from the various countries through the world will be able to get something valuable which may contribute to the recent studies on energy conservation, and will contribute to its farther development through the constellations on this problem.

Therefore we do hope that all of you here will present your ideas, pleading for mutual understanding through exchange of various opinions and comments in order to make this congress a real success.

Now, please remember that this session will finalize at 12 o'clock and coffé break is expected to be taken from 10.15 for 30 minutes. I will tell you another thing, that the announcement table is just outside of this lecture room, so please look at the table from time to time to observe any messages.

Now, ladies and gentlemen, I would like to introduce dr. Stan Leach from Building Research Establishment of U.K. to you. He is at present acting as secretary of CIB W67, which is the working commission of energy conservation in the built environment. Dr. Leach will serve as key note speaker of this session 3B on energy conservation and I expect your comments or discussions following dr. Leach's reporting. After the discussion I have on mind to call some participants who have submitted some supporting papers to this session 3B. Now, dr. Leach please:

Assistant director Dr. Stan Leach, Building Research Establishment, Great Britain:

Thank you, Mr. chairman, and good morning, ladies and gentlement. My presentation is the first of this congress in the field of energy conservation in buildings. It is therefore appropriate that I should begin by briefly discussing the world energy situation, although of course the extent of importance of the problem was stressed by our president, Mr. Lundby, yesterday.

Now, my first slide shows the history of the last 75 years and in a moment I shall be showing one of the many predictions for the next 75 years.

Now, this slide shows that enormous changes have taken place. Firstly the consumption has grown approximately 9-fold, from roughly 1000 million tons of coal equivalent per annum to roughly 9000 million tons of coal equivalent per annum. This supply has been almost all my fossil fuels and of course initially this was mostly coal, but recently it has become mainly oil and gas.

Now, this slide starts where the last one finished and is one of the many projections that have been made about the future. The first point I want to make about it is that it is bound to be wrong. No one has ever made an energy projection half as far into the future as this one that was right, and I believe it will be right in only one respect and that there will be enormous further changes from the present situation.

Now, this particular projection is the so-called low growth case, put to the 1977 World Energy Conference, and in fact the growth rate is halved compared with the growth rate experienced over the previous 75 years, going from about 9-10.000 million tons of coal equivalent to 40.000 million tons of coal equivalent.

Now, even if growht is as low as is shown here, there are very important implications for the future. World population is expected to almost double over this period. Now, currently the greatest growth in energy consumption is in the developing countries, but today over half of the world energy consumption is in industrialized countries, which have less than 15 % of the worlds population.

This has tremendous social, political and economic consequences as was made clear by our president yesterday. But I am not going to go into these, I am going instead to concentrate on a rather narrow aspect, which is the implication of this for building services.

Now, by that I mean the energy consumption in buildings, the energy use for providing space heating, water heating and lighting in buildings. It is clear to me that the industrialized nations will have to limit their growth in energy consumption, and also that they can do so by investment in energy conservation, and of course in particular by investment in energy conservation in buildings.

This is because around about 40 % of all of the primary energy is consumed in building services each year, and in some countries, examples being the U.K. and Denmark, over half of the annual consumption is for the heating and lighting of buildings.

Now, building lifetimes are traditionally long, as long, perhaps longer than the whole period covered by this slide. One conclusion that I think will emerge from our discussion in session 4A, the session this afternoon, is that it is relatively easy to produce a building fabric, which leads to a low energy consumption at the design and construction stage, but rather difficult and expensive to improve it after construction.

Now, the same point of course apply to building services, but not with quite the same strength that it has for the fabric. If we look at this slide, we can see that the present mix of fuels is going to change, change drasticly.

And this brings me to a conclution, that building services must be designed to be flexible, and there is a second associated conclusion that it may be worth while to pay more for building services than the lowest possible cost, if the additional expenditure provides the flexibility to cope with this future changes.

Another way of looking at this is to regard it as an insurance premium being taken out to prevent the building becoming impossibly expensive to run. Now we give examples of the sort of things one might do as insurance premiums in the written version of the paper.

A final point about this slide is that even in the year 2050 the majority of the fuel used is by burning conventional fossil fuels, and this means that we, as building researchers, must study and improve traditional methods as well as the new and more exiting technologies, for example solar energy and heat pumps.

And I am pleased, Mr. chairman, that in the papers for this session we have an example of coal heating and we have a number of examples on the detailed operation of conventional building services, for example two papers from Sweden on thermostatic radiator valves showing how important it is to use them in the right way.

Now, I am going to turn to the possibility of improved efficiency in the use of gas boilers. This is a very mundane topic, this graph showes how the efficiency of a range of boilers varies with the applied load, plotted as the system efficiency against the applied load.

The results are typical of boilers on the European market today, all the boilers have a high efficiency at their maximum demand, in the region of 65-75 %. But peak demand occurs only rarely during the heating season and for most of the time the demand is well below this peak, and you can see that the boilers labeled A and B differ greatly from boiler C at low loads.

Now, boiler A is light-weight and has a high efficiency at low loads and will therefore maintain a good performance throughout the heating season. Now, these still here are conventional boilers, but further improvements are possible. If both the air supply and the the flame are modulated according to load, efficiencies of greater than 75 % are possible even at the lowest loads. If we go further and condense flue gases, than efficiency can rise to over 95 %, and such boilers are now being developed in research laboratories in several places.

Now, I would like to turn to the subject of heat pumps. The CIB commission W67 has a technical sub-group on heat pumps, which I coordinate. It has become clear from the discussions of the sub-group that there has been a world wide explosion of interest in heat pumps with many new machines and new applications under investigation all over the world.

Now, Mr. chairman, I am anxious I do not get too carried away in discussing heat pumps, and I am going to confine my remarks to rather general remarks. In my paper I have identified 2 main categories for heat pump application, the first is the extracting of heat from the ground or from the air. The second is heat recovery, that is heat recovery for example from outgoing ventilation or from waste water or possibly from a low temperature heat store.

Now, we have another use for heat pumps identified in the papers for this session not mentioned in my paper, which is their use as dehumidifiers. This helps to solve two problems at once, reducing both energy consumption and helping to control the widespread problem of condensation.

Now, where are we with heat pumps today? At present, air and ground source heat pumps driven by electricity can produce between 2 and 3 times as much useful heat as the energy required do drive them.

But many new and advanced heat pumps are under development, which shall have a better performance and we are now finding that the sales of heat pumps are booming, with many of the factories in Europe working to capacity.

Now, my next slide shows 4 experimental low energy houses constructed at the Building Research Establishment near London. As you can see we took the photograph in the snow with the sun shining. This is obligatory for all photographs taken of experimental low energy houses. It was quite difficult to get a picture like that in England anyway.

I have described this houses on many occasions, what they work and what they do, and my experience tells me that I need at least half an hour if I am not going to cause more confusion than clarification.

The energy system diagrams for 3 of the 4 houses are included in the paper and all I want to say now is that as well as other energy conserving features these houses actually contain 8 heat pumps, all different, covering many of the possible applications in housing. The energy savings of these houses are of major significance, between 30 and 70 % reduction in energy consumption compared with current designs in the UK.

Well, to conclude my remarks on heat pumps I will say that I expect heat pumps to play a large part in reducing energy consumption in a wide spread range of building types in the future. There are many ways that they can be used and their potential for saving energy is of major significance.

To turn now to the use of solar energy in buildings there is no doubt that the quantity of solar energy reaching the earth's surface far exceeds the worlds requirements for energy. However, there are 2 major problems in using this energy. Firstly it arrives with a low energy density, rarely exeeding a kW/m^2 and averaging much less, which means that we require large areas for its collection. And secondly, in most countries, there are large differences between the availability of sunshine in summer and in winter, requiring costly heat storage if the majority of the sunshine available is to be used.

Now, despite these 2 major drawbacks there is much interest in developing the use of solar radiation, both in socalled active solar collector system and in the passive building design employing the windows and fabric of the building as a solar collector.

Now this slide, the one I still have on the screen, has 2 houses, which utilize all of the roof as a solar collector. The house on the left which, if it was not covered with snow, would be a matt black finish, is an air solar collector feeding 2 heat pumps, one heat pump for the domestic hot water, and the other for space heating.

The house on the right uses a conventional flat plate solar collector behind patent glazing, feeding a large interseasonal heat store, which is actually in the small building at the extreme right of the picture. And this interseasonal store then enables the solar radiation collected in the summer to provide winter-time space and water heating, which of course is an extreme example of solar collector applications.

If we come now to the currently most common use of solar collectors, this is for supplementing the heating of domestic hot water. Here we see another experiment of the BRE, which is measuring the performance of 90 identical systems, so that realistic value for the average energy savings can be found, taking measurements across a wide range of user behaviour. Now, these are simple systems saving about 30 % of the water heating bill, or to put it another way, about 10 % of the total fuel bill of a house.

These things are not new, there has been for many years a well established market for such systems in sunny countries, for example Israel and Australia and South Africa. And, in fact, we have a paper from South Africa for this session, which shows a new very low cost system, combining the collector with storage.

Now, in other countries markets are just beginning and governments are sometimes helping by providing grants and cheap loanes to encourage the use of such systems. This is happening for example in France and the USA, and in the USA there are now more than 300.000 houses which have systems, mostly in the southern USA.

Now, Mr. chairman, I am going to discuss for my last 2 topics lighting and ventilation. In my opinion these are much neglected topics and certainly previously have not been covered in the depth they merit in the activities of the CIB.

In the case of lighting it is not an important contributer to the energy consumption in houses, but it can account for more than 50 % of the primary energy consumption of some buildings, for example deplanned office buildings.

This slide shows 2 things, firstly you can see that offices with airconditioning consume much more electricity than those without, and secondly that in airconditioned buildings the electricity supply to provide the lighting dominates the running costs.

Now, with regard to the first point, the comparison between airconditioned and non-airconditioned buildings in many parts of Western Europe it is possible to design offices with high environmental standards without airconditioning. This is of course for most sites, but where deplanned design is essential then airconditioning is inevitable. But where it is used there is of course an energy penalty.

Now, this slide shows observations made in a school classroom. These are observations of the use of lights over the day for 2 months of the year. The top set is for December, and the lower set for June. The first point is that despite the enormous difference in the availability of daylight in the U.K. between December and June, there is almost no difference between the use that is made of the artificial lights.

This is because it is quite common to switch on lights first thing in the morning and then not to realize that they are not contributing usefully to the illumination when the daylight level increases. Automatic lighting controls can therefore save energy, and the result shown in the 2 shaded areas are the saving calculated from the use of firstly automatic switching and then the lower one, the largest savings, from automatic dimming, both controlled by the availability of daylight. Now, these results have been confirmed in a number of real experiments installing control systems.

If we turn now to the use of lighting control in offices this shows the very recent results of quite an important experiment where a large building was used, and idential offices on two floors of the building where compared, on the eight and on the tenth floor. One office had a sentralized time control related to the occupancy pattern with automatic switching in the early morning and the lunch-hour, for the cleaners.

There was in addition local lighting switches, flexible local switches, on each of the luminaires available for the occupants use. That then was the modified office, the other office had the traditional arrangement of a single switch-panel near to the entrance door.

Now, it can be seen that the energy savings associated with the automatic control system are very large, averaging at least 40 % over a full year. And of course had this particular office had airconditioning the savings would have been even greater because the cooling requirement would have been reduced. Now, that then illustrates savings associated with the use of lighting controls, but there are further savings still possible from lighting by paying attention to lighting design rather than to lighting control.

This slide, not a very good one I am afraid, this slide is a medium size office belonging to Pilkington lit conventionally with fluorescent luminaires providing, as is common, even illumination across the working surfaces. Now, the lighting design was changed to this: Instead of even illumination we have lights directed on to the requred working surfaces with the overall level reduced, and in addition to that desk lights were employed providing illumination from the side to maximize the contrast for reading, unlike my lectern light here, which is the worst possible arrangement.

These changes of lighting design altogether led to a reduction of 80 % of the lighting consumption of this office. That is, it was operating with only 20 % of that used originally.

Now, in connection with changes of lighting design further research is needed in order to determine the general acceptability of such systems for widespread application. But a general conclusion about lighting is clear, that the potential savings from improved lighting design and control are together of very great significance.

Now, my final topic is subjects of ventilation. Adequate ventilation is an essential feature of all habitable buildings, in order to insure both the safety and health and comfort of the occupants, and in many cases to preserve the condition and integrity of the fabric.

But ventilation has an important effect on energy consumption. In the heating season energy is expended in raising the temperature of the air brought in from outside, and energy is of course also consumed by the fans of mecanical ventilation or airconditioning systems.

It is estimated that for the U.K. the ventilation heat loss is responsible for approximately 15 % of the total U.K. primary energy consumption, that is as much as we use for the whole of our road transport sector. There is therefore scope for making substantial contribution arising from ventilation heat loss.

It is first of all important to establish the requirements for adequate ventilation. This really depends upon the use of the building or perhaps the spaces

within the building. Now, we have existing requirements in all our codes, regulations and soforth, but in many instances these go back very many years to conditions which may no longer apply.

Resently, certain airborn contaminants, which in the past was not considered important, have been shown by more resent work to have important effects, for example radon and allergens. In the period when requirements were set energy consumption was not, by large, a significant factor, and it is possible that there was no clear upper bound and that we are now overventilating our buildings.

It is therefore important to review requirements for ventilation, to reasess these, and to ensure a balance between energy consumption and a safe and comfortable environment.

Now the lead in this fields is being taken in Scandinavia, particularly in Sweden, where requirements in resent building regulations are being set, which are only just above the minimum which are adequate for the occupants for some of the contaminants.

Having set requirements for ventilation, the next consideration is how do we actually achieve them. Well, 2 general methods: Use natural or mechanical ventilation. The latter method, mechanical ventilation, can in principle be designed to satisfy the requirements exactly. But natural ventilation is much more difficult to deal with, since the factors on which it depends, wind and temperature, are highly variable.

The influence of users is of great importance as is shown in one of the papers we have grouped for this session, which looks at the importance of the effect of window opening on the ventilation of a whole house.

Now, with mecanical ventilation systems, we have a further possibility for energy conservation. In addition to simply meeting the minimum requirements it is possible to adopt some technique for heat recovery. There are many methods of doing this, ranging from the simple flat plate heat exchangers to complex systems incorporating heat pumps as was used in the experimental houses I showed.

It is probably true to say that building ventilation is the area of greatest ignorance when looking at the energy balance and energy consumption associated with largely because of the difficulties associated with making measurements in buildings and developing a mathematical simulation and taking proper acount of natural ventilation. But without this knowledge of ventilation the application of meaningful energy targets to buildings is not possible.

Well, in conclusion, Mr. chairman, I would first like to make one point, and that is that I think it is quite wrong to look at the fabric and the services installations in isolation. These must be taken together when assessing the thermal performance of buildings. This point is brought out in many of the papers grouped for this session and I am sure this will emerge also in our other session on energy conservation. Thank you, Mr. chairman.

The chairman thanked the key-note speaker and then called the first author of the supporting papers.

Dr. Derek John Croome, University of Bath, Great Britain:

Thank you, Mr. chairman, ladies and gentlemen. Within 5 minutes I would just like to survey some of the main aspects of my paper. The 2 main conclusions are:

Firstly that I believe you can not separate the active and the passive elements of design, which is the last point Dr. Leach was making. This is a principle feature of my own contribution.

Secondly that we need to have an intergrated view of how we link the mass of the building and the heat pump systems, which we are going to use in the buildings.

My first slide. The important thing about low energy building design is that we are trying to make effective use of ambient energy and free heat sources in the building. This can only be really achieved if the energy consumption in our buildings is decreased below that which we are normally accustomed.

The principle components of energy consumption are the fabric loss and the ventilation loss. The easier thing to control perhaps in a way is the fabric loss, and as Dr. Leach has just been talking about, the ventilation loss is a far more difficult area which will require much more information.

In talking about ambient sources in my own designs that we are doing in England we are principly concerned with solar sources. When we talk about free heat sources we are basicly concerned with the occupants, lighting, cooking, hot water appliances and processes.

Our own analysis was based on 3 housing types: a standard house, which is in fact a building regulations house, British building regulation type house, an insulated house using U-values of 0,6 and a low energy house using U-values of 0,3. And you see on the graph there that when one comes to about 0,3 one has very effective use of the free heat sources, that is the orange band going across the diagram.

Perhaps a more effective way of explaining this is by the load lines here where one sees energy required pr. unit of floor area on the ordinate cross the abcissa a plot against degree days. And for the 3 housing types you can see the effect of decreased heating band and also decreased heating season as the effectiveness of the building becomes apparent.

An important aspect which I think the building services engineer in particular has neglected and left too much entirely to the architect in the past is that of the passive thing. We are all aware, around the world, various climates, how man has adopted to requirements, wether it is in the Mediterranean hot humid climates or in the polar regions.

The sort of things that we are interested in at Bath University, some of these have started its developments in Sweden, is the airvent window. The fact that rather than use double glazed windows with the air as a static layer, moving the air through the gap and getting in fact a reduced U-value for the construction.
Another feature, which is of interest
block floor where the green line here is the supply temperature range, the red line shows the attenuated temperature wave pattern as a result of the air passing through the concrete floor, and for particular season the mass of the floor can be turned to the local climate conditions.

This slide is a design diagram for a hollow block floor. I have not time to go into detail on that now. If any of you are interested I can talk about that in the discussion.

Integrated energy systems, basicly here the fact of putting what I have just been talking about together, ambient energy, domestic hot water as a source, the use of heat pumps and the mass storage system and finally the spaces that have to be heated and cooled. By combining these with heat pumps, the mass of the building, orientation, all those features which we normally associate with passive control, one can get effective use throughout the seasons of the year, the winter and the summer, days and nights.
Thank you, Mr. chairman.

Engineer Katsumori Miyazaki, N.T.T. Public Corporation, Japan:

It is very important to make the energy saving efforts in practice for world-wide requirement due to the critical energy resources situation.

The final subject of my paper concerns the evaluation method for energy saving effect.

It is necessary to compute energy consumption amount for evaluating energy saving effect.

It is very important to estimate accurate energy consumption amount in design stages. It is necessary to define some indices for evaluating energy saving effect.

We defined three indices as shown in our paper.

These are coefficient of primary energy consumption in airconditioning system, coefficient of building thermal load and coefficient of air-conditioning system performance.

Engineer Michel Rubinstein, C.S.T.B. - Station of Research, France:

Mr. Chairman, Ladies and Gentelemen,

I think, I will make som troubles in this meeting, but as I remember that French is one of the official language og CIB, I beg your pardon, but I will speak French.

Monsieur le Président, Mesdames, Messieurs,

Monsieur LEACH l'a rappelé, l'energie solaire paraît être une source énergétique exemplaire, largement répandue, en particulier dans les pays en voie de développement, inépuisable et réputée non polluante et elle peut être exploitée de différentes façons. Il n'est donc pas surprenant que la crise de l'énergie ait conduit à développer les recherches sur l'exploitation de l'énergie solaire dans l'habitat.

C'est ainsi que ces dernières années, en France, le Centre Scientifique et Technique du Bâtiment a entrepris un important programme de recherche sur les possibilités d'utilisation de l'énergie solaire pour le chauffage des bâtiments.

Un des objectifs de nos études dans ces domaines est de disposer et de fournir aux participants à l'acte de construire des méthodes de calcul de l'énergie solaire récupérable pour le chauffage des logements par différents systèmes et notamment les systèmes actifs.

Notre communication, qui figure dans les documents qui vous ont été remis, présente un exemple d'étude de ce type qui porte sur le calcul de l'énergie récupérable par des capteurs solaires associés à un stockage à eau de faible volume. C'est un exemple de démarche de recherche visant à aboutir à des méthodes d'aide à la conception d'habitat économe en énergie.

Le calcul peut être étendu à d'autres systèmes de chauffage solaire comprenant par exemple:

- un stockage par matériaux à changement de phase,
- un système avec capteurs à air et stockage sur lit de cailloux.

Les outils de modélisation ainsi définis sont également utiles pour les études sur les systèmes de stockages intersaisonniers de chaleur dans le sol.

Rappelons, en effet, sous nos latitudes, le chauffage solaire nécessite d'accroître les possibilitiés de stockage et que le stockage de chaleur intersaisonnier, ou du moins sur plusieurs mois, permettrait d'utiliser le soleil d'été pour le chauffage. Cela accroîtrait considérablement l'énergie solaire utilisable par m^2 de capteur.

Cette rapide présentation étant faite, je voudrais, Mesdames, Messieurs, et avec votre permission, Monsieur Le Président, vous donnez quelques précisions qui ne figurent pas dans les textes dont vous disposez. Il s'agit d'exposer quelques données concernant l'industrie solaire française.

Nos études, en cette matière, montrent qu'en France, le marché des capteurs solaire dans le bâtiment, s'étend à un rythme soutenu principalement pour ce qui est des capteurs plans à eau.

Les débouchés dans le bâtiment ont ainsi atteint 33 000 m^2 en 1978 dont 30 000 m^2 de capteurs à eau et de l'ordre de 85 000 m^2 en 1979 dont 81 000 m^2 de capteurs à eau soit une progression de 160 % d'une année sur l'autre.

Le préchauffage de l'eau sanitaire reste l'application dominante, plus de 70 % des débouchés en 1978 et la plus porteuse d'avenir à court terme. Mais les cahuffage et la production d'eau chaude simultanés représenteraient déjà 22 % des ventes totales de capteurs.

C'est l'habitat, en particulier individuel qui demeure le premier support de la diffusion des applications solaires en bâtiments en France. Ainsi l'habitat individuel a représenté la moitié des débouchés en 1978 dont 35 % en habitat neuf.

Le capteur plan à eau est le premier à profiter de la croissance du marché. Son amélioration porte sur les détails de conception autant que sur l'emploi de nouveaux matériaux (matières plastiques pour couvertures transparentes et absorbeurs notamment).

Le capteur à air n'a pas connu cette progression mais il n'est pas exclu que l'on assiste à un certain démarrage à plus ou moins court terme.

Des matériels à hautes performances, dont l'emploi est aujourd'hui pratiquement inexistant dans le bâtiment, pourraient préfigurer des solutions technologiques pour l'avenir : capteurs à couche sélective, capteurs sous vide et capteurs à concentration.

Encore faudrait-il que ces opportunités technologiques ne fussent pas masquées par la dominantions des matériels existants et l'insuffisance des efforts de Recherche et Développement et que les problèmes posés par ces techniques au niveau de leur aptitude á l'emploi et de leur bon comportement en service fussent résolus.

Je voudrais pour terminer vous rappeler, Mesdames, Messieurs, qu'outre le solaire actif dont je viens de parler, nous escomptons beaucoup du solaire passif ou en d'autre terme de l'habitat bioclimatique, la maison elle-même devenant maison capteur quand sa structure est conçue comme collecteur et comme stockage, quand son rôle d'enceinte thermique adaptée pousse à l'utiliser pour l'hiver, capter la chaleur le jour et la conserver la nuit, l'été protéger du rayonnement le jour et refroidir la nuit.

Cette voie ne soulève pas seulement des problèmes de conception architecturale et constructive de l'habitat, elle pose également problème au plan:

- de l'urbanisme et du droit au soleil,
- de comportement des usagers au regard de leur appropriation des espaces construits.

Je pense n'avoir pas dépassé le temps de parole qui m'était imparti. Je vous remercie, Monsieur Le Président, Mesdames et Messieurs de votre attention.

Jack B. Siviour, Electricity Council Research Centre, Great Britain, on behalf of D. J. Dickson and G. W. Brundrett:

I would like to emphasize the following points on behalf of the authors.

In the paper by Dickson, experimental measurements of ventilation rates over a range of wind speeds and temperature differences were in the range 0,3 - 0,5 ac/h with all external windows and doors closed, and all internal doors open. With just a single change to these conditions, that of opening one bedroom window only to a gap of 100 mm resulted in whole house ventilation rates of 1 - 7 ac/h depending on the direction of the wind.

If windows are opened to remove water vapour and reduce condensation, a high ventilation heating energy penalty may result. An alternative to ventilation to remove water vapour from inside a house, is a dehumidifier. The advanced dehumidifier described by Brundrett uses a heat exchanger as well as a heat pump. Its performance then is over a litre of water extracted for each kWh needed to drive the device. In addition, the useful heat from it is nearly 2 kWh for each kWh of electricity, the extra coming from the latent heat of condensation.

Question from BSC FICERAM FIOB Ian L. Freeman, Building Research Establishment, Great Britain, to Jack B. Siviour about the paper of G. W. Brundrett:

May I ask Mr. Siviour a question about the economics of using dehumidifiers of the advanced type described in Mr. Brundrett's paper in minimising condensation and mould growth in low-income housing? Our experience of this problem in the UK is that it is caused primarily by a combination of inadequate heating and ventilation. An accepted solution to the problem, effective in all but a minority of cases, is to provide a modest amount of extra heat, and ventilation from outside. A better solution - and one which would doubtless be more acceptable to occupiers - would be to preheat the incoming ventilation air. Has Mr. Brundrett evaluated the relative cost-in-use, for a given reduction in condensation risk in a typical poorly-insulated housing design, of using his advanced dehumidifier against the alternative, rather simpler, procedure of introducing prewarmed air?

Answer from Jack B. Siviour to Ian L. Freeman:

In reply to Ian Freeman's questions, then a guide to the cost of a dehumidifier can be obtained by comparing it with other equipment of similar size and complexity. I would expect in mass production for it to be smaller than a domestic refrigerator, but more complex, but simpler than a domestic cooker. The cost should therefore be between those of these two items, hopefylly nearer that of a refrigerator.

How successful a dehumidifier could be in reducing condensation in a thermally poor dwelling, which is also badly managed, has yet to be found out by field trials. I regret the fact that medium technology in the form of the dehumidifier is expected to make up for the poor thermal design of dwellings, which itself is low technology.

Comments and question from Ian L. Freeman to Jack B. Siviour:

I think the question I was really trying to make was that, you see, given a certain amount of money available, which we can use to reduce condensation and mould growthing houses, we can either spend it on paying for the capital equipment, fairly expensive equipment, or spend rather less money on a simple fan and a simple heater and put a bit more heat into the house drawing the air from outside thereby reducing the humidity, producing a little bit of the necessary minimum ventilation in houses.

Really the houses I am talking about are those in which nobody opens any windows, you see, and I really have this question in my mind, is this a medium technology solution where perhaps a lower technology solution might be more economic, or at least as economic. Thank you, chairman.

Answer from Jack B. Siviour to Ian L. Freeman:

I certainly agree with the approach that when we have a limited amount of money to spend, which is always the case, we must always assess the alternative ways of doing things, and certainly use the cheapest first. Now, I would certainly agree with that approach.

The slight problem here is that certainly in Britain we have a relativly mild climate, which is very humid and there comes a time when you can no longer ventilate with a small amount of heat in order to dilute the internally generated moisture.

So the condition is probably most critical in mild weather, which is perhaps unusual, or perhaps not really the way people approach the problem at first. But yes, I can say again I certainly agree we should always use the cheapest method first.

The chairman now opened up for discussion and comments on the key-note papers and supporting papers.

Question from Jorge Fucaraccio, Argentina:

Well, in our country we are working with problems of computerized systems for calculation of heating and cooling loads. Most of those programs are based on the thermal response factors, but one of my interests about this subject is what happens with the relation of the cooling load with the lighting.

In an airconditioned building if you decrease the fenestration area or you increase the shading coefficient the cooling load will be reduced, but at the same time the level of artificial illumination has to be increased. It seems that an optimal point of minimum total energy use could be achieved.

My question is: Is it available a computer procedure that take into account the relationship between airconditioning and energy use in illumination, and if it is any procedure to design a proper window system? I have not seen yet a procedure for calculating total energy used in building that design the correct window system in order to minimise the total energy consumption.

Answer to Jorge Fucaraccio from the key-note speaker Dr. Stan Leach:

I agree fully with what has just been said that a very important tool for building design and for the optimisation of the fabric and the services is a computer program which enables you to look at such important things as the right glazing area to minimise the energy consumption.

Now, this is a problem which is exercising a good many people around the world, and in particular the International Energy Agency has seen this as a task which it can make progress in, and in doing so it has first of all got together a comparison of the existing computer design methods to see how they compare with each other when used with the same input data.

And the second stage of their work which is now in hand, is to look at how then the results of the computer predictions compare with the actual performance of real buildings. To do that they have arranged for an office building to be extensivly monitored so that this proper comparison can be made.

So I agree it is a very important area, it is by no means solved yet as you suggested in your statement. I think that even when we get the computer programs that work well, we still are going to be faced with the problem of the right input data, because there is always the difficulty in knowing exactly how a building will be used, what are the actual requirements of the users, and this is particularly so with regard to lighting.

One of the things that we have been finding at BRE in our lighting studies is that by not simply accepting the way that lighting was used in the past, but look in particular at what people need, it is possible to make the substantial economies in the way I described, and that sort of input data is of course not yet beeing fed into those computer optimisation porgrams.

General comments on computer programs from Jack Siviour, Great Britain:

I believe that a designer needs two much more important things than a computer program for doing calculations. The first is accurate data covering his requirements. The second is a calculation procedure which he can operate himself, and therefore get a feel for his design and the sensitivity of the results to changes in design and data values. He may then find a computer program useful to refine the calculations. One problem that may be encountered with commercial programs is that they may be blocked to prevent a listing from being obtained, making it difficult to know what simplifying assumptions have been made and the values of any data incorporated in the programs.

Comments on Jack Siviour's speach from the key-note speaker, Dr. Stan Leach:

Could I, Mr. chairman, support that very much. I mean it seems to me there are two stages, there is the initial stage of design when the architect is making the major decisions about the energy performance of the building, and it is at that stage which he wants to be able to manipulate the main parameters and get some rather crude indication on how this various things influence each other.

Later on perhaps the computer program becomes important in precisely sizing a particular piece of, say, cooling equipment, but I think we need a two-stage approach where people really do understand what they are doing, and what are the consequences of certain basic design decisions.

The chairman, Katsuro Kamimura, at this stage asked anyone to feel free to take the floor for comments or discussion.

Jack Siviour, Great Britain:

I want to add a little to the discussion earlier this morning by Mr. Freeman and myself about doing things the cheapest way. One thing that has not really been mentioned is that really the cheapest way of saving energy is to switch everything off, but the second cheapest way is to insulate the building well, and we have seen from Eric Croome the effects of insulation reducing the space heating load significantly.
In fact there is no reason why, if we insulate enough, a building should not be self-heating even in winter on its own free heat or internally generated heat.

As far as I am concerned all space heating is waste, the lot. We don't need heating, we are average temperature of 35 ^{o}C or thereabouts, and we are comfortable if we are in temperatures between 20 and 25 ^{o}C if we are lightly clothed. So we don't really need any heating at all, this is the point.

Now, the other thing I would like to emphasize is that we see too often too many complicated systems, one piled on top of the other. We saw the BRE houses, we have a solar collector connected to a heat pump, connected to this, connected to that, there are all sorts of things like this. And you would need to be a fairly qualified technissian to operate the thing, or certainly to repare it.

Now, once you have got your building fabric connected and once you have got a form of ventilation control, either mecanical ventilation or decent natural ventilation system, I think you should start reassessing whether you need all this extra things like heat pumps and solar collectors and all the rest of it, because your space heating load is now so small that you do not need this high capital equipment to put into the house.

One final point, a person from France this morning had chauffage complementaire written on his diagram. Now, I do not know where he is going to get it from, because I know that the electricity supply industries are not interested in this occasional load, and the gas industry is not interested either in this occasional load, which is asked of the utility when it is least capable of supporting it. It is an occasional load, high demand, in other words high connected load, but low usage. If you expect the utilities to provide the capital cost for your occasional demand, then I think you will have to pay a premium for the gas, electricity or whatever you use at that time. I hope I have not covered too many topics.

Comments from the key-note speaker, Dr. Stan Leach:

If I could just comment on what Jack Siviour just have been saying, he really is making a plea for high levels of thermal insulation and saying that after that the services become simple because there is really no demand for the space heating part of them. I go a long way with that point of view.

He mentioned the four experimental low energy houses I showed a slide of and in those houses they of course do have these sort of high levels of thermal insulation that Jack is looking for, because there we are insulating our walls to a level which is low by Scandinavian standards, but it is three times as high in insulation level as is currently required by our latest building regulations for housing.

Now, in those houses of course we are not adressing ourselves only to the question of the space heating load, I agree in those houses that is quite small, it is perhaps a third of the total requirement for energy, what else you have to supply is of course the hot water for washing purposes and also the requirement for coping with the ventilation heat loss, which perhaps is equal to the fabric conduction loss.

Now, in that situation you do have to supply some heat, you do have to think about the best ways of doing it, and what we have there, is not an optimized solution to the UK-housing problem, but an experimental facility in which we can try out new technologies and new equipment before inflicting it upon a possible user whilst there may still be hardware problems.

You mentioned supplementary heating which comes up in connection with things like heat pumps and solar collector applications and you mentioned how undesirable this supplementary heating load is to the supply utilities, be they electricity or be they gas. That of course is absolutely right, the sort of problem that you have with heat pump is that as the winter gets colder the demand for heat rises, the performance of the heat pump itself falls off and we really have a most unfortunate heating caracteristic and it is usual because of the high capital cost aspects to put a requirement in with the heat pump for providing supplementary heat.

Now, where this is done by direct electric resistance heating, for example, you then most certainly do have the sort of undesirable load caracteristics that no utility likes to have.
But there are ways around that and it is possible to combine the heat pump with some sort of low temperature heat storage system and call upon that when required, or it is possible to have a mixed fuel

system, it is possible for example to operate an electrical heat pump with supplementary heat provided by propane, which would be met by quite a small sylinder of propane kept for this peak demand occasions. So I agree the point is very important, but it is not necessarily condemning universally these applications.

Comments from Michel Rubinstein, France:

Je crois que, Mr. Leach a répondu pour l'essentiel ce que j'allais dire, a savoir que, il est effectif que le developpement important des usages de l'energie solaire dans les bâtiments, qui necessite d'être associe à une energie en point, pose problemes au niveau de ce qu'on appelont en France la periode des points.

Alors c'est vrais que, en particulier les producteurs d'electricité s'interrogent sur les investissements, la maniere d'utiliser le moyen production de façon en satisfaire ces points. Il est vrais q'une solution qui pareille la plus satisfaisante, c'est l'utilization des gaz de petrole, notamment du propan. Ceci etant, je crois que, hier matin il a eté fait mention três souvent dans les exposes d'ouverture de ce congrês du probleme generale de l'energie, et Mr. Leach on a rappelé le theme tout à l'heure, et que les pays developpées que nous sommes, et qui manquent de sources d'approvisionnement durable de l'energie, ne peuvent pas faire autrement que d'utiliser toutes les techniques possibles. Le soleil est une technique, la pompe en chaleur est une autre technique, est tous ceci ne sont pas exclusives de la necessité d'isoler parfaitement les bâtiments. Je pense que ceci sont complementaires et que de toute maniere on ne peut pas echapper ces types des solutions.

Unidentified speaker:

Especially in the United States, as far as I know, there are very sofisticated computer programs and some of them are publicly available, public domain, computer program and you can quite easily buy it and you can see the methodology, listing, output, input and everything and you can use it at the design stage of a building.

But, I would like to add this, the cost, especially in the less developed countries, the cost of computer running is so prohibitive that, I do not know what is the cost in developed countries, but it is nearly impossible to use such computer programs at the design stage of a building. That is one thing I should like to add.

If the cost is not so prohibitive I believe that especially the DOE 2 computer program, which is developed for Department of Energy at the University of California at Berkeley, is a very sofisticated program and you can use it as you wish, let me say it so.

Question to Dr. Croome and Mr. Siviour from Peter Foster, Building Research Association, New Zeeland:

In respect of the computer program we have modified for New-Zealand, because you need your local climate, using the annual loss factor method developed by Division of Building Research in Ottawa, we think this is pretty well ideal for this preliminary stage of an architect being able to get a very good idea that if he changes a window from here to this wall or double this size or whatever, you get a very good idea of what effect it would have on his airconditioning or whatever. That is offered as a comment, I wonder if

I could ask two questions on two separate papers, Mr. chairman?

I would like Dr. Croome to comment on the understanding I have that thermal mass is critically dependent on, or can be critically dependent on, the extent to which it may be covered. For example if you have a slab on ground concrete floor, this is virtually useless as thermal mass and should be ignored, if you are not going to be happy walking around on bare concrete. That as soon as you cover it with a carpet its rate of storage is minimal and its rate of recovery is minimal in respect of time constance, and I would like to hear Dr. Croome's comment on that.

I would also like Mr. Siviour to comment on whether there is any knowledge with these dehumidifiers, we have one central dehumidifying operation, on the extent to which this can in fact, without very expensive ducting, do anything effective throughout something as complexe as a house with people living in it?

If you have it in the sitting room what happens in the bedrooms which is were we commonly have mould in New-Zealand where we get humid winters and low temperatures, fairly low temperatures, at least by our standards?

If you have it in the bedroom what is going to happen in the living room when you have got all the doors shut because you are heating the rooms individually predominantly? I would think in the U.K. as well in the low income occupant housing that we are talking about, I would suggest that these will be mostly individual room heating and not air conditioned or space heated and therefore each room is in fact a separate entity. I would appreciate comments on both these questions, Mr. chairman.

Answer to Mr. Foster from Dr. Croome:

To reply to the question just said, first of all in designing a building one would hope that possibily the consideration of concrete floor and the use of carpet would be considered as part of the design process. Nevertheless, supposing it is not, then it is true of course if one is going to use a carpet or such as a covering, you will get changes in the surface temperature.

Now there is two points about this, in the houses we are doing actually we are using hollow block wall, not floor so we will not be covering it with carpets, unless one is exhibiting persian carpets or something like that. We are using the wall, there is an extra point here, that using a mass wall we have an advantage with regard to privacy and regards to sound.

However, coming back to the floor situation on page 63, fig. 3, this graph represent on the ordinate the damping factor plotted against angular lag and if I just briefly go through the symbols which are explaned in the paper, the G is an airflow rate, C_p is spesific heat capacity, ω is the frequency of change and mc is the mass. On the abcissa we have h, which is the heat transfer coefficient, A is the area of the surface carrying the air, G is the airflow rate again and C_p as before.

So if one has some variation in the mass, in the c, what we are trying to do is attempt to get the performance of the system between the curves 3 and 10, for Z equal 3 to 10, thats the idea, that slightly blackened area.
And one has some opportunity of changing that by simply altering the G, the airflow, and so variation in airflow can in fact compensate your position on that diagram and counteract the point being made.

Answer to Mr. Forster from Mr. Siviour:

In answer to the question of siting a dehumidifier in a house, then the best compromise position is probably at high level in the landing. Here it is close to all bedrooms where the highest absolute and relative humidity is likely to exist over long periods. Air generated and vibrational noise will need to be low enough for occupants to operate the dehumidifier overnight as well as during the day.

Lecturer David William Cheetham, University of Liverpool, Great Britain:

I agree entirely with Dr. Siviour on the importance of passive conservation, but I think we should not comment too much on it, since that is the purpose of this afternoon's session. With regard to this active systems of heat exchangers, heat pumps and solar panel etc. I am particularly concerned about the possibility of their lack of durability.

We are designing houses to last 60-100 years. We are told that these machines will be massproduced using the components which are common in refrigeration equipment and other such facilities. My personal experience, as a householder, with refrigerators is that compressors tend to fail after 5-6 years. By the time I come to ask for it to be repaired, I find the model is no longer being manufactured, and I am told I have to buy a whole, new piece of apparatus.

This does not only apply to these innovatory appliancies, but it also applies to things like gas-fired boilers. I have three colleagues who have gas-fired boilers that were installed in houses some 10-15 years ago, and they can no longer buy gaskets to replace when the gaskets have broken around the flues, because the manufacturer in his concern for product improvement, so they say, but I personally believe plant obsolescence, no longer hold stocks of the necessary spare parts.

It would seem to me that as responsable designers we should ensure that we do not specify and use equipment which will not be available and can be supplied. I would simply ask those people who have been doing work in this field, because it is some way from my own interests, what experience they have of durability, of forecasting and of responsible behaviour from manufacturers.

Comments to Mr. Cheetham from Dr. Leach:

If I could make a comment on what David Cheetham have just said, I agree absolutely with him if we are talking about new technology and if we are not at the same time going to look at the maintenance and reliability aspects as part of our assessements, we have got it wrong.

We must know how reliable things are, we must know how long they will last, we must have means and backup systems for both installing them and maintaining them as part of a new development.

On the other hand I am not quite as pessimistic as he is about these things coming in due course. The real emphasis on solar collector applications in the last 5 years or so throughout the world has been in the

development of much more reliable systems, and that is the emphasis that has been given in most countries. Certainly in the U.K., the emphasis has been brought in not just looking at the performance of systems, but in looking at their lifetimes and all the sort of running problems that can arise.

Heat pumps, I think it is interesting to talk about the American experience, it is possible that someone in the audience here may be able to do it rather better than I can, but if I have got the story right heat pumps have been going for quite a long time in the USA. They started off with just the sort of problems that you described, they were unreliable machines, they got a bad reputation, but then the American government did let a contract to produce a reliable heat pump. This happend, the heat pumps now are reliable, there are maintenance contracts you have with them and they are now selling like mad, something like 500.000 a year are being sold for application in the USA. So these problems are certainly there, but they are also soluble problems.

Comments to Mr. Cheetham from Dr. Croome:

If I could just come back to Mr. Cheetham's remark I too agree that it is very important. On the other hand the whole purpose of some of the papers in the session I think has been emphasizing the things is we are asking fundamentally for less services, better services as regards buildings. And one of the reasons for that is because service systems do require maintenance, do break down and have a much shorter life than the buildings they are being installed into.

So I think one can not say we are here talking about an interactive, active, passive system which involves a minimum use of energy from equipment, a minimum maintenance, and this is done by reducing energy consumption and also using the building materials, the built form, the fabric and the mass as part of the system. You can not detach it, I think that is where there have been problems in the past by thinking of the architects responsability for the passive part of the thing and then attaching solar collectors and various bits and pieces on to the buildings. I think that is discontinous thinking.

Jorge Fucaraccio, Argentina:

I would like to say a few words more about computer programs for calculating the performance of passive system, and with the recent speed of small desk computers with high memory capacity and low cost, lets say for about 5000 $ you can have one of 100 K-bytes, it seems to be possible that in the near future we have to consentrate in to build special languages and compiler for a small desk computer in order that for example an architect can use it as a design tool.

Also what we need is a standardization in the field of computer language. For instance in our country we are working with a small desk computer as a H.P.9845 and in that computer we have implemented a conversational program that could calculate the performance of shading, passive system, and natural evolution of inside temperature and it is so simple the language that an architect or a person who does not know anything about computer programs could use it. But I guess that the future in computer program is in the small desk computer with high capacity and high speed and low cost.

David W. Cheetham, Great Britain:

If I may develop my theme on durability a little partly with a question to Mr. Rubinstein asking him about French experience. It would seem to me that the inherit contradiction with solar panels is that you want a lack of mass so that you get quick response as it fluctuates during the day, whilst for durability you want fairly thick members, fairly thick sections so that you do not get corrosion to quickly. I was wondering if he could give us any information as to what the French experience has been on such optimization between durability and speed of response.

Answer from Michel Rubinstein to David Cheetham:

Ce de qui vouns voulez parler c'est de l'inertie proprement dites du capteur, c'est a dire, du temps de reponse du capteur. Alors, le temps de reponse du capteur depend, dans une certaine mesure, mais dans une mesure trés faible, de la masse des parties de l' echangeur. L'echangeur etant constitué par la plaque d'absorption et les collecteurs qui sont des tuyeaux. Et l'inertie du capteur depend egalement du maniere plus on moins importante du debits dans la capteur.

L'inertie du capteur sont quand même dans une plage de variation tres faible, l'accidence sur le rendement globale de la system est relativment faible.

Engineer Dick Bjoerkholtz, Oy Partek AB, Finland:

My name is Bjoerkholtz and I am from Finland, and there is one subject I have not noticed in these papers, but perhaps someone here has studied the problem. I mean the problem of too big boilers, or too big

heaters. I think anyway in our country all the heaters they are overdimensioned, I mean the oil burners, or whatever fuel we burn. What is the influence of too big heaters, how much do they waste energy, or how much do a smaller boiler save energy? I have not seen anything about this in these papers, but I can mention one example from my own house.

I changed the heater too another one, which I chose as small as possible and the reduction in oil consumption was 20 % on annual basis. I know new heaters of course are better than old ones, but I think also that the smallness of the heater had some influence on that 20 %.

Another point, the heaters, anyway in Finland you can buy, they have an insulation thickness about 50 mm, 30-50 mm. The temperature gradient over the heaters wall is around 50 ^{o}C, you have 75 ^{o}C inside the boiler and perhaps 25 ^{o}C outside, that means 50 ^{o}C. And thermal insulation is 50 mm. In outside walls for houses you have a temperature difference of about 20^{o}C on annual level. Against that you insulate with 15-20 cm of mineralwool, in Finland anyway. So I put another layer of insulation on the new boiler as much as there were place, around 15 cm. That gave me 10 % extra saving, so the question is: Have someone here studied the influence of boilers, small enough boilers? What is a good small enough boiler? I don't know.

Answer to Mr. Bjoerkholtz from professor Hans Granum, University of Trondheim, Norway:

I think this question in fact should not be solved by making small boilers. The whole system of heating small houses with sentral heating is wrong in well insulated houses. I come back to what Mr. Siviour said that the heat consumption in well insulated houses is almost zero, you can heat it with the free heat. And therefore I do not think we should use boilers at all in such houses where we really need a small boiler.

Comments to Bjoerkholtz and Granum from Dr. Leach:

I would really like to comment on the last two remarks that have been made from the floor. I am first of all very pleased that we have really got away from the things like heat pumps and solar panels and got down to what I think are the ways we are actually going to save energy in the bulk of our buildings.

If we are talking seriously about conserving energy, it is the existing building stock which we must look at, and we must consider then what we have, which is not a high level of thermal insulation, but is a structure which has to be heated.

Now, in looking at that we must look very hard indeed at the question of the sizing of our boilers, the choice of our boilers in relation to the use of the building, how intermittent is the use of the building, how we insulate the boiler as you suggested, how we control both the boiler and the heat distribution system as a whole.

Now, in my paper I do introduce this as a topic without covering it in any depths, but from one of the illustrations that I give it is quite clearly demonstrated how boiler performance varies with the load on the boiler, drawing attention to the fact that at the sort of demand we have on the boiler for the majority of our heating season the boiler can in fact turn out to be a very inefficient machine.

Now when we come to new houses, well I agree to some extent with what professor Granum say, but there are other solutions that we ought to consider as well. I do not go as far as him and think that we should not have any boilers altogether, but I think that there will be situations where there are alternatives which could be used.

Conclusion of session by key-note speaker, Dr. Leach:

Now, Mr. chairman, I think you also asked if I would like some concluding remarks to finish the session. We have of course a plenary session on our last day where we are due to collect together the points from the papers and the discussion and I think I would like just to really pick up one point that has come from my presentation and it has been mentioned I think at least 4 times from speakers from the floor, and that is the importance of not looking at the heating system of the building, not looking at the fabric of the building, but looking at the two things together, taking the whole thing as a system when trying to optimize the energy consumption and the general thermal performance. Thank you Mr. chairman.

Chairman Katsuro Kamimura:

Thank you Dr. Leach. Well ladies and gentlemen, our time is up. I beg you pardon, but I have to cut off our discussion at this point for the time being. I know you still have many discussions, but I am sorry, I have to ask for your forgiveness that we have to conclude at this moment. Thank you for your variable discussions, opinions and comments as well as the key-note papers summarized by Dr. Leach and the 16 supporting papers. I also thank you for your kind cooperation. I would like to close this session now, thank you.

SUBJECT
SUJET

3C

Housing sociology. Human requirements. Basic needs related to family and national resources

Chairman: O. URAL

Exigences humaines. Sociologie de l'habitation. Besoins élémentaires concernant les ressources de la famille et de la nation.

Président: O. URAL

Report from Section 3 - Subject 3C:
HOUSING SOCIOLOGY. HUMAN REQUIREMENTS. BASIC NEEDS RELATED TO FAMILY AND NATIONAL RESOURCES

Key-note speaker: Stefan Dahlgren
Invited paper: Odd H. Guntvedt and Haktor Helland

This session delt with about 20 papers.
Mr. Dahlgren and Mr. Helland presentated their papers by calling attention to their main points.
Few of the participiants (six or seven) contributed to the discussion. Several pointed out that developing countries need practical results from the research.
Questions were asked about the usefulness of western sociology for the developing countries.

Prof. Oktay Ural, International Association for Housing Science, Po.Box: 340254, Miami, Florida 33134

The human factors which include Sociology, Psychology, Culture, Education, Open space, recreational facilities need to be studied by an multi-disciplinary group. The results must be incouporated in the final planning of a large housing prosject. If human needs are not studied and included, the produced housing units might not be acceptable to its occupants.

Mathur G.c., U.N. Regional Housing Centre, New Delhi, India:

I congratulate Mr. Dahlgren on his excellent presentation. In the context of developing counties I would like to emphasise three important aspects in the field of housing sociology and the role of CIB.

Firstly, for housing the urban and the rural poor housing attitide surveys are of great significanse for promoting housing and environmental improvement largely through self-help. Guide-lines in this regard should be suggested by CIB.

Secondly, for evolving national housing policies inputs on the basis of housing sociology are of crucial value particularly for laying down the goals and realistic standards of housing outlines as regard ingradients of housing policies should be provided by CIB.

Thirdly, evolution and promotions of appropiate technology are largely governed by social and economic consideration. As this is a matter of vital importance to the developing countries, CIB should consider providing criteria for selection of technologies, appropiate to the socio-economic needs of the developing countries.

D.P. Wyon, SIB, Box 785, S-801 29 Gävle, Sweden

On page 134, at the end of Stefan Dahlgren's paper, is a table I should like you to consider. It was compiled, rather provocatively, to show how in detail we would draw the line between W45, Human requirements, and W69, Housing Sociology. I hope that if you do not agree with our compilation, you will object to it now! We surprised ourselves in drawing up the list by finding that for every topic susceptible to the "hard science" approach of environmental hygiene there was a continuum extending into W69, the area where "soft science" is appropriate. The table shows therefore in detail why hard and soft science need each other, and how they can collaborate, which was the question posed initially by the chairman.

Mathur G.c., U.N. Regional Housing Centre, New Delhi, India

In order to take into account the sociological aspects of housing, it would be very useful to undertake demonstration housing projects. The National Buildings Organisation in N. Delhi is undertaking demonstration projects for improving housing and environmental conditions in the rural areas in different climatic and geographical regions in the country. To account for sociological aspects related to housing, socio-economic surveys of villages and households are first undertaken. Based on the data obtained designs of lowcost houses and for improvement of environmental conditions are prepared. The reactions of the prospective house builders on the designs are obtained and this self-help is taken advantage of in constructing of houses. The livebility and performance of dwellings are obtained over a period of time to improve the designs of houses and construction techniques Over 35 such demonstrative projects have been put up in selected villages in diffent regions in India, and these have been instrumental in accounting for the housing needs of the people of varying soci-economic backgrounds.

Philip Arctander, SBI, Box 119, DK 2970 Hørsholm, Danmark

While some of the papers presented to this section deal with research on user needs or habits, another group of papers deal with research done with the users. As researchers generaly run a risk to isolate themselves from the users, the general public, it is dangerous to increase the distance between researchers and those we work for. My suggestion is therefore to develope methods of research involving the

users instead of treating the inbabitants as rabbits whose habits we study with traditional methods.

Ph. Mouterde, Centre de liasons operationelles des chantiers, 69393, Lyon. BP52 Cedey 3. France.

Pour faire suite à la demande de M. Arctander d'impliquer les usages la théorie suivante provenant d'un Architecte Français M. Pionchon peut être rappellée -

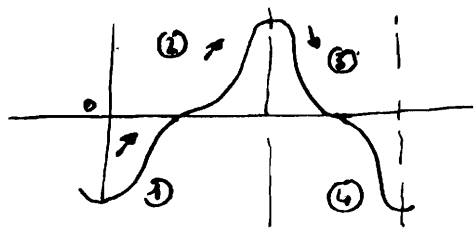
Il y a un rapport entre l'homme (H) et son habitat (h)

$$\frac{H}{h}$$

02 en matematique un tel rapport peut évoluer de la manière suivante

$$\frac{H}{h} \begin{matrix} > \\ < \end{matrix} 0 \quad \begin{matrix} \text{croissant} \\ \text{ou} \\ \text{diminuent} \end{matrix}$$

définissant ainsi 4 phases (1) (2) (3) (4)



La Phase (1) est l'appropriation des lieux par l'usageur ou l'enfant

La Phase (2) est celle de l'imagination allant jusqu'à la "maison imaginaire"(Valery)

La Phase (3) est celle de la conception à partir de la vision imaginaire de la phase (2)

La Phase (4) est celle de la realisation

Et le schéma peut se continuer indéfiniment avec l'appropriation de lieux successifs.

Dans notre société actuellement l'usageur subit chaque phase à laquelle il n'est associé que par un simple échange d'argent. Ce qui ne lui donne pas satisfaction et explique ses reactions negatives.

Ne faut il pas pour les pays en voie de developpement associér et faire participer l'usageur aux phases (2), (3), (4). Ce sera le meilleur moyen d'éviter un refus et une inadaptation des objets construits.

The use of physical and human measurements in assessing the energy "characteristics" of buildings

Professor Patrick O'Sullivan, BSc, PhD, FCIBS, Hon. FRIBA, MIOA, and Dr. P. Jones, BSc, PhD, and Mr. P. McGeevor, BSc. Econ., of the Welsh School of Architecture, University of Wales.

This paper argues that to determine the factors affecting energy use in buildings; research and demonstration projects involving both physical and human scientists must be performed. A number of projects are discussed and one is described in detail to illustrate our approach to the design of such experiments.

1.0 Introduction

The history of building design can be interpreted as an evolutionary process. Buildings have a number of functions. These functions change and vary in importance with time. The availability of materials and technical innovation also varies with time. In the past both the function of buildings and the availability of materials and technology varied slowly so that change was only slowly progressive. Today one aspect of building design has become of major importance - energy conservation. It is important both nationally - buildings use a large proportion of the nations energy and there is potential for saving energy in buildings. It is also important on an individual building level - with rising fuel costs energy conservation can reduce the financial burden of fuel bills in dwellings and in industry and commerce.

Building materials and methods are, today, so varied with technical innovations in such abundance that a number of solutions are offered to the problem ofsaving energy in buildings. Because of the nature of the problem of energy conservation there is a need to find solutions quickly - a need to speed up the evolutionary process. Solutions to certain problems can be arrived at in the laboratory, (e.g. the 'performance' of materials and systems) and by modelling (both mathematical as in computer simulations and practical as in wind tunnel experiments). However, buildings form complex systems which cannot be fully understood or explained as simply the sum of their constituent parts. Buildings must be understood 'holistically', though this does not negate the value of studying the individual components. Such research is the essential groundwork for any 'holistic' explanation.

Evaluating how buildings actually operate involves the study of the whole system in its natural setting. That is, under its normal operating conditions. Normal conditions inevitably involve the occupation and control of the building by people and must, therefore, include both physical and human parameters. The depth and extent of the parameters used will vary according to the objectives of the research, but that both are important is now common knowledge in architectural science. This new wisdom has produced a number of projects that the Welsh School of Architecture has keenly participated in. This paper discusses some of the experiences gained from this participation and suggests certain techniques in setting up interdisciplinary research.

2.0 Interdisciplinary Projects

The linking theme of the four studies that will be discussed is the operating use of actual buildings and the consequences (particularly the energy use consequences) of such practices. Within this theme there is a wide continuum of research objectives. This continuum varies from management advice on energy policy through building performance analysis to the assessment of design innovation. Such a range requires different methods - but the basic research question remains constant. That is, how do buildings currently perform and what would be the effect of an alteration to the physical construction or social use of the building. This question requires information on the design and construction of the building and its attendant services and the use that its occupants make of it. The physical properties of buildings may be available from secondary sources at some centralised location (e.g. City Architects' Department) but the use of a building (apart from very general statements such as library opening times) requires primary research. Given that, the time and money required to conduct such research is always limited, what measures should be taken? What are the acceptable and respectable limits? Ultimately these can only be decided in the light of the specific research objectives but our examples may suggest some solutions to this familiar research predicament.

The Hampshire Schools project [1] was largely concerned with implications of managerial policy on energy conservation. There was no possibility of a detailed monitoring exercise of the energy used in buildings. Here the social scientist had to devise a method of finding out what the official policy on energy use was and, more significantly, what was the actual energy use. Interviewing skills were required but the crucial choice of who to interview was made according to the formal authority structure. That is, it was assumed that headmasters are the 'building managers' in overall responsibility for carrying out official policy and 'caretakers' are the people actually doing the controlling of the heating and ventilating equipment. With these considerations decided, the interviews were conducted (by a person with considerable technical knowledge) to find out how the buildings were 'worked' and what were the intended and unintended consequences of these practices; e.g. does the award of the maintenance contract to the lowest tender actually increase the number of plant breakdowns.

The Liverpool energy study [2] was a much larger project but had similar constraints on the gathering of primary data. Here the aim was to illuminate policy

choices for energy conservation in some 2,000 civic buildings. The sheer scale of such a project makes detailed monitoring impractical. What was done was to survey the physical construction of a sample of 300 buildings and to use the modelling techniques developed from more detailed monitoring studies in order to calculate the likely savings achieved by upgrading buildings or modifying patterns of use. The social aspects of the study were similar to that used in the Hampshire schools project. Key personnel were interviewed in order to reveal the institutional pressures which shape the decisions and actions that have energy consuming consequences. In other words, what makes people make the energy choices that they do and how could these factors be altered.

The research at Chaucer School Ilkerston [3], which is still continuing, involves detailed monitoring and social fact gathering in order to study the 'operational' use of the School. This project consists of the measurement of the thermal environment and energy consumption of one typical (Clasp Mark 5) school. An inexpensive continuous monitoring system was developed to provide data on internal temperature, weather conditions and energy consumption. Social data was obtained by informal observation of use patterns and by formal questionnaires and semi-structured interviews with staff.

These three projects recognised the importance of social facts in energy use and utilized social science in arriving at conclusions. The physical conclusions were more robust and of greater practical value because of the inclusion of social data. The conclusions drawn from the social research were important in their own right.

The Liverpool study revealed how precarious it is to draw conclusions from secondary data. Institutional pressures frequently corrupt such information. For example, the size of existing buildings might be 'increased' for administrative purposes - such as providing a covert pay increase for cleaning staff. There were many points of convergence between the findings at Liverpool and Hampshire. Both showed that the implementation of an effective energy conservation policy requires an alteration in administrative structure. The Ilkerston project demonstrated that a building's ability to satisfy design criteria does not ensure that users will be satisfied with the physical conditions it provides.

All three studies produced similar conclusions on the attitude of building users to their environment. They found that people do want some part in the control of the heating and ventilation. 'Overt' waste is unanamously criticised and its existence lowers the motivation for economy in other areas. 'Excessive' use of electric lights are thought wasteful. They do expect to be able to open windows in summer and accept that one should wear warmer clothes in winter. There is an expectation that water for washing will be available in lavatories. There will be complaints if the water is too hot, but not if it's only warm. It is expected that the building will be warm and dry when it's cold and wet outside, but it is also appreciated that when it is very cold it is not going to be too warm inside. It is considered profligate to be too hot as a result of the heating system. They accept that rooms will be warm when it is hot outside but see no reason why there should not be adequate air movement at such times. They expect that their place of work will be warm when they arrive but accept that it might be a bit cool by the time they go home. These conclusions have important consequences for the design and management of buildings. [4]

At Liverpool and Hampshire the roles of the physical and human scientists were segregated but complementary. At Ilkerston these roles are more tightly integrated with correlations being produced between what people say of the conditions and the conditions that actually exist. The results of these projects have been encouraging for interdisciplinary research. At each of the different levels the social data added confidence in the conclusions of the physical sciences and produced interesting and potentially useful findings. They also suggest important considerations in interdisciplinary experimental design.

Firstly, there is a need to collect primary data and to subject any secondary data to rigorous examination.

Secondly, in sample selection it is useful to be able to compare identical buildings with different use patterns and different buildings with similar use patterns.

Thirdly, to truly integrate the two sciences it is important that the data collected is on a similar time scale. The social scientist should attempt to produce time based data, and not merely 'typical' behaviour.

It was against this background that the Abertridwr project [5] was conceived and was thus, from its conception, aiming to integrate social and physical data. It is the most detailed study of its type (incorporating the three principles referred to above) and we believe it sets new standards for how building monitoring should be carried out.

3.0 The Abertridwr Project

The Abertridwr project [5] [6] involves the continuous monitoring of thirty-nine occupied houses. The objectives here are to assess the benefits of better insulation, with the attendant capacity and ventilation improvements, when combined with lower output heating systems. To measure the operating efficiencies of these heating systems and the effects of patterns of use on these efficiencies.

3.1 Introduction

The stages in the design of a monitoring experiment can be summarised as follows:-

3.1.1. Given a set of 'realistic' objectives the parameters to be measured can be selected.

3.1.2. The required accuracy of the objectives and the sensitivity of the parameters to be measured will then be used to determine the choice of instrumentation and

the rate at which data is sampled - subject to the availability of suitably accurate instruments and the handling capacity of the data acquisition system.

3.1.3. A data acquisition system is next designed to record the measurements at the required rate of sampling. The data needs to be stored on a suitable medium. Storage usually takes the form of local storage, immediately on collection, plus permanent storage, from which the analysis is performed. There is usually some data reduction during the data acquisition and storage stages.

3.1.4. The data collected has to be validated and analysed. The validation is preferably carried out on site from the local store, while most of the analysis is carried out using the permanent store.

3.2 Parameters Measured

The physical parameters of the main experimental programme can be divided into three sections:-

3.2.1. Those associated with the measurement of the boiler efficiencies. For each house:-

(a) Boiler flow-return temperature differential.
(b) Water flow rate in heating circuit.
(c) Gas supply to the boiler.
(d) Hot water top-up to the domestic hot water supply.
(e) Temperature of hot water drawn off for domestic use.
(f) Temperature of cold water supply.
(g) Status of heating system, i.e. heating on, hot water on, or both on.

3.2.2. Those associated with assessing the effects of better insulation. For each house:-

(a) Temperature of each room and for both roof spaces.
(b) Energy inputs for heating, lighting, cooking and appliances.

3.2.3. Meteorological conditions.

(a) Solar radiation, diffuse and total.
(b) Outside temperatures at various site positions.
(c) Relative humidity at various site positions.
(d) Rainfall.
(e) Wind speed and direction.

The sociological parameters measured as part of the main programme are:-

3.2.4. Demographic characteristics:-

(a) Age, sex, family structure.
(b) Income, occupation/work status.

3.2.5. Background information:-

(a) Previous accommodation and heating system.
(b) Household appliances.
(c) Unusual circumstances, e.g. illness or infirmity, family breakdown, long-term guests.
(d) Understanding of how heating system and controls work.
(e) Attitude towards energy use and thermal comfort.

3.2.6. Time based data:-

(a) Central heating control settings.
(b) Hot water control settings.
(c) Room thermostat setting.
(d) Thermostatic radiator valve settings.
(e) Window opening.
(f) Use of cooker.
(g) Use of additional heating.
(h) Use of washing machine.
(i) Method of drying clothes.
(j) Use of tumble dryer.
(k) Number and time of baths.
(l) Number of people in house.
(m) Times living room occupied.
(n) Time kitchen occupied.
(o) Time bedrooms occupied.

Now interdisciplinary research requires that each science takes account of the other in selecting the parameters to be measured. This operates in three ways:-

(a) Avoiding hindering the work of the other science.
(b) Supplementing the data of the other science.
(c) Collecting data at the appropriate level for analysis with the data of the other science.

(a) The physical scientist must plan his instrumentation in such a way as to cause the minimum of interference to the occupants of the building. Abertridwr is fortunate in having the data acquisition system (see below) for each house situated in a 'bin store' which is separate, as far as access is concerned. This care must work both ways. Insensitive questionnaire design might offend occupants and jeopardise the entire monitoring programme.

(b) The awareness of the requirements of the other sciences allows the data gathering of each to supplement the other. For example, at Abertridwr it is not practical to measure ventilation rates continuously. Nor is it practical to record physically the opening of windows and doors. Since energy loss due to ventilation forms a significant proportion of the total energy loss from buildings it is important to acquire some measure of its effect. The social data, therefore, includes information on window opening patterns for selected days. This data, together with data from actual measurements on ventilation rates in unoccupied houses with closed windows and with controlled window opening patterns, provides the necessary information to relate to the main results (see below).

(c) Because the objectives of the project are formulated in terms of the physical sciences it is important that the social scientist produces data that is supportive to these aims. One aspect of this has already been referred to - the need for time based data. The physical scientist will want to know, not merely what people do typically but also what people did specifically on certain days. The second aspect of this is that the physical scientist is interested in social data only in-so-far as it effects the physical behaviour of the building. It is at this point that the two sciences meet and it is here that the interdisciplinary analysis must begin. The objective of identifying the actions that physically impinge on the environment is an unusual one for social science, which is more typically concerned with

the 'meaning' of actions. 'Meanings' cannot be directly translated from, or to, physical actions [7] . Similar actions may have different meanings, so that opening a window might 'mean' the person perceived the room as being hot, stuffy, humid or, just right - he might have wanted to shout to his neighbour. Similarly, the 'meaning' of being hot might be manifest in several very different physical actions, such as switching off the heating, opening a window, taking off a jumper or getting a beer from the 'fridge'.

The social scientist needs to provide data on the physical actions of occupants - and then extend the analysis to include 'meanings'. For example, the social scientist should provide information on window and door opening habits (it is these actions and not their meanings that effect ventilation rates). He can then proceed to identify underlying meanings (the why it's done rather than the what is done). This information can itself then be combined with further physical evidence e.g. humidity and temperature.

Clearly, in a monitoring experiment such as Abertridwr it is not practical to measure all the parameters that one would like to measure in order to obtain a complete picture of how the building is performing. It is necessary to first select the parameters needed for achieving the objectives and then to select additional parameters to be measured in less detail to place the results in context of the buildings performance as a whole.

During the design and initial running stages of the experiment it became apparent that there was a need for a 'second order' of experiments to provide base data from which a fuller interpretation of the main experiments results is possible. For the physical scientist these experiments included:-

(i) Measurement of ventilation rates. Measurements of air infiltration were carried out in unoccupied houses using tracer gas and pressurization techniques. These measurements, along with measurements of natural ventilation rates with controlled window/door opening, can be used to both determine the order of magnitude of the energy loss due to ventilation, and to combine with the social data on window opening patterns to account for energy consumption on an hourly basis. The analysis of these measurements so far has indicated that over a three year period the air leakage rates (which correspond to crackage) of the houses, determined from the pressurization tests, approximately doubled over the first year, but did not increase in years two and three. However, the base infiltration rate, determined from the tracer gas measurements, did not appear to have changed significantly with this increase in air leakage rate, and has remained approximately constant throughout the three year period at 0.5 a.c.h.

Thermography Surveys. Infra-red surveys have detected missing insulation due to poor workmanship, which could in part be rectified, and design 'mistakes' which could not. The surveys have therefore helped to give a general understanding of the heat loss characteristics of the houses in question (e.g. cold bridges due to poor detailing, variation of surface temperatures, etc) and therefore helped in explaining the results obtained.

Experiments on unoccupied houses. Measurements were made during the heating season of the air temperatures achieved in unoccupied houses without the heating system operating. Such measurements provided useful data on the effects of passive solar gains and the thermal capacity. Temperatures were also recorded in the unoccupied houses with the heating system operating on a controlled pre-set pattern, to observe the effects of operation of the heating system on the internal conditions. These measurements provided data on the operation of the systems controls, both local (TRV) and central.

For the social scientist such 'calibration' experiments often involved going outside the sample being studied. By collecting survey data from a larger sample of people (though obviously at a lower level than that used within the sample), the social scientist can test the representativeness of the sample and increase the degree to which experimental conclusions can be generated. This greatly enhances the policy applications of the research.

3.3 Sensitivity and Error Analysis

To determine the rate of sampling and therefore the required instrumentation, not to mention the 'accuracy' with which the results can be viewed, a sensitivity and error analysis is required.

For the physical scientist this is fairly straightforward, although seldom carried out with rigour. The purpose of a sensitivity analysis is to determine how sensitive particular parameters are to change and as a result how often they should be measured to obtain the accuracy required. The error associated with the rate of measurement is then combined with an instrumentation error analysis to give the accuracy with which the objectives can be achieved. A computer simulation indicated that to measure the boiler efficiency to within 3% (the maximum accuracy of the available instrumentation), a sampling rate of 12 seconds would be required. This rate was selected and the values then averaged over a five minute period and stored.

Fortunately a sampling rate of five minutes is sufficient for the temperature sensors to detect variations in the room temperature with time, as a result of boiler thermostat cycling, the operation of TRV's, occupancy, etc. The temperature variations that can be

detected by the room sensors and also the accuracy with which the inside-outside temperature difference can be measured must also be determined before any heat balance calculations can be performed. The actual temperature sensing devices can be and have been calibrated to an accuracy of 0.3°C. As the main spatial variation of temperature within a room is vertical and as the location of temperature sensors in occupied rooms create 'problems' only one sensor was chosen and was positioned in each room at a height which would both give a reading close to the average room temperature (considering the likely temperature gradients in a room) and be 'out of the way'. The height chosen was 1.9 m from the floor. The sensor was also positioned 60 mm from the wall to avoid surface effects. To determine, in practice, how representative the reading at this position was of the spatial average room temperature an experiment was performed. Similar temperature probes were positioned at 18 gridded points within a room. The spatial average room temperature was measured for a 24 hour period at 1/2 hourly intervals. Figure 1 shows the temperature profiles for a room for three sensors positioned vertically from floor to ceiling, illustrating the sort of temperature gradients found and the variation of temperatures with thermostat cycling and heating on-off periods. Four different rooms were analysed in this way. In all four rooms it was observed that the probe temperature reading differed from the spatial average temperature by no more that 1°C. Figure 2 illustrates the difference for one room. From a statistical analysis the mean difference over an experimental period, between the probe and the spatial average was for the worst case 0.5°C, with a standard deviation of 0.2°C . This implies that a spot reading of the temperature within a room is within 0.9°C of the average, so temperature changes of the order of 0.9°C could be detected.

The external air temperature is measured at six points (at the front and back of each of three houses) 'strategically' located throughout the site. The temperature sensors being housed in Stephenson screens. The instrumentation accuracy is again within 0.3°C. Comparisons of the 'front' and 'back' house external air temperatures observed over a period of some weeks, indicated that again a temperature change of 1°C could be detected.

To enable an accurate description of the energy use patterns and also for comparison with the other physical parameters, the energy inputs were also monitored at a five minutes sampling rate. Standard domestic electricity and gas meters, modified for data logging, were used. The gas meters proved to work with an accuracy of within 4%, while the electricity meters at loads greater than 100 watts are accurate to within 2.5% (at lower loads the meters stall and are inaccurate). In addition to the errors associated with the operation of the meters there is an additional error associated with digitising the readings. The electric meters produce one pulse every watt hour and the gas meters produce one pulse every 0.1 cu. ft. Fortunately the errors due to digitising are normally insignificant except perhaps when considering very low loads over small time intervals.

The accuracy of the meteorological equipment, should be such that it is possible to relate to climatic variations to changes in internal conditions. The describe the variation of solar radiation with time it is necessary to sample once per minute. At Abertridwr two identical instruments measure the total horizontal component of the solar radiation and two identical instruments measure the diffuse component. Duplicating the instruments gives confidence to the results and a check on correct alignment, effects of maintenance etc. An examination of the results has indicated that the solar radiation readings are accurate to within 5%. This means that on a typical winters day with the total horizontal component of the solar radiation rising to a maximum value in the order of 300 w/m^2, solar radiation could be reliably measured to ± 15 w/m^2. Since the response in room temperature, for a room with southerly facing windows, to this amount of total radiation would be in the order of 1°C, (results from experiments in houses without heating - see Section 3.2), this degree of accuracy is sufficient, considering that room temperature changes of less that 1°C cannot be accurately measured.

Wind speed and direction are measured at two strategically located positions on the site, the instruments being positioned at a height of approximately 1 m above the pitch of the roof. The wind speed measurements are digitised and averaged over the five minute intervals while the wind direction is measured once every five minutes. Wind speed is accurate to within 10% and the direction is measured in 45° segments, i.e. the direction at any one time is read as being on one of eight segments. The ventilation measurements that were performed (see Section 3.2) indicated that air infiltration rates were only significantly sensitive to wind from one direction and in other directions the 'stack effect' dominated. In this direction a change in wind speed from 1 m/s to 2.0 m/s results in an approximate doubling in air infiltration. Our measurements are sufficiently accurate to detect such changes. In view of the turbulent conditions at the siting of the instruments, it would be unreasonable to expect greater accuracy.

The social data that is time based is also gathered at regular intervals. The interviewer asks about the previous days activities. Each interview provides valuable data in its own right, but by interviewing all of the houses, on the same day, variations in responses due to weather conditions are elimated and allows households to be ranked according to the criteria referred to above (Section 3), e.g. House A has a higher window opening rate than House B. These interviews have to be collected in such a way as to allow 'typical' occupation patterns to be identified. The sampling of interview days is such as to allow seasonal variation to be identified as well as variation between days (e.g. the difference between Mondays and Saturdays). The optimal

time to leave between interview days is as small as possible without taxing the patience of the occupants. Initially this was chosen at every eight days but this has now been reduced, by experience, to twenty-one interviews a year. These are evenly distributed with seven interviews (one for each day of the week) in Mid Winter, in Mid Summer and in the intervening months.

The validity of the results are checked by using a triangulation of methods. The interview replies on window opening behaviour is checked against the direct evidence from observation. The social scientist occupies one of the houses and keeps a field work diary. The information gained by participant observation is used as a check on that provided by formal interviews as well as being a source for the interpretation of findings and the generation of hypotheses.

3.4 Data Collection and Storage

At Abertridwr a highly sophisticated data acquisition system is used for the physical data. The collection of data involves the continuous monitoring of approximately 900 instruments and roughly 1/3 of these (those associated with the boiler efficiency measurements) have to be read every 12 seconds. Because of the quantity of data the efficiency measurements are averaged over a five minute period and stored with the room temperature and other measurements. This data reduction necessitates the use of a computer and the computer is used then to control the data collection and storage. Each house is provided with a small box of electronics which gather the data from that house under the control of the computer. The computer then stores the data locally on magnetic tape. At five minute intervals temperature data from all 39 houses and the meteorological station is collected along with the boiler efficiency data intergrated over the five minute period. This is then stored on the magnetic tape. While the data taking programme is running the computer can be used to interrogate the system for validation, for fault finding, for collecting data from additional experiments or for just general analysis.

In addition to storing the complete set of data on magnetic tape the computer is able to store subsets of selected data on floppy discs, for immediate access and analysis (since data cannot be assessed from the magnetic tape locally). Such data, as hourly averages of temperatures, energy consumptions etc., can be obtained directly. This can be used for validation purposes and to provide a feeback within the project. Such a 'low level' data base is essential to the success of a monitoring project and provides constant incentive for social explanation and enquiry.

At weekly intervals the magnetic tape is changed and the complete set of data for that period transferred to permanent storage on the IBM 360 computer at the Rutherford Laboratory.

With the social data the twenty-one interviews with each of the thirty-nine houses gives a yearly data base of 819 cases. Each interview is pre-coded into 500 variables. The data is stored on floppy disc on site before being transferred into a SPSS file. Field work notes are stored on floppy disc as text files.

3.5 Analysis

The way in which the Abertridwr data is analysed and especially the way in which the physical and social data inter-relate in the analysis is best illustrated by a set of examples. In view of the objectives the analysis is carried out at a number of levels. On an annual basis Figure 3, shows the energy used in heating for a year for a reduced sample containing better insulated and control houses. This type of physical analysis only provides a limited amount of useful information. Social data is needed to both assess the sample in both cases to find the extent to which comparisons can be made between the samples and to determine the representativeness of the samples, and to explain the variations in energy consumptions within each sample. To achieve the second point, it is not enough to consider just the general social data such as size of family, age group, etc. It is necessary to use a more dynamic approach (to the social analysis) and actually to examine the way in which houses are used for selected days, on an hourly basis. This set of social data is then combined directly with the physical data on temperature, energy consumptions etc., on an hourly time base, to explain fully the actions of the occupants. An example of such an analysis is given in Figures 4 and 5, where a set of daily profiles for a high energy user and a low energy user are compared. In this case the main causes for the higher energy use appears to be the higher temperatures maintained and the ventilation habits. A further application of this dynamic approach to the analysis is in determining if control systems are being used in the designed manner. Figures 6 and 7, examine the use of thermostatically controlled radiator valves (TRV's). In Figure 6 the TRV in the kitchen is used with its setting at 4 on the 0 to 8 range. In Figure 7, the kitchen radiator TRV is set fully on at 8. The resulting effect on the kitchen temperature in each case is obvious from the profiles. At this stage the temperature profile has been explained (it is caused by the TRV setting and the incidental gains), but further questions suggest themselves. We would be interested in the extent of the apparently 'incorrect' use of the TRV's and the reasons for this phenomenom. The extent can be gauged from the interview data. It TRV's are being used correctly one would expect their settings to be in the middle of the range - say between 2 and 6 - they are effectively fully closed or fully opened at 0 and 8. Figure 8, shows a histogram of the reported settings of the kitchen TRV. These figures are based on 99 interviews conducted between September and December, 1979 and show that in 58% of the cases the kitchen TRV was set at 0 or 8 - effectively negating its function as a thermostat.

An explanation of this incorrect usage was sought in one of the secondary interviews. Residents were asked

how they thought the controls of their heating system worked and probe questions sought out the nature of any misunderstandings. These interviews (which were prompted by observations and conversations noted in the field work diary) were tape recorded. The replies illustrated clearly that the majority of residents were unaware that their radiator valves were thermostats. More surprising, this error extended to some of the houses that did have the expected settings. Both the houses illustrated by Figures 6 and 7, were unaware of the thermostatic properties of their radiator valves. This itself, was explained by the lack of information provided and by the uninformative design of the valves.

Clearly, there is a lot of other information in these, and other results, and a full analysis is outside the scope of this paper. It has become apparent though, during the analysis that there is far more information available in the data, than was envisaged at the start of the experiment. Therefore, it is essential, that if full use is to be made of the data, it must be in a form that is easily accessible to others.

The Abertridwr experiment is funded jointly by the Science Research Council and the Department of Environment, plus considerable assistance from the British Gas Corporation.

4.0 Conclusions

The most obvious and significant conclusion to be drawn from our experience is that effective interdisciplinary research is possible and can produce valuable results. The setting up of such research does require more critical experimental design and each science must adjust its methodology to the interdisciplinary needs. For the social scientist, the existence of physical data is a constant incentive to investigation and explanation. Hypothesis testing becomes inter-active and progressive. For the physical scientist the availability of social data has the effect of increasing the range of his data. What would usually lie dormant becomes liberated, its richness more fully examined. The information becomes more valuable not only at the level of theory but also at the level of practice. Architectural science is inevitably practice orientated. Its subject matter concerns human constructs (buildings) and its purpose is to improve these to meet human needs. Science attempts to establish propositions connecting two or more variables. These variables exist in a context in which the proposition is defined and explored. In architectural science the context frequently includes people behaving in particular ways.

Social 'facts' impinge at another level. Once propositions have been developed their policy application involves assumptions about the social setting. In selecting policy, certain assumptions must be made about the social effects of proposed changes. Applying policy intrinsically involves evaluating human consequences.

Assumptions about human behaviour cannot be excluded from the development or application of architectural science. Either the social information is gathered or it is fudged. The choice is between having it based on commonsense, personal experience, prejudice etc., or based on commonsense and empirical investigation. We would suggest that it is more dignified and honest to let social information in at the front door than have it climb in through the back window.

References

1. Cooper, I. Hampshire County Council Energy Conservation Programme . Energy Conservation in Educational Buildings: A Social Inquiry. UWIST Internal Report October, 1979.
2. Liverpool Energy Study. Social Aspects of Institutional Energy Use. UWIST Report submitted to Liverpool Energy Study.
3. Jones, P. J. Monitoring of Chaucer Infant School, Ilkerston. Internal Report UWIST September, 1979. Cooper, I. Chaucer Infant and Nursery School, Ilkerston, Derbyshire. Environmental Appraisal: Users' Evaluation of the Building's Internal Environment. UWIST Internal Report 1979.
4. O'Sullivan, P. and Jones, P. J. The Effective Use of Electricity in School Buildings for the Future, Proceedings of the IEEE Conference on the "Effective Use of Electricity in Buildings", 1980.
5. Jones, P. J., McGeevor, P. A. and O'Sullivan, P. Operating Efficiency of Domestic Central Heating Systems and Better Insulated Houses Programme, Abertridwr. UWIST Internal Report September, 1978.
6. Jesson,P.F., Jones, P. J., McGeevor, P. A., Smith W. A. and O'Sullivan, P. Better Insulated Houses Abertridwr. Monitoring of Domestic Central Heating Systems. UWIST Internal Report September, 1979.
7. Winch, P. The Idea of a Social Science and its Relation to Philosophy. London: Routledge, 1958.

Acknowledgements

The authors wish to acknowledge British Gas, Department of Environment Housing Development Directorate and the Rutherford Laboratory (Science Research Council) for their participation in the Abertridwr project, and especially W. A. Smith and colleagues of the Energy Support Unit at the Rutherford Laboratory, who developed the instrumentation and data logging system.

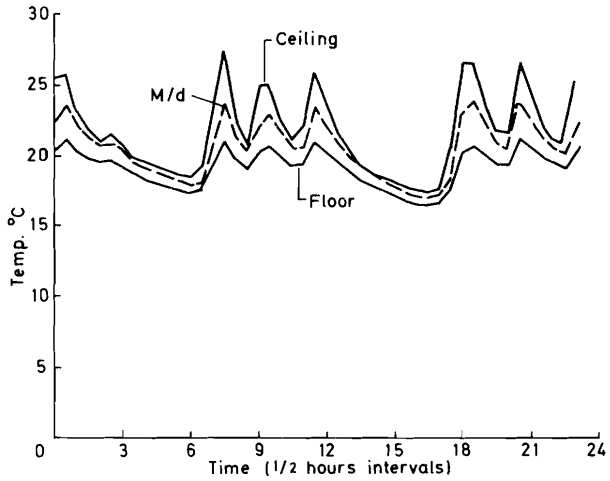


Fig. 1 Room temperature profiles illustrating vertical temperature gradients.

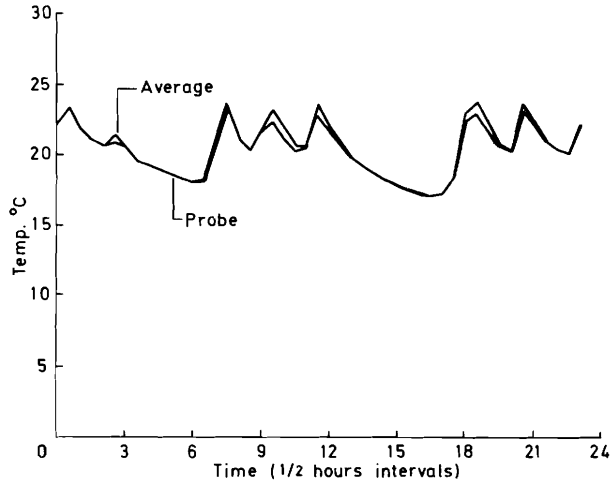


Fig. 2 Comparison of probe temperature with spatial average for one room.

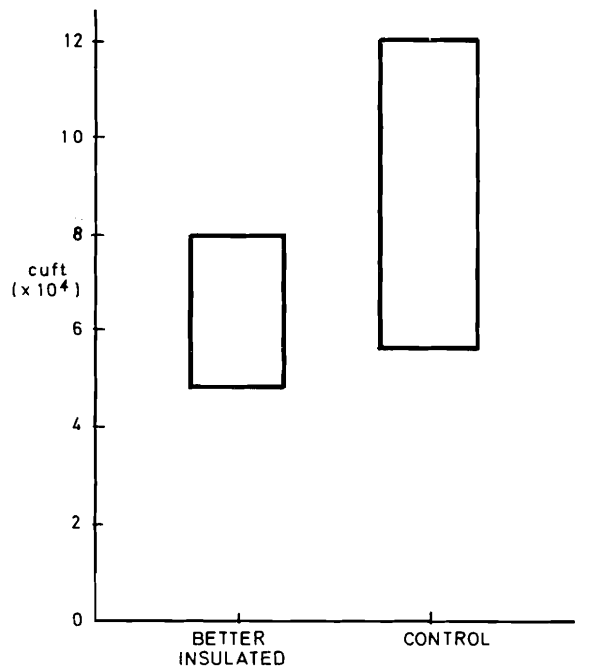


Fig. 3 Range of annual heating energy consumptions comparing better insulated houses to control houses, i.e. houses with the standard amount of insulation.

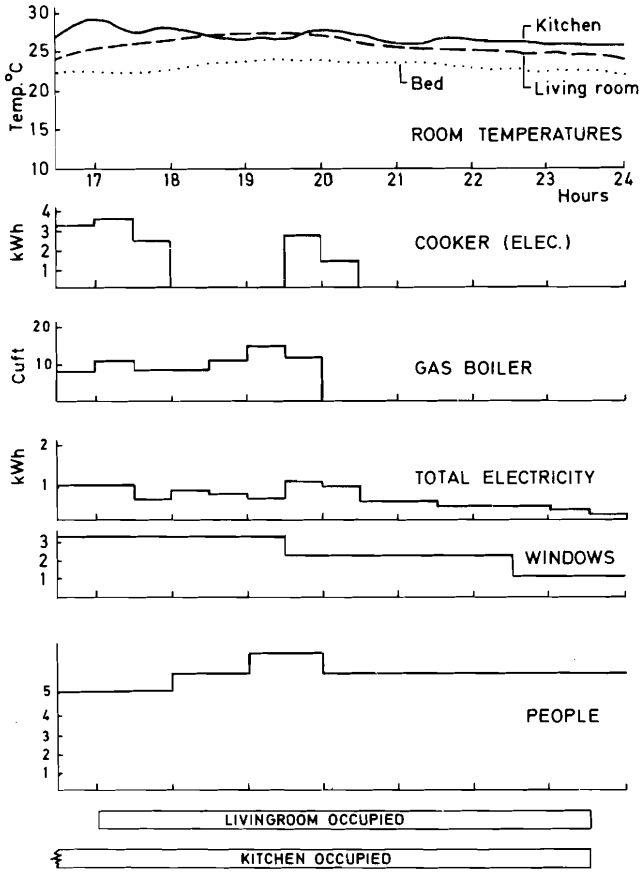


Fig. 4 Occupancy profiles for a 'high' energy user.
Living room thermostat set at 23 C.
Kitchen set at 8.
Bedroom set at 0.

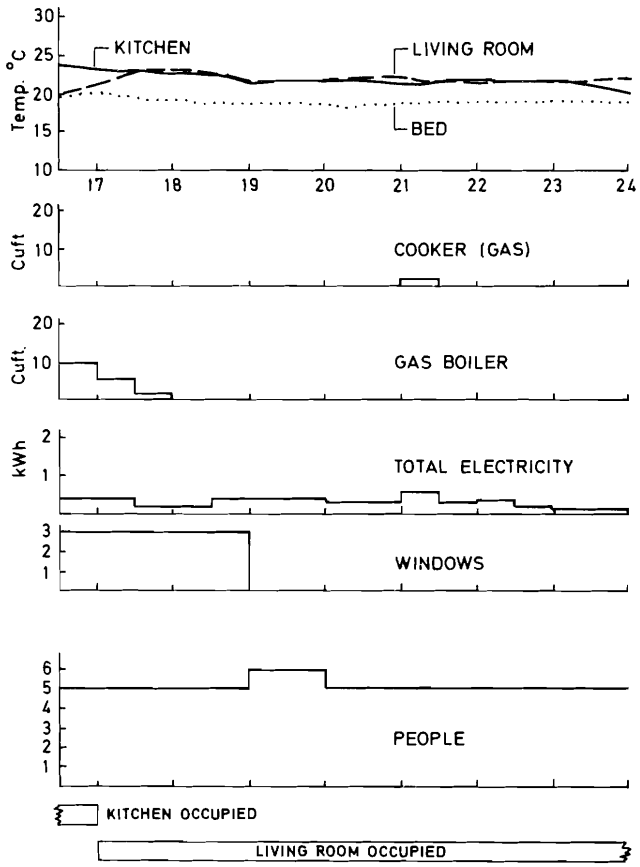


Fig. 5 Occupancy profiles for a 'low' energy user.
Living room thermostat set at 20 C.
Kitchen set at 4.

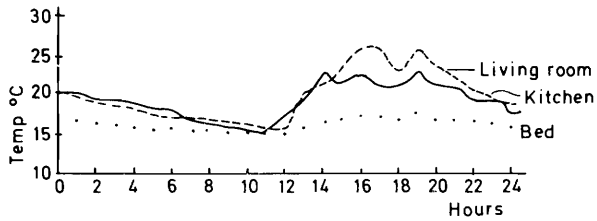


Fig. 6 Temperature profiles with correct use of kitchen TRV.

Living room thermostat set at 23 C.
Kitchen TRV set at 4.

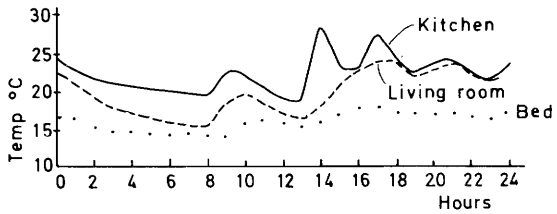


Fig. 7 Temperature profiles with incorrect use of kitchen TRV.

Living room thermostat set at 21 C.
Kitchen TRV set at 8.

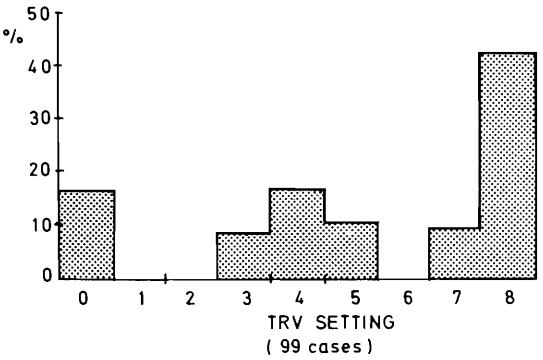


Fig. 8 Histogram of TRV settings.

SUBJECT
SUJET

4A

Energy conservation: Building envelope. Roofs, walls and openings

Chairman: V.A. DROZDOV

Economie d'energie. Gros-oeuvre du bâtiment. Toits, murs et baies.

Président: V.A. DROZDOV

Report from Section 4 - Subject 4 A

ENERGY CONSERVATION
BUILDING ENVELOPE. ROOFS, WALLS AND OPENINGS

Key-note speaker: Prof. H. Granum, University of Trondheim, 7034 Trondheim - NTH, Norway

Prof. H. Granum, University of Trondheim, 7034 Trondheim NTH, Norway

He presented his own paper, The Role of the Building Envelope, Volume 1a, page 243.

Ass. Prof. A. Elmroth, Royal Inst. of Technology, 100 44 Stockholm Sweden

He presented his own paper, Well insulated Airtight Buildings, Energy Consumption, Indoor Climate, Ventilation and Air Infiltration. Volum 1c, page 30.

J.B. Siviour, Electric Council Research Centre, Capenhurst, Chester, CH1 6ES, U.K.

My contribution relates to the paper by J.B. Siviour.

It is a pleasure to speak after Professor Hans Granum because my work has so much in common with his. On this occasion I want to illustrate his point that communication between researchers is often difficult. Recent measurements which I have made on cavity walls insulated with urea-formaldehyde foam have given k-value of about 0.07 W/mK, twice the "book" value of ~0,037 W/mK. My results, which were obtained from measurements using small heat flow transducers and embedded thermo-couples in the walls, are similar to those obtained earlier in Scandinavia.

In contrast, however, Belgian experience reported by M. Lebegge at this conference, supports a value of ~0.035 W/mK. I would like more information on these measurements from the author.

Dick Björkholtz, OY Partek AB, Munkkiniemen Puistotie 25, 00330 Helsinki 33, Finland

My contribution relates to the paper by Klaus Blach.

Studies to improve thermal insulation from todays standard has also been made in Finland. U-values today are around 0.30 $W/m^2 \cdot C$. If improved to a level of about 0.13 $W/m^2 \cdot C$ an effect of 0,17 $W/m^2 \cdot C$ is obtained. This gives in Finland about 20 kWh/m^2 annual energy savings (degree-hours 115.000). With a heat energy price of about 0.004 US $/kWh, which is quite common in Finland, the annual savings will be about 0.8 $\$/m^2$. The present value of these savings are about 20 $\$/m^2$ (50 years, 5 % interest, 2 % annual increase in energy price).

The problem was to find technical solutions which do not increase building costs more than 20 $\$/m^2$. About five solutions were found that increase building costs less than 8 $\$/m^2$. One of the most promising wall construction consists of (from inside): Concrete hollow-slab + polystyrene + thin layer of concrete. Main advantages with this construction are:

- No cold bridges at all
- can be produced with same machinery than the hollow-core slabs

Such panels, (not load bearing), have now been in experimental use for 9 years. Thus far have all tests given positive results.

Prof. D. Mohan + Dr. B.K. Sascena, Central Building Research Institute, Rorkee (UP), India

Our contribution relates to general discussion.

CBRI has carried out extensive research in the field of energy conservation in buildings. A project sponsored by Ministry of energy was recently completed, in which the pattern of consumption of energy and measures for energy conservation in buildings were studied with specific reference to multi-storeyed office, hotel and commercial buildings. Design of energy efficient buildings for thermal comfort, natural illumination and ventilation can effect a considerable saving of energy otherwise expended in heaters, coolers, air conditioners, fans and artifical lights. Optimum orientation, thermal insulation of roofs and shading of windows constitute important aspects of energy efficient buildings. These have to be optimised with respect to the prevalent climate for achieving desirable environmental conditions indoors. The active and passive methods of solar energy utilisation for heating and cooling can further augment the energy conservation in buildings.

The optimum orientation of longer facades of a building for minimum solar load in summer and maximum advantage of sun (from south) in winter is north and south facing. These facades may be slightly tilted towards north-west and south-east for taking advantage of prevalent wind direction for natural ventilation.

Guidelines on thermal insulation of roofs and exposed walls for three main climatic zones of India viz. hot dry (northern plains), hot humid (peninsular plains) and warm humid (coastal regions) have been worked out for conditioned and unconditioned buildings. To conserve energy in conditioned buildings, a reduction of

U value of roofs from 2.0 kcal/sqm.hr^{o}c to 0,5 kcal/sqm.hr^{o}c has recently been incorporated in Indian

Standards on thermal insulation.

Design of windows to provide daylight and natural ventilation in buildings is important for energy conservation. Based on prevalent clear sky conditions, a minimum glass area, from 15 to 30 percent of floor area (depending upon external obstructions) is recommended for adequate daylight in buildings. The heat ingress through the glass area is minimised by provideing appropriate shading devices. For good natural ventilation, most of the fenestral area (at least 80 percent) should be openable with a provision of equal opening area in opposite walls for cross ventilation.

Efficient design of supplementary artificial lights for periods of poor daylight availability saves a considerable expenditure of energy in daytime artifical lighting. Use of flourescent lamps has been recommended in place of incandescent lamps which consume about four times more power than the former for the same amount of light.

The tolerable limits of comfort have been studied for Indian conditions. The upper limit of dry bulb temperature is recommended as 30^{o}C with slight air motion instead of 25^{o}C, for reducing power consumption in summer cooling. For winter heating the dry bulb temperature may be reduced from 21^{o}C to 18^{o}C.

Evaporative coolers can provide comfortable conditions in hot dry climate and are recommended in place of air-conditioners which comsume four to five times more power.

Both active and passive methods of solar energy utilisation have been recommended for energy conservation in buildings. Requirements of water heating and space heating can be met by solar energy. CBRI has designed solar water heaters with and without storage. The later is suitable for daytime use and also for saving energy in electric geysers by providing preheated water. The solar water heating system has also been successfully employed for space heating in winter. For cooling of buildings the roof surface evaporative cooling (a passive method of cooling utilising solar energy) has been found to be very effective.

References

1. Thermal design of buildings for desert area, K.N. Agarwal, B.K. Saxena and V.V. Verma, Second All India Conference on Desert Technology, Oct. 1979 organised by Indian Society of Desert Technology.

2. Energy conservation in buildings, N.K. Garg, K.N. Agarwal, B.K. Saxena and Ishwar Chand, CBRI Building Digest 129, Aug. 1978.

3. Energy economy in daytime lighting design; B.K. Saxena and V. Narasimhan; ISI Bulletin Vol. 29, No. 6, pp. 195-98 (1977).

4. Supplemental artificial lighting in buildings; V. Narasimhan and B.K. Saxena, CBRI Building Digest 120, May 1976.

5. Guidelines for designing airy buildings, Ishwar Chand and P.K. Bhargava, CBRI Building Digest 121, Oct. 1976.

6. Evaluation of thermal stress - Tropical summer Index; M.R. Sharma, CBRI Building Digest 127, 1978.

7. Cooling of buildings by roof surface evaporation S.P. Jain, S.P. Chakrabarty and S.A. Siddiqui, Climate Control Vol. 1 No. 3 pp. 30-35,1978.

8. System design for supplementary water heating by solar energy, Vinod Kumar, Ranjit Ganguli and K.N. Agarwal, Energy Management Oct. - Dec. 1978, pp. 277-81.

9. Pipe type solar water heating, S.K. Kaila, R. Ganguli, J.S. Puri and N.K.D. Chowdhury; Solar Technology for Buildings Vol. 2, 6.10, pp. 598-602, 1977; Proceedings of the first International Conference on Solar Energy, 25-29 July 1977 at the Royal Institute of British Architects London, published for UNESCO and NELP by RIBA publications Limited London.

10. Water and Space heating by solar energy; Prof. Dinesh Mohan, N.K.D. Chowdhury, S.K. Kaila, R. Ganguli and J.S. Puri, International Solar Energy Congress, New Delhi, Jan. 19-26, 1978.

Dr. D.C. Spooner, Cement and Concrete Association, Wexham Springs, Slough SL3 6PL, U.K.

My contribution relates to the paper by Professor Granum and Mr. Siviour.

I should like to support the points raised in the papers of Prof. Granum and Mr. Siviour concerning the importance of thermal bridges in otherwise well insulated buildings. In our own comparisons of heat input and heat loss from the experimental house which is described in my paper at the Congress, we are now finding that thermal bridges are important. Our measurements have shown that some 15 - 20 % of the energy input was not accounted for in the measured heat losses and there are good reasons for believing that this

heat is escaping through thermal bridges, particularly at the junction of the external walls and the ground floor slab. I suspect that thermal bridges are a common problem in well insulated buildings and their effects are not in general considered in calculations of heat losses. Steps have now been taken to extend the external wall insulation right down to the foundations of the house.

Our measurements also appear to be revealing shortcomings in the concept of external surface resistances for building elements. For example when we consider the heat losses from the external surfaces of the house walls we find that the measured surface resistance are much higher than those usually accepted and that they change with orientation with the time of year. It must be pointed out that we are using a measured "sol-air" temperature in these calculations and therefore the effects of radiation should apparently be accounted for. I feel that this is an area of some concern since it has a direct influence on all calculations of heat losses from buildings.

Prof. E. Deutschmann, Technical University, 8027 Dresden, DDR

He presented his own paper, Improvement of the heat insulation of multipane window glazing in residential buildings, Volume 1a, page 298.

Key-note speaker Prof. H. Granum.

I do not think it has come forward any major disagreements between us, but I could like to make a few comments to dr. Deutschmann first. The problem with heavy gases is whether the sealing of the pains will be sufficiently strong to keep the gases there for 30 - 40 years. There must be a very good sealing if the gas shall be conserved. A double sealing as we call it with two layers of glue in the sealing and with very careful sealing I think it is possible to conserve the gases for 20 - 30 years, so that it really is possible to utilize them. One good thing about heavy gases is that they are more efficient for small distanses then for larger distanses, and this has some importance for triple-glasswindows. The effect of selectiv covering of glasses, however, is larger than for gases. Dr. Spooner asked for information about surface resistance and the reason why the surface resistance has shown such a varying value. One thing is that it does not tak into consideration the radiation so infact there is a considerable amount of energy sucked up from radiation. Particularly in brick and concrete walls with fairly heavy layers on the outside of the insulation material the storage possibility for solar-energy or radiation-energy in the outer surface may change so that the surface coefficient may be negative instead of positive. It certainly has very marked influence and I think our calculation methods should be worked out in a way so that we could take into consideration the radiation effect even on opac constructions. The theory is not difficult.

Mr. Björholtz mentioned that the walls he showed was completely without cold bridges. I wonder whether it is really possible to build a concrete wall without steelstraps or any other connection between the outer and inner layer. The sharestrengs of the good insulation materials is usually not good enough to take up actual shareforeces, so it seems to be very difficult and I would ask how this really could be possible. I realize that the steelstraps perhaps may not mean very much but without thermal bridges it cannot be built.

Mr. Siviour and I seem allways to be in agreement with each other so I have no particular comment. His results regarding urea-formaldehyde was exactly the same as we have observed.

He asked for Mr. Maurice Lebegge, Belgium, about his paper. If he is here I think he could give an explaination of his results compared with what we have observed other places.

Mr. Elmroth confirmed what I mentioned so I have no particularly remark to his presentation other than it seems as the Sweeds have been better than us to get reasonable values in their building code for U-values and for airtightness, and the reason may be that the researchers in Sweeden have been more clever than us to bring the message forward to the building office.

Chairman, Mr. Drozdov, Soviet Union

Some comments to Mr. Deutschmann. If we reduce the air-thickness between glasses it will increase the U-value. In this case the third glass will not improve heat insulation. It is necessary to increase one air gap up to 120 mm. You must take into account the noise problem too.

T. Stathopoulos, Centre for Building Studies, Concordia University, 1455 De Maisonneuve West, Montreal, Quebec, Canada, H3G, IM8

My contribution relates to the paper by Brian E. Lee.

The discusser reffered to the prediction method of air infiltration due to wind as suggested by the author of this supporting paper. He said that it would be better to neglect the direction correction since wind may blow from any direction and it is not always easy to have

enough meteorological data about the wind rose. Consequently infiltration rates should be calculated for wind direction of 0^{o} as indicated in Figure 3 of the paper (max. effect).

The discusser also agrees with the author of the paper regarding the fact that the wind effects on an isolated building are more severe in comparison to a building surrounded by other buildings (grouping effect). He added, however, that in case that the nearby buildings are significantly taller than the building examined, some adverse effects may occur and these should be taken into account. This observation is based on the discussers own measurement, the results of which have not been reported as yet.

Finally the discusser said that the important effects of wall openings and inherent building permeability have not been considered in the paper but information is now available in this respect and is included in the second last paper of this session authored by the discusser and Dr. H. Homma.

T. Stathopoulos, Centre for Bruilding Studies, Concordia University, 1455 De Maisonneuve West, Montreal, Quebec, Canada, H3G IM8

My contribution relates to the paper by Hans Granum.

The discusser said that he was glad to see the new air tightness requirements for the new Building Code of Norway (1980) along with the Swedish specifications (1978) as presented in Prof. Granums lecture. He posed the question to the participants of the Congress to denote any different requirements appearing in standards of their own countries. He mentioned the importance of climatic factor in these specifications and he referred to the Canadian standards specifying a minimum value of 1 ac/hr for mechanically ventilated residential buildings.

S. Mandorff, Box 785, 80129 Gävle, Sweden

The two key-note speakers today, Mr. Leach and Mr. Granum pointed out the importance to regard the building envelope and the mechanical services as a unit.I would like to contribute with some experiences from a modern office building in fact the Swedich Research Institutes premises. We started plotting the consumption of energy against the outdoor temperature. The building is five years old, very well insulated and has windows with three glasses. About the installations: We found that the heating system did not work very well, the room temperature varied from $19^{o}C$ - $25^{o}C$ in spite of the fact that the heaters were equiped with thermostatic radiator valves but they were not blocked and the system were not balanced to ensure the right flow distribution between the heaters. We started to balance the system and to block the valves. The result was that the energy consumption decreased from 132 kWh/m^2 to about 100 kWh/m^2 (15,2 l oil/m^2 to 12,4 l oil/m^2).

We went further and reduced the running time of the fans and a lot of measurements were taken. After this the energy consumption was 83 kWh/m^2 (10,4 l oil/m^2) and I think the energy consumption still can be reduced with about 10 %.

Rufus S. Ogundana, Assistant director, Federal Housing Authority, Lagos, Nigeria

My contribution relates to the paper by Professor Hans Granum.

I agree completely with Professor Granum that the attentions of Research Institutes in the developed countries in the area of Energy conservation are now with heeting problems rather than with cooling and ventilation.

However, significant savings in energy can be achieved especially in the hot developing countries and during the summer in the developing countries if the energy required for air conditioning, forced ventilation and lighting is drastically reduced.

To this extent, solar energy research needs to be further promoted as this energy is invariably available in large quantity in the hot climates and in the hot months of the summer in the temperate requirs.

CIB member Research organisations may need to establish field experimental stations in the hot areas outside their respective countries to promote such solar energy research so that an early breakthrough can be achieved in this field.

H. Tabesh, BHRC, Tarasht Highway, Teheran, Iran.

We must not forget that many developing countries are in regions with hard solar radiation and they need energy conservation in summer-time as well as in winter. And I hope that in the future we can have some discussion about this and about how soft energy such as solar energy, wind energy and so on can be used in contries with warm climate.

Key-note speaker, Prof. H. Granum

Some comments to prof. D. Mohan, Mr. R.S. Ogundana and Mr. H. Tabesh. They come from other climates than most

of the members in the W67, the energy conservation group in CIB. We have discussed in that group several times the question whether it should be concerned also with energy conservation under varm climatic conditions. And we found that this would need a different set of people with different experience and background perhaps so this would be up to the CIBs board to find out whether they want to set up a separate commission and I think it should be as proposed of prof. Mohan a separat commission because the energy conservation under quite different climatic conditions are quite different the cooler climate. I do not think I have much more comments about what have come forward in the discussion. It seems to me that we need better and simpler tools than we have to day do predict the energy consumption in buildings. Tools which can be used by the architects and the engineers in their work. As some other participants have mentioned, it is very important to regard the mechanical installations and the building envelope as a unite. That needs a basic understanding, and I think CIB can contribute considerably to this through its work.

Chairman, Prof. V.A. Drozdov.

I think we are at the beginning of the road of energy consumption and we shall discuss this problem many times in the future. But it is clear now that there are some questions which we cannot answer. We begin to use many new materials very effectivly. But we do not know their durability and we do not know in which way these materials will behave in humid air. I want to comment that for the countries with warm climate the main problem is cooling and cooling cost much more than heating as you know.

G.W. Brundrett

Correction to paper "Field Trials in Well-Insulated Houses" p 290, figure 4, x-axis:

Replace weekly outdoor temperture
by average weekly indoor temperature

Supporting paper by: Arie Gottfried and Saverio Mecca

RESEARCH PROJECT PROGRAMME: "HYGROTHERMAL COMFORT IN THE WHOLE BUILDING STOCK. TOWARD A DESIGN GUIDE"

This is a contribution of two research workers of "Procedures and methods in industrialized building" functional Unit of the Architectural Research Institute.
The functional Unit has long been involved in developing and thoroughly investigating the researches regarding the systematic approach to building planning. Such approach is based on a conception which is involved either in the requirements of the building activity or in the processing of the building trade itself. We do consequently define distinct effective stages having exact correlation rules which set out the building procedure on the whole. The basic phases have to be found in the building systems planning, requirements systems planning and consequent sources and means systems as to the operative enterprise optimization and results control.

The functional Unit is a structure devoted to research activity and furthermore develops an intense educational programme. This often leads the research activities to expand most the aspects closely connected with the planners' vocational training and guide.

The topic concerning energy saving is rather new for our institute: such a research started off in November 1979 and constitutes the first organic experience.

Currently the first phase is being run, which shall end up by october 1980.

The project goes under the general heading of "Hygrothermal comfort in the whole building stock".
Only the subject concerning the hygrothermal performances of the building envelope shall be developed at the functional Unit.

This choice depends on three basic reasons:

- Functional Unit qualification and specialization
- Comments about the high incidense of primary energy consumption as to building air conditioning on the primary energy general consumption
- Importance of a spread concerning a change in design guide.

Basic passages in Italian law

The energy problem in the building field was tackled on the law scale in Italy on April 1976.
An act and two decrees law [1] were issued in order to reduce energy consumption for thermal use in buildings.
First the act establishes the thermal comfort maximum level which is one for the whole national territory that is 20^{o} C ($\pm 1^{o}$ tolerance).
The law, then, regulates either the active part, that is heat use and production plants, homologating them in order to greatly reduce fuel waste and imposing control devices with reference to outside temperature variations, or the passive part that is all the building components separating the inner from the outer side, at any rate separating from not-heated rooms or premises (horizontal and vertical outside closing components).
In accordance with the different climatic conditions, different levels of loss of heat overall volume factors have been established (Cg).

[1] Act no 373 of April 4th 1976

The Italian territory has been divided in six climatic areas according to the winter outside temperature and the days average of annual heating.
The Cg factor comes from the addition of Cd and Cv factors, respectively the thermal power lost by transfer and the loss of the thermal power due to the premises change of air.

For buildings used as dwelling-places a change of air per hour equivalent to half a volume has conventionally been assumed.

Law application criteria

Any project concerning new buildings of houses or "effective maintenance must be provided with a technical report listing in detail and describing the materials used to construct the envelopes of the buildings.
The Cd loss of heat factors regarding the whole building overall and the individual rooms must not exceed the maximum factors established by law.

It is the duty of the local Council to check the project and the technical data analytically and subsequently to verify the conformity of the execution.
The heating plant homologation lies within the competence of a specific organism, A.N.C.C. (National Association for Combustion Control).
The law controlling the residential buildings thermal arrangement intends to reduce energy consumption by restricting the loss of heat, but it does not indicate either the way or the means to achieve such a goal.
The law, then, positively does not bind any planning arrangement, neither as to the built form nor as to the technology of the envelopes.

Undoubtedly it constitutes a favourable matter because it releases the projecting research, but given the poor specific training of Italian planners, it has determined a great hesitancy causing delay and unfairness about the enforcement of the law.

Aims of this research

The situation described above led us to undertake the appointment of determining the projecting means which could make us able to get through the situation itself. A second reason concernes the need to awaken the planners that it is necessary to project in accordance with a residential quality prospect, implying a multidimensional concept which ought to define the specifications (as to the performances) of a block of rooms, which have to face and meet users several requirements, as far as functioning, environmental well-being, safety etc. are concerned. A third reason comes from the need to equip a system acting as a guide in vertical and horizontal closing components projecting, supplied with a components performances optimization pattern, first of all performances bearing upon energy budget, although they must not be seen separately, conceptually, from all the other performances.
From this basic aims exposition, a division of the research project into three stages can follow.

First stage

Planning guide preparation in conformity with No 373 act and report describing the current closing technology for new building, with an analysis of their economic implications.

Sesond stage

- Preparation of a complete report describing the closing technology available on the Italian market, in comparison with the european one, either conserning the new buildings or the existing ones.
- Preparation of a decsional projecting pattern
- Acquisition of a programme showing a building heating arrangement.

Third stage

- Preparation of a design guide for the envelope regarding the thermal comfort of the entire building
- Preparation of a design guide concerning the individual closing components
- Preparation of a cost guide with regard to the thermal comfort in residential dwelling.

As it has been stated above, the first stage might be concluded by october 1980. At the present time we cannot disclose any result yet. Anyway we will send a short summary in English to all people taking part in this section 4A. A more detailed report can be sent on request addressing our Institute.

SUBJECT
SUJET

4B

Sanitation problems. Solutions by dry and non-waterborne systems and by infiltration

Chairman: C. CRAWFORD

Problèmes d'hygiène. Solutions sèches, systèmes ne demandant pas d'eau et infiltration

Président: C. CRAWFORD

Report from Section 4 - Subject 4B:
SANITATION PROBLEMS. SOLUTIONS BY DRY AND NON-WATER-BORNE SYSTEMS AND BY INFILTRATION

Key-note speaker: F. Perrier, France
Invited paper : T. A. Pedersen, Norway

Mr. Crawford wished the delegates welcome etc. and gave the word to

Mr. Perrier, CSTB, France

He gave a general view of the worlds problems with producing drinking water. UN had made the decade from 1980 to 1990, the years of water supply and hygiene. The goal was for the women not to use to much time going for water.
To be more exact, everyone should have drinking water within a distance of 200 m. (See proceedings.)

Prof. Pedersen, NLH, Norway

Solution of sanitation without common sewer systems was his theme. He told about dry toilet systems in a cold climate like Norway. The problems to get useful bacterias to work in biological toilets was dealt with. 6000 houses are built every year in scarcely populated areas in Norway. He will therefor try to find an alternative to the water closet and he is developing a system for on-site disposal methods for the grey water. (See proceedings.)

Prof. Mohan, SBRI, India

Latrines in rural areas as shown in the following figure has been convenient in India.

The construction of latrines in the rural areas is a necessity for proper sanitary conditions and environmental improvement. But due to its high cost of construction, villagers are not in a position to adopt it. The CBRI made a study on different alternative designs of latrines that could be feasible and acceptable in the rural areas. A design of water seal hand-flushed latrine has been proposed. The superstructure is designed utilising locally available materials, thereby reducing the cost of construction. The proposed design consists of a latrine structure, two leaching pits and a connecting chamber. Studies have been conducted on the shape of the leaching pit, volume of the leaching pit, distance between the two leaching pits and the design of cover for the same. The superstructures are proposed with the following alternative specifications:

1. Burnt brick in cement mortar
2. Burnt brick in mud mortar with cement pointing
3. IInd class brick in mud mortar with cement or lime pointing
4. Sundried brick in mud mortar with non-erodable mud plaster
5. Burnt brick work upto floor and bamboo matt for enclosure
6. Leaching pits with brick, stone, bamboo matt and empty bitumen drum lining.

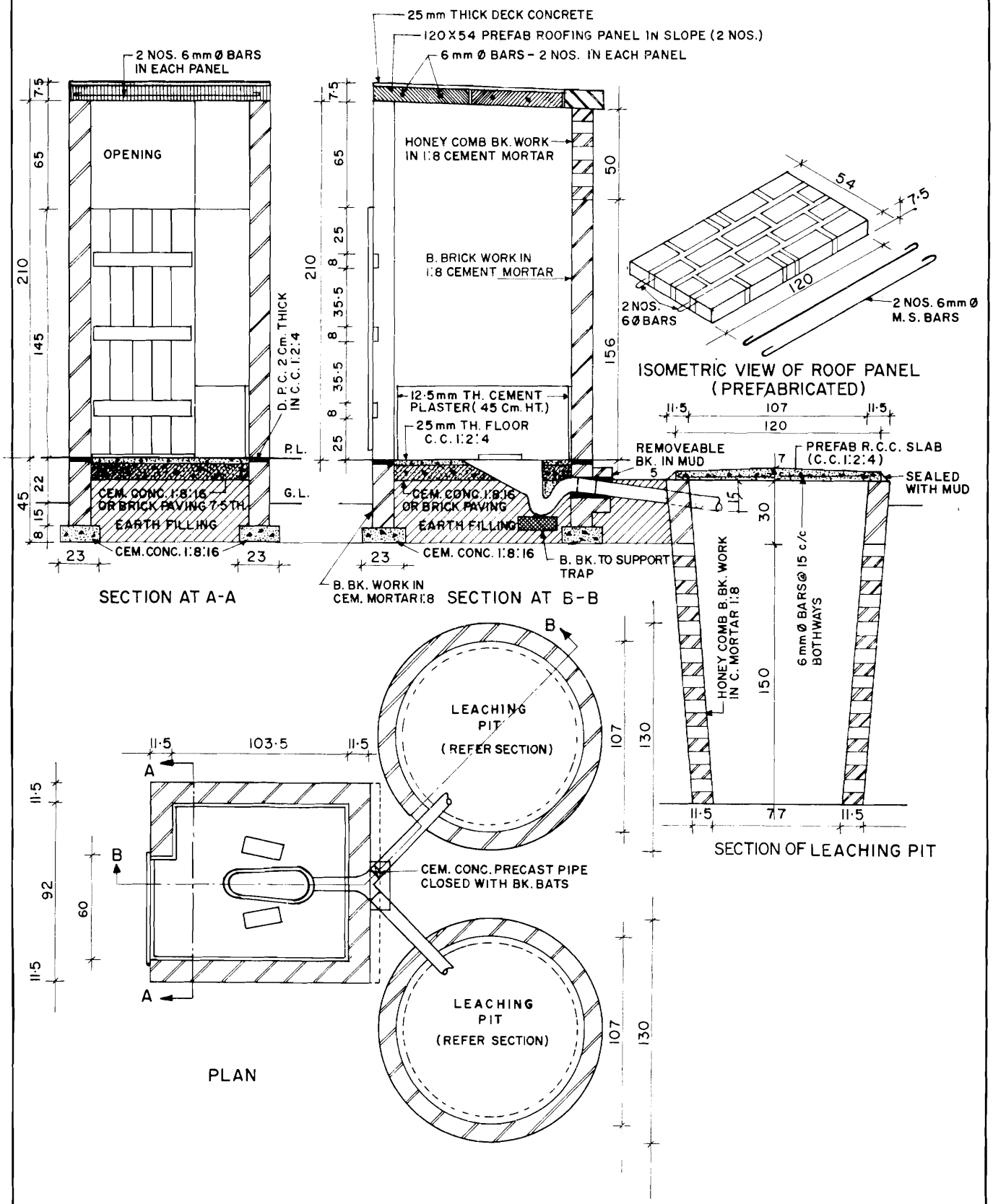
The cost of latrine with different specifications varies from Rs. 550/- to 720/-. (US dollars 70 - 90). Replacement of pit by a large fretcher has good potental.

The waste water coming out of the kitchen and bathroom generally flows to the streets and makes them muddy and dirty, thereby creating unhealty environment. A soakage system has been developed to take care of such water within the premieses of the house owner itself. It consists of an ash and silt trap chamber and a bore hole. The chamber is devided into two compartments. In the first, silt and ash i.e. heavier particles in waste water settle down and floating and greasy material is trapped. Waste water is then taken to the second compartment through a special entry system. This compartment is filled with brick aggregate which helps in removing suspended and colloidal material. Subsequently clear water is allowed to flow into a 30 cm dia. bore hole for disposal underground. The bore hole is carried down deep enough to reach the first layer of sand, subject to a maximum of 3 m depth for proper soakage. The bore hole is filled with brick aggregate.

Unlike the soakage systems currently in use where the ash and silt directly flow into the soakage pit causing clogging, the proposed and unforced system provides for their retention in ash and silt trap chamber, and subsequent cleaning when water starts overflowing the chamber.

A prototype of the proposed soakage system was built in a bar colony in a village near Roorkee about two years back. Satisfied with its performance, four such soakage systems have been provided in four different houses in another village. The system has been proposed for disposal of waste water from kitchens and bathrooms only as this water has little B.O.D. and will not contaminate the ground water.

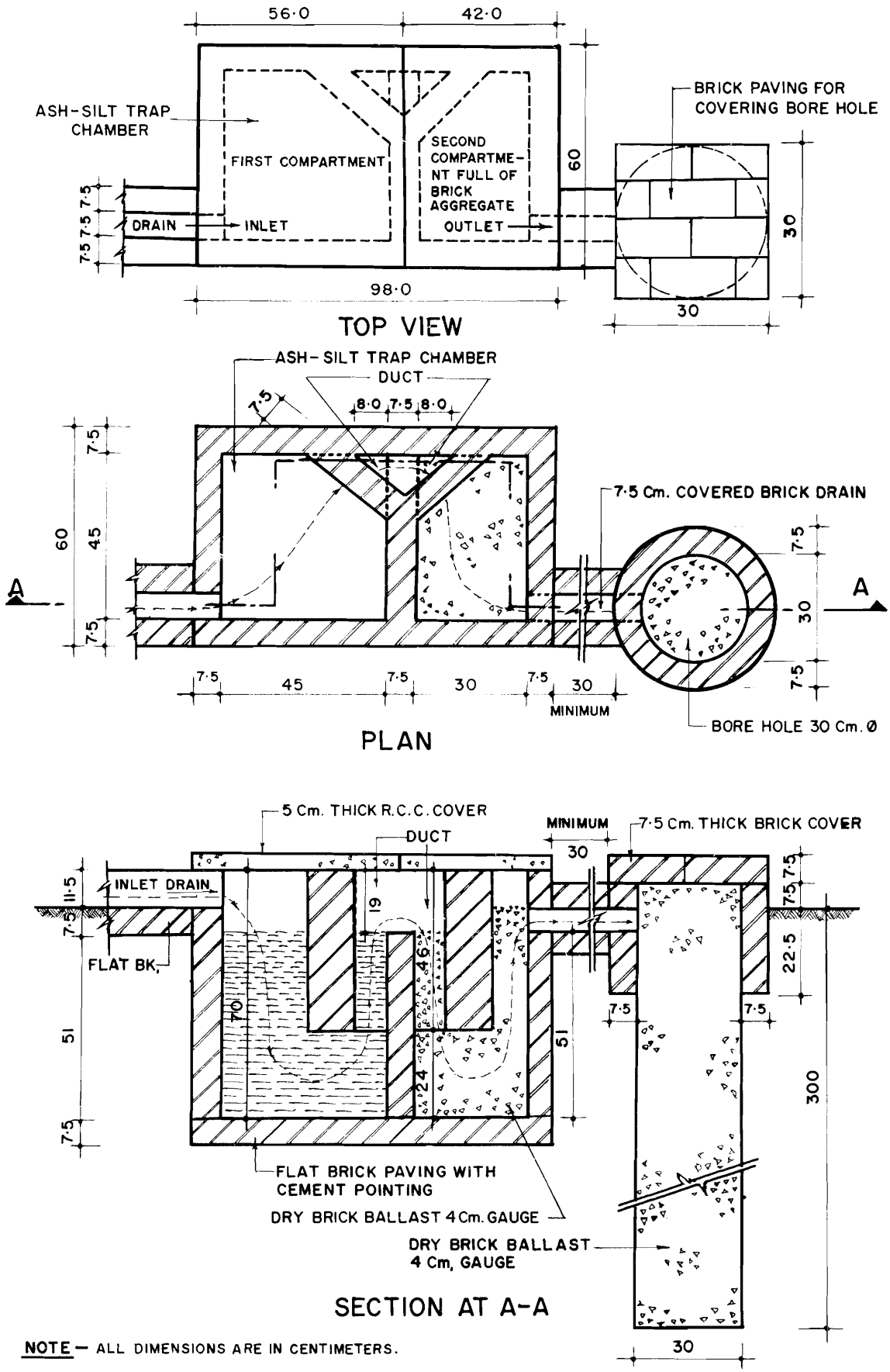
The cost of the system is Rs. 150 ($ 20).



HAND FLUSHED WATER-SEAL LATRINE FOR RURAL AREAS (TYPICAL DESIGN)

TYPE-5

Fig. 2
Latrines in rural areas



WASTE WATER DISPOSAL SYSTEM FOR RURAL AREAS

Fig. 1
Waste water disposal system for rural areas

Mr. Barantes, Guillermo, Argentina

I want to make a brief commentary about biological toilets' experiences in my country. In cooperation with the U.N.D.P. Technical Assistance, and within the Technological Research Program (018), sponsored by the State Secretariat of Urban and Housing Development we have started some research programmes related with the use of biological toilets. There is one program, entitled "Self sufficient House" carried out by the Provincial Housing Institute of a northern province (hot climate) in which the objectives are the development and experimentation of systems capable to reduce the amount of water used for waste disposal.

So, the problem, in this case, was, in one hand to purify water for drinking, which was achieved with solar destilation (we obtain 4 or 5 litres/day/m^2), and in the second hand not to pollute water.

It must be taken in account that these are low cost housing projects, so it's necessary to reduce costs using local materials and available skill working.

As a result we designed and constructed a biological toilette, adapting a "multrum" but using soil-cement treated blocks, done in the area.

We want to remark that we proubed that the system works all right, but, the people didn't know how to use it adequately, so after some time, we found out that it's stop working. So, we concluded, that it is very important to develope first a social assistance program, training and teaching the people in the use of this alternative systems, otherwise it won't be useful to transfer technology.

As a question to CIB. I would like to remark the need of studying some kind of alternative (dry stystems) for multifamiliary houses, due to the reason that in many cases, for economical reasons, whenever constructing new groupes of houses, they are designed in high density projects, and it's very difficult to use this dry solutions in buildings of more than one floor.

Mr. Jens Seip, Ministery of local affairs, Norway

He is an economical specialist and has experienced problems in urban districts in countries like Afghanistan and Tanzania. One problem is that waste water may come in connection with the sources for drinking water.

In Kabul the sources is dry most of the year. The river must be used for water supply.
The next year UN will discuss the problems. What can CIB do for UN to solve the problems in different climate? What kind of research work will be necessary to give the most economical solutions in density populated areas?

Prof. Pedersen answered Mr. Seip as follows:

Eight to ten years research work is done with the none water born toilets. The biologists knew that these kinds of toilets did not work. We know, however, very much about why they do not work. Biologists and engineers work together. They are setting the conditions for the use. The toilet should work under certain conditions.

Mr. Åke Fleetwood, Stockholm, Sweden

What happens in the latrines? The breaking down of organic materials are dependent of the temperature. Climatical conditions should be Pertinent.

Mr. Guttormsen, NLK, Norway

In a warm climate there is no problem with the organic demolition. You will have to test the system in an other climate. The bacterias are dying quite quickly under certain conditions. Otherwise he refered to his paper.

Mr. Kristiansen, NBI, Norway

He was concerned about disposal of grey water. New areas must be evaluated as a resipient for wast water in the ground. The soil has to be tested as a resipient. The situation of new living areas is dependent of this.

Mr. Arctander, SBI, Denmark

This seems to be a typical example of a subject where industrialized countries could benefit from taking part in research on problems now raised in developing countries. Because what is it we are doing in large European sities now? We are searching for water sources 100 kms away (from Copenhagen for instance) - transporting water at great expense, carefully purifying it - and then using 6-10 liters of it for each use of a toilet, with the main effect, after an inadequate purification of the waste water, of polluting our bathing water in the nearly sea. If we could assist in developing more biological solutions to replace our expensive and unsatisfactory technological solutions, we might possibly take them back and adopt them for our own use, - and maybe even obtain some useful manure.

Mr. Birkeland, NBI, Norway

I only wish to second the proposal of Mr. Seip that the CIB should take up for solutions the questions we are discussing here.

As demonstrated during this discussion and expressed by Mr. Pedersen,there is a gap between the knowledge the biologist have on the biological process taking part in a compost latrine and development of practical designs of such latrines securing that the desirable biological processes are taking place.

It is obvious that out from the knowledge of the biologists it is possible to develop a compost latrine functioning according to every reasonable sanitary demand.

Mr. Crawford, NRC, Canada

He pointed out the importance of the subject and thanked the delegates, the speakers and the contributores for taking part in the session.

Features of water supply and sanitation in developing countries

Geoffrey H. Read
c/o Ross Institute of Tropical Hygiene
London School of Hygiene & Tropical Medicine

Introduction

1. Meeting basic needs in water supply and waste disposal is the daily provision of between 20 and 50 litres per person of safe and convenient water for drinking, food preparation and personal hygiene, together with adequate and safe means of excreta and personal hygiene, together with adequate and safe means of excreta and wastewater disposal. There are some 1 500 million people (the urban and rural poor) in developing countries (excluding China) whose basic needs are not met. The UN General Assembly has declared the 1980s as a decade during which a real and substantial effort should be made to meet these needs.

2. In 1976 the World Bank, aware that the benefits of its lending program in the water supply and sanitation sectors were not reaching the urban and rural poor, undertook a two year research program into appropriate technologies for low cost water supply and sanitation in developing countries. The results of this research program (Ref. 9) show that low cost technically viable alternative technologies to conventional water supply and sewerage do exist and that these technologies can have a public health impact similar to that of conventional approaches.

3. Following this research program, the United Nations Development Program (UNDP), as part of its preparations for the International Drinking Water Supply and Sanitation Decade (1981-1990), has sponsored a global project of demonstration programs in low cost water supply and sanitation in developing countries. Under this project, which the World Bank is executing, the Bank established a Technology Advisory Group (TAG) in late 1978 to facilitate the design, implementation and monitoring of these demonstration programs in selected parts of the developing world.

4. This paper summarizes the sector background, highlighting some of the current TAG sector thinking and highlights areas of further applied investigation which have been identified by TAG.

BACKGROUND

5. Sanitation and water supply planning and development work in developing countries is set in a range of social, economic, demographic and climatic situations, wide variation in some aspects is contrasted by remarkable similarities in other aspects. These are highlighted in Table I, which shows for example Sudan with an area of 2,5 million km^2 and a population density of 7 persons per km^2 contrasted with Lesotho with an area of 30 000 km^2 and a population density of 43 persons per km^2 (the U.K. has an area of 244 000 km^2 and a population density of some 246 persons per km^2). The countries have largely rural populations (generally over 85 % rural) and a low per capita Gross National Product (GNP) of under US $ 500 per capita (the U.K. per capita GNP was US $ 5 000 in 1978).

6. Life expectancy is generally under 50 years with much of the population undernourished, and generally with poor curative and preventive medical facilities. The infant mortality rate is generally greater than 120 per thousand live births and in a few countries greater than 180 per 1 000. This human misery and sadness which this brings has a serious debilitating effect on society as well as on individual families. Between 40 % and 50 % of the population is under 14 years of age, with fewer than 5 % at primary school; adult literacy is low (generally under 40 % literate). The position is summarized in Table II.

7. Existing service levels of safe drinking water and adequate excreta disposal are variable but not particularly good as shown in Table III. Rural areas in particular have very poor water service levels and almost negligible excreta disposal facilities. In urban areas, service levels are highly skewed in favour of high income households who consume well above basic need levels and in many cases receive free, services for which the poor have either to pay or do not receive at all.

8. The countries are all low income countries. The outlook for improvement in per capita GNP, particularly when compared with the industrialised countries such as USA or the United Kingdom is poor, due to slow economic growth combined with high population growth; Figure I highlights this, showing the present and projected continued vast gap in GNP per capita between nations, while Figure II shows the considerable past and projected growth in population. A major feature of this growth has been the trend towards increased urbanisation as shown in Figure III; this trend is projected to continue such that typically in sub-Saharan Africa the estimated 1975 urban population of 80 million (about 21 % of total population) is expected to grow to over 259 million (about 40 % of total population) by 2000. The countries also have a variety of different religions, political, economic and socio-cultural environments which affect planning and implementation of water supply and sanitation programs.

DEVELOPMENT REQUIREMENTS

9. To overcome the existing very poor levels of water supply and sanitation services in the developing countries a range of technologies and "service delivery models" have been identified by the two World Bank executed programs discussed previously (Ref. 9, 13, 14, 15) which have been fairly widely reviewed; the major findings of these reviews are that there is a wide range of affordable, appropriate and acceptable technologies available (but in many cases poorly developed) which can give adequate levels of service.

10. Water supply technologies include not only individual piped and metered house connections (costing typically $ 120 per capita) but also

- yard taps,
- communal stand posts (Figures IV & V)
- deep well and shallow well hand pumps (costing typically $ 25 per capita - Figures VI and VII) and
- wells.

11. Sanitation technologies (for excreta disposal) do not, as is still widely believed by the professions, consist of either waterborne sewerage, bucket latrines or nothing; a range of other sound systems is available including

- Ventilated Improved Pit Latrines (VIP latrines - See Figure VIII)
- Pour Flus (P.F.) latrines (See Figure IX)
- Sewered Pour Flush latrines
- Communal latrines
- Septic tanks
- Aquaprivies and
- Waterborne sewerage.

12. Figure X shows a generic classification of Sanitation Systems, and Table IV shows a detailed cost comparison of the technologies which highlights the high per-capita cost of waterborne sewerage compared with other options, and emphasizes the importance of affordability.

LIKELY SANITATION OPTIONS

13. Excreta disposal systems need to be technically appropriate, financially affordable and socially acceptable. From the work done on recent program development, there are two particularly attractive solutions to excreta disposal which meet this criteria: These are the VIP latrine and the PF latrine, both using alternative pit technology (see Figures VIII and IX). They are suitable for both urban and rural developments; when the first pit is filled, it is rested to allow for pathogen decay (see Ref. 9) while the second pit is used. When the latter is full, the first pit is emptied (after a period of at least 2 years) and the resulting humus (which has been formed by microbial action) can be safely removed and used for soil conditioning or agricultural fertilizer. The first pit is then used while the second pit rests and the contents biograde. The cycle continues. No further treatment of the humus is required; and the systems can be used in high density situations; pits are not continually excavated and reexcavated, which would be both expensive and cause household decommitment.

14. Both systems use the soil as a receiving body for liquids; P.F. are latrines which have twin leaching pits, are particularly suitable where personal ablution is with water as is done in Muslim and Hindu cultures (typically 4 to 6 l.c.d is generated) and VIP latrines where dry materials are used for cleansing. This implies (particularly for the PF latrine) that the soil must have leaching capacity.

15. In parallel with excreta disposal, provision must be made for sullage disposal; this would be to either a soakway disposed of in the yard, to a stormwater drain or into gardens. (Sullage management is often overlooked in development projects; it can cause major health problems by providing insect vector breeding sites).

16. In situations of very high density, poor soil absorption capacity or once water consumption rises (with income level) to exceed soil absorption capacity an alternative system is the piped PF latrine; liquids (from excreta, ablutions, flushing and sullage) which would normally leach into the soil are carried to treatment in shallow flat sewers which have widely spaced manholes.

17. The order of magnitude of investment required to meet the current broad service goals in developing countries is considerable; estimates vary widely and depend on the technical and institutional models adopted. The table below gives an indication of the required investment.

TABLE 17.1

1/&2/

Estimates of Investments Required to Meet Current Service Deficits of Water Supply and Sanitation in Developing Countries

			CASE 1			CASE 2		
		Unit Cost $/cap.	Pop. Served %	No. (mill.)	Cost $ US (bill.)	Pop. Served %	No. (mill.)	Cost $ US (bill.)
Urban Water Supply	hc	120	70	447	53.6	40	255	30.6
	stp	40	30	191	7.6	40	255	10.2
Sanitation	sew.	250	40	260	65.0	25	163	40.0
	sept.	100	40	260	26.0	15	98	9.8
	Lat.	30	20	131	3.9	40	260	7.8
Sub Total Urban					156.1			98,4
Rural Water Supply	hc	150	20	313	46.9	10	157	23.6
	stp	40	40	628	25.1	30	471	18.8
	hc	25	40	628	15.7	40	628	15.7
Sanitation	sew.	250	20	335	83.8	10	167	39.2
	Lat.	20	80	1338	26.8	70	1171	23.4
					198.3			120.7
TOTAL URBAN AND RURAL					354.4			219.1

1/ It should be noted that 100 % urban coverage using water supply house connections and sewerage only (i.e. no appropriate technology) would cost $ 329.4 billion rather than the $ 156.1 billion calculated with a mix of technologies.

2/ Software costs are not included in these estimates.

3/ SOURCE: Ref. 16.

4/ hc. = house connection
sew. = sewered
lat. = latrine
stp. = standpipe

18. It should be noted that these estimates exclude both sullage disposal and the "software" required to ensure sound program delivery and development together with long term maintenance; the investment implication of these inputs are considerable. They also exclude the capitalized value of operations and maintenance costs. Annex I shows details of these estimates.

19. Work undertaken in the water and sanitaion sector over the past 18 month has raised a number of issues of note and identified areas in which further applied reaserch is required.

ISSUES OF NOTE

Manpower development and training

20. Sound manpower development and training programs have long been recognized as crucial for economic growth and development in developing countries. Low cost sanitation developments are still in the formative stages; training and information dissemination is therefore essential at all levels. Decision makers, planners and engineers need orientation, technicians and operators need to be trained and householders need orientation, technicians and operators need to be trained and householders need to be informed; the impact of this on project costs is substantial however and could often best be borne by central government.

Self-Help

21. "Self-help" 1/ which (together with "community participation") has tended to become the development planner's surrogate for sound programme design has a major role in sanitation programme development. The two major objectives of self-help are:

- to reduce system costs by having the householder undertake part of system construction, operation and maintenance; and part of system construction, operation and maintenance; and

- to achieve householder commitment through involvement, thereby improving the chances of adequate system usage and maintenance, thereby realising investment benefits.

22. Numerous self-help orientated programmes have experienced implementation problems principially due to insufficient technical support thereby stretching householders beyond their capability. In these situation the waste of resources and squandring of householder goodwill will have a long term detrimental impact on sector development.

23. In many countries the traditional method of trying to improve low cost sanitation has been for the Health Ministry to verbally exhort householders to build latrines; in a few countries, sketches are provided (generally very poorly ' engineered ' structures) after which the householder is left to his own devices with no access to technical backing, materials purchasing or financing. Latrines, when built, often collapse; in some cases children fall into the pits.
What is needed in reality is sound, well-illustrated designs (bearing in mind adult literacy rates) preferably modelled in 3 dimensions, together with access to building materials, tools, low level technical assistance, finance and supervision. The level of input required will clearly vary in each country and programme. It is crucial to seccessful program development that self-help is not stretched beyond its capability, and that the correct level og resource support is provide to assist participants.

1/ Self-help inputs to sanitation programs in the context of this paper are defined as inputs by beneficiaries in the form of householder labour and materials in the construction operation and maintenance phases.

Socio-cultural aspects of sanitation

24. A sound understanding of socio-cultural aspects of sanitation at community, household and individual level is essential to ensure effective program design and subsequent successful implementation; this implies working in multi-diciplinary terms, and program design must include socio-cultural inputs throughout project life to enable sound implementation.

Communal Sanitation Facilities

25. Consideration has been given in many countries over the years to the construction of communal or shared facilities. With the exception of the well documented and unique "Comfort Stations" program in Ibadan, Nigeria and a number of Indian programs, communal facilities have either been a failure or have been rejected by the community. However since community facilities are substantially more cost effektive than individual household facilities, it is felt that their development should be explored further in African programs, such as programs in which each household has a private room with it maintains.

Beneficary Oriented Information Systems

26. The development of beneficiary and community oriented information systems is crucial to program success. It is generally agreed that health education is an essential complementary input to water and sanitation investments; emphasis is now placed on the development of broad-based information systems which will include health education and will:

- introduce the program to the community
- stimulate interest and encourage participation
- provide technical information and identify benefits
- identify financing mechanisms and sources of materials
- promote continuing facility use by all the family

A range of communication media are available for this including radio, cassette tapes, pamphlets and posters. Urban authorities, and "hardware" oriented authorities (Ministries of Works) have limited experience in this area; project design in future will need to strengthen these functions.

Cost Recovery

27. Policy and mechanisms for effective administration of water supply and sanitation cost recovery are in the formative stages in many countries. A common decision criteria has been that the monthly household financial cost of water supply and sanitation services should not exceed 5% of monthly household income. Low cost projects aim to deliver services to the rural and urban poor and by implication are aimed at households near of often below the poverty treshold; cost recovery policies for this population group are intrinsically difficult to develop and administer. There is little point in developing a cost recovery policy which requires effective institutions for implementation if these institutions do not exist; therefore, institution strengthening is considered a major project objective concurrent with the development of cost recovery policies.

Typical Program Components

28. From the work undertaken in the various countries, and experience to date in the sector it is concluded that a general structure for water supply and sanitation program development should include the following key elements:

- a central steering committee comprising the ministries of departments responsible for finance and planning, health, urban and rural development, water supply and sewerage;
- sound project management, technical assistance and site investigations,
- preinvestment assessment of socio-cultural factors, and beneficiary preference;
- information systems development and community dialogue;
- access to and delivery of building materials and mass produced components, combined with financing mechanisms;
- integration of design with sanitation related physical infrastructure development (particularly water supply, storm water drainage, and housing layouts),
- integration of program management with existing administrative structures (such as village or town councils),

- a monitoring and evaluation program,

- a program for briefing central government personnel, and training engineers, technicians, artisans and extension workers.

AREAS OF APPLIED RESEARCH

29. Applied research is needed in a number of areas, in both water supply and sanitation; significantly less has been done in sanitation than water hence the need is greater in this area. Some of the more significant areas which must be investigated if low cost sanitation programs are to proceed with confidence are discussed below:

Latrine Emptying

30. Latrine emptying is largely unresolved; there is no recent experience of emptying well engineered latrines and the recently developed twin pit latrines have yet to handle excreta (fully decomposed or otherwise) and in investigations done by the IDRC Research Project 1/ into the accetability of alternate sanitation systems, composting was rejected as being unacceptable due mainly to a reluctance to handle fresh or decomposed excreta.

31. In both urban and rural areas, latrines are currently moved when they are full; this is clearly uneconomic when they are well built, and also unacceptable to householders who have put substantial effort and finance into latrine construction . As urban plot sizes reduce 2/ it becomes both technically difficult and expensive to re-excavate pits and move superstructures. The development of twin-pit latrines will overcome the problem. The BRE (UK) is planning to evaluate pit emtying methods in Botswana, and TAG is planning to investigate this elsewhere; this work is crucial to the development of low cost sanitation.

Environmental Pollution Hazards

32. Extensive improvements of service levels of water supply and sanitation in developing countries can be undertaken if groundwater sources are substantially developed and low cost on-site systems of excreta disposal adopted. These two strategies are in conflict in that on-site excreta disposal will in many cicumstanced pollute groundwater sources. Insufficient is known at present about these potential hazards in developing countries, and consideration is beeing given in a number of countries to assessing the impact of on-site systems on the environment in general and groundwater in particular. The recent improvements in membrane filtration techniques (making them simple, inexpensive, reliable and rugged) together with more reliable methods of sampling (such as the Water Research Centre UK in-situ sampling device) has meant that the rigorous monitoring programmes needed can be relatively easily ndertaken. TAG is working with various governments in adressing this issue but much work still needs to be undertaken.

Small Bore Sewer Design

33. Small bore shallow flat sewers are a cost-effective solution to the removal of liquids from pour flush latrines and to carry sullage in areas with high water tables or impermeable soils. Little is known about their long term performance nor have firm design criteria been established and proven.

Ventilation of Pit Latrines

34. Ventilation dramatically reduces odour and insect problems usually associated with pit latrines, but the vent pipe is expensive. Field trials are required to optimize configuration, diameter, height and material and to test and verify theoretical models, establishing clear design criteria and confidence limits.

1/ The International Development and Research Centre of Canada undertook a Research Project into low cost Sanitation in a number of countires in 1976 to 1978.

2/ Site and serivce plots sizes in low income urban Africa have reduced from over 100 sq m in the early 1970's to currently under 200 sq m.

Pit Desludging Techniques

35. Double pit systems are preferable as they avoid the need to handle fresh excreta. However there may be many situations where single pits have to be used (in dense urban areas), where vault toilets have to be emptied frequently (in areas where on-site disposal of excreta is not possible) and where double pits need to be emptied mechanically (in areas of high groundwater). Many current pit desludging methods are unhygienic or damage the pit substructure. There is a need to test and evaluate a range of existing equipment and methods for pitemptying in a number of developing countries (cost-effective and acceptable technologies are likely to be highly country spesific).

Evaluation of Pour Flush Latrines

36. Pour flush latrines with either twin or single soakage pits have been found to be a socially acceptable and financially affordable form of sanitation; it is expected that a large scale sanitation projects using this technology will be developed over the next decade.
Technical and sociological performance data as a basis for planning these investments is very limited; this

data can be obtained however by rigorously evaluating a number of large scale sanitation projects in India which use pour flush/soakage pit technology.

Sanitation Entomology

37. Most of the technologies being proposed or implemented as appropriate low cost sanitation pose a definite risk of increased fly or mosquito breeding. Pit latrines of any kind (including VIP latrines) which have squat holes rather than a water seal are prone to massive fly breeding if the pit contents are dry and mosquito breeding if the pit contents are wet. Septic tanks and soakage pits are also major mosquito breeding sites. It is essential to know to what degree various designs of latrine (especially VIP and PF latrines) promote major fly or mosquito breeding and how such breeding may be controlled or eliminated at reasonable cost.

Septic Tanks

38. To permit lower cost solutions in higher density areas septic tanks should probably be multicompartmental, accept sullage and sewage in different compartments and possibly used in conjunction with upflow anaerobic filters. There are no rigourously tested design criteria for multi compartmental tanks. Little is known about the long term absorbtion capacity of drainfields in different soil types, for accepting either sullage or septic tank effluent.

Nightsoil Treatment Ponds

39. Performance data on waste stabilization ponds used for the treatment of nightsoil is limited. Reliable design data is essential for areas where a vault toilet system is likely to be extensively used or where sludge from VIP, PF or other on-site system needs further treatment.[1]

1. Twin pit technology will obviate this need.

"Palafitic" Area Sanitation

40. Many developing countries have extensive low income housing areas built on stilts over waterlogged ground. Excreta disposal is a formidable problem, and there is a need to develop and evaluate workable cost effective services for these areas.

Water Demand Management

41. The range of low-water usage plumbing hardware and relevant information on it which is available to developing countries is very limited. Current designs and design methodologies are based on high-income and hence high usage needs. More effective water usage through improved hardware (with possibly user education) will both make water more affordable and service a far larger portion of the community. Rigourous analytical data is required on low volume flush cisterns and pans, drain performance problems, flow limiting devices, simple taps and stop cocks, P and Strap design optimisation together with data on appropriate manufacturing methods with appropriate quality control.

CONCLUSION

42. While the need for improved sanitation and water supply in the developing countries is substantial, many Governments have a commitment to develop programs to meet these needs. Although sanitation developments are still in the formative stage, institutional structures and technical options are emerging which it is anticipated will prove successful.
Crucial to success in this new area of development will be continued high government commitment combined with sound planning, sensitive implementation and considerable support by mulitlateral and bilateral agencies. These efforts will produce effective programmes only if sustained householder commitment to programme development is achieved by culturally responsive design and implementation.

43. Recent work has highlighted specific areas where further applied research is needed in order to build on exiisting experience. The water supply and sanitation industry in Europe, both public and private sector is in a unique position to be able to contribute to this having a wide range of skills and experience readily available. Undertaking this work would represent a major contribution to the massive effort being planned by developing countries to meet the basic water supply and sanitation needs of their low income population.

Acknowledgements

The author would like to express his thanks to the many Government and Agency officials and to his colleagues in TAG for much of the information and ideas contained in this paper. The views expressed however are those of the author alone, as are the ommissions.

REFERENCES

1) WORLD BANK, "1979 World Bank Atlas", World Bank, 1979, 23 pp.

2) WORLD BANK, "World Development Indicators", World Bank, June 1979, 51 pp.

3) WORLD BANK, "World Development Report, 1979", World Bank, August 1979, 188 pp.

4) WORLD BANK, "World Atlas of the Child", World Bank, 1979, 39 pp.

5) AGIB, A.R.A., "Some aspects of Sanitation in the Sudan", Proceedings of Cairo International Regional Seminar on Sanitary Engineering, May 1979, 30 pp.

6) WORLD WATER, "International Drinking Water and Sanitation Decade 'Dossiers'", December 1978, July 1979, August 1979.

7) WORLD BANK, "UNDP Global Project GLO/78/006 Technology Advisory Group International Country Reports", various reports from November 1978 to January 1980 inclusive.

8) WORLD HEALTH ORGANISATION, "World Statistics Report", WHO, Vol, 29, No. 10, 1976. pp 543-603.

9) WORLD BANK, "Low Cost Sanitation Research Project Reports", Volumes I to VI inclusive; RES 22; Drafts, October 1978.

10) WORLD HEALTH ORGANISATION, "Sodium, Chlorides and Conductivity in Drinking Water" WHO ENRO Reports and Studies 2, WHO, 1979, 63 pp.

11) LEWIS, W.J., FARR, J.L. & FOSTER, S.S.D., "A Detailed Evaluation of the Pollution Hazard to Village Water-Supply Boreholes in Eastern Botswana", G.S. 10, Department of Geological Survey, Botswana, June 1978.

12) WORLD BANK, International Memorandum S.E. Daher, December 1977.

13) WORLD BANK, "Water Supply and Waste Disposal - Basic Needs", TWT Department, December 1979, Internal Draft.

14) Mara, D.P., Feachem, R.G., "echnical and Public Health Aspects of Low Cost Sanitation in Africa", Insitute of Engineers, India, Calcutta 1980.

16) WORLD BANK, Internal Estimate, December 1980.

FIGURE I

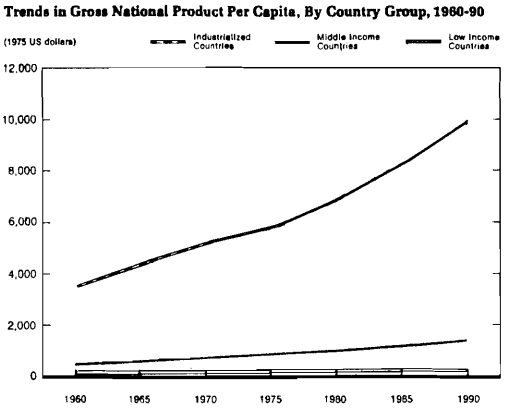


FIGURE II

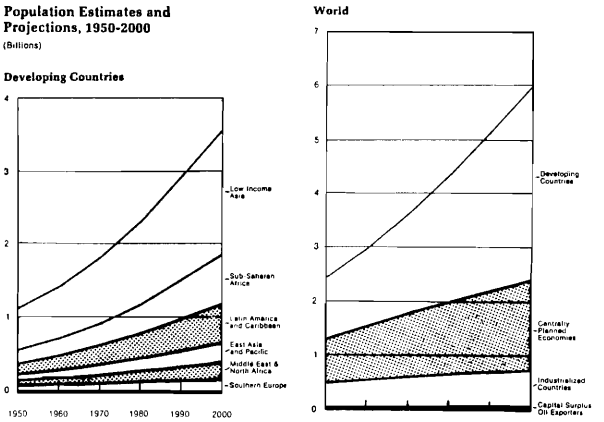


FIGURE III

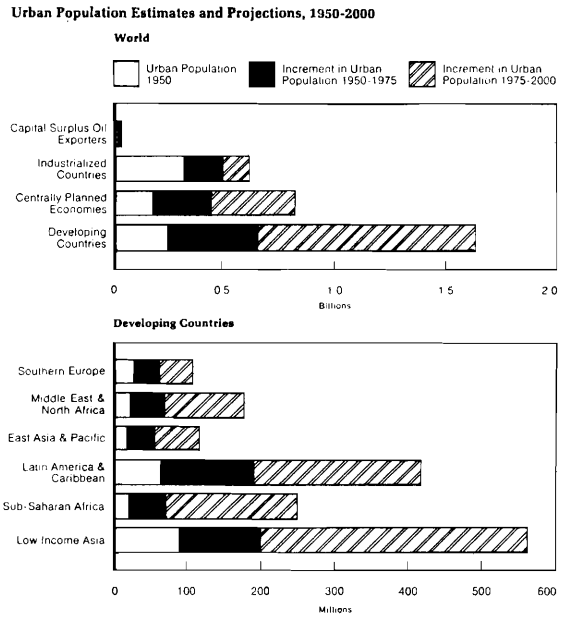
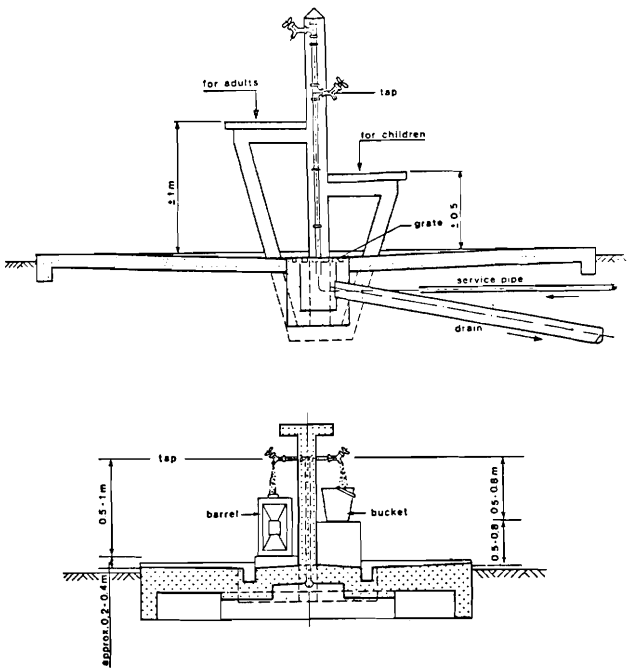
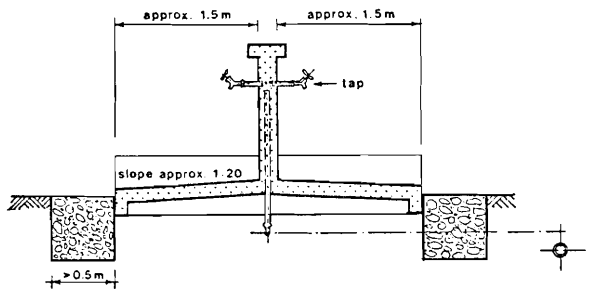


FIGURE IV

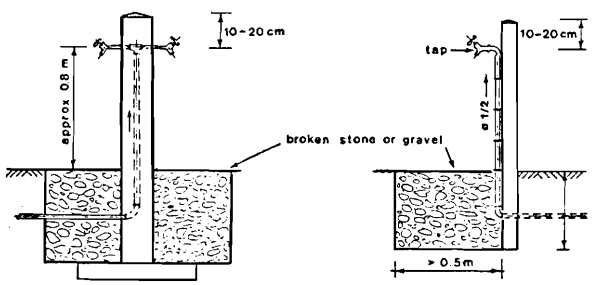


STANDPOSTS WITH RAISED PLATFORM
(a) to accommodate different categories of users
(b) to allow containers of different sizes to be used.

FIGURE V



A: CROSS-SECTION OF STANDPOST WITH TWO SCREW TAPS AND A CONCRETE PLATFORM

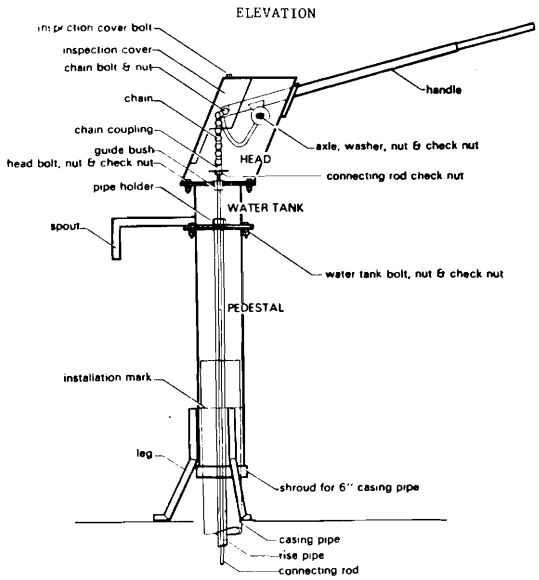


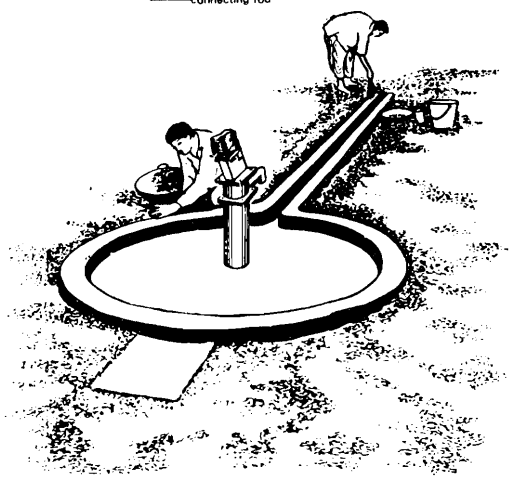
B: CROSS-SECTIONS OF SIMPLE STANDPOSTS TYPICAL OF RURAL WATER SUPPLIES

FIGURE VI

INDIA MARK-II HANDPUMP

TYPICAL DEEPWELL HANDPUMP



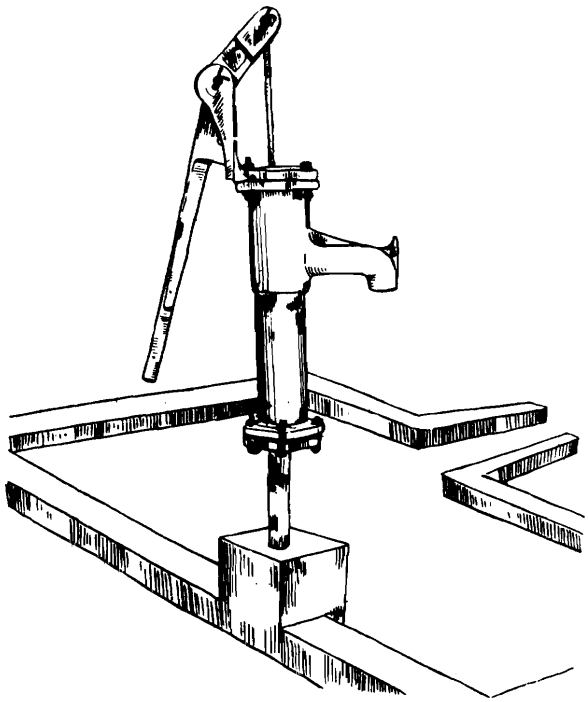


PLATFORM AND DRAIN

FIGURE VII

SHALLOW WELL HANDPUMP No.6

নলকূপের পাম্প মেরামত সম্বন্ধে জানবার বিষয়



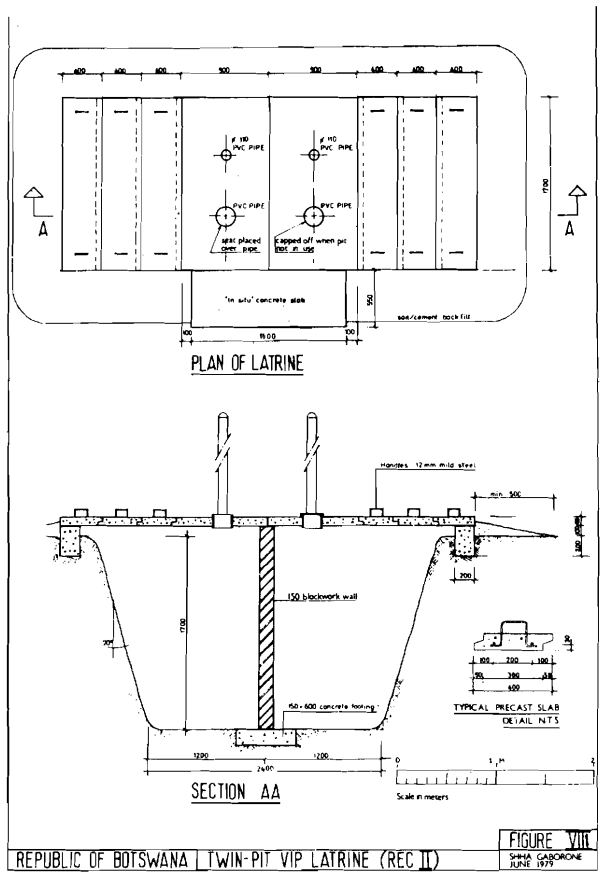


TABLE I

BACKGROUND DATA I

GEOGRAPHIC, DEMOGRAPHIC, AND ECONOMIC DATA

Country	Area square km	Population mid 1978	Population density Persons per sq km	% of Population that is rural	GNP per capita US $-1978
Botswana	570 000	0,7 m	1,23	85 %	620
Egypt	1 001 000	38,7 m	38,7	58 %	400
Lesotho	30 000	1,3 m	43,3	90 %	360
Nigeria	924 000	81,0 m	87,7	77 %	560
Ghana	239 000	11,0 m	46,0	n.a.	390
Sudan	2 506 000	17,4 m	6,9	85 %	320
Tanzania	945 000	16,9 m	17,9	88 %	230
India	3 288 000	643,9 m	195,8	80 %	180
Bangladesh	144 000	83,6 m	580,6	94 %	90
USA	9 363 000	218,4 m	23,3	-	9 700
United Kingdom	244 000	60,0 m	245,9	-	5 030
China	9 597 000	914,0 m	95,2	n.a.	460

Source: REF. 1, 2, 3, 4 and 7.

TABLE II

BACKGROUND DATA II

DEMOGRAPHIC, HEALTH AND SOCIOLOGICAL

Country	Life expectancy at birth-1977 (years)	Daily Per Capita Calorie Supply as % of Requirement 1974	Population per Nursing Person 1976 No.	% of children 0-14 years in total population 1975 %	2000 %	% of Age Group enrolled in Primary School 1976 %	Adult Literary Rate 1975 %
Botswana	44 (1975)	n.a.	n.a.	46	44	n.a.	n.a.
Egypt	54	113	1 150	41	34	72	44
Lesotho	50	99	3 780	38	39	100	40
Nigeria	48	88	3 210	45	46	49	15 (1960)
Ghana	48	101	860	48	45	44	30
Sudan	46	88	1 260	46	42	39	20
Tanzania	51	86	3 300	47	46	70	66
India	51	89	6 320	42	35	79	36
Bangladesh	47	92	53 700	47	42	83	22
USA	73	133	150	25	22	100	99
UK	73	133	180	24	23	100	99
China	64	99	n.a.	34	25	n.a.	n.a.

Source: Ref. 1, 2, 3 and 4.

TABLE III

LATEST ESTIMATES OF LEVELS OF SERVICE OF POTABLE WATER SUPPLY AND SANITATION IN VARIOUS COUNTRIES

Country[1]	% of Population with Safe Potable Water Urban	Rural	% of Population with[2] Adequate Sanitation Urban	Rural
Botswana (Ref.7)	90 %	28 %	30 % to 50 %	less than 25 %
Egypt	80 %	50 %	n.a.	n.a.
Lesotho (Ref.7)	65 %	14 %	51 %	2 % to 17 %
Nigeria	n.a.	n.a.	n.a.	n.a.
Ghana (Ref. 6)	86 %	14 %	95 %	40 %
Sudan	40 %	45 %	less than 10 % (Ref.5)	less than 30% (Ref. 5)
Tanzania (Ref.2)	88 %	36 %	n.a.	40 %
India	83 % (Ref.7)	20 % (Ref.7)	87 %	2 %
Bangladesh	15 % (Ref.7)	55 % (Ref.7)	40 %	5 %
USA	100 %	100 %	100 %	less than 100%
United Kingdom	100 %	100 %	100 %	100 %
China	n.a.	n.a.	n.a.	n.a.

Note:

1) Unless indicated otherwise, source is Ref. 8.

2) "Adequate" is the definition used in compliation of official statistics. It does not imply that the sanitation facility is sufficient in terms of current TAG thinking.

2. Population to be served 1/

	Population Without Service (millions) 1975 Water	Sanitation	1990 Water	Sanitation
Urban	127	144	638	651
Rural	1 106	1 210	1 569	1 673
Total	1 223	1 354	2 207	2 334

3. Investments Required 2/

		Unit Cost $/cap.	CASE 1 Pop. %	Served No. (mill.)	Cost $ US (bill.)	CASE 2 Pop. %	Served No. (mill.)	Cost $US (bill.)
Urban Water Supply	hc	120	70	447	53,6	40	255	30,6
	stp	40	30	191	7,6	40	255	10,2
Sanitation	sew.	250	40	260	65,0	25	163	40,0
	sept.	100	40	260	26,0	15	98	9,8
	Lat.	30	20	131	3,9	40	260	7,8
					156,1			98,4
Rural Water Supply	hc	150	20	313	46,9	10	157	23,6
	stp	40	40	628	25,1	30	471	18,8
	hc	25	40	628	15,7	40	628	15,7
Sanitation	sew.	250	20	335	83,8	10	167	39,2
	Lat.	20	80	1338	26,8	70	1171	23,4
Sub Total Rural					198,3			120,7
TOTAL URBAN AND RURAL					354,4			219,1

1/ Calculated from information contained in UN Document E/CONF. 70/14 "Report on Community Water Supplies".

2/ It should be noted that 100 % urban coverage using water supply house connections and sewerage only (i.e. no appropriate technology) would cost $ 329.4 billion rather than the $ 156.1 billion calculated with a mix of technologies.

TABLE IV

ALTERNATIVE SANITATION TECHNOLOGIES

Financial Requirements for Investment and Recurrent Cost per Household

(1978 $)

	Total Investment Cost [a]	Monthly Investment Cost [b]	Monthly Recurrent Cost	Monthly Water Cost	Hypothetical Total Monthly Cost [b]	Percent of Income of Average low Income Household
	(1)	(2)	(3)	(4)	(5)	(6)
Low Cost						
Pour flush toilet	70	1,5	0,2	0,3	2,0	2
Pit latrine	125	2,6	-	-	2,6	3
Communal toilet [d]	355	7,4	0,3	0,6	8,3	9
Vacuum truck cartage	105	2,2	1,6	-	3,8	4
Low cost septic tanks	205	4,3	0,4	0,5	5,2	6
Composting toilet	400	8,3	0,4	-	8,7	10
Bucket cartage [d]	190	4,0	2,3	-	6,3	7
Medium Cost						
Sewered aquaprivy	570	7,1	2,0	0,9	10,0	11
Aquaprivy	1 100	13,1	0,3	0,2	14,2	16
Japanese vacuum truck cartage	710	8,8	5,0	-	13,8	15
High Cost						
Septic tanks	1 645	14,0	5,9	5,9	25,8	29
Sewerage	1 480	12,6	5,1	5,7	23,4	26

SOURCE: Ref. 13

a/ Including household plumbing as well as all other on- and off-site system costs.

b/ Assuming investment cost is financed by loans at 8 % over 5 years for the Low Cost systems, 10 years for the Medium Cost Systems and 20 years for the High Cost Systems.

c/ Assuming average annual income per capita of $ 180 and 6 persons per household.

d/ Based on per capita costs scaled up to household costs to account for multiple-household use in some of the case studies.

Investments Needed to Achieve
Drinking Water and Sanitation Decade Targets

1. Assumption

(a) Unit Costs

Water Supply,
- Piped System with House Connccetions (Hc) 120$/cap
- Piped System with Standpipes (stp) 40$/cap
- Rural Piped Water Supply with hc 150$/cap
- Rural Piped Water Supply with stp 40$/cap
- Rural Handpumps Water Supply hp 25$/cap

Sanitation,
- Urban Waterborne Sewerage (sew) hc 250$/cap
- Urban onsite with (i) Septic Tanks (sept) 100$/cap
  (ii) Pourflush latrine or Communal Latrine (lat) 30$/cap
- Rural Waterborne with hc (sew) 250$/cap
- Rural Onsite with lat 20$/cap

(b) Service Levels

Case 1 (100 % coverage using 1980 WHO Target Urban Service Standard Distribution)

Urban — Water Supply: 70% hc, 30% stp

Urban — Sanitation: 40% sew, 40% sept. tanks, 20% lat. & communal lat

Rural — Water Supply: 20% hc, 40% stp, 40% hp

Rural — Sanitation: 80% sew, 20% lat

Case 2 (80% coverage with service standard as suggested)

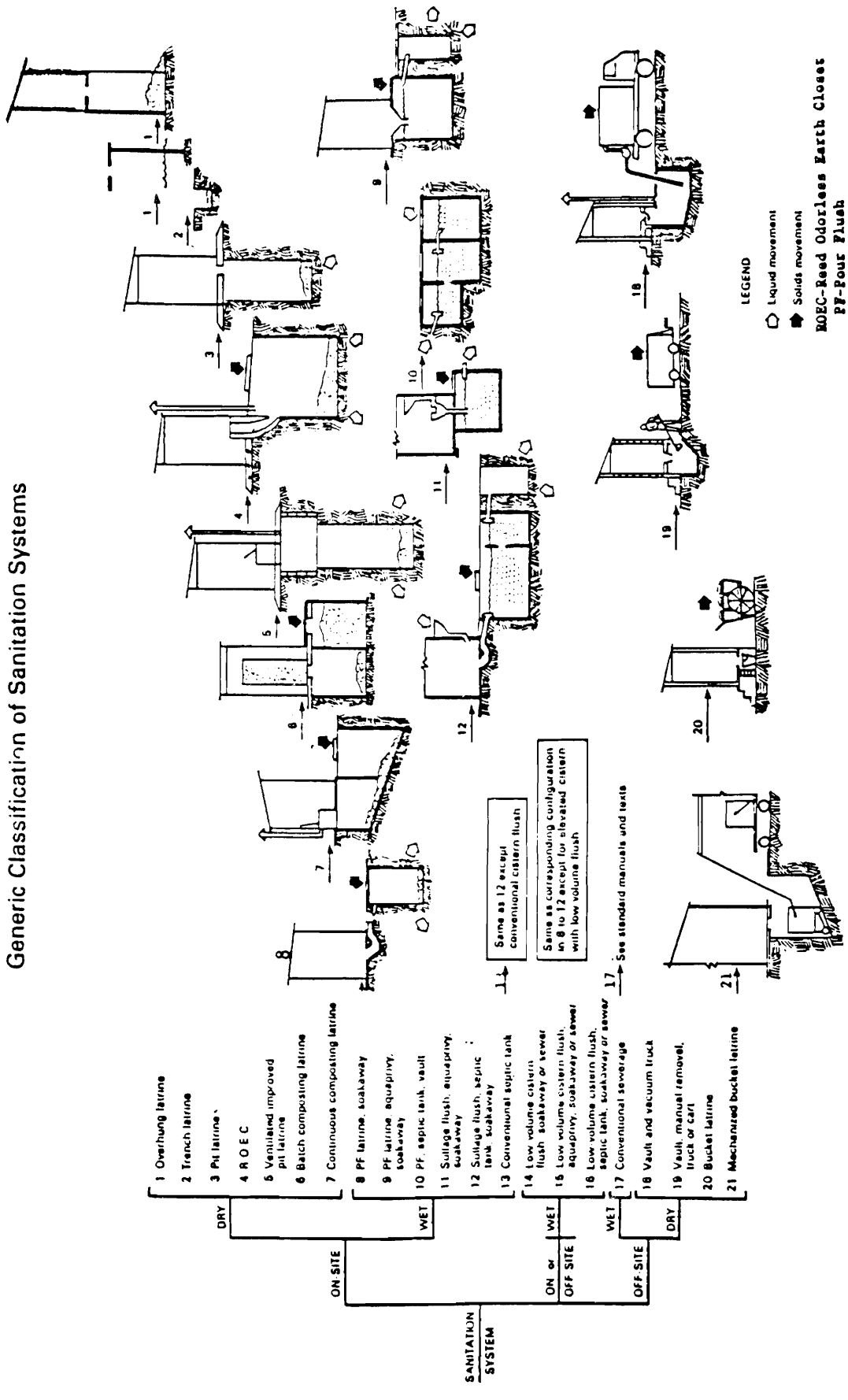
Urban — Water Supply: 40% hc, 40% stp

Urban — Sanitation: 25% sew, 15% sept. tank, 40% lat & communal lat

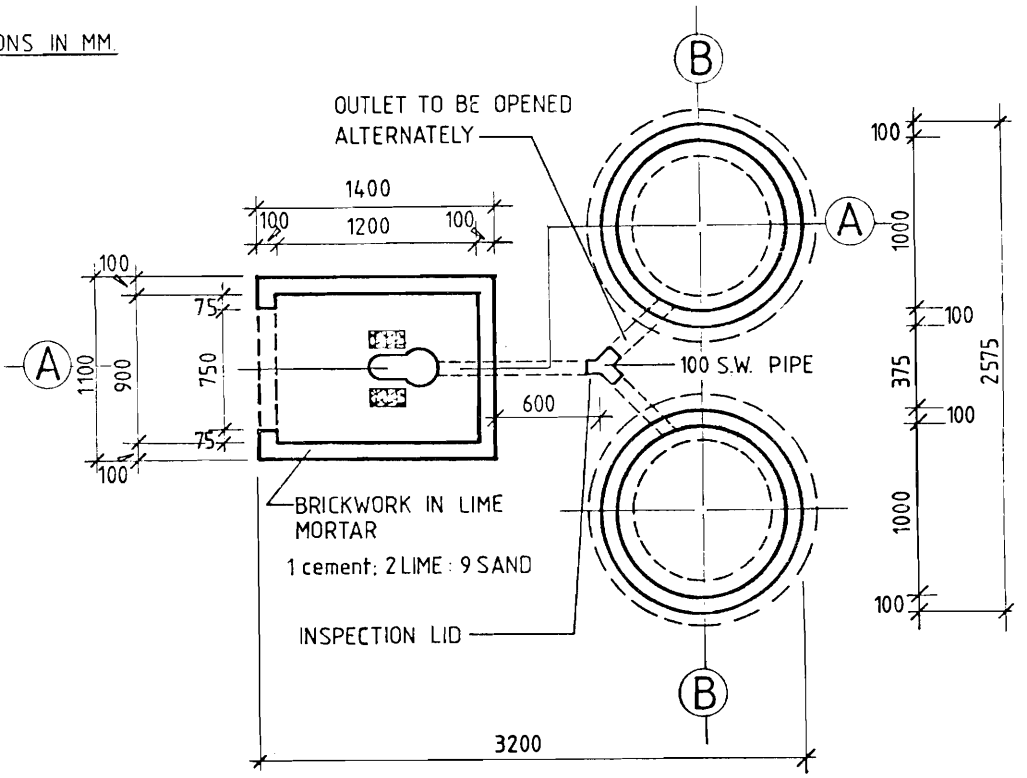
Rural — Water Supply: 10 % hc, 30 % stp, 40 % hp

Rural — Sanitation: 10 % sew, 70 % lat

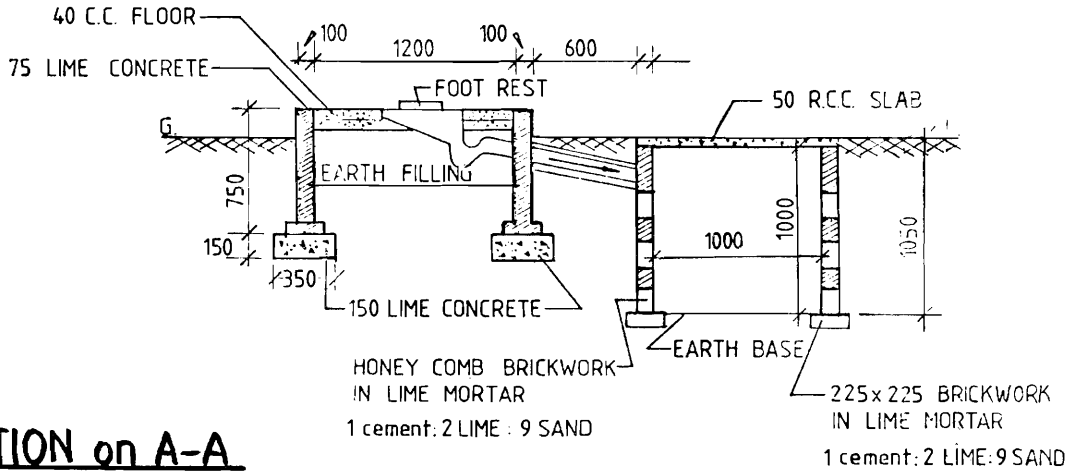
FIGURE X


Generic Classification of Sanitation Systems
SANITATION SYSTEM
ON SITE
OFF SITE
ON or OFF SITE
DRY
WET
1 Overhung latrine
2 Trench latrine
3 Pit latrine
4 ROEC
5 Ventilated improved pit latrine
6 Batch composting latrine
7 Continuous composting latrine
8 PF latrine, soakaway
9 PF latrine aquaprivy, soakaway
10 PF, septic tank, vault
11 Sullage flush, aquaprivy, soakaway
12 Sullage flush, septic tank soakaway
13 Conventional septic tank
14 Low volume cistern flush soakaway or sewer
15 Low volume cistern flush, aquaprivy, soakaway or sewer
16 Low volume cistern flush, septic tank, soakaway or sewer
17 Conventional sewerage
18 Vault and vacuum truck
19 Vault, manual removal, truck or cart
20 Bucket latrine
21 Mechanized bucket latrine
Same as 12 except conventional cistern flush
Same as corresponding configuration in 8 to 12 except for elevated cistern with low volume flush
See standard manuals and texts
LEGEND
Liquid movement
Solids movement
ROEC-Read Odorless Earth Closet
PF-Pour Flush

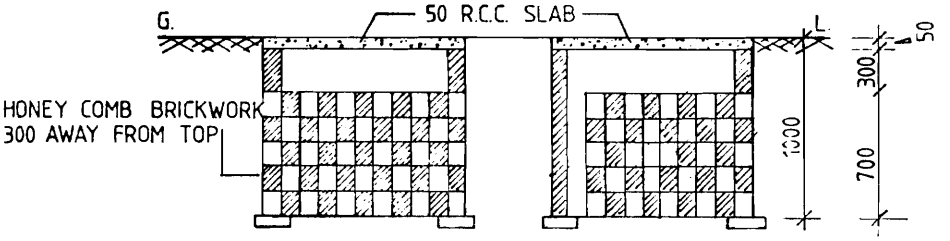
ALL DIMENSIONS IN MM.



PLAN



SECTION on A-A



SECTION on B-B

POUR-FLUSH LATRINE FIG. IX

TAG / UNDP / INDIA FEB 1980

SUBJECT
SUJET

4C

Timber structures and modern wooden housing

Chairman: T. VIHAVAINEN

Constructions en bois. Habitations modernes en bois.

Président: T. VIHAVAINEN

Report from Section 4 - Subject 4C:
TIMBER STRUCTURES AND MODERN WOODEN HOUSING

Key-note speaker: K. Thomas
Invited paper: K.V. Koslov and A.Y. Lemke
Invited paper: Å Hallquist and T.Ø. Ramstad

The first subject for discussion was the use of grouping system for the structural utilization of timber from multiple species forest.

F.A. Blakey, Australia, gave a short introduction of the subject. He stressed that grouping system was of great importance for countries with tropical forests. Tropical forests are large and an important resource both for local use and for export. Theese forests are multispecies and it is quite impractical to extract only one specie of timber. Even if the timber is given a specie name it is almost certain to be a mixture of species.

In Australia experience of multispecies forests has led to the development of the grouping system described in the paper (see proccedings vol 1b). The example given in the paper is based on strength, but it has also been possible to device system based on durability and shrinkage.

The keynote speaker Mr. Thomas has asked about the waste through inefficient use that might arise from the use of the system. There certainly must be some ineffiency, but by experience it is small. About half of the timber members in a house is determined by stiffness or buckling, criteria not sensitive to grouping. The waste is more than balanced by the advantage which arise because of the freedom given to designers.

The use of the grouping system is very similar to the system of stress grades used in specifying steel and concrete and should therefore be readily accepted by the designers.

Hasan Nawab, Pakistan, said that the numerous species and subspecies of timber used in building construction raised very serious problems. The stresses differ widely in many framework and the strength is dependent on the weakest member. If this member happened to be of an unknown specie the probability of failure might increase.

K. Thomas, U.K. The british draft code proposes eight groups to cover the whole range of timber included in the standard, which means considerable simplification for designers as the current code includes over 200 species.

P.K. Foster, New Zealand, agreed that strength was important property, but to use only this property could be an oversimplification. In many cases the following properties matter more than strenght.

a) Stiffness
b) Stiffness of connections
c) Strength of connections

I. Webster, New Zealand. The failure under extreme conditions usually involves broken connections rather than broken members, and that stiffness rather than strength tends to govern the design of timber structures.

When many alternate load paths are available, the "weakest link" consept ceases to be valid. After all, stresses are usually based on a 5 % exclusion limit.

The most important structural elements are typically the roof and floor diaphragmas which transfer lateral loads to the brazing elements.

S.K. Malhorta, Canada, complimented Dr. Webster for his well organized paper on the design of timber structures in inelastic range under dynamic loads. He noted that a number of research projects are under way in New Zealand and added that a significant research activity has been initiated in Canada and USA.

G. Iizuka, Japan, gave a review of his paper on effictive use of small logs and showed colour slides of different constructions. The use of small logs is important for the Third World because of decreasing availability of large timber sections.

Hobbs, U.K., asked the following questions:

1. Why do norwegians limit timber houses to two stories for fire reasons when in New Zealand much higher houses are allowed?

2. Has Mr. Webster any worries or experience about corrosion of gadges when embedded in insulation?

3. How to ensure that vapour barriers are not penetrated by e.g. plumbing and electical services?

Mr. Hallquist, Norway, simply stated that the norwegian building code limit timber houses to two storeys.

I. Webster, New Zealand, was worried about corrosion of gang nail, especially when placed in green timber. How will the peform in 20 years time.

K. Thomas, U.K., answered that corrosion seems not to be a serious problem. This statement was based on investigations carried out in U.K.

S.K. Malhorta, Canada, gave more details of his paper on nailed laminated timber constructions. He stressed that this type of construction can be undertaken, for the most part, using unskilled labour and most rudimentary carpenters tools, thus lending it very well to the socio-economic conditions of developing countries. Furthermore, the process could be used to train carpenters on the job, starting from simple nailing assignments to more sophisticated ones.

The use of nailed laminated timber in Canada has decreased and the gluelam has taken over because it is more economic although it require more sophisticated factories.

SUBJECT
SUJET

5A

Building documentation, information and local demonstration projects in developing countries

Chairman: Ø. BIRKELAND

Documentation concernant le bâtiment, information et démonstration de projects locaux dans les pays en voie de développement

Président: Ø. BIRKELAND

Report from section 5 - subject 5A:
BUILDING DOCUMENTATION, INFORMATION AND LOCAL DEMONSTRATION PROJECTS IN DEVELOPING COUNTRIES

Key-note speaker: G.C. Mathur

Altogether ten members of the congress took the chair to respond to the key note speaker G.C. Mathur or to comment on their own submitted papers. Finally G.C. Muther made some concluding observations on basis of the discussion.

The written contributions (nine) are printed below.In some cases they do not correspond to what was said during the discussion, but are much more elaborate. We have, however, chosen to print what was submitted.

Mr. Michael Munday
Construction Information Education Project
University of Stratchclyde
131 ROTTENROW GLASGOW - UNITED KINGDOM

May I make an observation about CIB's possible future role in building information in the so called developing areas of the world ? It is one which emerges from points made in a number of papers in this and the other 'Group 5' sections.

As we all know (not least from the work of CIB information-related Working Commissions over many years, eg the late W52, W57, W65 and hopefully the new W74) information in building can be regarded in one sense as having two complementary dimensions.

One is the USER dimension - where they are concerned with information as a dynamic element central to the management of the design and construction and use of building projects. As such it clearly has a key place in the technological core education and training of those who design and those who build, in whatever country.

The other dimension is that of information PROVIDER, where the concern is about documents, libraries, information centres, databanks, - the acquisition, storage and dissemination of building data and litterature in general.

In programmes of resource transfer from one end of the world development scale to the other, it is this latter dimension that - understandably, inevitably and perhaps rightly - is the focus of increasing national and international effort. The work of UNCHS, UNISIT/GPI, UIA/ARKYSIST and CIB/CIBDOK to name but a topical few are witness to this.

Although all such programmes are given and welcomed on a relatively high level of research and practice based expertise drawn from the developed end of the scale, they all at least purport to help out, at a level that participant authors Volbeda and De Vries, Hegdal, Gaspar and Terrebessy and Turner, in their own ways, describe as being the first phase or level, the 'grass roots', end of this scale.

Movement of course takes place in convergent directions along the development scale, but as Mr Svensson reminded us in the opening Plenary Session, it takes place very slowly. From one end bureaucracy and a shortage of expertise hold things up. From the other, the non-expert end, where the need is greatest and the numbers multiply rapidly, the problems is one of education at its most fundamental.

What is required at this 'mass user' level, - what Mr Mathur has just described as application, self-help or extension work - is not the documentation as such, but information transfer in the learning sense. The task is to meet a widespread need with translated and distilled local and imported experience, disseminated through visual educational media like posters, wall charts, talking and television.

Tanzanian-type 'work units', 'Roving Seminars' and TV-graphics etc., are likely to be better indicators of experience in use than lists of books and papers, but they need education as much as information-type skills to produce.

For both these dimensions of 'building information in development' then EDUCATION seems to be a common factor. It is of course one which the Brandt Report identified as a main area for resource transfer. I would suggest that if CIB is to participate in development programmes in any way it must be ready to embrace this role and link up with building education resources.

Certainly CIB Member Institutions and Working Commissions will not be able to avoid and educational element in this kind of work. Nor will they be able to dodge the political element which exists, and which Tehranian* writes about so well, when INFORMATION and DEVELOPMENT are brought together.

A recognisable CIB framework in which these and similar building information problems (pertinent to both the developed and developing world) can be worked on together by all contributors is, I suggest, a first and urgent priority.

* Tehranian, M.

Development Theory and Communications policy - the changing paradigms, in Progress in Communication Sciences, Voight & Hammerman (Eds), Ablex J. 1979.

Mr. Moses D. Mengu
Building and Road Research Institute
University
Kumasi - GHANA

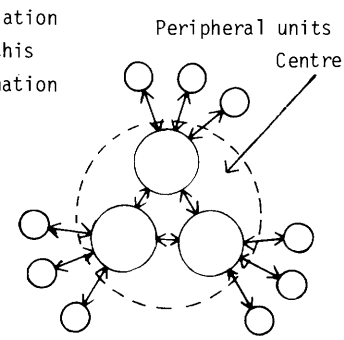
The information problems of the developing countries are now well known. Basically, they are problems relating to manpower (expertise), management and money (The 3 "M's"). Attention must now be turned to a demarcation of these problems within the context of the individual countries through case studies such as contained in the papers on Turkey, Tanzania and Ghana. This will enable prospective partners in the developed countries to clearly define the form of assistance that will be required. In providing assistance attention must be paid to training of local information workers who will be the principal recepients of any assistance in terms of equipment, finance and ideas. This trained cadre of information workers will eventually ensure the continued viability of any information systems that may be established after the withdrawal of foreign assistance and aid.

Dr. Mustafa Pultar
Faculty of Architecture
Middle East Technical University
Ankara - TURKEY

I have a remark on the structure of the international information network and a question to pose to the participants.

1. REMARK - The international information system is best explained by a centre-periphery model where information generated or used by the periphery (developing countries) is processed by the centre (industrialized countries). Really pertinent knowlegde generated in the periphery, may not flow in the periphery unless it is also of pertinence to the centre. (Figure on overhead projector).

2. QUESTION - What sort of international organization would be able to alter this structure so that information may also flow between peripheral units ?



Dr. Techn. Ingvar Karlen
Royal Institute of Technology
Stockholm, Sweden

The CIB work in the field of information and documentation is extending.
As a result of proposals from CIB W52 'Building information' as well as from discussions within W57 a study group Information Study Group has been created within CIB for a time scheduled work. Those activities of W52 which were related to rules & tools for building information are directly continuing in the new working commision W74 Information coordination for the building process.

The study group which starts its work now has the following objectives

1. To consider the whole information field within CIB with particular reference to the work areas and interrelationship of the two existing Commissions and the needs of other CIB Commissions.

2. To make recommendations from time to time, and perhaps on a long term basis, as to how any defined need or field should be dealt with e.g. by either of the existing Commissions or by a new Commission or an ad hoc Study Group - or perhaps not at all.

The study group comprises the coordinators of W57 and W74 Mr. Stoddart and Mr. H. McDonagh and the co-ordinator of the former W52 J. Karlén together with Mr. B. Johnson, dr. Kunszt and Mr. H.P. Sundh

The group has to report its work within 12 max 18 months.

As this session must be the place to report about projects which are organized jointly between the Royal Institute of Technology Library and National scientific and Technological information and documentation services in Portugal, Tanzania and Sri Lanka, bared partly upon the principles, methods and direct assistance by a computerized system for Selective Dissemination of Information (SDI) at the Information and Documentation Centre (IDC) at the Library (using EPOS-VIRA = Profile handling program for a search system for the SDI service at IDC-RITL).

The projects embraces for instance

- education in information service
- instruction of computerized current-awareness services
- establishment of contracts with supplies

of interactive retrospective services
- union catalogue of periodicals
- establishment of contacts with international organizations etc. in the field of information service
- creating of a reference library in the field of information service

One is aiming at getting a responsible centre which currently can give I & D services to research and development in a country by help of modern methods. Thereby is acknowledged that the aim of an information centre is to give the right information to the right person at the right time. "One way of doing this is by finding references to literature. But the work is not finished there; the full service is to be identified and found" (From the Portugal project). In the Tanzanian project was recognized three distinct rates for a Tanzania Research Information Service to perform ensuring the execution of the tasks to provide information services such as compiling bibliograhpies on specific subjects on demand or providing current awareners services eg SDI and to collect, compile and make available research information genereated in Tanzania

a) the rule of a national focal point which is to co-ordinate local services and servences and provide channels for contacts with international services etc as well as to promote the formulation of national policies
b) the role of an operative agency providing certain services directly to users.

c) the rate of a funding agency which makes resources available to existing or planned local information services *

The following conditions are referred (dec. 1979): any information service on and for R & D in Tanzania will for the immediate future mostly have to rely upon existing library resources and the use of traditional manual methods.

For a Tanzanian Resarch Information Service the following tasks and roles are mentioned:

a) be the international focal point in S&T information and documentation with a co-ordinating function for information services in research and development in Tanzania;

b) make scientific and technical information and documentaion produced locally as well as in foreing countries accessible to national users;

c) promote the international dissemination of scientific and technical information produced nationally;

d) support scientific and technical activities in bibliographic information and documentation work,

e) disseminate new techniques and promote standardized methodology;

f) maintain necessary relations with foreign information and documentation centres and services;

g) facilitate the acquestion of needed documents not available in the country;

h) co-operate with similar institutions in other countries;

i) promote co-operation between libraries and information services in the country;

j) promote and participate in training and continued education of professionals in information and documentation work;

k) promote general awareness of the increasing importance of research and development (and the corresponding information produced) as a resource for the social, economic and technical development in the country;

l) ensure availability of, and access to, books, journals, reports and other documents of interest to research and development in Tanzania;

m) promote the utilization and further development of information services;

n) pursue research and development in the field of information sciences in co-operation with others;

o) perform and maintain evaluation of library and information services.

In performing the roles and carrying out the tasks indicated above, a Tanzanian Research Information Service (TANRIS) could:

a) offer bibliographic information services relating to research and development;

b) ensure the cataloguing of reports and other documents produced in Tanzania related to research and development;

c) compile, publish and maintain inventories of 1. research and development projects;

2. research institutions and their facilities and personell;
3. information and documentation services and resourches in Tanzania.

d) produce bibliographies of literature in areas of special interest to research and development in Tanzania;

e) promote and facilitate the acquisition of books, journals, reports and other documents necessary for the activities of the service ;

f) sponsor seminars and conferences in the field of information science;

g) assist TNSRC in the evaluation of research projects and proposals;

h) accomplish any other task within its mandate pending the approval of TNSRC.

The work in Sri Lanka concerns advices on improvement of existing information services and advices on the application of modern techniques in information storage and retrieval, on collaboration with other libraries and information centres. Further the project comprises preparation of training programmes and related activities. A bilateral programme is developed between the Sri Lanka Scientific and Technological Information Centre and the RIT Library, whereby eg RITL is to provide computerized current awareness searches and retrospective (on-line) searches for S&T projects in Sri Lanka. Some obstacles in development of a centre to an international "standard of excellence" are reffered to under a heading of the'small system syndrom" which is referring to the Sri Lanka project.

The Portugal project and the Tanzania project get support from SIDA and its Agency for Research Co-operation with developing Countries (SAREC) and the Sri Lanka prosject was related to UNDP and UNESCO. Information is available in reports from RIT Library. I have got the permission of the Head Librarian of RIT, Dr. S. Schwartz to inform about the projects. Working in the field of Architecture at the RIT, being member of the Council of the RIT Libraries, being active in the creation and first year of Bygdok and acting in CIB I am anxious to find ways to get closer connections between the general developments for S & T and the development in the building field, and to find ways for closer relations to education eg in universities.

Dr. Schway states in Journal of Documentation March 1976 that the technical university library "is in fact not in any strict sense an information centre for industry", but "has specific important functions in a network of Scientific and technical Information Systems and Services which co-exist in a knid of symbiotic or feed-back structure.

I want to refer to two other Swedes who have made substantial contributions to international development work in the field of information. Dr. Bjørn Tell, earlier Head Librarian of RIT and now Head Librarian at University of Lund expresses in the journal of information review in article 1980:1 about The awakening information needs of the developing countries the problems of the usual approach to set up a centre to assist a country and bring the attention to the power of new information technology.

In recent years the new information technology has completely changed the traditional way of gathering, retrieving and disseminating scientific and technical information in the industrialized countries. The advent of computers, electronic communications networks, and huge databanks have contributed to closing the information gap which was earlier thought to be unavoidable because of information overflow. In many Western countries, using terminals in libraries and information centres is a daily routine. The tapping of a database in Italy or California is now performed in the same building or on the same campus. Online searches in the world are up to more than two million terminal hours a year to the 500 databases which are publicly accessible and the immediate yearly growth of use is expected to be 30 per cent.

It has been said by leading personalities of the non-governmental organisations that the new technology and the use of computers for information retrieval and the like is not yet suitable for the developing countries. Instead, it is claimed that those countries should build up a meticulous infrastructure of service organisations by emulating the traditional libraries and documentation centres of the industrialized countries. Such a task is commendable but does not take into account the time factor, nor the shortage of personnel, premises and material.

A closer examination shows that such a view is untenable. Demonstrations of online searches made by the European Space Agency and Unesco in countries as Morocco, India and Kenya, show an interest and a growing demand for online retrieval services among the developing countries.

The demands of the developing countries cannot be ignored any longer when it comes to the development of modern information and communications systems. Instead, the needs expressed by these countries should receive priority attention by Unesco, UNIDO and other organisations. It is therefore necessary to improve Unesco's activities within the UNISIST program so that mechanisms are set up in the developing countries to connect them with the information networks. So, emphasis must be placed on the structure of such mechanisms in contrast to traditional services. That is where computers and communication technologies come in to provide a basis for a new information

infrastructure which will permit the transition from "present, essentially static information as represented in books, journal articles and other printed matter to dynamic information in electronic form" [5]

Bjørn Tell draws some conclusions:
It should be emphazized that the infrastructure of information services suitable for developing countries is a matter for international concern. The timescale needed to build a structure of traditional libraries and information centres, however commendable and attractive that idea may seem to Westeners, is such too long in most cases due to the acute shortage of resources, premises, trained staff, etc.

Dr. Kjell Samuelson responsible for the programme of information and systems science at at the University of Stockholm and RIT brings in a paper ' communicating within a world system' 1974 based upon a UNESCO coundtancy project attention to the same kind of problem, form which I refer:

> "International computer communication, teleprocessing and "compunications" are feasible today on a worldwide basis. It is no longer a technical problem although there are many technological details that need to be improved through actual experiments and pilot projects. The constraints against progress are rather of socioeconomical nature ".

> "A basic philosophy should be, not to transpose yesterdays mistakes and outdated technology or information handling, practices to developing countries. Instead the applicability of lowcost minicomputers that can be interconnected already existing telex facilities have not been utilized in full extent mainly due to lack of financing. The technology is one asset which should be utilized for "living and learning" within the network project".

The organizational functions of the "Information Network for Scientific, Techno-Economical Communication" is based on the following elements:

- Information Flow Nodes and Centres
- Universities
- Computer facilities
- Telecommunications
- Continous Education and Training in Information Science
- Professional Associations
- On-going Projects and Developments within the Region

These would all benefit from improved information transfer and communication in a multitude of directions. During the first project mission the resources and plans of several organizational contributions toward an information network have been described. The next project phase would include the formalization of information flow patterns and launching of pilot projects.

Samuelson brings the attention to effective information management.
The second missing factor is effective information management. Since the whole field of information science and technology is still emerging it is quite understandable that its applications have not been taken advantage of. More prevalent is the "poor management" of the information that exists or is being implanted. There is little use in "dumping" current information into storage buildings or repositories unless it can diffuse across institutional barriers and national boundaries along elaborated channels. This requires the identification of holdings and interest areas as well as the education and training of "information managers" with a qualified background in information science.

Concerning Infrastructure Samuelson states:
The Information field is multidisciplinary and therefore multidepartmental. Even a specific subset such as Scientific and Technological information of value for Economic Development will tend to cross several departmental borders and should be of prime concern to three or sometimes five different ministries. The relevant ministries are foremost those of Science & Technology; Education; Industry, Communications, Agriculture, Fishery, Health, National Development, etc. and bear different names for each country. The appropriate infrastructure may best be thougt of as a subnet built from interlinkage of information activities supported by those ministries and their non-governmetal counterparts. Sometimes a concept termed "focal point" is used which was inherited from OECD and recommended by UNISIST. It should be stressed, however , that the meaning of "focus" actually stands for voluntary coordinated mechanisms and local networks that would require support from a few ministries. The word "focus" was never meant to be identical with a single national institute, building or centre . The multiministerial participation will have to be promoted to avoid overlap of efforts, as well as in order to take advantage of the valueadded nature of information networking and communication improvements "per se'. The approach to take is that information must be treated as a flowing resource, not as waste for disposal or archival deposit. Only then can "truly Economical Development" become Effective and Economical.

In one of the reports to the mission to Portugal 1976, are mentioned three aspects on information services.

1. a basic distribution can first be made between the need for current awaceness services which keep the scientist or researcher aware of the current situation in his area of research and interest, and retrospective services which give him the possibility of finding out what

has been done earlier ... The volume of research and correspondingly the volume of information makes the volum mangeable only through the utilization of computers.

There is often an intermediary, an information officer or documentalist, between the uses of the system and the system.

2. The special distinction to be made is the difference in providing someone who has requested information with a reference or with a document or into the requested information .. Good library services are a fundamental prerequisite for modern information services...

3. A third aspect is the organizational and administrative context, its structure and components. The context of research and information services (incl. the relation to the library system) and the relations between these have critical influence on the fate of information services, and in the long run on research. Included in this aspect are aslo the economics of information services.

We know from several discussions in the CIB context about the problems of information input overhead, the input to the databases and the input to the customers. Principles for selections are required. But also the access to information stores by help of the language as a tool for communication must be carefully studied.

Intermedias are converting the custumers search work to terms which are precise enough so that a system can performe a precise retrival. Q. A. Winhlor i TD 1980:2 We have various languages, not least are the languages used in education. The international use of nationally pershueed information with existing language barriers create as we know difficulties. "ABC" creates one of the tools, creating a classification which can help us over the language barriers. Universal systems require organization for succesive revision.

During certain years CIB W52 (the earlier) made a lot of work for consiliation of thesauri and published two reports. Those thesauri concerned the normal references to articles in periodicals, research reports etc. but not information related to the building prosesses directly as eg product information and not research planning and stering, and not regulations. When we ask for information at various nodes in communication networks, they have to use various thesauri and similar tools in the search. When we apply at hue search as well as batches a better economy could be possible if we know which therausis is used by the database concerned, by the indexes and may be also by the authors. I have discussed a lot of these matters with the core of a thesauris centre in Stockholm created by Dr. K. Malmsten. He is eg collecting information about existing therausi. Certain recommendations for the uses of various databases. could be given already now in connection with a revision of the mentioned reports. This is only an advisory step. A lot of work is in front of us to support the solutions of the communication problems between the searcher for information and the inforation braker or inter mediary, particulary in a situation when the substantial part of the output through databases is pershution-oriented and not user-oriented and when diverqueeses are created to support competition . We have to review classification systems, therauri, free text search, common indexing rules, automatic switches, etc. and be prepared to do a system oriented development work and at the same time apply the facilities which we have. A relevant question is than, what is the duty of CIB in this context ? Another question is how to co-ordinate the efforts with more general information networks than the CIB net-work. In the coming studies we have to regard the linking to education if we wish to avoid a lot of wasted information activities in the future and we have to co-ordinate the efforts with the work for the information co-ordination for the building process. These persons in practice searching for information are using their language. The work going on in CIB for studies of the processes and of information support to processes, has compired conceptual analyses which will facilitate the use of various languages.
May I finish this conclution by quoting the late R. Mølgaard Hansen, a o chairman of FID/CR, "when we are talking of classification for retrieval, we often forget that the final goal of information is not retrieval but the right decision".

Prof. D. Mohan and Mr. P.L. De, Central Building Research Institute, Roorkee, India

I BUILDING DOCUMENTATION IN (INDIA)

Documentation services at CBRI include:

a) Publication of CBRI abstracts (Quarterly), Documentation lists (Weekly), Information Bulletins (Monthly), Library Bulletin (bi-monthly), selected Bibliographies and other serial publications like Building Digests, Data Sheets, B.M. Notes, Project Proposals etc.

b) Reprography Services

c) Translation Services

d) Project Oriented surveys

e) Library and Reference Services

f) Patent Information

g) News Paper clipping services

Documentation Research at CBRI

Studies on building documentation were initiated at CBRI in the early sixties (1,2) with the objective of identification of information sources, standardization of format and layout of documentation material and classification for easy filing and retrieval. Subsequently several experiments were carried out for selecting a suitable system of documentation and retrieval. Uniterm System in information record and retrieval (3,4) was introduced in the CBRI in 1963 for the documentation of papers published in scientific and technical journals. It markedly facilitated the retrieval of information. The system has been subsequently improved with the introduction of "Current Awareness Service"in the form of classified "Documentation Lists" issued weekly. This service has been extremely useful to the research scientists in keeping them abreast of latest developments in their fields of specialisation.

Another study was devoted to the identification of Indian sources of information on Building Science. As a result of this study [5] it was possible to identify some 32 organisations in India producing some kind of information related directly or indirectly to Building Science and 27 journals regularly publishing information related to Building Science. Besided these, six abstracting Periodicals were identified which cover information of Building Science.

A study was also carried out on the identification and analysis of the various problems of documentation in developing countries [6]. This study showed that most of the developing countries in Africa, South America and Asia, heavily depend on the developed countries for scientific and technological information. It not only involves considerable cost in foreign exhange but also causes delay in the transmission of desired information because the documentation services in the developing countries are not well organised. The problem of language barrier makes the situation worse. As a result of this study several suggestions have been offered for the improvement of the documentation services in developing countries:

A. National and Regional Level:

1). Every research worker should be made aware of the existing documentation facilities at his institution, national and regional centres.

2). Financial grants to the special libraries should be on an increasing rate in view of the increasing number of books, periodicals, proceedings of conferences and greater documentation services that are to be provided.

3) Sufficient financial aid should be given to the scientific societies so that they may bring out their valuable publications. Liberal funds to these bodies will encourage subject specialists of developing countries to meet and promote their activities vigorously.

4) Surveys of the available knowledge on the production and use of certain materials special to developing countries should be made available.

5) Exchange of research programmes should be initiated within the nation and among developing countries so that unnecessary duplication of work may be avoided.

6) While exhange of publications with developed countries is common, there is not much evidence of this being done among developing countries themselves. It would also be helpful if each special library prepares a list of unwanted or duplicate journals, books and other publications so that they could be exchanged with institutions within and outside the country through a centralized agency.

7. Every research institute should open a documentation centre and there should be a national Scientific Documentation Centre for every country. National Centre should further have regional centres at important locations. A national Science Library should be established in close proximity to the National Science Documentation Centre. It should acquire important scientific and technical periodical of the country so that it may be quikcly available on request.

8. Activities of the existing National Documentation Centres and documentation research institutions should be expanded. The National Centre should undertake the responsibilities of training documentalists, translators and run refresher courses for trained personnel.

9. Relevant national and international standards and patent literature should be made available to the applied research scientist. Importance of this type of information has so far not been realised.

10. A large number of scientists return from abroad every year and join various research institutions. The knowledge of foreing language acquired by these persons should be fully utilized. It is believed that translation

work is best done at the institute itself where subject specialist is also available for consultation. Further such work ca be done speedily. Only those translations that cannot be done locally should be sent to the National Documentation Centre.

11). Research projects of top priority and defence importance should be provided with special documentation facilities.

12). Photo-duplicating equipment should be provided in all research institutions to enable speedy communication of information.

B. At The International Level :

1). There should be a centre to study and cater information which are of special interest to the developing countries. Since the resources of the developing countries are less, it could ensure that they do not repeat a work already done or in progress in another country.

2). The cost of expensive periodicals of importance to developing countries should be substantially reduced. For example, no research institution can afford to purchase Science Citation Index (Quarterly) which costs about Rs. 19.000.

3). Reduction in the rates of air mail and surface mail for all scientific documents will help a great deal for easy flow of information among individuals and institutions of developing and developed countries.

4). Many developing countries have been thinking of switching over to their native language for the purpose of teaching science at all levels. This would mean an enormous burden on those nations in terms of translating thousands of books and periodicals. It is a pity that these countries which had fortunately acquired working knowledge of English French or Dutch should do away with these language which publish enormous technical literature. Efforts should be made to impress on these nations the importance of foreign language for technical development.

Several case studies were undertaken, e.g. Documentation useage in a specialist library [7], Prepublication abstracting [8], Impact of user study in the improvement of documentation services in developing countries [9].

REFERENCES

1. A study of building documentation, P.V. Gopalakrishnan and M.R. Parthasarthy, Jour. Nat. Build. Orgn. VII (3), 1962, 7-17.

2. Standardisation in building documentation, P.V. Gopalakrishnan, Indian Builder, 10(12), 1962, 147-8.

3. Use of Uniterm System in Information Record and Retrieval, P.L. De, Seminar (1964), Documentation Research and Training Centre, Bangalore, Dec. 1964.

4. Information record and retrieval in a technical library, P.L. De, IASLIC Bulletin, 10(2) 1965), 110-8.

5. Building Documentation in India, S. Srinivasan, International Journal of Special Libraries (USA, 6 (3 & 4), July-Ocotber, 1971, 99-109.

6. Documentation for users in developing countries, S. Srinivasan, 33rd Conference of FID and International Congress on Documentation. Tokyo, Sept. 12-22, 1967.

7. Documentation useage in a specialists library: A case study, S. Srinivasan, S.G. Sinha and R.K. Goel, Annual Seminar (7) of Documentation Research & Training Centre, Bangalore 1969, Proceedings (1969), P. 448-62.

8. Pre-publication abstracting: A case study with BBRI Abstarscts, S. Srinivasan and R.K. Goel. Proc. of the Documentation Research and Training Centre, Bangalore, Annual Seminar (6), 1968, 67-72.

9. Impact of user study in the improvement of documentation services in developing countries, S. Srinivasan, 35th FID Conference, 1970, Buerps Aires, Sept. 14-24, 1970.

III INFORMATION SERVICES AT CENTRAL BUILDING RESEARCH INSTITUTE ROORKEE

The major responsibility of dissemination of the results of research lies with the Information Division of an Institute with active cooperation of the scientists of the research teams. For this purpose the activities are organised under the following groups:

i) Planning and evaluation
ii) Industrial liaison and consultancy
iii) Publication
iv) Library and Documentation
v) Photography, reprography and audiovisual

services.

vi) Public Relations

vii) Training and Organisation of Special Courses

viii) Surveys

The activities of the Planning and Evaluation Group include identification of research problems and arranging discussion of such problems with the scientists, Advisory Committees and Executive Committee for chalking out the Annual Research Programmes as also for formulating the Five year Plans. For evaluation of the merits of a project, a system of 'Monitoring and Evaluation of R&D* has recently been introduced which involves the computation of a "Project Merit Index" by assigning marks to the project on various relevant factors such as social, economical, scientific and technological as well as on the current rate of progress, resource utilisation and anticipated resource requirements for the remaining Part of the work. Based on the score, the project is rated as excellent, very good, good, poor, not recommended.

The Industrial Liaison and Consultancy Group handles all correspondence and negotiations with the industry for the utilisation of results of research and prepares Technical Notes and Project Proposals. This group also handles patenting of processes, technology transfer (through National Research Development Corporation of India), testing and consultancy services. All technical enquiries (numbering about 300 per year) are also attended to by this Group. This group also handles all legal and managerial aspects of sponsored and consultancy projects.

The Publication Group compiles, edits and publishes all publications of the Institute which include:

- Annual Report
- Building Digests
- Building Material Notes
- Data Sheets
- Technical Notes
- CBRI Abstracts (Quarterly)
- Project Proposals
- Special publications like symposium proceedings, books, brochures etc.

The research and review papers by scientists, after examination by two experts referees, are sent for publication in a suitable Indian or foreign journal. Separate Mailing Lists are maintained for each type of publication and for reprints on different subjects. The distribution and sale of publications are also handled by this group. Besides regular mailing lists, publications are also supplied on specific request.

The Library and Documentation Group renders library and documentation services to the scientists of the Institute as wlso to a limited extent, to outsiders on request. The Library has now a collection of about 25.000 books and 15.000 bound journals. It subscribes to about 170 periodicals and receive another 150 under exchange arrangement. Besides regular periodicals, it also recieve a large number of reprints, reports, standards and other publications from within and outside the country. All publications are systematically classified and catalogued and arranged for easy retrieval with the help of catalogue cards. All new additions to the library are announced through a bi-monthly Library Bulletin.

The Reprographic facilities available at the Library include photostat copies, xerox copies, microfilimng and micro-film reader. The Photographic Unit takes photographs and movie films of important works. This unit also prepares slides required by scientists for lectures and arranges screening of scientific and technical films of interest to the staff. Audiovisual services are alsom handled by this Unit.

The Public Relations and Publicity Group is mainly responsible for giving publicity to the achievements of the Institute through press, radio and TV, documentary films and nwe reels, popular talks, exhibitions etc. It also renders shows round visitors, organising seminar and get together with industry. The Institute maintains a permanent museum and display centre of its work. Special exhibitons are also occasionaly organised in the museum as well as at other places.

Training and Special Courses

This Group maintains collaboration with Universities and other organisations for the purpose of all collaborative research, conductiong post-graduate courses, training etc. A two-year post graduate course on "Building Science and Technology" is run by the University of Roorkee in collaboration with the CBRI. Students from Universities are also offered training facilities at CBRI during vacations ranging from 6 to 8 weeks. Training facilities on specific subjects are also offered to persons deputed from industry and other departments. Weekly colloquia and occasional special lectures are organised.

Surveys

Surveys are occationally conducted to collect information needed for the planning of research and other services. Typical examples of such surveys are:

- Surveys on the utilisation of Building Digests
- Survey on the use of under-reamed pile foundations
- Survey on industrial wastes
- Survey on the use of silt deposited in the

Waterworks of big cities.

REFERENCES

1. Information record and retrieval in a technical library,
O.L.De, IASLIC Bulletein, 10(2), June 1965, 110-188.

2. Information services for the building industry at the CBRI, P.L.D, e, Vishwakarma, VI (4), August 1965, 7 - 10.

3. Building Research and the Information needs of the Building Industry, P.L.De, Indian and Eastern Engineer, 107th Anniversary number (1965) 91-94.

4. Information on Building Scinece - Where and How to fins it, P.L.De, Engineering News of India, 20(12), March 1969, 713-724.

5. Experiences with Building Digest - A user orinted publication, P.L.De, Presented at the Seminar on Information organized by DESIDOC, during 4-6 Dec. 1969.

6. Builders and Building Digests, P.L.De, Bulletin of the Building Association of India, 3(9), Sept. 1970, 27-30.

7. Information Services at CBRI can help refresh knowledge, P.L.De, Technical Teacher, Vol. 4, 1970, 49-50.

8. Information needs of the building industry and the role of CBRI, P.L.De, presented at the National Seminar on Communications for industry, SIET Institute, Hyderavad, Sept. 2-4, 1974.

III LOCAL DEMONSTRATION PROJECTS

There is generally a considerable gap between research and its practical application. Many a times research institutes are able to give solutions to various problems which the construction agencies have been facing for quite some time. The experiences shows that results of such researches do not reach the consumers for quite some time to be. This is all the more so in developing countries where the media of information are not so advanced and sophisticated as in developed countries. Though this problem exists in other scientific fields too, but it is somewhat more pronounced in the field of building research. Normally, efforts are kept limited to desseminate information about the research work done by means of publications, seminars, lectures, exhibition etc., but this has not been adequate and it is now being realised that if actual demonstration projects are taken up and executed by the research institutes themselves, utilising the various techniques developed by the Institute, it will make much more impact than the extension through other media.

The Central Building Research Institute which as a pioneer institute for building research in India, realised the importance of demonstration constructions. It took up a large scale project in demonstrating the use of various techniques developed by the institute, in the field. Under this project the institute constructed about, 2,600 primary school buildings in rural areas of the State of Uttar Pradesh which is one of the largest state in India having a population of about 66 millions. The entire designing, planning, and construction was handled by the institute through its construction units and several of the techniques developed by the institute were adopted in the construction of these buildings. Encouraged by the success of this project, the Institute opened a full fledged division for handling the work of extension and demonstration constructions. The division, assisted by its 5 extension cells spread all over the country extends various techniques and new materials developed by the institute amongst the user agencies, manufacturers, and entrepreneurers. It also takes up construction projects for demonstration whereever is considered necessary and feasible. These demonstration projects cover a wide range of construction techniques. The role of the Construction & Extension Division in these demonstration projects is also varied according to the requirements and cover the following activities.

- Demonstration of various techniques and materials by actual casting of the prefabricated units and/or doing proto-type construction to demonstrate the actual use of the materials and techniques.

- Undertaking actual designs for the user agencies, utilising some of the techniques and helping these agencies by causual supervision in the field .

- Construction of building projects of various magnitudes right from the designing stage up to the actual construction and their completion.

The staff of the user agencies is generally associated with such demonstration constructions to impart full working knowlegde and confidence to them so that they may be able to handle similar projects, on their own, in future. Some of the large scale construction projects already completed by its construction division are the construction of 144 houses at Infore

and 144 houses at Bhopal for the Madhya Pradesh Housing Board construction of 20 school buildings for the education department, Govt. of Orissa. By actually demonstrating some of these techniques at Hyderabad in Andhra Pradesh, the institute has helped in the construction of cyclone, relief housing project in the State in which the R.W.D has constructed about 8.000 houses with material and techniques developed by CBRI. More projects are going to be taken up shortly in various states and it is expected that these will go a long way in extending the work of the institute to the various user agencies including manufactures of building materials.

Dr. A.G. Madhave Rao
Structural Engineering Research Centre,
CSIR Campus, Madras
India

I like to congratulate Mr. Blach for his excellent paper. His idea of roving seminares and slides and lecture notes on Modular co-ordination, component building and standardization are very useful. Similar idea can be applied to other subjects also.

There should be closer linkage between CIB, U.N. Centre for Human Settlements and world Bank. The proper and quick dissemination of research results are very essential and also avoid dublication of research results. In the field of disaster mitigation the UN has prepared very useful monograhps. These were useful during the rehabilitation of cyclone victims in Tamil Nash and Andra Pradesh in India. CIB with the help of UNCHS should bring out monographs and films on Low cost housing and other subjects. There should be more exchange of information of results of research between CIB member countries.

Bertil Johnson, Information Director,
Swedish Council for Building Research
Stockholm, Sweden

1. A very important question for the CIB information work is the role of the CIB as an organisation. There is none more important task for the CIB than to serve as an information network. Due to that, the following problems should be regarded:

- information on on-going research
- documentation and transfer of research results
- the output from the WCs.

2. Mr. Mathurs suggestions are interesting and worth serious consideration.

3. Mr. Blachs paper reminds us of the fact, that information systems just can store and distribute information. There is still a need of developing the application into knowlegde
- by education, instruction and training.

4. One important problem - not mentioned in the papers - is information management in the meaning of capability to recieve, use and understand information.

Emilio Beltranena, Director, Engineering
Research Center,
Guatemala

We have heard many valuable sugestions and recommendations on how to organize and develop information and documentaiton Centers and about systems and methodologies to implement their actoris for the benefit of the several potential users. But I feel it necessary to mention the need for coordination of international efforts to help developing countries in this field.

My country (Guatemala) and several latinamerican countries have recently established national information Centres in the field of construction or in Human Settlements. Some regional networks have also been formed (one of them called latina with a central office in Colombia). I know there are at least two more networks. This actions have been supported or sponsored by international and regional organizations like the organization of American States (oAS), the UN Economic Commission for latin America, several foreign aid offices of developed nations and other organizations.

I think CIB in collaboration with the U.N.Centre for Human Settlements should strive to coordinate these efforts and try to avoid duplication of methodologies and systems. The implementation of uniform proceedures and common policies would be for the benefit of all countries.

Mr. G.C. Mathur, Director,
National Buildings Org.,
New Delhi, India

I would like to emphasise, that although in a long-term strategy, information techniques and documentation proceedures should form a part of educational programme, as suggested by Mr. Mandane, priority needs to be given to the work of supply of information and documentation geared to achieving application of results for improving the human settlements. The role of information for development is crucial and therefore effecient management of information system in building and housing should be given priority in developing countries and should receive attention of CIB.

I agree with Mr. Blach regarding reducing the time lag in supply of information and documentation. When concepts, methodologies and approaches are to be transferred to developing countries on the basis of experiences of industrialised countries, some time lag is inerifeste as for example in the case of modular coordinations industrialised building methods and prefab. building component technologies etc., as these involve study of their appropriateness, adaptability and creation of infrastructure facilities. For transferring the results of research, putting up demonstration housing projects, holding seminars workshops and training courses, can greatly help in reducing the time lag.

I feel time is opportune when CIB should take a leed in organising an international network structure of informations system of special relevance to developing countries in colloberation with UN system and other international organization.
I belive the Study Group announced by Mr. Karlen working in CIB will have representatives of developing countries - personally I am interested to participate and will consider the possibility of evolving a charter for building information worldwide.

In the field of information system for human settlement the lead taken by ESCAP needs to be appreciated, and cooperation of all concerned brought about to achieve the early implementation of the report on the subject which Prof. D. Mohan has submitted to ESCAP.

I would to reiterate the suggestion of Mr. Johnson, for giving due attention to Information management by CIB. In my opinion the aspects related to information and documentation leeding to application to fullfill the end-use should be covered in the scheme of management.

I am grateful to Mr. Birkeland - chairman for his support - for directing the information and documentation work of CIB for achieving practical application in the field particularly for promoting adoption of innovative concepts, materials, techniques, etc. in developing countries.

(The National Buildings Organisation N.Dehli would endevour to argument its role both- as a national Centre as well as U.N. Regional Housing Centre of ESCAP to strength the activities and role of CIB in the management of Information Needs of Human settlements in developing Countries.

SUBJECT
SUJET

5B

Advanced methods of documentation.
Chairman: A. STERN

Méthodes avancées de documentation
Président: A. STERN

Report from Section 5 - Subject 5B:
ADVANCED METHODS OF DOCUMENTATION

Key-note speaker: H.A. Stoddart, Great Britain, presented the paper in the absence of W. Wissmann, Federal Republic of Germany

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain, Chairman of CIB Working Commission, W57:

In presenting Dr. Wissmanns paper I wish to highlight the problems to which he directs his attention. He outlines the early form of development of an information system within CIB. This theme moves through the conventional but now outdated exchange of abstracts to the sophisticated computerised databases. He also examines information systems and how they can work and explains the derivation of the worlds first accessible database devoted to the needs of the Building Industry. Imperfect though it may be at this stage - it exists and it can be used. CIBDOC has been internationally accessible since the middle of last year.

The real problem is much more fundamental because in illustrating the solution today, it is a solution to yesterdays problems. We must ask ourselves whether it helps to solve todays or even tomorrows problems. The Building Industry has not got the best reputation for implementing good new ideas or even good old ideas. The problem of today therefore is how can the information industry overcome the inertia which has existed for so long. The excellent, often brilliant research conclusions just do not permeate through the industry fast enough. Investigations have shown that multi-millions of pounds have been wasted because existing knowledge had not been implemented. The information industry is in the position of being able to help the decision maker by ensuring that the available information is there for his consideration. Though not in a position to evaluate the information, necessarily the information industry can draw in evaluative information from available sources. The important thing being that the decision maker - whoever or whatever he may be - will be better informed before making a decision. Fine - Good - one might say - this thought is not new - why has this wonderful thing not been happening already?

Perhaps there are two basic reasons - the resources required to record information, to obtain it and to convert it for an information system have been very substantial. The benefits of international co-operation could lead to an improvement by minimicing duplication. This identifies the more basic problem of how to minimice the cost of information provision. Secondly the accessibility of information has always been a profound problem. Different industries would see this in a different light. Building research would not have the same problem as the on-site application of the results of research. Trying to improve accesibility of information has caused many people to spend much of their effort. Dr. Wissmanns paper provides a view of these problems and shows an approach to solving them.

There is, however, a technological revolution going on which it is difficult to grasp the implications of this stage. The capabilities of micro electronics to record and manipulate information has not yet been fully appreciated. It would appear that the universal accessibility of information is at hand - or is it?.

Some of the most wonderful devises are being developed for handling information, but are we not still up against a fundamental barrier like the sound barrier was to speed. Even if the information industry could break this barrier, whold the Building Industry accept the new found availability of information. Providing it could choose fundamental breakthrough, the information industry must work towards a goal which would exploit the new technologies to the maximum.

Some years ago I read a book by an eminent American Management/Economist called Peter Drucker. He was frequently critisised for his observations and predictions. I have read again prior to presenting this paper his observations made at least 12 years ago, and I found him to be remarkably good under retrospective examination. He had this to say about the information industry:

Quote: There is a great deal more to the information industry and data processing than the computer. Now the computer is to the information industry roughly what the central power station was to the electrical industry. The electrical industry became a certainty when Werner von Siemens in 1856 invented the first practical generator, but the electrical industry only became a reality 23 years later in 1879 when Edison designed the electric light bulb. Whitout the central power station there would be no electrical industry without the computer there would be no information industry.

In both cases the investment resources have gone mainly into the transmission and application rather than in the generation and storage. Since the computer first appeared in the late 1940s the information industry has been a certainty, but we do not have it yet. We still do not have the effective means to build an information system - this is where the work is going on however, the tools to create information systems may already exist. The communications satelite and other means of transmitting information, microfilm, and the

TV tube to display and store it, rapid printers to reduce it to a permament record. There is no technical reason why someone like Sears Roebuck should not come out tomorrow with an appliance selling for less than TV set, capable to beeing plugged in wherever it is electricity and giving immidiate access to all the information needed for school work from the first grade through to college. Yet though IBM is shipping computers at the rate of 1000 per month, we do not have the equivelant of the electricity light bulb. What is lacking is not a piece of hard ware as was the light bulb. What has still to be created is the conceptual understanding of information. As long as every set of data has to be laboriously translated into a separate programme we do not understand information. We have to be capable of classifying information according to its characteristics. We have to have a notasion comparable to the one S'Ambrose invented 1600 years ago to record music that can express words and thoughts in symbols appropriate to electronic pulses rather than the clumsey computer language of today. Then each person could with very little training store his own data whithin a general system. Then we shall have true information systems.

I remind you again that that was written 12 years ago and since then a great deal of inventiveness has gone into making devices and producing equipment with increasing power of compaction. The ability of an organisation to capture, store and process informmation has assumed an almost explosive proportion. The opportunity to provide access to vast amounts of information is there as suggested. The accessibility of information will be improved beyond the recognizable boundaries of when this was written. Devices will be so small and compact that remote situations would be served as effectively as the centres of the big cities. Does this prospect give us encouragement or is it a collosus we will have difficulty using. Is not Peter Drucker still correct in proposing that a new conseptual form of expression must be conceived. I do not know the answer, otherwise the problem would be solved. Until this is proven, one way or the other, we must stay with the capabilities of today. Dr. Wissmann gives us a glimps of the near future and provides a practical approach to some of the problems. In this paper he refers to the taking of information from information networks as energy is taken from energy supply networks. This analogy is supported by the early observations of Peter Drucker. Not only that the concept is sustain by a recent publication by Barron and Currow of the Research Unit at Sussex University. Their publication which is the report of a UK government sponsored research project, again makes the plea for a better teoretical basis for information. They say it is urgent and they believe that advances will be made as a result of the new information technology. They state that, information has to do with the representation or mapping of one system by another. The system represented is the Universe of discourse, the representing system is the language and the mapping is the semantics. Within such an interpretation it would seem that the analogy to information is not the entropy of a system as developed by Brioulling and Shannon, but energy itself. Indeed the analogy between information and energy is very close at many different levels and needs to be studied. I find this hypothesis facinating, there has always been a conceptual conflict in my mind that the provision of information on one hand would lead to a better understanding and therefore a stabilization of a situation but at the same time the provision of information can stimulate fresh ideas and situations and promotes the idea of the energy supply. The opposite of this course is with reduced provision of information a more stable, passive and less productive, but also less disruptive society or industry exists.

Is this one of the answers we are seeking to the inertial problems if not only the Building Industry. New information does not necessarely solve our problems, but it can cause new ones.

Assuming that the majority of people are not concerned with these more philosophical problems, though I would hope a few seeds for thoughy have been sewn, I would recall the finite problems identified during my presentation of Dr. Wissmanns paper which I hope will assist in the following debate and contributions.

1. How can the information industry help to overcome the inertia in the Building Industry in the adoption of new or proven ideas.

2. How can the costs for providing information be minimised.

3. How can the accessibility of information be improved.

4. Is the Universal Accessibility of information at hand. If so will the investment be available to achieve it.

5. Will that investment if available be routed to the most critical or the most profitable section of the information industry.

6. Is the explosive development of hardware devices going to serve the Building Industry and if so how.

7. Do we need a conceptual approach to information which is new as described by Peter Drucker. If so does anyone understand the hypothesis.

E. Loncaric, Institute of civil engineering, Zagreb, Yugoslavia

Some countries of institutions organize their own information systems by classifying building technology in various and often different subdivisions. Frequently this leads to many different filing systems. Would it be possible to create a system of classification of subject groups with a common thesaurus of coded keywords and a reference manual similar to the United Nations system "UNISIST" or the International Standards Organisations "ISONET", which could be generally used by all Information-documentation-communications centers (INDOC) dealing with building and civil engineering?

H.A. Stoddart, Cement anc Concrete Association, Slough, Great Britain

Yes. It would be possible in theory: although a classification system, the UDC is perhaps the best and the most universally used example of a unified system which has been used on a wide scale. Although this is a classification system, we did, in the early days, attempt to produce a comprehensive thesaurus. It is appreciated that there is more than one description of a thesaurus but an attempt was made. It was found to be difficult to define the scope and the depth of this thesaurus and the discussions became most protracted. One of the most vigorous debates was concerned with the term which would be used to describe its size. Terms such as mega - were used but very little progress was made towards an overall thesaurus derivation. The problem arises not just from the derivation of the appropriate thesaurus but from its application and control. If such a thesaurus is to be implemented at one documentation centre, the difficulties are still there but they are minimal. If it is to be implemented at many centres, then the degree of control that one can use is extremely limited. Some form of verification has to be used to ensure the appropriate consistency and it is found that this is probably the most important factor in the whole problem co-ordinating consistent input to one system. Accepting this difficulty and that the fact that many centres duplicate their material input, within Working Commission W57 we attempted to tackle the problem of how we could optimise the efforts of all the co-operating centres whilst accepting the historical differences between their existing systems. We mounted a project aimed towards deriving a set of common terms. These common terms would be minimal initially as the object of the exercise was to prove the concept that searching could be done using generalised terms which had been agreed between a multiplicity of languages. This polyglot language was developed and is about to be implemented. The first 250 terms have been agreed in English, German and French. When these are finally approved by the General Assembly of W57, they will be implemented. This will mean that each language base will be able to use its own tongue for searching the system but recall information in whichever language it is recorded.

P. Foster, Building Research Association of New Zealand, Poriua, New Zealand

Is not the major obstacle to afflication of information neither storage nor accessibility, but reluctance of the user? Does not the information industry have to market and then sell?

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain
A. Stern, Swedish Institute of Building Documentation, Stockholm Sweden

Yes. We agree entirely with your hypothesis. The information industry should not be afraid of identifying the need to describe the product and to sell it as one might sell the dog biscuit to which you refer. Information can be packaged and sold and promotion of the product can take a lead from many of the conventional presentations of marketing dynamics. One of the first essentials expressed by the information industry is measure what the user wants. It is then asked to make sure that this is what the user needs. This is nothing more than the standard approach adopted in market research. The information industry has, for too long, adopted the attitude that their product is something the world cannot do without. Unfortunately, in many instances, the world has got along without this product and the subsequent consequences tend not to fall at the feet of those responsible for ignoring the information which is available.

J. Webster, School af Architecture, Victoria University, Wellington, New Zealand

It may be of interest to record that students at the Victoria university, School of Architecture are exposed to a wide variety of information storage and retrieval systems during the course. We certainly hope that they will pull this knowledge to good use after their graduate.

I would like to make a special plea for conceptual simplicity in all building database systems. The relational data model is probably optimal from their point of view. Of course, the physical nature of a database may be complex and should reflect the actual paths along which data is accessed. But this paths cannot all be foreseen when the database is designed, and a simple logical model will both speed the process of data entry and

permit the ready development of links between complementary databases, quite apart from the obvious advantages in terms of flexible access by the individual user.

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain

Yes, I can understand the desire by the end user to have a much more simplified presentation of the available information. It is important to recognise, however, the historical build up to the present day databases and the distinction between these and data banks. Preprocessing of databank information is vitally necessary. How one would do this with conventional databases is difficult to appreciate. However, this is beginning to occur in circumstances where the amount of display space is limited as in such systems as Viewdata. My organisation is heavily comitted to an experimental database Contel in which the space is limited in any one frame of information to 22 lines by 40 characters. In such circumstances it is important that the available information is condensed in order to present the maximum amount of information to the end user in the most cost effective way possible.

P. Bakker, Hollandsche Beton Group NV; Rijswijk, The Netherlands

In which language will CIBDOC be accessible? Is the polyglot vocabulary already made? Will it be possible to search with the help of UDC? Will the French database ARIANE be indluced in CIBDOC?

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain
A. Stern, Swedish Institute of Building Documentation, Stockholm, Sweden

The polyglot language which is to be used in CIBDOC is at the moment in French, German and English. The first 200 - 250 terms have been agreed informally within CIB W57. It is expected that they will receive final approval at the General Assembly this year and then adopted for use by the database suppliers within the CIBDOC Group. This will mean that the whole of the CIBDOC databases will be searchable in English, French or German but only from the time of adoption not in retrospect. UDC can only be used in searching the Byggdok database and only in the condensed form as used as UDC numbers are not allocated to any of the other inputs. The French database ARIANE is not available through CIBDOC at the moment but it is difficult to predict what may happen for the future. As the co-operation develops it is always within the realms of possibility that this might be available. If there were no technical difficulties then I feel that if the appropriate arrangements could be made then it would be a desirable thing to happen.

J. Fucaraccio, Instituto Nacional de Tecnologia Industrial, Buenos Airos, Argentina

"Information is a resource", state of the paper of Dr. Wissmann. I would like to point out that information is vital for our countries in process of developing.

I believe that if the industrialized world contributes only with things such as connecting our countries to computer data base information nets like CIBDOC or ARIANE, a great breakthrough will be achieved.

I would like to know in which way CIB may contributes to make this possible.

A. Stern, Swedish Institute of Building Documentation, Stockholm, Sweden

The reply was followed up during the interval and consisted of an explanation that providing the technology was available to process magnetic tapes then it may be possible by arrangement to obtain copies of databases such as CIBDOC for information searching. At the same time it was agreed that every encouragement should be given to advancing the implementation of communication networks so that developing countries could make increasing use of information which was available.

H. Nawab, Council of Works and Housing Research, Islamabad, Pakistan

We have in Pakistan an information and documentation organization called PASTIC, Pakistan Scientific and Technological Information Centre. It is working on more and less the same lines as the one here. But difficulties have been experienced in the way of efficient exchange of valuable information with other centres. It would facilitate matters greatly if, on the international plane, ways and means are formed for, not only establishing a network of information centres in at least regional countries, but also for strenghtening the network of similar centres.

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain

Yes, I agree with you entirely. Greater co-operation is needed between CIB and these growing networks in developing countries and especially the work which is being carried out under the Human Settlements programme.

J. Overgaard, ESCAP, United Nations, Bangkok, Thailand

I whish to call the attention of the meeting to the efforts of ESCAP to set up a regional info.system. While it is being covered in session 5A it can briefly be outlined as a network of national focal points which provide relevant information to users within the country and to a regional centre located at ESCAP, Bangkok. A computer will soon be available to ESCAP and it should be used for this purpose. We have eager to make the system compatible to other global systems and wish to be associated with the work of CIB in this field. It should be mentioned that United Nations Centre for Human Settlements also has a global information system in its programme of work.

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain

Yes, in CIB W57 we are very conscious of the need for help to developing countries. The Human Settlements programme is of great interest to us and the possible needs of this programme in Nairobi has been debated between members of my Commission. As chairman of W57 I would be more than pleased to welcome any members of the Human Settlements project with a concern for documentation and the provision of information. The objective of a global information system which you mentioned is within the scope of objectives of the CIBDOC activity.

P. Bakker, Hollandsche Beton Group NV, Rijswijk, The Netherlands

The value of databanks can be considerably increased when publiched patent applications are included.

Most databanks contain little information on international and national standars, e.g. modular coordination, and this kind of information is often wanted. Can CIB exert some influence on the contents of databanks?

H.A. Stoddart, Cement and Concrete Association, Slough, Great Britain

Firstly, it was never the intention of CIBDOC to compete with already well established database providers. The inclusion of patent literature in any database must be seriously considered in the economic sense as the well established role of Derwent in this field should always be borne in mind. It is however, sensible to assume that if the interest in patents is extremely small and limited then it could be economic to process such a small quantity rather than rely on an established database. On the question of standards, then within W57 we are currently looking at the possibility of an international library or database of standards and regulations. At this point in time I have no measure of the size of the problem. After our General Assembly in November I should hope to have a clearer picture of the size of the problem and what we might hope to achieve in studying it. Further the inclusion of any other well established databases within the CIBDOC collection is more a matter of commercial arrangement and appropriate networking. As CIBDOC develops then I feel sure that more and more will become available through the appropriate form of arrangements. The advent of Euronet is going to make things change very substantially over the next few years. By the time of next Congress we should see some very significant advances.

I. Ural, International Association for Housing Science, Florida, USA

The information generation, collection and dissemination are extremely important for a successful national housing program. Without the necessary correct information, the success will be doubtful. To optimize the limited resources of the Third World Countries, we have to optimize the use of information systems.

SUBJECT
SUJET

5C

Management information systems. Construction project management, building sites management and technology, cost management.

Chairman: Gy. KUNSZT

Systèmes d'information de gestion, gestion des projects de construction, gestion et technologie des chantiers, gestion des dépenses

Président: Gy. KUNSZT

Report from Section 5 - Subject 5 C:

MANAGEMENT INFORMATION SYSTEMS. CONSTRUCTION PROJECT MANAGEMENT AND TECHNOLOGY, COST MANAGEMENT

Key-note speaker:	L.R.Shaffer
Invited paper:	S.S. Atayev
Invated paper:	N. Lemunge

Ian L Freeman, Building Research Establishment
Garston, Watford, Herts, WD2 7 JR - England

Following on Professor Peer's comments it may be helpful if I expand a little on what I said earlier about our examination of the use of CPM on a major building project. A report on this has already been published (1)

The network failed because it did not represent the construction strategy that the contractor normally used - though he was obviously unaware of this fact. The network assumed predominantly sequential operations, or small groups of operations, each being completed before the next operation was started, whereas the contractor normally started every operation at the earliest possible moment - presumably in order to open up many work places and thereby reduce the risk of having men unemployed. But even if the contractor had followed the network it would probably still have failed because he was unable to resource the individual network operations, which were based on building elements, at all accurately. His estimates for time for each operation were, inevitably, grossly optimistic, since he started operations much earlier than the network assumed; but his estimates for time , were also very poor: he could be as much as 300 % out either way. Because of the construction strategy adopted by the contractor, this was hardly surprising: work on elements was extremely discontinous, and it must have been virtually impossible to obtain meaningful feedback of labour input.

Reference (1): Roderick, I.F., Examination of the use of critical path method in building; BRE current Paper CP 12/77, Building Research Establishment, Garston, England.

In view of what has been said by Dr Schaffer and Mr. Lemunge, I would like to draw attention to the paper published in the Proceedings, written jointly by Mr Bentley and me, on 'Quality Control in Construction on Site'. The work reported there shows clearly that the success with which quality is controlled depends more on the competence and compatibility of the people involved in the control work than on the formal system of control laid down. Systems only work through people, and we should take care to develop our systems in the full realisation of how people will react to them, in the context of their own priorities. It was encouraging to hear Dr. Shaffer say that researchers are, increasingly, developing systems which respond to feedback from sites, rather than in isolation from the site, on some idealised model of site behaviour. In my opinion, the comparatively limited success of critical path methods of programming in construction work, both in the US and in the UK, is due to lack of this essential feedback. Our own studies of the use of a critical path network on a typical one-off project have shown that it failed because the contractor's own model of the operations he was to carry out, as represented by his own network, did not accord at all closely with what he normally did in practice.

He was applying the method in a simplistic way which did not recognise his own behaviour. I would therefore make a plea that we, in CIB, pay greater attention than we have, to what actually happens on site when people have to apply our fine systems.

Peter Manning, Technical University of Nova Scotia
PO Box 1000, Haufax NS Canada BJ3 2x4

My colleague professor Biskaps and I may have some contribution to the problem expressed by Mr. Lemunge.

The paper by Manning and Chin on Construction project management in the Caribbean: and educational approach described the detailed planning and marketing of multi-national and multi-professional seminars.

Those were sponsored by the University of the West-Indies, the Technical University of Nova Scotia and the Canadian International development Agency, and were designed to help solve current problems in the region's development caused by insufficient communication and coordination among top managers in governments, banking, the design professions, be construction industry and others.

The penultimate paragraph of the paper, written in the Fall of 1979, contained the sentences: "The seminar that have been described, and the care studies of which they are comprised, are still in the preparating stages, for the first seminar will not be held until shortly before the 1980 CIB Congress. It is, therefore, too early to present conditions, except to promise that a critical review, based upon the evaluation that will be conducted at the conclusion of the Barbados seminar in May 1980, will be offered in Oslo in June 1980".

This intervention comprises that promised review.

Briefly, the Barbados seminar, held during May 2nd to 11th, 1980 attracted 42 seminar managers from 10 Caribbean countries. Six cohorts each of seven members worked upon case studies designed to secure constructive proposals for reducing the Island og St. Lucia's needs for more Industry and housing. The results justified expectations. A more detailed report, and the case study material, will be offered to the 1981 W 65 symposium.

Dr. S.K. Malhotra
Technical University of Nova Scotia
(Formerly, Nova Scotia Technical College)
P.O. Box 10000, Halifax, N.S., Canada

I would like to congratulate Mr. Freeman for his very interesting and useful remarks he presented on his paper given in the Congress Proceedings. I enclose his sentiment that we should be paying much more attention to the aspect of human motivation in the construction industry. I would also like to make a brief comment on Professor Warszawski's presentation relating to the application of critical path method. No doubt the critical path method would not have much success if it is maintained relatively rigid all the way from planning level to final construction stage.

However, it can be used quite effectively if the system model is "dynamic" and capable of accomodating modifications as a result of "feedback" during the entire process.

Odd Sjøholt
Norwegian Building Research Instiute
Forskningsvn. 3b, Blindern, OSLO 3

1. An evaluation of the effect of the cooperation project will probably start in 1981.

2. It is necessary to promote practical solutions for workers participation in the work planning. This will be the next step of the cooperation project.

3. The growing use of management information systems in the building industry must be supported by adequate education of staff and operatives. As a consequense of the cooperation project there are made special compendiums and exercises in production planning and control, beeing introduced in the engineering schools all over the country. The same will be done for the schools of the basic education of building workers.

Prof. V.B. Torrance
Department of Building, Heriot-Watt University,
Chambers Street, Edinburgh, U.K.

Even after decades of education, at all levels of personnel for the construction industry the work of Freeman and of Torrance & Mor shows that lack of co-ordination both during construction and between the design stage and the construction stage remains a huge problem. After years of experience in education, training and research I realise the full extent of the manpower problems in the construction industry. Management is "getting things done through people" and building in the most labour intensive industry of all. The industry needs managers who are better skilled in man-management. We also need usual more research into and emphasis upon manpower managment in the construction industry.

Prof. Shlomo Peer
Technion - Israel Institute of Technology
Faculty of Civil Engineering
Haifa, Israel

Shaffer and Freeman have stressed the importance of feedback. In most information systems, which have been developed for the building industry, the tender documents form the principle communication link between the contractor and the other parties involved in the construction process. It should be recognized, however, that the element-items used in the bill of quantities cannot readily be identified at the production point, and data collected on wite is not directly, impossible before translating the tender data into the operational system of the contractor.

The cost planning and control system of a construction company can be subdivided into two main subsystems (Fig. 1).

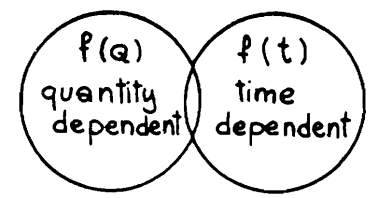


Fig. 1 SUBSYSTEMS OF COST CONTROL

One subsystem comprises functional elements which are mainly quantity dependent (cost-estimate, cost control, progress payments, labor man-hour and cost control, incentive schemes, material control, quantity surveying, accounting, etc.). The other subsystem consists of time-dependent elements, where the time factor is an indispensable parameter of the compilation procedure (progress scheduling and control, liquidity and cash flow planning, key personnel and equipment utilization scheme, etc.).

In solving the feedback problem in a construction company, we are faced with the existence of three main information channels: cost-estimate, site reporting and financial accounting (Fig. 2).

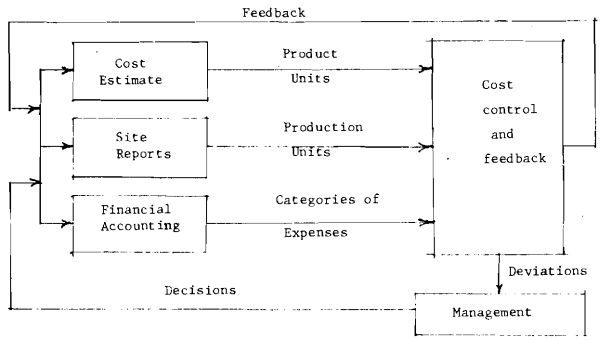


Fig. 2 INFORMATION CHANNELS IN COST CONTROL.

In each of these channels information is generated and organized in a different structure. Data of cost-estimate is based on product-units, elements of the project (columns, beams, slabs, walls, etc.), classified according to measurements, materials, etc. Site reporting, by its nature, provides information on production units, on operations executed by a working team without interruption or changing place (formwork, concreting, masonry, etc.). It is unfeasible to anticipate a subdivision f.e. between formwork or concreting of beams and slabs, or between columns differing in cross section, without employing expensive time-study methods. Financial accounting, in which the focal point is the firm as a whole, and which has been introduced to keep track of relationships with outsiders, classifies information into cost categories (labour, equipment, materials, subcontractors, etc.). The effeciency and effectiveness of any cost control sytem depends largely on the solution for linking these three information sources.

Freeman related also the failure of Network Analysis to the lack of feedback. I think that the main reason for this failure is in the fact that all these methods, whether arrow or node oriented, were originally developed as a management tool for coordination and control of complex projects. Limitations on its use in planning a production process are imposed by the basic assumption of unlimited resources, definite activity durations, and independence of each activity with regard to shifting it between earliest start and latest finish. Planning the construction process is not a problem of determining an incidental critical path from arbitrarily fixed activity durations, but rather a problem of balancing it into a comprehensive system of production. This means to provide working continuity by making as many activities critical as practical schedule for site management. Consequently, the plans are quickly put aside before the work is really under way, and the following up-dating is a permanent adjustment to the real situation of the progress on site.

Professor Reidar Hugsted, Norwegian Institute of Technology, Univeristy of Trondheim, Norway.

With reference to N. Lemunge's paper to the need of education and training in different areas of work I would like to mention the NORAD fellowship's opportunities and the special course programs offered to students from developing countries at The Norwegian Institute of Technology, Trondheim, Norway.

NORAD - The Norwegian Agency for International Development - offers course programs from 6 - 10 months at different universities and institutions in Norway. The courses at the Norwegian Institute of Technology - (NTH) - are offered to individuals holding engineering degrees at the Bachelor level or eventually Master level. Broadly one can say the courses are to provide training in an engineering field, and thus to bridge the gap between university training and engineering in practice.

The NTH course programs cover one academic year and terminate with examinations and a diploma certificate but with no academic degrees.

For the academic year 80/81 7 courses are offered. The courses cover the following areas of work:

1. Pulp and Paper Technology (Chemical Engineering)
2. Hydro power Development (Civil Engineering)
3. Electric Power Distribution Systems (Electrical Engineering)
4. Fishing and Fish Technology (Food Technology Mechanical Engineering, Marine Engineering)
5. Petroleum Prospecting and Reservoir Evaluations (Geology, Mining, Petroleum Engineering).
6. Offshore Planning and Construction (Civil Eingineering)
7. Oceanography for Marine Civil Engineering (Civil Engineering).

Some of the courses have been offered for some years, others are new. The course in Hydropower

Development covers all important steps in the planning of hydro-electrical power plants including hydrogology, engineering geology, hydraulics, soil mechanics, dams, tunnels, powerhouses, turbines and electrical equipment. Included in the course are project work covering the different items. Thus the engineering of a hydro-electric project are covered from the beginning to the actual constructing problems arizing from design.

The course is intensive with 4 hours of lectures 5 days per week and in addition project work and laboratories. All course materials are in English. Lectures are given in English.

Without going into more details on the other courses I can say that the experience with thess types of course programs are very positive. University staff and professional engineers are engaged in the courses. Great efforts are made to select students with interest and the right background to go through the courses. From 10 - 15 students will attend each course covering mainly African and Asiatic countries. So far no course program exists in the building field. The course programs are described in a brochure from NORAD which is sent to Norwegian Foreign stations abroad and to special contacts in developing countries.

Surinder Singh
Department of Building & Estate Management
University of Singapore
Singapore - 0511

I disagree with the statement made by a few earlier speakers viz. failure of the CMP due to impractical application of crewsizes etc. In fact, it is not, the failure of CMP but of the programme due to inadequate experience. The technique CPM is very sound but may have minor limitations for which alternative solutions do exist.

I would further like to point out certain results of the survey carried out in the Singapore construction industry about the status of preaiming and controlling techniques which may be reflective of conditions preventing in the developing countries as well. Some of the important observations of the findings were:

1. More than 50 percent of the firms reported that they were using still bar charts

2. Only about 20 percent of the fims used CPM

3. None of the firms used or had heard about the line of balance technique when most of the constructions were of repetitive type

Besides above, another survey had indicated that in majority of the firms, quantitative methods of decision making viz. operation research techniques were never used. The above position clearly indicates that the construction industry lacks of personnels having adequate knowledge and experience of management methods, systems, techniques, subjects etc. It is therefore suggested that an affort should be made in the developing countries to improve the syllabus of management subjects for those concerned professionals getting training the universities and refresher courses be arranged for those in the profession so as to update the knowledge.
It is only then we can expect to achieve the proper benefits of management.

Mr. Latina Corrado, m.sc.
Italy

This paper deals with the theme of appropriate technologies and aims to contribute to the definition of strategies of production and intervention adequated to those market situations characterized as by a low standard of technological development - that is in case of some of the emerging countries -, as by conditions of housing demand, in terms of quantity and quality, to such an extent to require the launching of very innovative housing policies, implying a profound modification of the productive and management system.

The study carried out above this topic starts from the analysis of the influence exert by the "local" conditions over the technology of construction, that is the conditioning relationship existing between contextual situation and choices concerning the techniques of building.

No argument on the contextualization of the techniques of building can therefore be developed without reference to the circumstances and the modalities by which they are evolved in the long run. Indeed, the most important feature of a local condition is tradition, that - with regard to house-building - has to be intended either as know-how experience in sytems, procedures, practices of construction in use, deep-rooted in a certain territorial reality, or as "mode" of conceiving the building event, which means even the notion of habitation typical of the social culture of that particular context. The meaning ascribed to terms like "context" or "territorial reality", here and later, is wider and more complex than that which would result from the simple location of juridical-administrative areas and boundaries, but

is reffered to the territorial precints identifiable on the basis of the unitarian characters and the congruence of some socio-economic phenomena which take place within them. In this sense any reference to the usual territorial organizations like "commune", "district", "nation", and so on, does not correspond, while a definiton of the context based on geo-morphological, climatic, marketing, or even only antropological considerations would be more meaningful.

There is not a univocal relation of conditioning between local conditions and techniques of building but a complex influence determined by a set of interdependent factors. Another characteristic of a local conditon is that of not being independent, but determind by the presence, as well as of elements "of its own" (derived from the tradtion or in any case also of "relation" elements, resulting from the exchanges carried on by the context with the others in different circumstances. These elements of a local confition, recognizable for their dialectic features, can be defined as:

a. CONTEXTUAL FACTORS
b. EXTRA-CONTEXTUAL FACTORS

In relation to the conflictual character of these two kinds of factors, it can be noticed how, during the historical evolution, the roles they have played in conditioning the use of building techniques have undergone a deep modification, passing from ages in which the contextual elements on the local condition were the essential factors in establishing the technical event, to the present time in which the extra-contextual factors often prevail over the others, a consequence of the huge progress achieved in the mass-media and the transportation sectors. From this dialectic dynamic present between these two kinds of elements which determine a local condition derives the need to define a parameter of 'scale' to evaluate the actual influence the factors operate on the mechanism of conditioning.

Local conditions, in other words, must be analysed considering the scale of the intervention, the kind of building programme, and the roles played by the different decision-making centres. This parameter can be defined as "Contextual level".

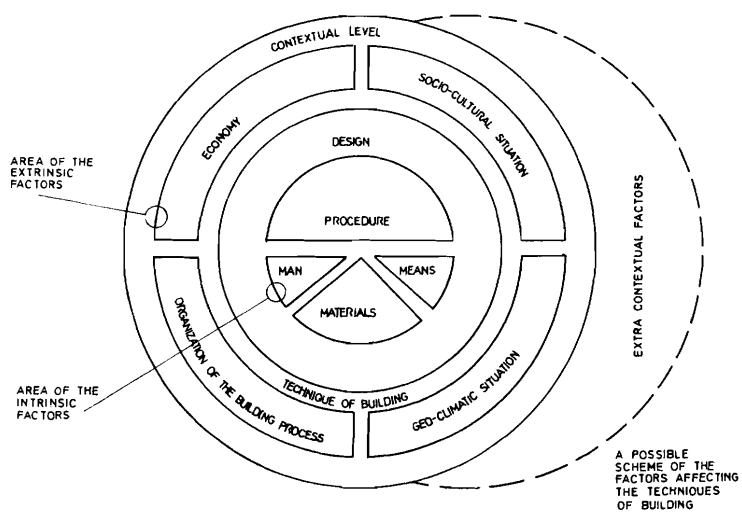
The study of the internal structuring of a local condtion is limited only to the contextual factors. The influence of the extra-contextual ones (which depend on a similar structure) has to be considered by 'overlapping', as their conditioning can exert its influence at any level and in every sector.

In relation to the role that contextual factors exert, there can be Instrinsic and Extrinsic factors. In point of the fact, the factors belonging to the first group come from the basic components of a techniques, that is Materials, labour, means and procedure. The other factors produced by the contextual situation, which influence the building activity directly or indirectly, belong to the second group. The principal categories of these factors being considered are:

- Social-cultural conditions
- Geo-climatic
- Economic
- Organization of the building process

Moreover there are factors of scale which, in the sector of the extrinsic, depend on the considered contextual level. By analogy, in the sphere of the instrisic factors, those depending on the design concerning the individual spesicific intervention or housing programm are considered 'scale factors'.

The overall situation is summarised in the diagram which follows. An outline of preliminary lists of factors to be considered are given in the following papers.



A POSSIBLE SCHEME OF THE FACTORS AFFECTING THE TECHNIQUES OF BUILDING

EXTRINSIC FACTORS

SOCIO-CULTURAL	- tradition - fashion - expressive and ideological motivations - socio-political situation
GEO-CLIMATIC	- characteristics of the climate (o) - geographic and geological situation
ECONOMIC	- general situation of the economy - economic situation in the building sector - housing policy - features of the building market - marketing factors (oo)
FEATURES OF THE BUILDING PROCESS	- organization of the purchasers - organization of the productive structure - organization of the labour - organization of the bidding-competitions - role of the designer
CONTEXTUAL LEVEL	- economy of 'scale (ooo) - characteristics of the inter-vention - conditions of operations (oooo)

(o) Solar irradiation, temperature and density of the air, termic ranges and humidity, wind, geo-termic situation, etc.

(oo) Market acceptance (tradional & innovation)/Characteristics of stability of market

(ooo) The 'scale' organization of the building process, that is: kind of settlement, type of purchasing, users, enterprises, labour, etc

(oooo) Normal, excetional, of emergency

EXTRA-CONTEXTUAL FACTORS

SOCIO-CULTURAL	- fashion - socio-political situation - cultural dependency
ECONOMIC	- general situation of the economy - economic situation in the building sector - housing policy - dependency on the foreign markets (o) - import-export volumes - international copy-rights

(o) Relative to the resources and the know-how

Common aspects	MATERIALS	LABOUR	MEANS
QUANTITATIVE LEVEL	- market availability - potential " - volume of available preserves	- market availability - potential " - rate of employment	- market availability - potential " - degree of sufficiency
QUALITATIVE LEVEL	- general qualitative standard - degradability, durability, obsolescence - possibility of surrogation, substitutability - market acceptance - (traditional & innovation) - functional performance - multi-use possibilities - typological & dimensional variety - pre-treatment level - pre-fabrication level - finishing level - possibility of deverse employment - transportability	- qualifications - type of professional standard - degree of specialization experience - degree of autonomy - " og collaboration - substitutability - possibility of multi-role - productivity	- condition of use - degree of automation - rapidity - safety - possibility of multi-use - market acceptance (traditional & innovation) - possibility of re-use - degradability, durability, obsolescence - maintenance requirements - transportability - productivity
TERRITORIAL DISTRIBUTION	- positioning in the market - distances from the sources - access to transportation (networks & means) - modalities of supply	- positioning in the market - mobility -	- positioning in the market - access to transportation - possibility of temporary use
ABSOLUTE COSTS	- market prices - production expenses - construction " - maintenance "	- fixed wages/salaries	- cost of aquisition - depreciation costs - oridnary maintenance expenses - supplementary maintenance expenses -running costs
RELATIVE COSTS	- transportation - autonomy of performance - quantity of supply	- special remuneration (specialists & consultants) - extra remunerations (transfers & overtime)	transportation - under-employment - risk-factor of the intervention -skilled operation

0 A research study on this theme is carried out, at present, by Mr Latina at ISTITUTO DI RICERCA ARCHITETTONICA of Firenze University Faculty of Architecture (Italy) in collaboration with Arch. Bengt Lundsten from Helsinki University of Technology (Finland).
For further information, please, contact:

Corrado Latina
Istituto di Ricerca Architettonica
Via Micheli 2 50100 FIRENZE

A little supplementary comments concerning the background of " A Microscopic Viewpoint of the Work Breakdown Structure in Building Construction " by T. Eguchi

1. Interest in the concept of qualitative and microscopic viewpoint for the site/design interaction problem.

I am interested in the discussion in D1 (W65) section, the proceedings of the Seventh CIB Congress, Edinburgh, September 1977, Volume 2, where the problems connected with the interaction between site and design were dealt by several speakers.

The main object of the paper I submitted is to attract an attention to the necessity of establishing any concept available in these fields from relatively microscopic point of view.

Of course, practitioners in design or construction have some concept as a tool for observing various phenomena caused by the design - site gap. But, their viewpoints might lean towards any side of designer or contractor. Any concept intergrating the both points of view is needed.

It may be mentioned that macroscopic concepts for intergrating the gap have been discussed and developped though the problems are not yet resolved actually. I am, also, very interested in so-called "organizational and procedural innovation" in building construction.

On the other hand, microscopic concept as a tool for intergrating the viewpoints of detail designer, contractor and building user is, I think, not yet developed.

Some conceptual tool which can integrate the detailed design, work study or work analysis of on-site work process and value engineering job plan should be discussed and developed, I think.
In my paper , three sets of breakdown structure are supposed. The three are function, physical components and work on-site. And then, the interaction between the three is supposed to be analysed. This concept has, perhaps, inherited from "structuralism" and "semiotics". I believe many possibilities lie in this direction.

2. Problem of low labour productivity in traditional construction method and cultural resistances to rationalised newly-developped or from-abroads-introduced construction methods of houses.

As to the housing construction, the labour productivity is fairly low in Japan. I estimate the on-site labour requirements of Japanese common houses have generally been reduced from about 30 man-hours per square meter of floor area at a few decades ago to nearly 20 man-hours per sq.m. in the present days. There are no official survey on productivity of building construction in Japan. In summer 1975 and 1976, I surveyed the on-site work process of to samples of Japanese conventional wooden houses in Tokyo Metropolitan district. And also, we surveyed the construction sites of several wooden construction methods, which include wooden prefabricated method and North American type wood frame construction.

As to the conventional wooden construction, the total on-site labour days are about 3 man-days per sq.m. (these units of labour is common in Japan). The total staying hours on-site are about 20 man-hours. The work on-site is done by about 20 sorts of trades.

About 60 percents of the total man-hours are of carpenters. And a half of the carpenter work is for trim and finish, 15 to 20% for carpentry grounds such as wood furring, and the residuals 30 to 35 % is for wooden structural bodies such as framing including the pre-cutting work of wood members in the cutting shop of carpenters.

Comparing with about 9 man-hours per sq.m. (that is 0.84 manhours per square foot) in the common wooden construction in the North America reported by Bureau of Labour Statistics, U.S. Department of Labour as the result of 1969 survey, the labour productivity of Japanese tradtional method is too wrong.

It can be mentioned that Japanese common wooden houses require about twice times of labour compared with North American type wood frame construction. Japanese common method uses about 10 cm x 10 cm bulk timbers as posts at 91 cm or its multiple distances along the walls. Jointing between wood members is composed of many sorts of tenon or traditional complicated joints.

Of course, various prefabricated houses are developped. But the share of the prefabricated houses in the

total housing construction is still small: about 12 % og total new builts units and not much than 10 % of low rised dwelling units in 1973. These figures were the peak as yet. Though the labour requirements is surely reduced in prefabricated houses, the ultimate sales prices are in most cases almost as same as those of conventionally built houses.

Various types of houses construction have been imported from European countries. Several log house type construction systems from Scandinavia have been introduced. Especially, the platform type wooden frame construction from Canada and United States created a great sensation in Japanese housing industry. Ministry of Construction openized this construction method by new law of 1974 so that any builder can build houses by this method without particular judging. Housing Loan Corporation has come to treat it with special advantages.

These imported construction method, also, are given remarkable influences to tradional wooden construction as described a little in the paper. However, some cultural problems are found in the details of construction method.

People who prefer to tradiotional taste are not yet the minority in Japan. The relation between traditional taste of houses and requirements of many skilled on-site carpenters is an interest of my study. I have been engaged in the field survey of on-site labour process and functional analysis of tradional components in the detail of house. From the standpoint mentioned above, I have proposed a viewpoint on microscopic breakdown structure study in my paper.

SUBJECT
SUJET

6

General papers.
Chairman: H. MENKHOFF

Documents généraux
Président: H. MENKHOFF

Report from Section 6
GENERAL PAPERS

The discussion lasted from 11.10 to 12.32 and the following made contributions:

1. Ozden Ozen
   Ass. Prof. dip. arch.
   Building Research Institute
   Ankara, Turkey

2. Zenon Zielinski
   Prof. & consult. Eng.
   Concordia University
   Montreal, Canada

3. Oktay Ural
   Prof. President
   International Association for Housing Science
   Florida, USA

4. Surinder Singh
   Lecturer
   Department of Building and Estate Management
   University of Singapore
   Singapore

5. Willem Diepeveen
   Dr.
   The Netherlands

6. Eberhard Deutschmann
   Prof. Dr.ing.
   Technical University Dresden
   German Democratic Republic

7. Richard Wright
   Director
   Center for Building Technology
   National Bureau of Standards
   USA

8. Gyula Sebestyén
   Director Prof. Dr. techn.
   Hungarian Institute for Building Science
   Budapest, Hungary

The substance of the contributions were as follows:

1. OZEN

Subject: Etablissement des services d'agrément dans les pays en voie de developpement.

Certaines remarques pour l'exposé intitulé "les services d'agrément chez les pays en développement pour les nouveautés dans la construction et leur union régional à vocation commercial":

Permettez-moi Monsieur le Président, mesdames et messieurs attirer votre attention sur certaines points de mon exposé. J'y ai essayé traiter le sujet d'établissement des services d'agrément au profit des pays en voie de développement pas seulement pour la Turquie. La première mission de ces services d'agrément sera l'encourragement des nouveautés adéquates dans la construction pas seulement des technologies industrialisées. Tandis que celles des pays en Europe occidentale consistent à faire une selection parmis eux. Sa deuxième mission a souligner est de devenir un organe consultatif pour la transfert de la technologie appropriée dans la secteur de la construction. Quand au sujet de l'union d'agrément régional, pendant le congrés avoir la possibilité des contactes entre les délegations de pays riches de resources naturels et de pays en voie de développement de la proximaté de ce région sera un premièr pas pour sa réalisation. D'autre port je trouve, cet congrés est une occasion pour les pays en voie de développement d'attirer l'attention de l'UNIDO et assurer son èntevention future sur ce sujet afin de l'abtenir son attribution d'assistance technique et substantiel d'abort pour l'establissement de service d'agrèment, puis pour la réalisation de l'unior régional. Ce sera utile d'indiquer également le besoin future de ce sujet à l'UEAtc ainsi que certaines groupes de travail de CIB, comme l'assistance et la cooperation technique.

Dèrnierement je vais faire une appele aux responsables du secteure de la construction dans les pays en développement interéssés à l'union, par l'intermédiaire des délégués qui sont présents au Congrés, pour qu'ils écrivent leur avis et leur tentation sur la crétation de "l'union régional d'agrément" à notre Institut.

2. ZIELINSKI

Subject: Universal Concrete Panel System for small and large Houses

Based on experience of developing and application, since 1950, of new precast concrete building systems we attempted to develop an universal, minimum consumption and cost, no-maintenance, simple, modular-low cost housing system. The system indentified now as UCOPAN (Universal Concrete Panel) SYSTEM, is used since the 1970 decade also in Canada and Iran and is being considered in other areas. The experience of using UCOPAN SYSTEM on numerous projects, some of which are illustrated in following selected slides, demonstrated that requirements for economic shelter construction technology are common and can be transferred from developed to developing and back to developed countries

and that process of technical improvement and development can be run both ways.

3. URAL

Subject: Integrated Systems Approach for large Housing Projects

The only solution to a complex problem, such as the planning and implementation of a larger housing project must be done by an Integrated System Approach which is based on the three basic steps:

1. Recognition and definition of all relevant factors to housing projects

2. To decide on the relationships between these factors

3. To inter-relate all these factors using the appropriate weighting or value functions

4. To optimize this approach to make the best use of the available resources.

There is a need of 20 million new housing units per year in the world today. This will actually increase every year. To be successful to produce so many units, every country, especially the Third World Countries must follow the following nine major logical steps:

1. The necessary laws must be enacted.

2. Necessary legislation must be enacted to generate continous and sufficient financial resources. This is mandatory to plan national housing program. A powerful financial-resource system can be obtained by the establishment of a national housing program taxlike contribution. This can have a percentage base with respect to the income of each family. The monies can be collected in a special government institution or bank. This will secure the continous flow of funds toward the realization of mass housing.

3. The municipalities should have a complete and longrange growth plan for their housing and housing-related construction. The building codes need to be strictly controlled without any exceptions. The municipalities, with the support and cooperation of the appropriate ministries, must prepare new housing development areas around the towns and cities. The infrastructures of these lands should be prepared before any superstructure is constructed.

4. The impact studies to define the influence of the new developments on the existing basic utilities must be finalized before the permit of the new development is approved. The neglect of this study will cause major problems in a short time and their corrections will be rather expencive, if not impossible.

5. The national Housing Policy should consider the prevailing land speculations and react to it by providing new urbanized land around periphery of the existing urban centers.

6. The appropriate government organizations should support the implementation of proper industrialized housing production systems and use them in their own projects. The modular coordination should be nationally adapted. The industrialization needs to be implemented in parallel with the existing classical construction schemes.

7. The expansion of the research and evaluation of all available indigenous construction materials. The results of such activities will defenitely introduce new materials and improve the use of other materials.

8. New technologies and management techniques need to be introduced to speed the construction activities in the nation. This will help to produce more and decrease the cost of elimination the effects of inflation.

9. The decision process should consider all factors related to users needs, costs, accessibility, job opportunity, density, environment and financing.

These nine points emphasize the overall approach to the initiation of any large housing project.

4. SINGH

Subject: Cost Estimation of Reinforced Concrete Framed Structures for High-rise Residential Buildings

A simple, rapid and fairly accurate methodology for the cost estimation of reinforced concrete framed structures for highrise residential buildings has been presented in our paper. The methodology is based on computing the quantities of constituents of reinforced concrete structures using the statistical relationships established and pricing the constituents with prevailing rates.

The statistical relationships established besides being useful for the cost estimation are also helpful for various other purposes viz. selection of optimum number of storeys, computation of cost indices, budgetting of materials, checking of cost estimates etc.

Similar relationships if established for structural schemes using different materials will be very useful for selection of most economical alternative.

Though the relationships established are for conditions prevailing in Singapore, the methodology can be applied in any other country and the results will be very useful to the various professionals of building team for different purposes mentioned above.

Paper: p. 755 Volume 1b Proceedings of the Congress.

5. DIEPEVEEN

Subject: The balance method for value analyses in the construction industry.

Value analysis wants to compare functions and costs. It wants better functions against the same costs or the same functions against less costs - or even better functions against costs, that are relatively not higher. The balance method may be a means to do it. Value analysis is not simply a method of cost reduction although it is often used for this end.

It is essentuel to try this method not on a building as a method, but to try the method on an easier level of components. The result will be a method that can be used in design and execution stage by designers and contractors and also by producers of components.

Paper: p. 694 Volume 1b Proceedings of the Congress.

6. DEUTSCHMANN

Subject: Application of large-panel structures in public buildings.
Mr. Deutschmann gave a summary of his paper and espesially he showed preferably combinations of precast concrete frame structures in the ground floor and in multi-storey buildings.

Paper: p. 717 Volume 1b Proceedings of the Congress.

7. WRIGHT

Subject: Modeling of Standards

Mr. Wright gave a summary of his paper and especially he delt with organisation, expression and interpretation of the information contained in a standard.

Paper: p. 492 Volume 1b Proceedings of the Congress.

8. SEBESTYEN

Subject: System in construction

Mr. Sebestyén gave a summary of his paper and a summary of the contributions concerning this problem. His conclusions were:

- The theory of systems can yield great benefits, however, it is not itself remedy for all maladies.

- The study and teaching of the theory of system is not very advanced in the construction industry, therefore systematic research and exchange of experience should be envisaged.

Paper: p. 773 Volume 1b Proceedings of the Congress.

SECTION

7

TECHNICAL VISITS
Exursion 7A: Building sites and projects
Excursion 7B: Wooden houses in the Oslo area
Exursion 7C: The Folk Museum. Collection of old wooden houses

VISITES TECHNIQUES
Excursion 7A. Chantiers et projets
Excursion 7B. Habitations en bois dans la région d'Oslo
Excursion 7C. Musée folklorique. Maisons anciennes en bois

Section 7A

Building sites

Residential area at Nordseter
Lambertseterveien
Oslo 11

MAIN CONTRACTOR

Working Partnership, STIANSEN-EVENSEN)
(Stiansen Entreprenørforretning A/S, Ragnar Evensen A/S)

CLIENT

Oslo Bolig- og Sparelag (OBOS)

ARCHITECTS

Alf Bastiansen, Alex Christiansen

INFORMATION ABOUT THE PROJECT

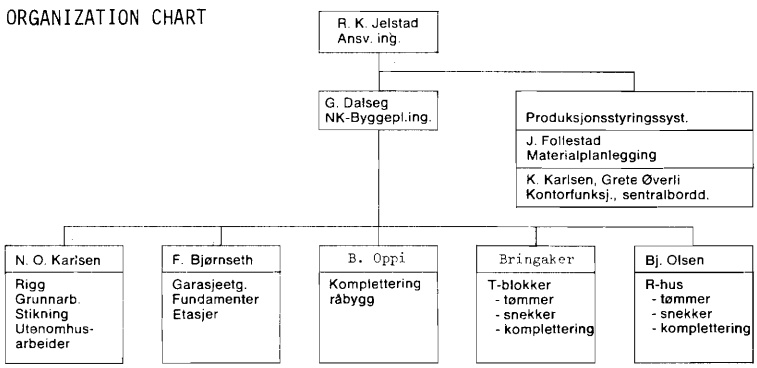
GENERAL PROGRESS SCHEDULE

Area	1978	1979	1980	1981
1-2	———	———	———	
3		———	———	———
4			———	———

SPECIFICATIONS

The building areas are designed with housing units in terraced blocks and in rows of two-storey houses. In some of the row houses the concrete basement houses a separate flat.

ORGANIZATION CHART



When in full operation, about 165 persons will be employed at the site. The visit to the building site is concentrated on the row houses of timber. Parts of the houses are produced as prefabricated elements in a special production tent at the building site. The rate of production is 2 days per housing unit. The time taken to build each housing unit above the foundation is about 300 hours.

DISTRIBUTION OF HOUSING UNITS

	In rows	In terraced blocks
Area 1-2	98	202
" 3	44	153
" 4 ca.	64	141

MAIN QUANTITIES

Shuttering	approx.	180.000 m2
Concrete	"	25.000 m3
Reinforcing steel	"	1.700 tons
Gipsum boards	"	140.000 m2
Floor covering	"	65.000 m2
Doors	"	6.000 pcs
Windows	"	6.000 pcs

The total building costs amount to NOK approx. 150 million, exclusive taxes and duties (VAT).

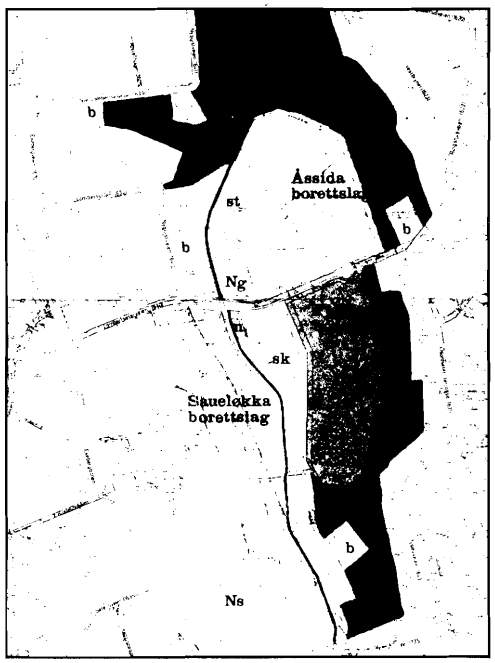


Fig. 1 Development plan

CODE

Ng Nordseter farm
Ns Nordseter school
n shop
b kindergarden
sk primary school

Fig. 2 Cross-section of the terrain

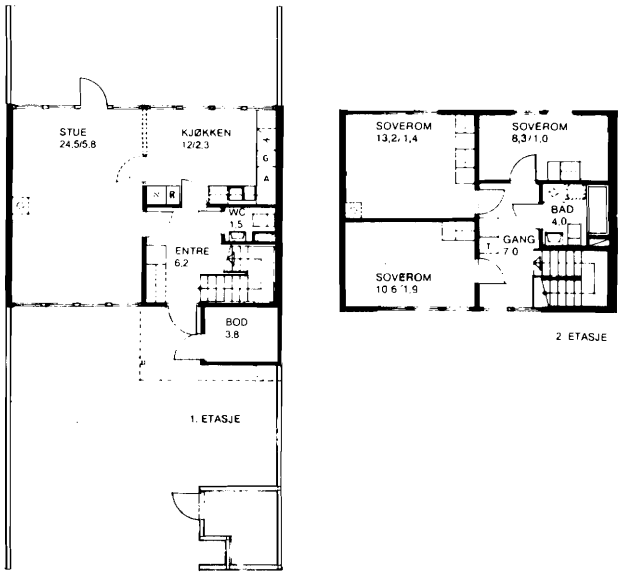


Fig. 3 Floor plan of 4-roomed row houses, 99,0 m^2 living area, Type 4C

SERIES OF PICTURES FROM THE SITE

Fig. 4 Site Office

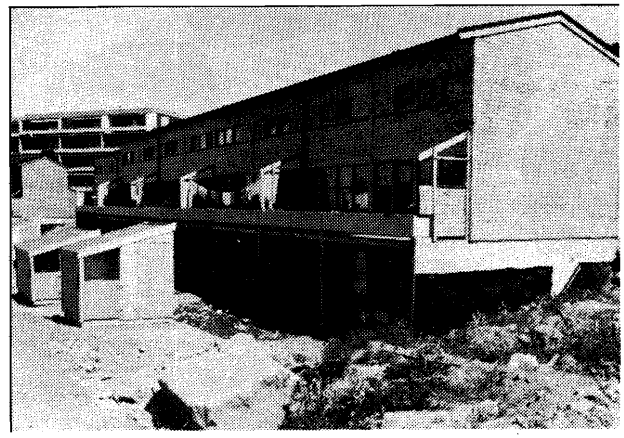


Fig. 5 Row house with basement, front elevation

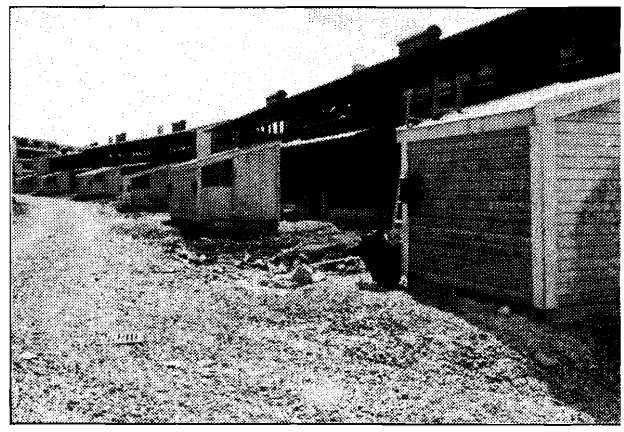
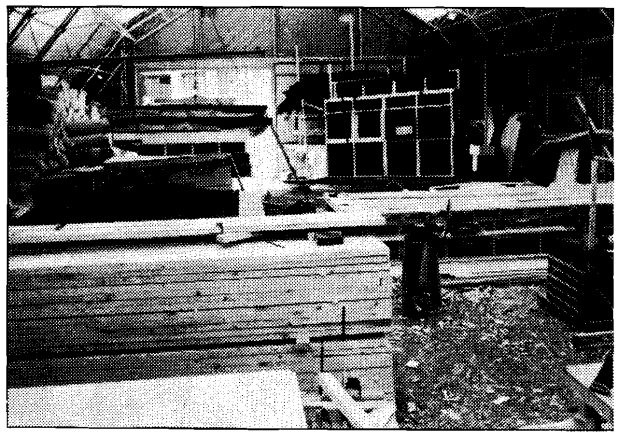
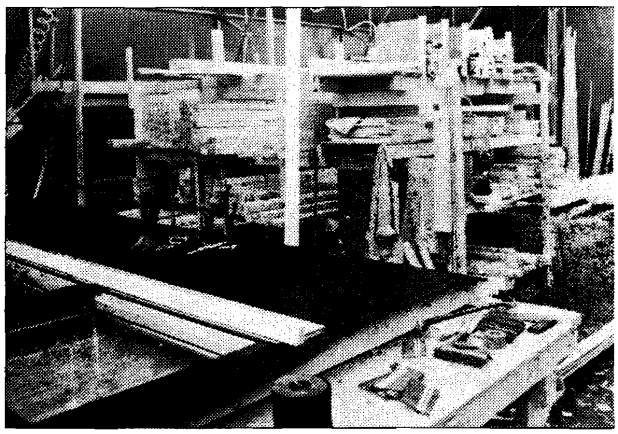


Fig. 6 Row house with basement, rear elevation





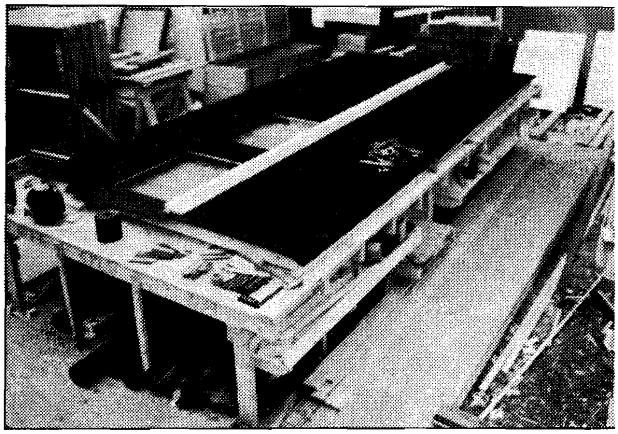


Fig. 7, 8, 9 Production of prefabricated elements

Fig. 10 Trailer for transport

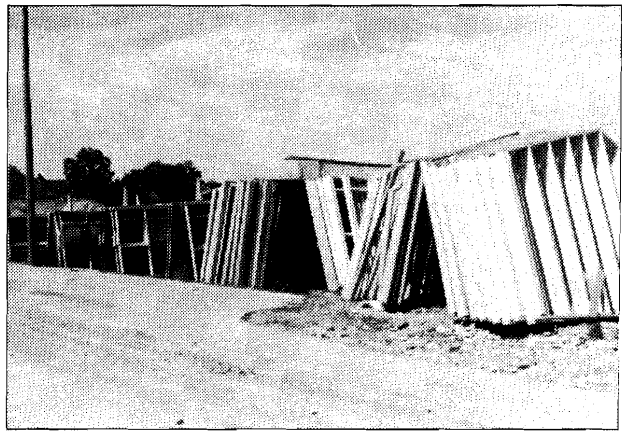


Fig. 11 Open-air storage of elements

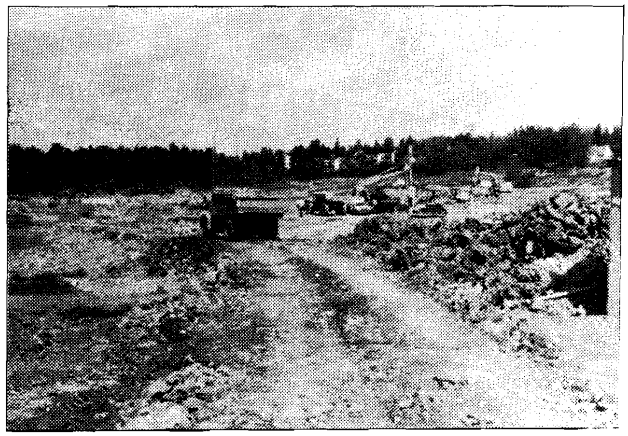


Fig. 12 Development of buildings sites

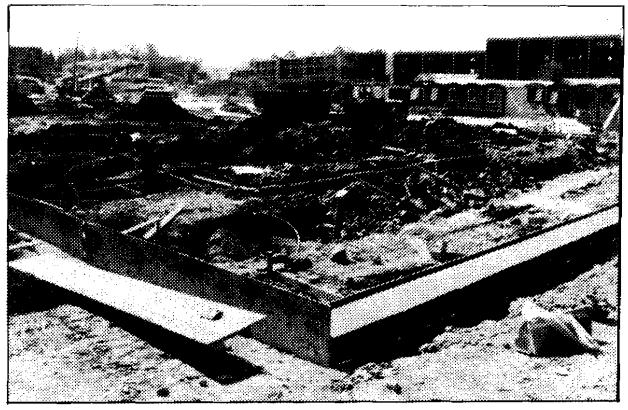


Fig. 13 Foundation

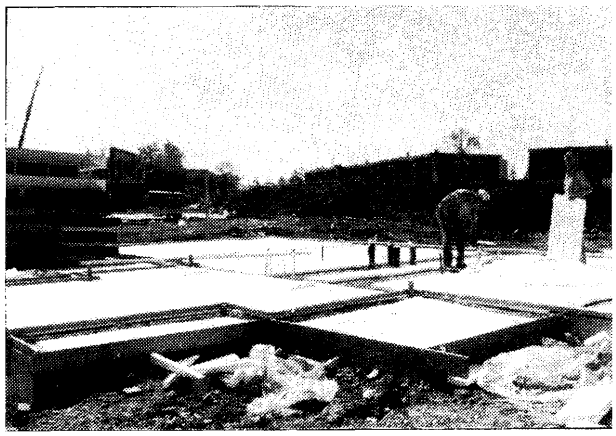
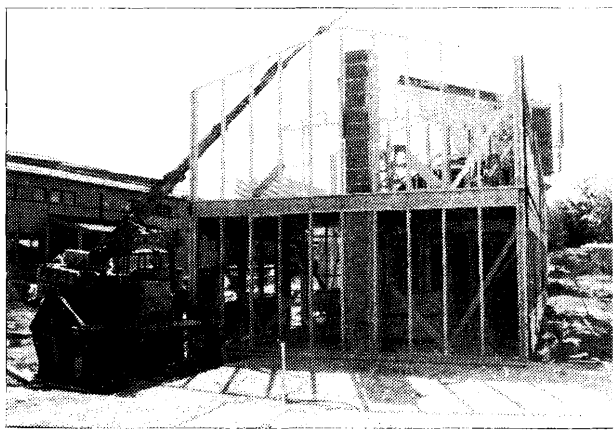


Fig. 14 Floor on hardcore



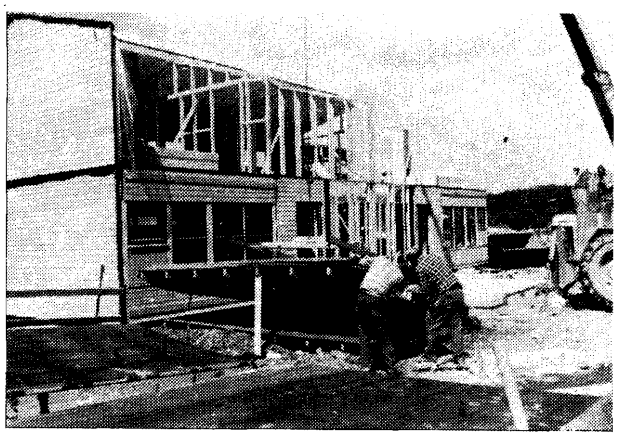


Fig. 15, 16, 17 Installation of elements

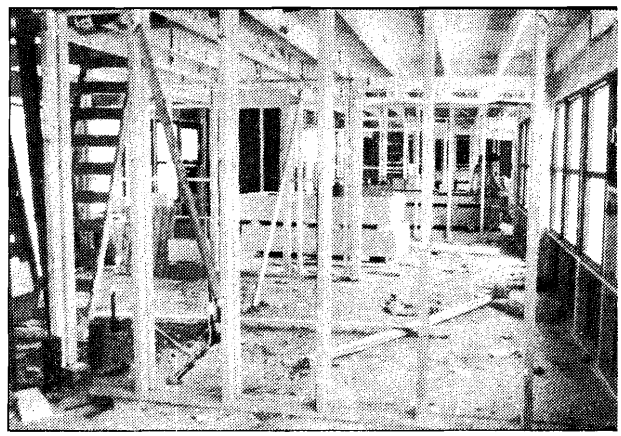


Fig. 18 Interior, ground floor

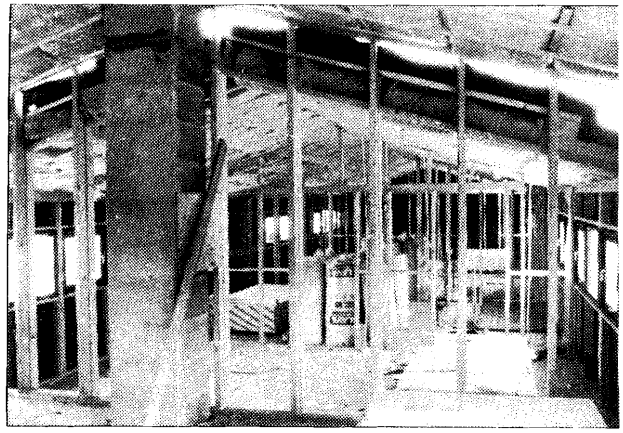


Fig. 19 Interior, first floor

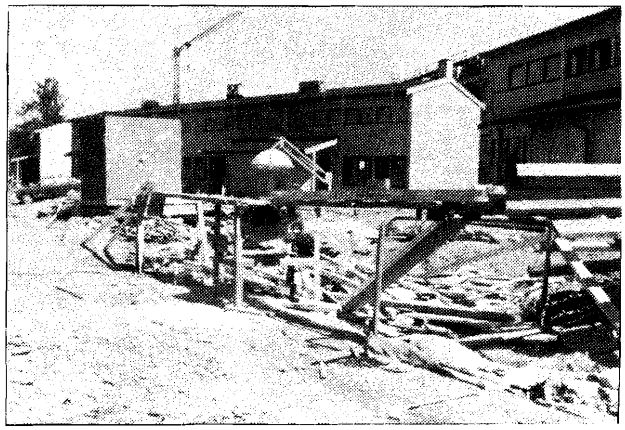


Fig. 20 Outside cutting site

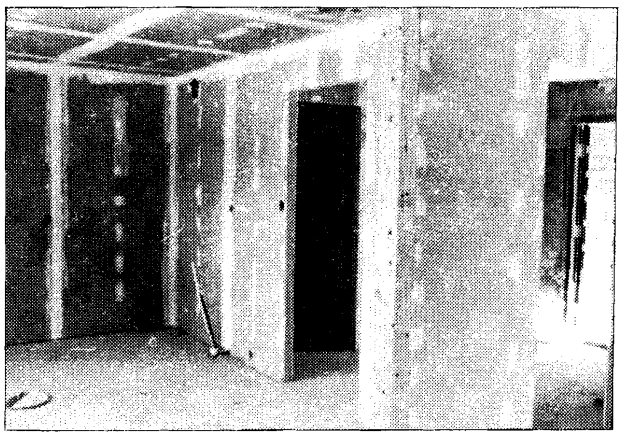
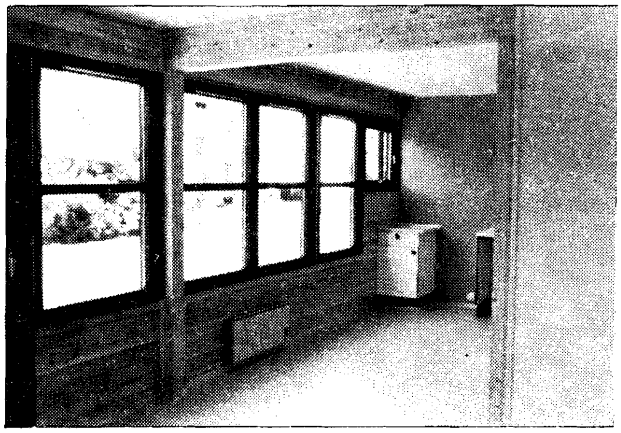


Fig. 21 Ready for painting

Fig. 25 Plants for surrounding areas



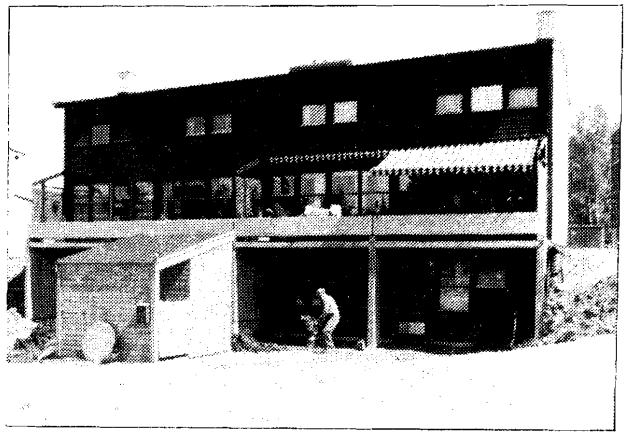


Fig. 26 The completed building

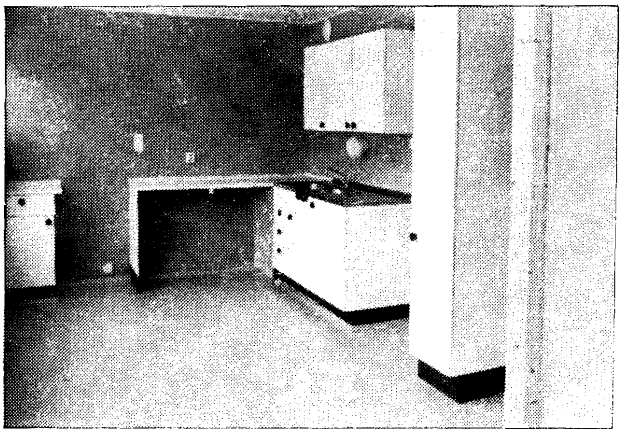


Fig. 22, 23 Completed interior

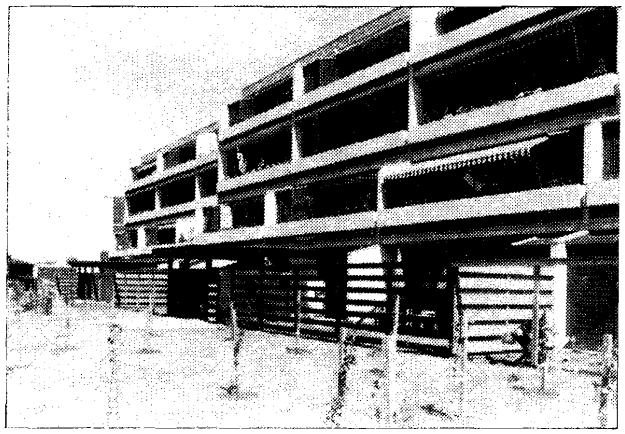


Fig. 27 Terraced block house, from the front

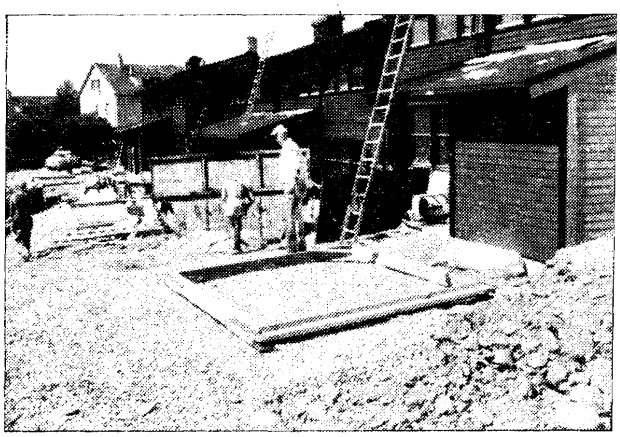


Fig. 24 Foundation for shed

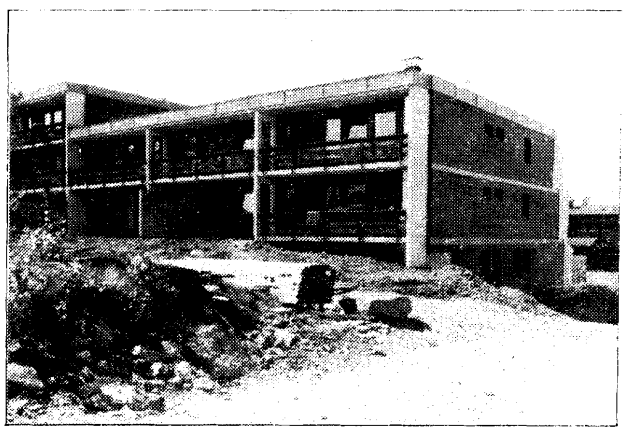


Fig. 28 Terraced block house, from the rear

ADRESSES

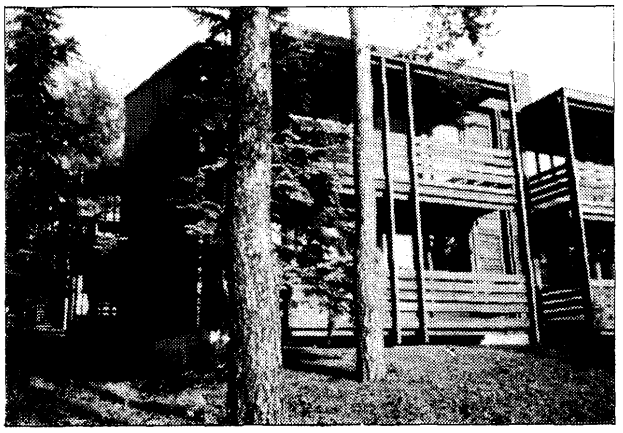
Stiansen Entreprenørforretning A/S
Hoffsveien 30, OSLO 2
Tlf. (02) 55 26 40

Ragnar Evensen A/S
Tollbugt. 25, Postboks 772, Sentrum, OSLO 1
Tlf. (02) 41 18 90

Section 7B

Wooden houses in the Oslo area

1) Risvollen, homes for elderly, Heyerdahls vei 3
Architect: Tore Drange (John Engh Architects)
Built: 1974 - 1975



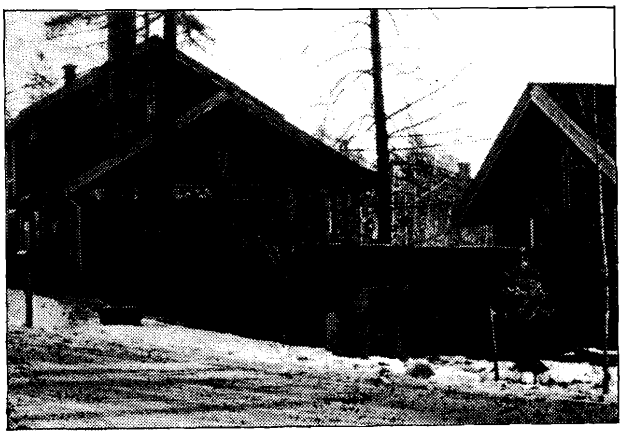
150 elderly in the Holmenkollen area formed some years ago a building society for the purpose of building homes for couples and single old people. At that time they paid approx. N. kr 33.000,- per unit, while flats provided by the municipality costed approx. N. kr 27.000,-. The houses are built with extensive use of wood, although floors and walls between flats are made of in-situ concrete. Structural glued laminated timber is used in the facades, and solid wood t & g boards are used for internal finish.

The old residential house at the top has been modernized. It was originally in "Swiss style", but rebuilt in 1920 by architect Lars Backer and later by architect Arnstein Arnberg. This house provides now all common facilities for the elderly. Living rooms, dining room and library, as well as offices for the administration. There is also a few hospital rooms to cover temporary needs. More hospital rooms are provided through an agreement with Eckbos Legat, a hospital nearby.

2) Residential area in Heyerdahls vei
Architect: Erik Anker
Built: 1970

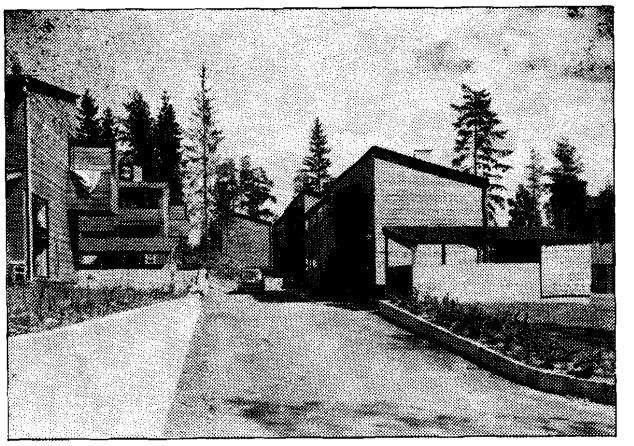
Excample of good area planning with houses in groups and divided by fences and garages. Traditional Norwegian style. Square shape in two stories with a rational design both in terms of construction and heating.

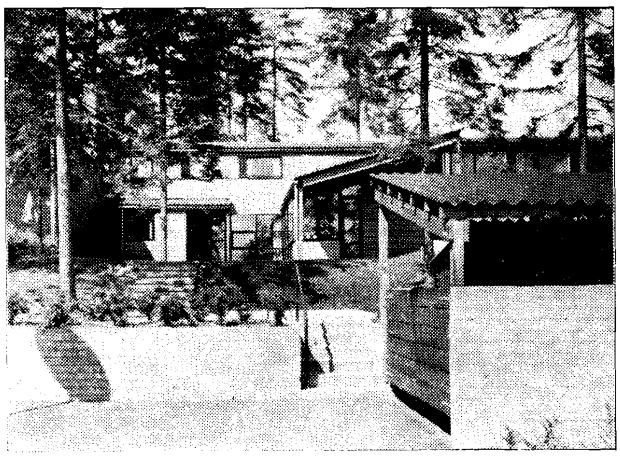
3) Heyerdahls vei near Ankers residential area
Architects: Westbø and Karlsen
Built: 1973



Single family, detached house built with the Tunhus design principle. Tunhus are houses grouped around a common court-yard. Construction with glued laminated structural wood and non load-bearing exterior walls.

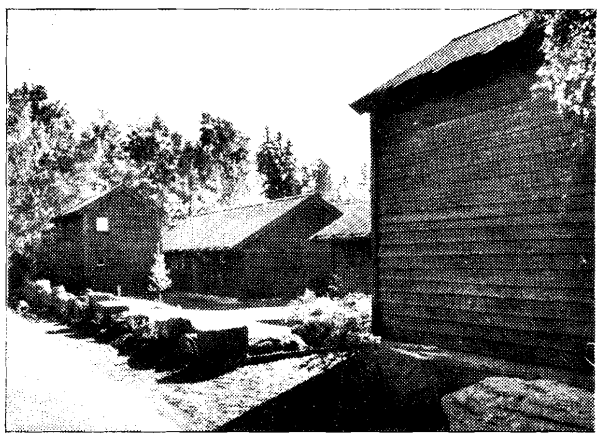
4) Svendstuen residential area
Architects: Are Telje, Fredrik A.S. Torp, Knut Aasen
Built: 1974
Number of houses: 23
Lot size: 300 - 350 m^2
House size: 155 - 160 m^2
Rate of land utilisation: 0,24





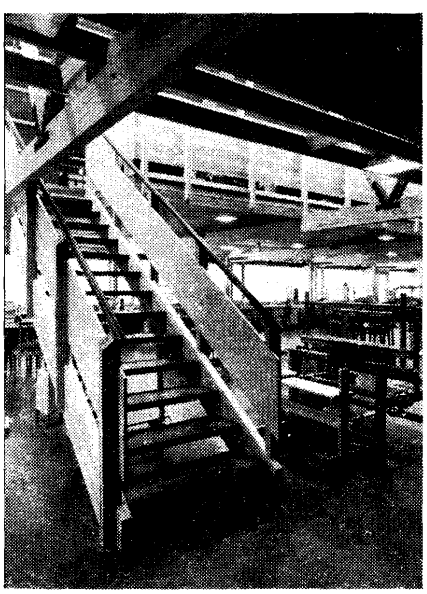
A simple plan system with both one and two stories combined in several ways to provide view and adjustment to the landscape and the neighbours.

5) Single family houses in group. Nadderudveien 9.
Architect: Per Johan Eriksen
Built: 1979



Built in accordance with good Norwegian tradition and is particularly successful in the site plan.

6) The Steiner school at Grav
Architects: Per and Molle Cappelen
Built: 1971



The new school building is built in connection with the old Grav farm which has roots back to the Middle Age. The school is based upon the pedagogy of Rudolf Steiner. The building has structural glued laminated wood and solid wood also for interior finish.

7) Tunhus at Høvik
Architects: Tor Karlsen and Ingolf Westbø
Built: 1970

The houses have an internal load-bearing post and beam system which provides non load-bearing exterior walls. This system makes Tunhus very flexible in terms of interior planning and construction. Today the system has been taken over by a housing company.

Section 7C:
Excursion to THE FOLK MUSEUM, Bygdøy
Collection of old wooden houses

The participants were divided into two groups, one englishspeaking and one frenchspeaking group. The englishspeaking group went to look at Åmlidstova from Valle in Setesdal, built about 1650, Raulandsstua from Uvdal in Numedal, built about 1250 and the Stavechurch from Col in Hallingdal built about 1200.

The frenchspeaking group visited Kjellebergstua from Valle in Setesdal, built about 1650, Barfrøstua from Stor-Elvdal in Glåmdal, built about 1670 and the Stavechurch from Gol.

SECTION

8

Building research institutions in developing countries, a case study.

Chairman: J. DICK

Institutions de recherche du bâtiment dans les pays en voie de développemens; un exemple.

Président: J. DICK

Report from Section 8 - Plenary session
BUILDING RESEARCH INSTITUTIONS IN DEVELOPING COUNTRIES - - A CASE STUDY

Key-note speaker: A.L. Mtui
Invited paper: G. Sebestyén

Eight papers were submitted to Section 8. Six will be found in the main volume, one in the supplementary volume and one paper, submitted at the conference, will be found in this.

In addition to the contributions from Mr. Mtui and Mr. Sebestyén, three papers, by Mr. Birkeland, Mr. Samarai and Mr. Okyere, were introduced during the discussions.

Contributions to the discussion which were not presented due to lack of time, have been taken into this report after the key-note speaker's final conclusions.

Øivind Birkeland, Norwegian Building Research Institute
P.O.Box 322 Blindern, OSLO 3

There are some conditions which have to be fulfilled to organize a successful building research institution:

1) There must be a political will behind the institution, a will to do something about the building problems of the country.
2) You must have means to introduce the results of the work into practice.
3) The placing of the organization in relationship to the governmental institutions and private building industry.
4) And last, but not least, the programme of the research institution.

This seems to be valid everywhere, both in developing countries and in industrialized countries.

You can not solve the building problems of a country through transferring the technology from another country. You have to develop the technology which is appropriate for the conditions in the country. This technology will as a rule not exist anywhere it has to be developed. You should not have a programme designed to give international prestige to the country which you sometime may find. What you really ought to do is to solve the local problems with knowledge available elsewhere in the world. This is not the type of work which will give prestige to the researchworker, at the same time it demands a researchworker which is very well qualified and able to work on his own. This will give you staff problems.

Dr. Zawde Berhane, Facility of Technology, P.O.Box 518, Addis Ababa, ETHIOPIA

In the paper entitled "Building Research in Developing Countries" it is stated that almost all existing building research institutions in developing countries are either attached to a university or to a ministry of public works. The author has given reasons why such organization setups might not be ideal ones.

The main reason why such organization setups are adopted in the developing countries is easily understood if one takes into consideration the concrete conditions being faced by such countries. In the first place there is an acute shortage of qualified people to conduct research works and do teaching in universities. Thus, it is not uncommon to find people qualified in the building profession or other fields doing both teaching and research. Another factor, which has been stated many times in the past, is the "brain drain" to which the developed countries have the responsibility to rectify.

Dr. Mufid Abdulwahab Samarai
National Centre for Construction and Laboratories
Iraq

Mr. Samarai's introduction of his paper will not be repeated here, but attention should be drawn to some of the unique technological problems presented. Some of them solved by redevelopment of ancient technology. Finally Mr. Samarai recommended that developing countries should not isolate. They should consentrate on applied research and get help from developed countries to carry out the basic research work, given that they know where to find people who can help.

G. C. Mathur
National Buildings Organization Ministry of Works and Housing, New Delhi, Indie

In the set up of building research institute in developing countries, I would like to suggest two important areas for consideration in which CIB can play a significant role.

The first concerns about evolution and promotion of appropriate technologies in developing countries taking into consideration social and economic situation. This is of vital importance in introducing innovations in building. As built of housing and construction activities are undertaken largely in private sector breaking the traditions and conservatism is of crucial value.CIB

should consider evolving criteria for selection of appropriate technologies.

The second relates to ensuring the utilization of results of research for which research centres should undertake to cover the risk, financial and on technical, and also by putting experimental demonstration construction projects. Looking in larger perspective I feel that guide lines should be evolved by CIB to methods and measures for achieving transfer of technology by systems of risk fund, or guaranties.

Inkeeping with the limited resources in developing countries, I feel the model of the set-up of building research center ought to be quite different in developing countries. The CIB, I am sure, would apply itself to suggesting an appropriate model for building research centres. Based on my study of some research centres in ESCAP region, I will be able to suggest some indicative approach.

Moses D. Mengu, Building & Road Research Insitute University, Kumasi - GHANA

1. The experience of the Ghana Building and Road Research Institute and that of other developing countries is that most research project are not often carried out to their logical conclusion. There is hardly ever enough time or resources to make them full proof. Hence, the "Risk Fund" for research as suggested by Mr. Mathur could in most countries prove to be very expensive and wasteful. It could also overburden the governments of the poorer countries and even further limit the resources available for research.

2. The Building and Road Research Institute has found direct collaboration with housing financing and development agencies, as well as village and town development committees a fruitful way of spreading some of its results. Student participation in research project during the long vacation could also ensure a future market in the building and construction industry for the research result of institutes.

Rufus S.Ogundana, Federal Housing Authority, Lagos, NIGERIA

Even now that research in the Developing countries is still in its infancy, care must be taken to ensure that there is no communication gap between recent results and applications. Big users like Government Housing Corporations need to get up research departments to actively liaise with Research Institutes and adapt the results of research to their particular activities.

To solve the manpower problems of the Research Institutes in the developing countries, is it possible for researchers in the developing countries who are interested in research problems affecting developing countries to arrange to spend their leave of absence in field work in the developing countries. The idea of regional conferences and seminar among Research Institutes in the developing countries will help to prevent duplication of efforts.

J.N. Okyere, United Nations Economic Commission for Africa, Addis Abeba, ETHIOPIA

I would like to congratulate Mr. Mtui, Prof. Sebestyén and the others who contributed papers on the present theme. Among them they have presented what to my mind gives a comprehensive picture of what should be the approach to building research in developing countries and what some of the problems and needs are. I would like however to draw attention to some areas which need special emphasis.

As of now only a few countries in Africa have full-fledged institutes of the type that Mr. Mtui has described. It was obvious however, at the meeting of directors of African building and building materials research institutes held in Bujumbura, Burundi in April/May 1980, that many African countries recognize the need for, and would therefore like to establish building research institutes. But the costs involved, the requirements of staff, and the fact that some of the countries in the subregions of Africa have common social, economic, cultural and climatic conditions, means that we should give serious thought to the setting up of joint research centres. There is therefore an urgent need of assistance for the establishment and running of building research institutes.

Existing institutes need assistance in respect of training of research personnel, assistance for the purchase of equipment as well as in securing books and other documentation. Cooperation among building research institutes in Africa should be encouraged and strengthened. Cooperation with international organizations and agencies, NGO's and other research organization outside Africa should also be promoted. ECA will seek to mobilise the assistance of these organizations/institutions for the benefit of African building reserach institutes. I have already had the opportunity to refer to the directory that ECA has been requested to prepare covering organizations /institutions which also, can or are willing to promote the development of building research in Africa.

ECA has also been requested by the African countries to collaborate with UNCHS (Habit of) to elaborate a suitable mechanism for the flow of information among building research institutes in Africa and

with institutions in other regions of the world. This is an area where the experience and collaboration of CIB can be used to great advantage.

D. Mohan, Central Building Research Institute, Roorkee (O.P.), India.

I would like to congratulate Mr. Mtui for putting out his problems and progress of Building Research in Tanzania. I have been impressed by the various means of dissemination of information e.g. demonstration houses, data sheets, books and pamphlets. We ourselves have found demonstration projects a very effective way of implementation of the result of research. The problems of finance and trained manpower are common to the research institutions in developing countries, at least in the earlier stages. An effective method of achieving this is to seek the help of various B.R. institutions in CIB and invite short-time experts to help them with their major problems in buildings and housing. But it is the training programme and motivation of research work by giving them a better status and salary that will help all of us, at least in the developing countries. In this matter some sort of regional corporation through U.N. agencies will help.

I have also been impressed by the review of B.R. made by my friend Prof. Sebestyén who has had a long experience of Building Research. He is now occupying the key position of Secretary General of CIB which should enable him to play a more effective role in CIB helping the developing countries.

I might as well give my own experience of building research in Indian environments in a period of 32 years.

There is no difference of opinion on the need for building research in developing countries. However, the factors to be taken into consideration in organising R&D in this field may differ from country to country. There is danger of too much technological dependence on industrially advanced building practices. The large economical and technological gap between a developing country and an industrially developed country comes in the way of direct implementation of foreign technologies. To overcome this situation, it was necessary for India to build up R&D activities and programmes suited to national economic, political, social and environmental needs. The economy itself forced India to begin with indigenous technologies based on the use of local raw materials and locally produced building materials and components. However, to meet the increasing requirements of improved housing, durability, hygiene, environmental comfort etc., it was necessary to carry out systematic investigation taking advantage of the basic scientific principles and their advancements.

This systematic research has resulted in the development of a number of improved materials and technologies which could be conveniently adopted with the locally available resources and skills.

Typical examples are:

- Protection of mud walls from rains and thatch roofs from fire
- Cement substitutes and economy in the use of cement
- Upgrading of local building materials and development of new materials from roads
- Solving foundation problems typical to Indian conditions
- Improving functional efficiency of buildings
- Planning, design and construction of economical, residential, educational, health and other community buildings
- Solving special problems of rural housing

Problems of utilization of results of research

Large scale utilization of the results of research has not been an easy task. Building trade being a conservative one, and being in the hands of a large number of scattered small and unorganised agencies, there has always been an apathy and even resistance to accepting any new material, design or technology. As a consequence, during the first two decades of research there was little impact on the building industry. Only during the seventies, there has been a fair amount of utilization of some of the researches put out by CBRI. This was possible through revision of objectives, greater stress on publicity and extension as well as by taking up more sponsored and consultancy projects from the industry and user organisations. Another means adopted for the wider application has been the introduction of CBRI findings in the National Standards and Codes of Practice relating to building. The Institute has also recently set up a Construction Unit, with extension cells in important cities, for demonstration and introduction of new materials and techniques in major construction projects.

Research Programming and Methodology of Execution

The new research projects to be included in the annual programme are conceived well in advance and thoroughly discussed with Scientists of the Institute as also with outside experts before finalising. Each project is clearly defined indicating classification, project number, project title, socio-economic justification, reference to identification, sponsorship, objective, present status, programme of action, date of starting and target date for completion. Personnel associated with the project as well as the effective time to be devoted by each member of the team is also indicated. After the project is finally approved its cost is estimated and necessary provision made in the budget. The industries and agencies which might be the end users are also identified and attempts are made to create

their interest in the project right from the planning stage.

After the research programme is prepared, copies are sent to the members of the Scientific and Technical Advisory Committee (consisting of 27 members). The experts, for various disciplines in the committee, discuss each project in detail with the project leader and the team and give their valuable advice. The projects are finally approved by the Governing Body consisting of 11 members. During the execution of the project its progress is evaluated at intervals of 10 to 12 weeks by internal group meeting and the progress reported to the members of the S&T Advisory Committee and Governing Body half yearly. After the project is completed a detail report is prepared and necessary follow-up action taken for its early implementation. The first step in this direction is the publication of the results and recommendations in suitable form - a research paper, building digest, technical note, data sheet. The second step is the extension and demonstration of the material or technology to practising engineers and architects and its adoption in experimental constructions. Finally the process is released to industry and included in Indian Standards, wherever necessary.

References

1) Building Research in India - Review and Future Trend, Dinesh Mohan and P. L. De, Bulletin of Builders Association of India, October 1976, 19-22.

2) Indian Experiences, Programmes and Modalities for R&D Pertinent to Developing Countries, Dinesh Mohan and P. L. De, Submitted to ECA meeting of Directors of African Building Research Institutes held in Brijumbura from 30-4-80 to 3-5-80.

CIB members should bring out a shopping list of their research results which would be given to developing countries. One such list was brought out by CBRI a few years back.

Anton L. Mtui, Building Research Unit, P.O.Box 1964, Dar Es Salaam.

Research institutions in developing countries have a wider role to play when compared to those in the industrialized countries. This is due to lack of necessary infrastructure to use or disseminate the research results. In developing countries many governments see and realize their housing shortage problem. The problem is that they have not come to a conclusion that research is really the answer or part of the solution to the problem. Research results are readily accepted and since they dwell on the dev. of existing technology there is no danger or harm to the recipients. In Tanzania demonstration houses are usually occupied by the heads if the villages after they completed. This is in a way a clear indication that our research is accepted. CIB can come to the assistance of developing countries by encouraging exchange of information within member countries, exchange of projects and staff even for short periods. Already our unit is enjoying these benefits.

Ezzat Hashem Morsy (research prof.), General Organization for Housing, Building and Planning Research, P.O.B. 1770, Cairo, Egypt.

A proposal regarding Building Research Centres in developing countries and CIB.

Extensive discussions regarding the relation between the CIB and Building Research Centres especially in developing countries. I do feel that time has come for some action to be taken to achieve optimum benefits by being continuously in touch rather than meeting only in the Congress periods.

Bearing in mind the fact that financial resources for both CIB and centres, each individually, are undoubtedly insufficient to cover the expenses for continuous links between the theme I would like to propose the following:

The world should be divided into regions or areas. Each is formed from centres from a group of adjacent countries, which most probably have some common problems, conditions, circumstances and materials resources.

Centres of region plan for the work together and divide the activities between them according to individual capabilities (personnel and laboratories). Their work can be through a Regional Centre. In the latter there should be a small centre for CIB to which a representative should come between now and then. A CIB expert may help in more than regional centre to minimize expenses. In the meantime Centres participating in the region should cooperate to cover the required budgets. By doing this it may be considered as investment which will be beneficial for them.

It is worth pointing out that cooperation should cover all matters concerned with building and construction: research work, survay work, documentation, evaluation of materials resources etc. By this I do feel that CIB will go much further in all respects especially with respect to application of research and transfer of modified and appropriate technologies.

On behalf of the General Organization of Housing, Building and Planning Research in Egypt, it is the pleasure for me to state that its potentiality and

capability can present it as a regional centre. An evaluation for the premises based on nowadays prices, is over six million dollars. The number of researchers and engineers is over seventy. With an appropriate planning it can help all of us to achieve the target. Thank you.

Dr. A. G. Madhava Rao, Structural Engineering Research Centre, CSIR Campus, Adyar, Madras - 600 020.

I like to congratulate Prof. Sebestyén on his paper. I suggest the following three points for the consideration:

1. Setting up of joint research projects between the developed and developing countries of CIB. The field suggested include wind engineering, earthquake engineering, off-shore structure, computer graphics and new materials like polymer concrete, fibre reinforced concrete etc.
2. Setting up of training centres for engineers and craftsmen.
3. Revision, updating and modernizing the national building codes.

Section 8

BUILDING RESEARCH ACTIVITIES IN AFRICA AND THE PROMOTIONAL ROLE OF ECA

By J.N. Okyere
Adviser, Building Materials Housing, Construction and Physical Planning Section
United Nations Economic Commission for Africa

I. Introduction

1. The provision of shelter in decent human settlement for an ever-increasing urban and rural population is a problem that continually occupies the attention of African governments. The production of housing however, lags seriously behind the demand because of a number of factors including the scarcity of financial resources, and the high cost of construction, the latter due in part to an excessive dependence on imported building materials and construction technologies.

2. The local building materials manufacturing industry in Africa has been unable to meet the needs of the construction industry due to a number of factors including dependense on imported raw materials, adoption of inappropriate manufacturing technologies, low capacity utilization and inability to improve and commercialize traditional building materials. The problem of shortages of building materials persists even though there is an abundance of raw materials that can be developed for the manufacture of building materials. The construction industry in Africa lacks local skilled manpower and well-equipped small- to medium-scale contractors. It is slow to adopt appropriate technical innovations and also suffers from the fact that the codes governing it are often inappropriate. Existing building codes and regulations are usually a replica of those prevailing in some developed countries and do not reflect the social, economic and cultural conditions which prevail in Africa.

3. The problems confronting the building materials and construction industries have not escaped the attention of African decision makers. The fourth ECA Conference of Ministers held i Kinshasa in February/March 1977 endorsed earlier recommendations, resolutions and decisions [1] related to the construction industry, and gave the necessary impetus to these actions by explicitly assigning high priority to the development of the building materials and construction industries in Africa. Following that Conference, ECA in co-operation with UNIDO and OAU formulated a programme for the development of these industries which started to be implemented in August 1977.

4. The building Materials and Construction Industries Development Programme

This project is a follow-up to a series of activities undertaken by the Economic Commission for Africa (ECA), the Organization of African Unity (OAU), the United Nations Development Programme, the former United Nations Centre for Housing, Building and Planning, now known as the United Nations Centre for Human Settlements (Habitat) and the United Nations Environment Programme (UNEP) with a view to developing the capacities of African countries in matters affecting human settlements.

5. The primary objective of the programme is to stimulate and assist African countries in increasing their

[1] F.ex.:Economic Commission for Africa resolution 209 (IX) of 14th Febr.1969; The Declaration of Principles and Recommendations for National Action relating to development of building materials and construction industries adopted at HABITAT: United Nations Conference on Human Settlements, Vancouver, 1976.

capabilities for self-sustaining growth and achieving self-sufficiency in these industries at the continental level in the shortest possible time. The current biennial (1980-1981) programme activities are geared to achieving the following specific objectives:

a) To assist in evolving, improving and strengthening policies, strategies and operational instruments for effective identification, co-ordination and implementation of programmes and projects for the development of building materials and construction services, mainly for the leastdeveloped countries and also on subregional basis;

b) To draw guidelines for the creation of new facilities for production of essential building materials based on criteria of appropriate technology, self-sufficiency in basic raw materials, balanced plant size matching the size of local markets within reasonable transport distance, efficiency of capasity utilization and quality standardization;

c) To promote the improvement of construction systems and services and promote their re-orientation to local conditions, requirements and cost reduction;

d) To assist in building up/strengthening African building research and information capabilities as an instrument for developing new, practical and low-cost technologies and for modernizing existing and traditional practices.

6. In the implementation of the programme, ECA has organized field missions to 16 African countries with a view to assessing the current situation in the building materials and construction industries with a view to identifying needs and specific projects, in consonance with government priorities and programmes, the implementation of which would contribute significantly to the achievement of greater self-reliance in these industries. ECA has also organized two meetings, in

July 1978 and July 1979, of African experts on the building materials and construction industries who examined the programme and the progress of its implementation and recommended priority areas of action. More recently, in April/May 1980, ECA organized, in collaboration with UNCHS, UNEP, UNIDO and the Government of Burundi, the Meeting of Directors of African Building and Building Materials Research Institutes in Bujumbura, Burundi.

II. General Characteristics of Building Research in Africa

7. The role of research as an instrument for the systematic and efficient development of the building materials and construction industries sector in Africa has not always been accorded the recognition it deserves, and the impression has sometimes been created that research in general and research on building and building materials in particular are luxury activities that should be reserved for the developed countries. Where building research institutes exist, they have not always been given the necessary financial and technical support to function effectively. Lack of adequate governmental interest and back-up in the activities of existing institutes has sometimes created a situation where research programmes do not reflect the actual needs sufficiently and do not seem to cover the areas requiring priority attention to improve the efficiency and achieve self-reliance in the building materials and construction industries.

8. Few countries in Africa have full-fledged building and building materials research institutes (see Annex). However, many have materials testing laboratories usually attached to the department of public works. These laboratories undertake tests on construction materials to ensure that they conform to prescribed specifications; some of them also undertake research work on building materials and construction techniques.

9. Common problems that face existing research institutes include inadequate funding, unavailability of suitably qualified indigenous research personnel, antiquated laboratory and field equipment which cannot be readily replaced because of lack of funds, inability to secure books and documentation on building research and development produced in other countries and poorly organized or non-existent national information and documentation systems relating to building research.

10. A review of research projects, both completed and on-going, shows that much effort has been and is being evoted to problems relating to the use of local raw materials for producing building materials needed by the construction industry. These building materials include aggregates, burnt clay bricks, stabilized soil, gypsum, cement, lime, pozzolana, and building materials based on agricultural and industrial waste products. This emphasis in research is desirable in view of the marked dependence on imported building materials and should be maintained in future research programmes. The construction industry in Africa uses only limited quantities of timber and wood products, even in those countries where the raw materials are abundant. High cost, lack of knowledge about physical and mechanical properties and low durability of these materials have been cited as factors leading to their low utilization in construction. These problems can, however, be overcome through research. Research on timber in some research institutes has been concerned with studies of the strength and durability of different types of timber, including the lesser known ones (so-called secondary species), and with methods of seasoning and treating wood to improve its performance in service. Studies of wood panel materials, including particleboard, fibre-bord and wood-wool, and studies of wood shingles for rofing, should receive greater attention in future research programmes.

11. Building design has been given priority in building research institutions. Studies of the influence of climatic and social conditions on house design and design of houses for low-income families have received special emphasis. Studies on indoor climate, thermal insulation, and the durability of building materials and components, which are essential prerequisites for any improvement in design, have been undertaken in certain institutions but need to be given greater emphasis in future research studies. Studies on housing have generally focussed on the problems of rural and low-cost housing. The preparation of typical house designs, studies of materials suitable for such housing, studies of methods for improving the durability of traditional housing through the application of suitable surface finishes to walls, and pilot and demonstration housing schemes have received special attention.

12. The solution to the problem of high building construction costs depends not only on the substitution of cheap local building materials for imported ones, but also, inter alia, on improved labour productivity based on economically viable and appropriate technologies; these will involve new techniques and processes, the standardization of building materials and components, appropriate labour-equipment mix, improved site management and work scheduling techniques, etc. Comprehensive studies are therefore needed to assess existing deficiencies and formulate suitable improvements. Projects on aspects of building economy and management are included in the programmes of some research organizations in the region. There is, however, no adequate basis whereby the impact of past studies on the construction in the respective countries can be assessed.

III. SPECIFIC ACTIVITIES OF ECA IN THE FIELD OF BUILDING AND BUILDING MATERIALS RESEARCH

13. ECA accords high priority to the development of building and building materials research as a means of promoting progress in the building materials and construction industries in Africa. ECA has been involved in the organization of two regional meetings on building research during the last decade, namely:

a) Meeting of the Ad-hoc Expert Group on Co-ordination of Building Research in Africa, Addis Ababa, Ethiopia, March 1971; and

b) Meeting of Directors of African Building and Building Materials Research Institutes, Bujumbura, Burundi, April/May 1980.

14. Meeting of the Ad-hoc Expert Group on Co-ordination of Building Research in Africa

This meeting was held in Addis Ababa, Ethiopia from 22-26 March, 1971 under the sponsorship of the former United Nations Centre for Housing, Building and Planning and the Economic Commission for Africa. The objectives of the meeting, which was attended by building research directors from four African countries, were to review current and long-term building research programmes in Africa, to identify research topics in which co-ordination was needed and to recommend machineries for the co-ordination of building research activities at the national, regional and international levels.

15. The Group examined the various research activities on which the organizations represented at the meeting were engaged and agreed that the research items on which co-ordination and exchange of information might usefully take place were building materials, bulding climatology, and rural and peri-urban housing. Co-ordinators were designated for each topic and were requested to prepare a comparative study and review of work in their subject area, point out any gaps in the programmes reviewed, and suggest any necessary measures by which these gaps could be remedied. They were also requested to propose a reginal strategy for work in their subject area and submit yearly reports to all other research organizations, ECA and the former Center for Housing, Building and Planning.

16. It was agreed that there was need for research organizations to be informed about the activities of other organizations so that they would obtain a clear idea on channels of co-operation and collaboration in order to complement each other's efforts. It was therefore recommended that all research organizations should prepare and circulate among other organizations detailed basic information covering all aspects of their operations including:

a) Short history
b) Statutes - relationship with government, etc.
c) Policies of operation - possibilities of international co-operation;
d) List of equipment, research programmes in hand
e) List of personnel available and their specializations, etc.

17. These measures which were designed to mark the beginning of fruitful co-operation and collaboration among building research institutions in Africa unfortunately did not achieve much success. One of the major factors that contributed to this failure was the lack of properly organized and functional information and documentation systems in the countries of the region. It is also important that organizations participating in a network of co-operation undertake the necessary internal reorganization to allow sufficient staff time to provide services to other organizations and to receive services rendered by these organizations and other institutions.

18. Meeting of Directors of African Building and Building Materials Research Institutes

This meeting was convened in Bujumbura, Burundi from 30 April to 3 May 1980. It was organized jointly by the Economic Commission for Africa, the United Nations Centre for Human Settlements (HABITAT), the United Nations Environment Programme (UNEP), the United Nations Industrial Development Organization (UNIDO) and the Government of the Republic of Burundi. The meeting had four main objectives, nemely:

a) To examine the current situation in building and building materials research in Africa and hence to identify priority research areas and recommend appropriate actions for the attention of African governments:
b) To formulate and recommend ways and means of co-operation in building and building materials research among African Building and Building Materials Research Institutes;
c) To identify areas and recommend ways and means of co-operation between African building and building materials research institutes and institutes outside the African region;
d) To identify national and international scientific, technical promotional and financial institutions and organizations whose assistance could be mobilized for the benefit of building and building materials research institues in Africa.

19. The deliberations of the meeting were organized under four themes:

a) Current status of building and building materals research in Africa;
b) Priority areas of further and new building research activities in Africa;
c) Co-operation arrangements in building and building materials research:
d) The role of institutions/agencies in promoting/strengthening building and building materials research.

20. Current status of building and building materials research in Africa

It was noted that building and building materials research was not receiving the priority it deserved in

the development plans and programmes of African governments. There was therefore the urgent need for the formulation of special policies for the development of this area of research. Such policies must cover the establishment and maintenance of building research facilities to ensure maximum benifits from such facilities. Furthermore, the meeting urged African governments to take immediate steps to promote the establishment of research centres where none existed and to upgrade and strengthen existing facilities to make them more responsive to the needs of the building materials and construction sector.

21. The meeting agreed that financial support for research was at present inadequate in the countries of the African region with the result that it was difficult to plan long-term research programmes. This had also accentuated the problem of replacement of antiquated laboratory and field equipment, and purchase of other equipment needed for research work. In this connexion it was felt that the co-operation and assistance of industry should be sought.

22. It was noted that the lack of suitably qualified local research personnel seriously hampered the implementation of research programmes and sometimes affected their continuity. More attractive conditions of service by industry and the private sector was a major contributory factor. It was therefore felt that there was a need for African governments to set up training programmes for local research personnel and to improve their conditions of service so as to attract and retain the right calibre of staff. The joint use of available subreginal facilities for training research workers should be promoted.

23. The need to improve and strengthen the capabilities of research institutes for compiling, processing, reproducing and disseminating information on their research activities was stressed. Building and building materials research institutes also needed assistance in acquiring books and other documents on research produced in other countries.

24. Priority areas of further and new building research activities in Africa

On the basis of seeking ways and means of reducing the dependence of African countries on imported building materials and construction technologies, and also achieving cost reduction in construction, the following guidelines on priority research areas were agreed upon:

a) The provision of shelter, infrastructure and services for low-income groups in urban and rural human settlements;

b) Optimization of production of cement and bricks from existing plant capacities;

c) The promotion of new methods of using traditional materials to improve rural buildings:

d) The search for substitutes of scarce materials and conservation of such materials; research on local building materials should be accorded high priority to reduce the expenditure of scarce foreign currency on conventional materials like cement, steel, etc.;

e) Conversion of industrial wastes;

f) Consideration of methods of reducing construction costs;

g) Medium- and small-scale production of building materials;

h) Study of building codes and regulations to make them more relevant to the changing conditions of Africa.

25. Co-operation arrangements in building and building materials research

The meeting recognized that there was an urgent need for African countries to pool together their scarce resources - research personnel, funds, equipment, etc. - to undertake such joint actions as would help to maximize returns on the resources available for building and building materials research in each country. It was agreed that regional and subregional co-operation in research could be effected in the broad areas of exchange of information and documentation; co-ordination of selected research activities: the promotion of study tours and exchange of research personnel; training of research personnel; establishment of joint research centres at the subregional level, and organization of conferences, meetings and seminars.

26. The existence of a viable and operational network of information and documentation exchange was considered crucial for any efforts aimed at achieving fruitful co-operation among African building research institutes and between them and institutes outside the African region. In this connexion it was noted that it would be necessary for African governments and international organizations to encourage and assist in the setting up of national systems of information and documentation on building materials and construction industries. International assistance would be required in securing publications, documentation and other information on building materials development activities. Such assistance should also include the provision of facilities for translation; reproduction and dissemination. It was agreed that ECA should, in co-operation with UNCHS (HABITAT), find the ways and means to design, set-up and co-ordinate an appropriate mechanism for information flow to and from the national, subregional, reginal and international focal points within a network of co-operating building research institutes and organizations.

27. The role of institutions/agencies in promoting/strengthening building and building materials research

The participants expressed great interest in the activities of the agencies whose representatives made contributions on this theme and therefore requested ECA

to prepare a directory listing the various organizations outside the African region which provide financial, technical and other forms of assistance in the field of building and building materials research and circulate it among African countries.

28. Recommendations of the meeting

The following major recommendations were agreed upon:

a) African governments should formulate special policies for the establishment of building and building materials research centres as an integral part of national development plans and budgets;

b) Comprehensive building and building materials research and development centres should be promoted at the national, subregional and regional levels. Where materials testing laborotories exist, their functions could be joined to those of the proposed research centres without confusion of the functions;

c) Specific training programmes and facilities should be designed and implemented for local professional and para-professional building and building materials research personnel in order to ensure adequate availability of competent personnel and continuity in research activities;

d) User oriented information and documentation systems should be established or strengthened at the national, subregional, regional and international levels in order to provide an effective base for building and building materials research;

e) Building and building materials research priorities must be outlined to meet specific national requirements taking into account the needs of all related sectors;

f) Co-operation arrangements in building and building materials research should be established and consolidated at national, subregional, regional and international levels (on the basis of the agreed priorities);

g) National building and building materials research centres acting as focal points should establish effective linkages with governmental, non-governmental and intergovernmental organizations within and outside their country.

29. Outline of some short-term activities

The need to compile accurate information on the existing situation in the field of building and building materials research in Africa was stressed by the meeting of African experts on building materials and construction industries, held in July 1979, and also the recent meeting of Directors of African Building and Building Materials Research Institutes held in April/May 1980. Following the recommendations of these meetings, ECA is currently circulating among member States of the Commission a questionnaire on building and building materials research institutions which requests, among other things, information on name and address, historical background, functions and objectives, research personnel, facilities and equipment, research priorities and programmes, funds for research, training courses offered, etc. It is expected that the information to be collected would provide a basis for intra-regional co-operation and permit the formulation of integrated plans for the development of building research in the African region. The information will also form the basis of a directory of building research instituttions to be published by ECA before December 1980.

30. ECA is also currently undertaking a survey aimed at producing a directory of African building and building materials research scientists and technologists. Such a directory will not only facilitate contacts among research specialists and promote co-operation and collaboration in building research activities in the region, but it will also contribute to the efficient use of the expertise available in the region. This directory is also expected to be ready by December 1980.

31. ECA is devoting much attention to the promotion of the establishment and operation of joint/subregional building research centres in its current 1980-1981 biennial programme for building research development in Africa. In this connexion ECA has secured the services of a consultant who will assist in studying the feasibility of setting up a joint research centre for Burundi, Rwanda and Zaire; and for the expansion of the Housing and Building Research Centre (Centre de la Construction et du Logement) at Cacavelli, Togo, to serve the ENTENTE countries (The Ivory Coast, The Upper Volta, Benin, The Niger and Togo) and other neighbouring countries. Studies on possibilities for setting up other joint building research facilities or transforming existing national research centres into subregional facilities will be undertaken during the second phase of this project component.

32. ECA will also, in co-operation with UNCHS (HABITAT) find the ways and means to design, set-up and co-ordinate an appropriate network for information flow at the subregional, regional and international levels to ensure an effective base for building research activities in Africa.

CONCLUDING REMARKS

33. The establishment of formal building research centres in Africa is a rather recent phenomenon. Many countries in the region do not have full-fledged research centres although there is an increasing awareness of the importance of research for the development of the building materials and construction sector. The lack of sufficient resources to establish a comprehensive building research centre in every country and the similarity of research problems arising from analogous physical, economic, social and cultural conditions mean that joint research centres for countries in the same subreginal groupings should be promoted.

34. Existing building research centres in Africa need international assistance to improve and strengthen their research facilities. Information and documentation systems have to be set up or improved to enable the research centres to disseminate widely the results

of their research and also to benefit from the experience of the building research world in general. There is also need for assistance in developing a corps of research scientists and technologists so that the scope of research can be broadened to meet basic needs of the building materials and construction industries.

35. ECA will continue to seek the collaboration and co-operation of international agencies both within and outside the United Nations system, as well as other research organizations in countries outside the African region and help to mobilize their assistance for the benefit of building research organizations and institutions in Africa.

Annex

LIST OF SOME MAJOR BUILDING AND BUILDING MATERIALS RESEARCH INSTITUTIONS IN AFRICA

Egypt

The General Organization for Housing, Building and Planning Research, El-Tahreer Street, Dokki, Giza, P.O.Box 1770, Cairo

Ethiopia

Materials Research and Testing Department, Addis Ababa University, P.O.Box 518, Addis Ababa

Ghana

Building and Road Research Institute University, P.O.Box 40, Kumasi

Forest Products Research Institute University, P.O.Box 63, Kumasi

Kenya

Housing Research and Development Unit University of Nairobi, P.O.Box 30197, Nairobi

Nigeria

Nigerian Building and Road Research Institute (Federal Ministry of Science and Technology), 15, Awolowo Road, Private Mail Bag 12568, Lagos

Forestry Research Institute of Nigeria, P.M.B. 5054, Ibadan

Sudan

Building and Road Research Institute, P.O.Box 321-35, BRRI University of Khartoum, Khartoum

Tanzania

National Housing and Building Research Unit, P.O.Box 9344, Dar Es Salaam

Togo

Centre de la Construction et du Logement, B.P. 1762, Lomè.

Zambia

Building Research Institute

National Council for Scientific and Industrial Research P.O.Box RW 166, Lusaka.

References

1. Report of the meeting of Directors of African Building and Building Materials Research Institutes. E/CN.14/HUS/40, Addis Ababa May 1980

2. The Current Status of Building and Building Materials Research in Africa. E/CN.14/HUS/37, Addis Ababa, April 1980.

3. Building Materials and Construction Industries Development Programme. E/CN.14/HUS/29, Addis Ababa, September 1978.

4. Report for the Ad-hoc Expert Group on Co-ordination of Building Research in Africa. E/CN.14/524; E/CN.14/HOU/87, Addis Ababa, April 1971.

SECTION

9

Closing of Congress
Chairman: N. Antoni

Clôture du Congrès
Président: N. Antoni

Report from Section 9. CLOSING OF CONGRESS, PLENARY SESSION.

In this session key-note speaker from each session presented a brief summary of his speach and the following discussion.

A. Kartahardja, Subject 3A

RESOURCES FOR CONSTRUCTION, AVAILABILITY OF MATERIALS, WITH FOCUS ON DEVELOPING COUNTRIES. LOCAL MATERIALS.

In the subject it was suggested that Governments of Developing Countries should pay adequate attention to the development of the building materials industry which plays a major role in contributing to the success of building programmes. Furher it was suggested that the use of local rather than imported building materials should be encouvaged, since these imports accounted for 14 to 40 per cent of the construction cost of a building.

The development of non-traditional and non-conventional building materials based on locally available and indigenous raw materials and resources including agricultural and industrial waste products, was also recommended. In the supporting papers and in the session research and development activities for the production of pozzolana-line blocks and cement, sisal-cement board, coconut-fibre board, particle board, etc. were reported.

The development and establishment of small-scale labour intensive industrial manufacturing units should also be a couraged and supported and that appropriate technologies be developed. In this connexion several experiouces and developments of small-scale lime kilns and brick kilns in some developing countries were reported by other speakers.
It was interesting to hear that in the Middle East the establishment of capital-intensive manufacturing units is prefered since in those countries there is a shortage of building materials to cope with the intensive and extensive building programmes.

This is however not the case in most develping countries in other regions.
The UNIDO supported project for the manufacture of local building materials in Indonesia and its results was also explained in the session.
Last but not least, Technical Co-operation among Developing Countries (TCDC) in the field of Building Research supported by CIB and other International Organisations was also recommend.

S. Leach, Subject 3B

ENERGY CONSERVATION: INSTALLATIONS, HEAT EXCHANGERS, HEAT PUMPS, SOLAR PANELS, ETC.

The energy used for operating building services is of great importance. In some industrialised countries the amount of money spent on heating and lighting buildings is equal to the annual cost of all new building. Therefore research into energy conservation in buildings is important - perhaps as important as all other aspects of building research taken together. The Eighth CIB Congress has recognised this by devoting for the first time a major part of the Congress to energy conservation under the headings "Installations" and "The Building Envelope".

There were 18 papers for Session 3B covering building services design, operation and installation. The first point that emerged clearly was the necessity of considering both the services and envelope design together when evaluating the thermal performance of a building. This point was also made at Session 4A which dealt with the energy conservation aspects of the building envelope. If the fabric and services are analysed as a unit then we shall no longer have inefficient buildings wasting energy because the architect has left the services engineer to provide and sakesfactory environment without, in the firm place, assessing whether a particular shape must lead to the use of our conditioning with a high use of electrical energy whereas another choice of shape would not heve done so.

This conclusion led the discussion to a second point which again emerged at both of the Sessions dealing with energy conservation. This was the need for better tools for the designer. It was suggested that the key was the use of the most accurate of advanced computer program but also that the architect should have available simple means for enabling him to chose between broad alternatives at the sketch plan design stage. I believe that both are required: The architect needs simple design aids to use at the initial stages followed by analysis by computers to solve the detailed aspects of design for the more complex buildings.

I would now like to list briefly some of the other key points that emerged in the presentatious and discussions of Session 3B:

a) The fuels that will be used in buildings are likely to change several time during the life of the building as oil decreases in significance to other fuels together with the ambient energy sources such as star energy begin to be widely used. This means that building services must be designed with flexibility to be able to respond to these changes.

b) The next point is that conventional fossil fuels will continue to play on important role for the forseeable future. There is therefore a need to continue to improve the design, operation of control as well as the components of heating systems. This is of paramount importance when seeking energy efficiency in the existing building stock.

c) The nest point is that the potential energy savings from the use and heat pumps of solar collectors are of major importance, practicularly in relation to new buildings where their application is by and large easier and cheaper than in existing buildings. However, there are many problems remaining with these devices since they connot without great expense be used to provide the whole of the energy requirements of a building. New developments are needed low temperature heat storage and in the use of supplementary heating before the fuel potential of these new technologies will be realised. Also we were urged not to neglect the maintenance aspects. There is a need for move R+D in this area.

d) Finally, two aspects of energy use in buildings were identified as having a major significance - "Lighting" and ""Ventilation". These topics have not been strongly featured in the activities of CIB so far and are therefore topics which particularly merit further discussion and collaboration in the future.

S. Dahlgren, Subject 3C

HOUSING SOCIOLOGY. HUMAN REQUIREMENTS. BASIC NEEDS RELATED TO FAMILY AND NATIONAL RESOURCES

In the session 3C introductory papers were presented, one by myself concerning the problem of human needs and requirements in general and one by the Norwegian researchers Odd Guntvedt and Haktor Helland, who discussed experiences from research in a develping sountry.

The discussion after the introductory papers was perhaps not as active as one would have wished, but many attended to the session and I believe that this could be seen as a good sign for the interest in psychological an sociological issues in building research.

In my key-note paper I stressed three points about social research in CIB. The first was that the field that we label "housing sociology" is very diversified and has existed as long as there has been urban planning and social policy activities in the present-day sense, and also that sociology has made substantial contributions to these activities. My second point was that the wide-spread concept of "needs" should not be emphasized too much in research. It is only one of many research approaches in the behavioural sciences and by no means the dominant and probably not the most useful one in housing or urban sociology. My third point was that, even if sociologists over the years have made a lot to provide planners, politicians, and the general public with knowledge useful for housing and urban planning, there have not been enough efforts to make the research result useful for practical purposes.

In the paper by Mr. Guntvedt and Mr. Helland the professional problems for western sociologists working in a developing country was discussed. They stressed that the pressure to produce practical results is very strongly felt in a developing country and also that one feels more obliged to the country's political ideology than when working at home.

A reflexion of this might be a discrepancy between the researsher's professional convictions, e.g. that local culture should be preserved in the design of dwellings while this may not be in line with national policy for design of dwellings and for village planning.

Another very important topic discussed was the problem of implementation. The authors strongly argued that it is not sufficient just to inform people in order to get any action, e.g. how improve one's house. A prerequisite is that people feel secure and that a person is certain that he can continue to live in his house and in his village. Furthermore, the informants must prove that what they say really works.

More than 20 papers were submitted to the session. About ten of these dealt explicitly with developing countries. Several topics were touched upon in the discussion. I will just mention a few.

Pointed out by one speaker was that the important thing in developing countries is to provide housing for the rural and urban poor, and for this objective ways must be found so that sociological knowlegde and echnology can merge in the practical work. It was stressed that the inputs in formulating national policy and in finding appropriate technology to a large extent must be based on sociological research.

In the discussion were examples given about mistakes in housing and design where sociological aspects had been neglected and which for these reasons had been failures. One speaker reminded the social researchers, with reference to some of the submitted papers, that the social scientists should not put him- and herself too far from the people for whom the research was being done. It is necessary not to make studies on people, and he stressed the importance of having the users in mind.

Another speaker raised the important topic of how sociological knowledge can be transferred to architects and planners. He argued that the social scientists

should not make matters more complicated but help in giving definite advise. Since designing virtually is a continous string of decisions, the architects are not very much helped by research reports but will also need interpretations and recommendations.

I have finally a couple of personal remarks to the discussion.

The first is that the possibilities and obstacles to transfer both theoretical findings and methodology in the social sciences must be thoroughly penetrated. My interpretation of what was said is that there is indeed a great interest for sociological and psychological knowledge in housing. However, the terms "social sciences" or "housing sociology" apparently mean many things. There is a risk here that the scientific content will become almost lacking and that the mentioned terms will refer to anything that is not technology.

My second comment concerns the possibilities for communication between social scientists and decisions-makers, be they architects, planners, or politicians. Many of the submitted papers contain results and conclusions that easily can be used for practical purposes. It might be that this, in some instances, is not so easily seen by e.g. architects, because we use different ways of expressing the same thing. The communication problem must therefore also be throughly discussed.

And that is, in my opinion, the reason why CIB should engage itself more in social science research. The mix of social scientists, architects, and technicians which exists in many institutes gives good opportunities to bridge the gap and to facilitate transfer of sociological knowledge both between researchers and people engaged in practical planning and between countries.

G.C. Mathur, Subject 5A

BUILDING DOCUMENTATION, INFORMATION AND LOCAL DEMONSTRATION PROJECTS IN DEVELOPING COUNTRIES

Based on the papers presented and discussion the following recommendations emerged:

1. An international network structure of institutions and organizations in different countries should be organized by CIB wth active support of U.N.C.H.S. and other international bodies for management of information, including documentation, dissemination as well as extension and application of results of research, covering all aspects of human settlements development.

2. The CIB should activise its work to Achieve Building Information worldvide with special focus of the needs of the developing contries. In this programme should be included
   - survey of institution and organisations on human settlements technology and preparation of a directory
   - Study of activities undertaken by institutions and organisations on human settlements technology and compilation of a catalogue, and
   - survey to identify the major priority problems in the field of human settlements technology in the developing countries.

3. The proposal to establich focal points in developing countries taking into consideration the existing national and international institutions, should be actively pressured to prognose the role of CIB for the third world countries and also foster orgional cooperation.

4. The CIB should extend its role in developing countries by organising training programmes, workshops etc. to achieve transfer of technology , directory of training facilities available in developed as well as develping countries should also be brought out by CIB.

H.A. Stoddart, Subjekt 5B

ADVANCED METHODS OF DOCUMENTATION

In the absence of Dr Wissmann I was given the privilege of presenting his paper. Dr Wissmann outlined the early form of development of an information system within CIB. This theme moved through the conventional but now somewhat outdated exchange of abstracts to the more sophisticated computerised databases. He identified the essentials of store restricted information systems and the concept of universal information supply. In the first case the information centre supplies only that which it has itself got and in the second the information centre accepts the responsibility for seeking further information from wherever it may be available and converting this information into the most appropriate form for the customer. He explains the derivation of the world's first universally accessible international database devoted to the needs of the Building Industry. Imperfect though it may be at this stage - it exists and can be used. CIBDOC has been internationally accessible and in practical use since last year. Dr Wissmann also refers to the technological explosion in the field of information storage and retrieval. He relates the future systems to the consept of energy supply. In presenting his paper I was able to show that twelve years ago Peter Drucker the eminent management/economist had recorded the same hypothesis and that recent United Kingdom government financial research by Barron and Curnow had again supported this hypothesis and pleaded for further research on this intriguing relationship. The questions presented in the paper were related to the inertia in implementing the new technology, reduction in costs through international

co-operation and a questioning look at the new technologies, asking whether they are going to help the Building Industry or just contribute to greater confusion. The subsequent debate was extremely fruitful and wide ranging so it is only possible to highlight the main themes of the contributions. There was a plea for simple format presentation by database providers. The complexity of some systems lead to significant information barriers espesially where a reluctant information population existed. Significant emphasis was placed on the needs of developing countries where information networks and sub-networks are being set up. For example in Pakistan and the work being carried out through the Human Settlements Programme. Additionally it was hoped that through the work of CIB an acceleration in the implementation of high technology communication networks would be achieved espesially for South America. The relative efficiency of database access was raised there the efficiency depends on the accessibility of induvidual database packages. This question is similar to the constant plea for all the information one needs to be in the location one first looks.

Finally the discussion firmly illustrated that the problems of documentation were fundamentally no different in developing countries or so called developed countries. The technologies available may be different but the problems were the same. It was clear that in documentation interdependence with developing countries is more definite now than ever before. The gradation in stages of systems and service development is such that in the UK we can be regarded as a developing country.

As the problems are so similar, exchange of experience and international co-operation can only lead to more effective solutions with significant reduction in overall costs of information provision.

List of participants

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY

00316 BARRANTES — GUILLERMO — MR
DEFENSA 120 — 1065 BUENOS AIRES — ARGENTINA
S.E.D.U.V. DIRECCION NACIONAL DE TECN:

00315 FUCARACCIO — JORGE — MR
AVDA. LEANDRO ALEM 1067 — 1001 BUENOS AIRES — ARGENTINA
INTI DEPTO. DE CONSTRUCCIONES

00057 BLAKEY — FRANK ALEXANDER — M — CHIEF OF DIVISION
GRAHAM ROAD — HIGHETT 3190, VICTORIA — AUSTRALIA
BUILDING RESEARCH CSIRO

00088 FRASER — J.B. — DIRECTOR
470 NORTHBOURNE AVENUE — DICKSON ACT 2602 — AUSTRALIA
DEPT HOUSING AND CONSTRUCTION

00151 TUCKER — SELWYN — DOCTOR
GRAHAM ROAD — HIGHETT 3190, VICTORIA — AUSTRALIA
CSIRO DIVISION BUILD.RESEARCH

00077 CEKAL — ERNST — DR.DIPL.ING.
LANGE GASSE 30 — WIEN A1082 — AUSTRIA
MAGISTRAT WIEN

00300 CSORBA — EMANUEL — SEN IND DEV OFFICER
PO BOX 300 — 1400 VIENNA — AUSTRIA

00249 APERS — JEF — ENGINEER ARCHITECT
KASTEEL VAN ARENBERG — 3030 LEUVEN — BELGIUM
K.U.LEUVEN POSTGRADUATE CENTER

00250 DE TROYER — FRANK — ENGINEER-ARCHITECT
KASTEEL VAN ARENBERG — 3030 LEUVEN — BELGIUM
KATHOLIEKE UNIVERSITEIT LEUVEN

00036 DECONINCK — HENRI — M — DIRECTEUR-GENERAL A.
RUE BREYDEL 12 — 1040 BRUXELLES — BELGIUM
SOCIETE NATIONALE DU LOGEMENT

00193 LEBEGGE — MAURICE — INSPECTEUR GENERAL
BLC. SAINT-LAZARE 10 — BRUXELLES 1030 — BELGIUM
INSTITUT NATIONAL DU LOGEMENT

00126 MARTIN — CHRISTIAN — NEW PRODUCTS MANAGER
AV.DE TERVUREN 36 BTE 19 — 1040 BRUXELLES — BELGIUM
PITTSBURGH CORNING EUROPE SA

00065 MOTTEU — HENRI — M — ENGINEER
RUE DU LOMBARD 41 — 1000 BRUXELLES — BELGIUM
CSTC

00104 RICHELLE — PIERRE — BELGIUM
RUE DU LOMBARD 24 BTE 6 — 1000 BRUXELLES
SYNDICAT D ETUDES IC-IB

00052 STEPPE — AMEDEE — M — SERVICE TECHNIQUE
RUE DE LA ROSEE — BRUXELLES 1070 — BELGIUM
CEDICOL

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY

00144 MOSETLHI — BOKAE — ARCHITECT
PRIVATE BAG 0025 — GABORONE — BOTSWANA
BUILDINGS DEPARTMENT

00188 ATTADIA DA MOTTA — CAIO FABIO — SOCIOLOGUE
CIDADE UNIVERSITARIA BP 7141 — SAO PAULO 05508 — BRAZIL
INST.PESQUISAS TECNOLOGICAS

00187 MAFFEI — CARLOS ALBERTO ABREU — ARCHITECT
CIDADE UNIVERSITARIA BP 7141 — SAO PAULO 05508 — BRAZIL
INST.PESQUISAS TECNOLOGICAS

00032 ABT — ROLF — M — DIPLOMINGENIØR
OBERKLAMMEG 6.POSTFACH 1280 — 6906 LEIMEN — BRD
HEIDELBERGER ZEMENT AG

00071 ACEVEDO-ALVAREZ — JAIME — DIPL.ING.
SILBERBURGSTRASSE 119A — 7000 STUTTGART 1 — BRD
INFORMATIONSVERBUNDZENTRUM

00119 LINDEMANN — GEORG — DIRECTOR
BURGGRAFENSSTRASSE 4-10 — 1000 BERLIN 30 — BRD
NA BAU IN DIN

00120 MENKHOFF — HERBERT — DR
AN DER MARKUSKIRCHE 1 — 3000 HANNOVER 1 — BRD
INSTITUT FUER BAUFORSCHUNG

00354 MARUSHI — THARCISSE — INGENIEUR CIVIL
BP 1860 — BURUNDI
MINISTERE DES TRAVAUX PUBLICS

00353 NDAHIRESHE — EGIDE — GENERAL DIRECTOR
0 — BP 745 BUJUMBURA — BURUNDI
MINISTERE DES MINES ET ENERGIE

00299 BISKAPS — OJARS — PROFESSOR
PO BOX 1000 — HALIFAX NS B3J 2X4 — CANADA
NOVA SCOTIA TECHN

00165 CRAWFORD — CARL B. — DIRECTOR
NATIONAL RESEARCH COUNCIL — OTTAWA K1AORG — CANADA
DIVISION OF BUILDING RESEARCH

00339 DAWSON — JOHN A. — DIRECTOR GENERAL
240 SPARKS ST. — OTTAWA — CANADA
DEPT.INDUSTRY TRADE COMMERCE

00186 FAZIO — PAUL — DIRECTOR
1455 DE MAISONNEUVE WEST — MONTREAL H3G1M8.CONCORDIA UNIV — CANADA
CENTRE FOR BUILDING STUDIES

00166 GERARD — MARGARET — EDITOR
NATIONAL RESEARCH COUNCIL — OTTAWA K1A 0R6 — CANADA
DIVISION OF BUILDING RESEARCH

00342 HANDA — VIRENDER — PROFESSOR
UNIVERSITY OF WATERLOO — WATERLOO ONTARIO N2L 3G1 — CANADA
DEPT. OF CIVIL ENGINEERING

00003 MALHOTRA — S.K. — PROFESSOR
PO BOX 1000 — HALIFAX, NOVA SCOTIA B3J 2X4 — CANADA
NOVA SCOTIA TECHNICAL COLLEGE

00070 MANNING — PETER — DR
PO BOX 1000 — HALIFAX NS B3J 2X4 — CANADA
NOVA SCOTIA TECHNICAL COLLEGE

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00107	STATHOPOULOS	THEODORE		ASS.PROF.
	1455 DE MAISONNEUVE BLVD WEST	MONTREAL QUEBEC H3GIM8		CANADA
CENTRE FOR BUILDING STUDIES				
00351	ZIELINSKI	ZENON		PROFESSOR
	1455 DE MAISONNEUVE WEST	MONTREAL H3G 1M8		CANADA
CONCORDIA UNIVERSITY				
00244	BAOZHEN	CHEN		DEPUTY CHIEF ENGINEE
	ZHEJIANG PROVINCE	HANGZHOU		CHINA
CAPITAL CONSTR.COMMISSION				
00243	QIHAO	GU		ENGINEER
	19 CHE GONG ZHUANG STREET	BEIJING		CHINA
CHIN.ACADEMY OF BUILDING RES.				
00240	ZHIQUN	LIN		ARCHITECT
	19 CHE GONG ZUANG STREET	BEIJING		CHINA
ADM.OF BUILDING CONSTRUCTION				
00242	ZONGREN	XU		INTERPRETER
	19 CHE GONG ZHUANG STREET	BEIJING		CHINA
CHIN.ACADEMY OF BUILDING RES.				
00054	AUSTERLITZ	HANUS	M	DIRECTOR
	PRAZSKA 16	PRAHA 10 10221		CZECHOSLOVAKIA
RESEARCH BUILDING INSTITUTE				
00317	JANECKY			MR
		PRAGUE		CZECHOSLOVAKIA
PRAGUE BUILDING TRUST				
00134	KASALICKY	VACLAV		ING.ARCH.DRSC.
	LETENSKA 3	PRAHA 1 11800		CZECHOSLOVAKIA
RESEARCH INST.FOR BUILDING				
00095	MATASOVSKY	MILOSLAV		ING.ARCH.
	NOVOTNEHO LAVKA 3	11001 PRAGUE 1		CZECHOSLOVAKIA
CZECH.BUILDING CENTRE				
00055	ONTL	VACLAV	M	DIRECTOR
	NA PORICNIM PRAVU 1	PRAHA 2 120 07		CZECHOSLOVAKIA
MINISTRY OF CONSTRUCTION CSR				
00083	DEUTSCHMANN	EBERHARD		PROFESSOR
	MOMMSENSTRASSE 13	8027 DRESDEN		DDR
TECHNICAL UNIVERSITY				
00158	FOERSTER	WERNER		RESEARCH OFFICER
	PLAUENER STRASSE	1125 BERLIN		DDR
ACADEMY OF BUILDING				
00159	TEUBER	WERNER		DIR. OF INSTITUTE
	PLAUENER STRASSE	1125 BERLIN		DDR
ACADEMY OF BUILDING				
00009	ARCTANDER	PHILIP	M	ARCHITECT DIRECTOR
	DR NEERGAARDS VEJ 15, POB 119	2970 HØRSHOLM		DENMARK
DANISH BUILDING RESEARCH INST				
00289	BLACH	KLAUS		ARCHITECT MAA
	POSTBOKS 119	2970 HØRSHOLM		DENMARK
DANISH BUILDING RESEARCH INST				
00089	GADMAN	PETER		FULDMÆGTIG
	SLOTSHOLMSGADE 12	1216 KØBENHAVN K		DENMARK
BYGGESTYRELSEN				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00122	JØNSSON	LEIF		ARCHITECT
	TORDENSKJOLDSGADE 10	1055 KØBENHAVN K		DENMARK
BYGNINGSTEKNISK STUDIEARKIV				
00010	NIELSEN	JØRGEN KRISTIAN	M	CIVILINGENIØR
	DR.NEERGAARDSVEJ 15,PO BOX 119	2970 HØRSHOLM		DENMARK
DANISH BUILDING RESEARCH INST.				
00102	OLSEN	IB STEEN		CIVIL ENGINEER
	SYRENVÆNGET 29	2830 VIRUM		DENMARK
0				
00022	STOKBAEK	KURT	M	ENGINEER
	HOVEDGADEN 501	2640 HEDEHUSENE		DENMARK
ROCKWOOL AS				
00172	HOSNY	ABDEL HADY HUSSEIN		PROF.OF RC
	41 KASR ELNIL STREET	CAIRO		EGYPT
AIN SHAMS UNIVERSITY				
00173	MORSY	EZZAT HASHEM		RESEARCH PROFESSOR
	PO BOX 1770	CAIRO		EGYPT
GENERAL ORG. FOR HOUSING,BUILD				
00269	ABAYNEH	MIKAYAS		ASS.PROF.
	PO BOX 385	ADDIS ABABA		ETHIOPIA
UNIVERSITY				
00258	BERHANE	ZAWDE		DR.
	PO BOX 518	ADDIS ABABA		ETHIOPIA
FACULTY OF TECHNOLOGY				
00270	OKYERE	JOSEPH		ADVISER BLDG MATLS
	PO BOX 3005	ADDIS ABABA		ETHIOPIA
UN ECON COMMISSION FOR AFRICA				
00075	BJOERKHOLTZ	OICK		ENGINEER
	MUNKSNAES ALLEN 25	00330 HELSINGFORS 33		FINLAND
OY PARTEK AB				
00203	ESKOLA	TAPANI		DIRECTOR GENERAL
	LOENNROTINKATU 20B	00120 HELSINKI 12		FINLAND
BUILDING INFORMATION INSTITUTE				
00184	LAAKSONEN	ENSIO		PRODUCT DEV.MANAGER
		08680 MUIJALA		FINLAND
OY PARTEK AB				
00206	LAIHO	AARO		M.SC.
	PO BOX 27	00131 HELSINKI		FINLAND
EKONO OY				
00164	RAHKAMO	KARI		CHIEF ENGINEER
	HAAPANIEMENKATU 4 A	00530 HELSINKI 53		FINLAND
NATIONAL BOARD OF BUILDING				
00015	ROUTIO	PENTTI	M	RESEARCH MANAGER
	PO BOX 232	00531 HELSINKI 53		FINLAND
NATIONAL BOARD OF BUILDING				
00007	SWANLJUNG	RITVA	F	RESEARCHER
	LAEMPOEMIEHENKUJA 3	02150 ESPOO 15		FINLAND
VTT				
00204	TIULA	MARTTI		DIRECTOR
	LOENNROTINKATU 20 B	00120 HELSINKI 12		FINLAND
BUILDING INFORMATION INSTITUTE				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00150	VAINIO	PIRJO-LIISA		SPECIAL SCIENTIST
	RAUTATIELAEISENKATU 6	00520 HELSINKI 52		FINLAND
MINISTRY OF TRADE -INDUSTRY				
00016	VIHAVAINEN	MRS.	F	D
	BETONIMIEHENKUJA 3.	02150 ESPOO 15		FINLAND
TECHNICAL RESEARCH CENTER				
00181	AUBERT	YVES		ENGINEER
	LAPEROUSE 9	PARIS 75016		FRANCE
UTIBTP				
00034	BAILLON	JEAN	M	INGENIEUR
	39 AVENUE D IENA	PARIS 16 75116		FRANCE
IRBAT				
00304	BLACHERE	GERARD		
	39 AVENUE D IENA	PARIS 75116		FRANCE
IRBAT				
00080	CONAN	MICHEL		CHEF D.SERV.
	4 AVENUE DU RECTEUR POINCARE	PARIS 75116		FRANCE
C.S.T.B.				
00329	DESDEVISES	ALAIN		INGENIEUR
	3 BOULEVARD LOUIS LOUCHEUR	SAINT CLOUD 92214		FRANCE
CIMENT LAFARGE FRANCE				
00331	DEVOGE			
	33 AVENUE KLEBER	PARIS 75784		FRANCE
FEDERATION NATIONALE BATIMENT				
00093	LALANNE	PIERRE		REDACTEUR EN CHEF AD
	RUE D UZES 17	75002 PARIS		FRANCE
LE MONITEUR				
00033	LOGEAIS	LOUIS	M	INGENIEUR
	33 AVENUE DU MAINE	75755 PARIS CEDEX 15		FRANCE
BUREAU SECURITAS				
00303	MAYER	RENE		DIRECTEUR
	4 AV DU RECTEUR POINCARE	PARIS 16		FRANCE
00118	MOUTERDE	PHILIPPE		DIRECTEUR
	14 RUE DE LA GAITE, B.P.52	69393 LYON,CEDEX 3		FRANCE
CENTRE LIAISONS OPERAT.				
00103	PERRIER	FRANCOIS		ENGINEER
	AV. J. JAURES,CEDEX 2	77428 MARNE LA VALLEE		FRANCE
C.S.T.B.				
00061	ROLLET	MICHEL	M	ENGINEER
	RUE DES LONGS REAGES	28230 EPERNON		FRANCE
CERIB				
00179	RUBINSTEIN	MICHEL		ENGINEER
	JEAN JAURES 84	CHAMPS SUR MARNE 77420		FRANCE
CSTB STATION DE RECHERCHE				
00239	VAN SCHOONBEEK	ANDRE		SECRETAIRE GENERAL
	CIMAROSA 4	PARIS 75116		FRANCE
COMITE FRANCAIS DE L ISOLATION				
00047	VANDENKERCKHOVE	MARC	M	INGENIEUR
	33 AVENUE KLEBER	PARIS 75784, CEDEX 16		FRANCE
FEDERATION NATIONALE BATIMENT				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00290	ASANTE	YAW		MR
	KUMASI			GHANA
UNIV OF SCIENCE AND TECHNOLOGY				
00163	BOOHENE	MICHAEL KWASI		DR
	LIBERIA ROAD	ACCRA PO BOX M1		GHANA
BANK FOR HOUSING-CONSTRUCTION				
00247	MENGU	MOSES DACHARIGA		MR.
	UNIVERSITY PO BOX 40	KUMASI		GHANA
BUILDING,ROAD RESEARCH INST.				
00167	ALLEN	WILLIAM JAMES		MR
	DEPT.OF ENG.TRUMPINGTON STREET	CAMBRIDGE CB2 19Z		GREAT BRITAIN
UNIVERSITY OF CAMBRIDGE				
00157	BLACK	DUNCAN IAN		DEPUTY DIRECTOR
	NEW ST ANDREWS HOUSE	EDINBURGH 1		GREAT BRITAIN
SCOTTISH DEV. DEPARTMENT				
00130	BURT	MAURICE EDWARD		BA
	GARSTON	WATFORD HERTS WD27JR		GREAT BRITAIN
D				
00021	CHEETHAM	DAVID WILLIAM	M	LECTURER
	PO BOX 147	LIVERPOOL L69 3BX		GREAT BRITAIN
UNIVERSITY OF LIVERPOOL				
00128	COOLING	CHRISTINE MARY		MISS
	GARSTON	WATFORD WD2 7JR		GREAT BRITAIN
BLDG.RESEARCH ESTABLISHMENT				
00191	CROOME	DEREK JOHN		DR.
	CLAVERTON DOWN	BATH		GREAT BRITAIN
UNIVERSITY OF BATH				
00023	DICK	JAMES	M	MR
	4 MURRAY ROAD	BERKHAMSTED HP4 1JD		GREAT BRITAIN
CONSULTANT				
00129	DUNSTAN	IVAN		DR
	GARSTON	WATFORD WD2 7JR		GREAT BRITAIN
BLDG.RESEARCH ESTABLISHMENT				
00136	FLEMING	FREDERICK WILSON		A.R.I.C.S.
	CHAMBERS STREET	EDINBURGH EH1 1HX		GREAT BRITAIN
HERIOT-WATT UNIVERSITY				
00131	FREEMAN	IAN		BSC FICERAM FIOB
	GARSTON	WATFORD WD2 7JR		GREAT BRITAIN
BLDG.RESEARCH ESTABLISHMENT				
00143	HILL	NEVILLE		
	26 LINGFIELD COURT	PORTSMOUTH PO 1 2TB		GREAT BRITAIN
NEVILLE R. HILL ASSOCIATES				
00014	HOBBS	CYRIL	M	MR
	MANOR WAY, BOREHAMWOOD	BOREHAMWOOD HERTS WD6 1LN		GREAT BRITAIN
JOHN LAING R AND D.LTD.				
00252	KITUNDU	HALIFA HASSAN JUMA		ASSISTANT ENGINEER
	225 WHIPPENDELL ROAD	WATFORD HERTS		GREAT BRITAIN
BUILDING RESEARCH UNIT				
00132	LEACH	STAN		ASS. DIRECTOR
	GARSTON	WATFORD WD2 7JR		GREAT BRITAIN
BLDG.RESEARCH ESTABLISHMENT				
00197	LETHERMAN	KENNETH MURRAY		DOCTOR
	SACKVILLE ST.,PO BOX 88	MANCHESTER M60 1QD		GREAT BRITAIN
UNIVERSITY OF MANCHESTER				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00190	MADDEN	LEONARD		EDITOR
	KENT HOUSE ROAD 108	BECKENHAM KENT BR3 1JY		GREAT BRITAIN
CIB JOURNAL				
00168	MUNDAY	MICHAEL		MR.
	131 ROTTENROW	GLASGOW G40NG		GREAT BRITAIN
CIE PROJECT STRATHCLYDE UNIV.				
00031	PILCHER	ROY	M	PROFESSOR
	PO BOX 88	MANCHESTER M60 1QD		GREAT BRITAIN
DEPARTMENT OF BUILDING,UMIST				
00180	SIVIOUR	JACK		
	CAPENHURST	CHESTER CH1 6ES		GREAT BRITAIN
ELECTRICITY COUNCIL				
00058	SPOONER	DAVID C.	M	DR.
	WEXHAM SPRINGS	SLOUGH SL3 6PL		GREAT BRITAIN
CEMENT AND CONCRETE ASS.				
00196	STODDART	HAROLD		HEAD OF LIBRARY
	WEXHAM SPRINGS	SLOUGH SL3 6PL		GREAT BRITAIN
CEMENT AND CONCRETE ASSOC.				
00153	THOMAS	KENNETH		DEPUTY DIRECTOR
	HUGNENDEN VALLEY	HIGH WYCOMBE BUCKS HP14 4ND		GREAT BRITAIN
TIMBER RESEARCH AND DEV.ASS.				
00135	TORRANCE	VICTOR BROWNLIE		PROF
	CHAMBERS STREET	EDINBURGH EH11HY		GREAT BRITAIN
HERIOT-WATT UNIVERSITY				
00020	WHITEHEAD	BERTRAM	M	SENIOR LECTURER
	THE UNIVERSITY PO BOX 147	LIVERPOOL L6938X		GREAT BRITAIN
DEPT OF BUILDING ENGINEERING				
00272	VAVAROUTAS	BASIL		DIPL.ING.
	MOUROUZI 7	ATHENS 138		GREECE
B.VAVAROUTAS CONS.ENGINEERS				
00328	BELTRANENA	EMILIO		DIRECTOR
	CIUDAD UNIVERSITARIA ZONA 12	GUATEMALA		GUATEMALA
ENGINEERING RESEARCH CENTER				
00268	HEINCZ	MIHALY		SCIENTIFIC DIRECTOR
	DIOSZEGI UT 37	1113 BUDAPEST		HUNGARY
QUALITY CONTROL OF BUILDING				
00267	KOVACS	KAROLY		DEP. LEADER
	BUDAPEST DIOSZEGI UT 37	BUDAPEST 1502 PO BOX 69		HUNGARY
QUALITY CONTROL OF BUILDING				
00092	KUNSZT	GYORGY		RESEARCH DIRECTOR
	DAVID F U 6	BUDAPEST 1113		HUNGARY
INST FOR BUILD. SCIENCE				
00108	SZOKE	KLARA		DEP HEAD OF DIVISION
	CSALOGANY U 9	BUDAPEST 1027		HUNGARY
EGSZI INST.FOR BUILD.ECONOM				
00263	MATHUR	G.C.		DIRECTOR
	NIRMAN BHAWAN,MANLANA AZAD RD.	NEW DELHI 11011		INDIA
NATIONAL BUILDINGS ORG.				
00005	MOHAN	DINESH	M	PROFESSOR
		ROORKEE U.P. 247667		INDIA
CENTRAL BUILDING RESEARCH INST				
00094	RAO	A.G. MADHAVA		ASS.DIRECTOR
	CSIR CAMPUS ADYAR	MADRAS 600 020		INDIA
STRUCTURAL ENGINEERING RES INS				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00006	KARTAHARDJA	ALBERT	M	IR.
	84 JALAN TAMANSARI	BANDUNG		INDONESIA
DIRECTORATE BUILDING RESEARCH				
00013	RINGSHOLT	THOMAS	M	PROJECT MANAGER,DR.
	JL. TAMANSARI 84	BANDUNG		INDONESIA
UNIDO CO DPMB				
00287	SOEMITROADI	BAMBANG		DIRECTOR
	JL PATTIMURA 20	KEBAYORAN BARU JAKARTA		INDONESIA
ROC MIN PUBLIC WORKS				
00349	TABESH	HASSAN		DIRECTOR
	TARASHT HIGHWAY	TEHERAN		IRAN
BHRC				
00194	ALANI	KAWAN		ASS. PROF.
	JADRIYAH, PO BOX 127	BAGHDAD		IRAQ
BUILDING RESEARCH CENTER				
00348	SAMARAI	MOFID		DIRECTOR GENERAL
	TEL-MOHAMMED	BAGHDAD		IRAQ
NAT.CENTER FOR CONSTRUCT.LABS.				
00125	DUNLEAVY	SEAN		DIRECTOR
	BALLYMUN ROAD	DUBLIN 9		IRELAND
CONSTRUCTION DIVISION IIRS				
00208	MC DONAGH	NOEL		DIRECTOR
	264 LOWER RATHMINES ROAD	DUBLIN 6		IRELAND
MULCAHY MCDONAGH AND PARTNERS				
00253	PIGOTT	PIERCE T.		
	WATERLOO ROAD	DUBLIN		IRELAND
AN FORAS FORBARTHA				
00171	PEER	SCHLOMO		PROF
	TECHNION CITY BUILDING RES.STA	HAIFA TECHNION CITY		ISRAEL
TECHNION-ISRAEL INST.OF TECH.				
00337	BEDOTTI	GIANCARLO		ARCHITECT
	VIA LOMBARDIA 49	SAN GIULIANO MILANESE		ITALY
ICITE-CNR				
00338	CIRIBINI	GIUSEPPE		PROFESSOR
	VIA LOMBARDIA 49	SAN GIULIANO MILANESE		ITALY
CNR-ICITE				
00137	CONTI	MARCELLO		PRESIDENT
	A CACCIA 25	UDINE 33100		ITALY
CONTI E ASSOCIATI SPA				
00340	ESPOSTI	WALTER		ENGINEER
	VIA LOMBARDIA 49	SAN GIULIANO MILANESE		ITALY
ICITE-CNR				
00124	FANTONI	LIVIO		
	VIA CACCIA 25	UDINE 33100		ITALY
CONTI E ASSOCIATI SPA				
00279	LATINA	CORRADO		CIVIL ENGINEER
	VIA MICHELI 2	FIRENZE 50125		ITALY
FLORENCE UNIVERSITY				
00281	MECCA	SAVERIO		
	VIA MICHELI 2	FLORENCE 50121		ITALY
UNIVERSITA DI FIRENZE				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00350	VINCI	ROBERTO		ARCHITECT
	VIA LOMBARDIA 49	SAN GIULIANO MILANESE		ITALY
ICITE-CNR				
00241	IIZUKA	GOROZO		DR.ENGINEERING
	156 TOKIWADAI HODOGAYAKU	YOKOHAMA 240		JAPAN
YOKOHAMA NATIONAL UNIVERSITY				
00056	IMAIZUMI	KATSUYOSHI	M	DOCTOR
	1-24-2,NISHISHINJUKU,SHINJUKU	TOKYO 160		JAPAN
KOGAKUIN UNIVERSITY				
00048	KAMIMURA	KATSURO	M	ASSISTANT DIRECTOR
	1 TATEHARA OHO-MACHI	TSUKUBA-GUN IBARAKI PREFECTURE		JAPAN
BUILDING RESEARCH INSTITUTE				
00209	KAWAGOE	KUNIO		DR.
	YAMAZAKI	NODA-SHI CHIBA-KEN		JAPAN
SCIENCE UNIVERSITY OF TOKYO				
00050	MIYAZAKI	KATSUMORI	M	ENGINEER
	1-5-3 OTE-MACHI CHIYODA-KU	TOKYO 100		JAPAN
N.T.T. PUBLIC CORPORATION				
00288	SAKATA	TANEO		LECTURER
	1 33 YAYOICHO	CHIBA CITY CHIBA P F		JAPAN
CHIBA UNIVERSITY				
00155	SAWADA	MITSUFUSA		VICE PRESIDENT
	14-6 KUDAN-KITA 1-CHOME	CHIYODA-KU TOKYO 102		JAPAN
JAPAN HOUSING CORPORATION				
00156	YAMADA	AKIO		PLANNING ADVISOR
	14-6 KUDAN-KITA 1-CHOME	CHIYODA-KU TOKYO 102		JAPAN
JAPAN HOUSING CORPORATION				
00265	CHANA	TARA SINGH		DIRECTOR
	PO BOX 30197	NAIROBI		KENYA
HOUSING RESEARCH,DEVL. UNIT				
00256	HANJARI	GIDEON		
	PO BOX 30197	NAIROBI		KENYA
UNIVERSITY OF NAIROBI				
00012	HØYEN	ARTHUR J.	M	CIVIL ENGINEER
	POSTBOX 52802	NAIROBI		KENYA
NORWEGIAN CHURCH AID SUDAN PR				
00273	KARIUKI	GATHUNGU		HOUSING PLANNER
	BOX 45958	NAIROBI		KENYA
MINISTRY OF HOUSING				
00275	MUIHIA	MOSES MGANGA		LECTURER
	UNIVERSITY WAY	NAIROBI 30197		KENYA
UNIVERSITY OF NAIROBI				
00205	MUNRO	ROBERT		SENIOR ADVISER
	KENYATTA CENTRE PO BOX 30030	NAIROBI		KENYA
UN CENTER FOR HUMAN SETTLEMENT				
00306	LEAO	ANTONIO JOSE ROXO		CIVIL ENGINEER
	RUA GIL VICENTE 36	MAPUTO		MOSAMBIQUE
MINISTRY OF PUBLIC WORKS				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00028	BAKKER	PIETER	M	CIVIL ENGINEER
	GENERAAL SPOORLAAN 489	2285 TA RIJSWIJK		NETHERLANDS
HOLLANDSCHE BETON GROEP NV				
00073	BENES	JAN		CIVIL ENGINEER
	BEUKENLAAN 2	5071 CJ UDENHOUT		NETHERLANDS
BUREAU IR J BENES BV				
00178	DE LANGE	PIETER A.		PROF .IR.
	DEN DOLECH 2	561 2AZ EINDHOVEN		NETHERLANDS
TECHNISCHE HOGESCHOOL				
00051	DE VRIES	KAREL LOUIS	M	DIRECTOR
	WEENA 700	POSTBOX 299.3000 AG ROTTERDAM		NETHERLANDS
BOUWCENTRUM				
00127	DE WAART	JULES		DR
	BOERHAAVELAAN 5	2713 HA ZOETERMEER		NETHERLANDS
MINISTRY OF HOUSING				
00029	DIEPEVEEN	WILLEM	M	DR.
	WEENA 740	ROTTERDAM 3001 JA		NETHERLANDS
STICHTING BOUWRESEARCH				
00123	HAMAKER	JACOPUS		PROFESSOR DR
	BOERHAAVELAAN 5	2713 HA ZOETERMEER		NETHERLANDS
MINISTRY OF HOUSING				
00090	HOLLANDER	JAN		MANAGING DIRECTOR
	CEDERLAAN 4	5616 SC EINDHOVEN		NETHERLANDS
PHILIPS-BLD.DESIGN-PLANT ENG.				
00017	POLLINGTON	CHRISTOPHER EDWARD	M	DEPUTY SECRETARY
	WEENA 704	ROTTERDAM 3001 JA		NETHERLANDS
CONSEIL INTL DU BATIMENT CIB				
00018	SEBESTYEN	GYULA	M	SECRETARY GENERAL
	WEENA 704	ROTTERDAM 3001 JA		NETHERLANDS
CONSEIL INTL DU BATIMENT CIB				
00112	VAN DER STAP	LEO		IR
	CEDERLAAN 4	5616 SC EINDHOVEN		NETHERLANDS
NV PHILIPS ARCH.-ING.BUREAU				
00027	VAN DER WIEL	DIRK	M	
	KOEKOEKLAAN 19	LEIDSCHENDAM 2261EX		NETHERLANDS
00117	VAN SCHAIK	HEIN		DEP MAN DIRECTOR
	BERKENWEG 7.PO BOX 220	AMERSFOORT 3800 AE		NETHERLANDS
BV ARTICON				
00113	VOLBEDA	ANNE		IR
	WEENA 700	3000 AG ROTTERDAM		NETHERLANDS
BOUWCENTRUM				
00251	HENAO	LOHIA		ARCHITECT
	PO BOX 6631 BOROKO	PAPUA		NEW GUINEA
DEPT. WORKS AND SUPPLY				
00059	FOSTER	PETER	M	DR.
	PRIVATE BAG	PORIRUA		NEW ZEALAND
BUILDING RES. ASS. OF NZ				
00195	WEBSTER	JOHN		DR.
	VICTORIA UNIVERSITY	PRIVATE BAG WELLINGTON		NEW ZEALAND
SCHOOL OF ARCHITECTURE				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00297	IBRAHIM	AYODELE		ASSISTANT DIRECTOR
	15 AWOLOWO ROAD PMB 12635	LAGOS		NIGERIA
NIGERIAN BUILDING RES INST				
00099	NGOKA	NELSON IWENOFU		PROF.
	DEPT. OF ENVIRONMENTAL DESIGN	ILE IFE		NIGERIA
UNIVERSITY OF IFE				
00274	ODUSANWO	A.O.		CHIEF ENGINEER
	P.M.B. 3200	SURU-IERE, LAGOS		NIGERIA
FEDERAL HOUSING AUTHORITY				
00260	OGUNDANA	RUFUS SUNDAY		
	BADAGRY ROAD PMB 3200,SURULERE	LAGOS		NIGERIA
FEDERAL HOUSING AUTHORITY				
00307	AASHEIM	ERIK		CIVIL ENGINEER
	FORSKNINGSVEIEN 3B	OSLO 3		NORWAY
NORSK TRETEKNISK INSTITUTT				
00308	AMUNDSEN	KJELL		CIVIL ENGINEER
	DRAMMENSVEIEN 126	OSLO 2		NORWAY
ELLIOT STRØMME AS				
00334	ASKELAND	ARNE		EXECUTIVE ARCHITECT
	MARIES VEI 20 BOX 9	1322 HØVIK		NORWAY
NORCONSULT				
00284	BIRKELAND	ØIVIND		SIVILINGENIØR
	FORSKNINGSVEIEN 3B	OSLO 8		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00202	BJUNE	KARL BERNHARD		HØGSKOLELEKTOR
	HVALSMOEN	3508 HVAL ST.		NORWAY
HÆRENS INGENIØRSKOLE				
00311	CAPPELEN	PAAL		CIVIL ENGINEER
	FORSKNINGSVEIEN 3B	BLINDERN OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00333	DAL	ESTEN		ARCHITECT
	MARIES VEI 20 BOX 9	BOX 9 1322 HØVIK		NORWAY
NORCONSULT				
00160	DALAN	VIGGO		CIVIL ENGINEER
	HOLTEGATEN 26	OSLO 3		NORWAY
THE ASSOCIATED CONTRACTORS				
00313	EDVARDSEN	KNUT IVAR		CIVIL ENGINEER
	FORSKNINGSVEIEN 3B	BLINDERN OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00149	ERIKSTAD	KARL		DIRECTOR
	HAAKON 7. GATE 2	VIKA ,OSLO 1		NORWAY
AS.BYGGTJENESTE				
00341	FAYE PETERSEN	KNUT		ARCHITECT
	AKERSHUS FESTNING BYGN.58	OSLO 1		NORWAY
FORSVARETS BYGNINGSTJENESTE				
00201	GRANUM	HANS		PROFESSOR
		TRONDHEIM, NTH 7034		NORWAY
UNIVERSITY OF TRONDHEIM				
00309	HAGEN	HALLVARD		CIVIL ENGINEER
	FORSKNINGSVEIEN 3B	BLINDERN OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00314	HALLQUIST	ÅGE		CIVIL ENGINEER
	FORSKNINGSVEIEN 3B	OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00282	HEGDAL	BJARNE		ARCHITECT
	FORSKNINGSVEIEN 38	OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00312	HERJE	JARLE R		CIVIL ENGINEER
	HØGSKOLERINGEN 7	7034 TRONDHEIM NTH		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00091	HONERUD	JOHN		RESEARCH-DEV.MAN.
	P.B. 1254	3000 DRAMMEN		NORWAY
NORGIPS AS				
00169	HUGSTED	REIDAR		PROFESSOR
		7034 'NTH TRONDHEIM		NORWAY
NORWEGIAN INST. OF TECHNOLOGY				
00121	HØIBØ	HALVOR		DOCENT
		1430 ÅS		NORWAY
AGRICULTURAL UNIV. NORWAY				
00295	KRISTIANSEN	HARALD		ARCHITECT
	FORSKNINGSVEIEN 38	PO BOX 322,BLINDERN,OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00198	LANDRØ	HARALD		SIVILINGENIØR
		7034 TRONDHEIM, NTH		NORWAY
SINTEF AVD.2F-NBL				
00327	LINDSTAD	JØRN		SIV ING
	HAAKON VII GATE 2	OSLO		NORWAY
A S NORCEM CEMENTDIV				
00296	LUNDBY	SVEN ERIK		DIRECTOR
	FORSKNINGSVEIEN 38	PO BOX 322,BLINDERN,OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00100	NILSEN	ODD		LECTURER
	BLINDERN	OSLO 3		NORWAY
GEOLOGY DEPT.UNIV.OF OSLO				
00185	RAMSTAD	TROND		CIV.ING.
	FORSKNINGSVEIEN 38	OSLO 3		NORWAY
NORW.BUILDING RESEARSH INST.				
00305	REYMERT	JAN		CIV ING
	BOX 70 TÅSEN	OSLO 8		NORWAY
NTNF				
00298	SEIP	JENS L		CONSULTANT
	PILESTREDET 33	OSLO DEP		NORWAY
MINISTRY OF LOCAL AFFAIRS				
00310	STØRSETH	IVAR		HEAD OF DIVISION
	FORSKNINGSVEIEN 38	BLINDERN OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00283	SUNDH	HANS PETTER		DEPUTY DIRECTOR
	FORSKNINGSVEIEN 38	PO BOX 322,BLINDERN OSLO 3		NORWAY
NORGES BYGGFORSKNINGSINSTITUTT				
00026	THUE	JAN VINCENT	M	DOCENT
	NORGES TEKNISKE HØGSKOLE	7034 TRONDHEIM-NTH		NORWAY
INST. FOR HUSBYGGINGSTEKNIKK				
00182	WIEDSWANG	LIV		ARCHIVIST
	FORSKNINGSVEIEN 38	BLINDERN,OSLO 3		NORWAY
NORW.BUILD.RES.INSTITUTE				
00280	WIGEN	ROBERT		ASS.PROF.
	NORWEGIAN INST.OF TECHNOLOGY	7034 TRONDHEIM-NTH		NORWAY
DIV.OF BUILDING TECHNOLOGY				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00152	NAWAB	HASAN		CHAIRMAN
	466 G6-4 STREET 79	ISLAMABAD		PAKISTAN
COUNC.FOR WORKS.HOUSING RES.				
00114	WEGLARZ	MARIAN		INGENIEUR
	FILTROWA 1	00-950 WARSZAWA		POLAND
INSTYTUT TECHNIKI BUDOWLANEJ				
00296	ALEIXO	MARIO ARAUJO		ENGINEER
	AVENIDA DA REPUBLICA NO 14 5.	1000 LISBOA		PORTUGAL
BATIMATE SARL				
00140	COSTA MANSO	ARMANDO NARCISO		ENGINEER
	AVENIDA DO BRASIL 101	1799 LISBOA CODEX		PORTUGAL
LNEC				
00087	FERRY BORGES	JULIO		DIRECTOR
	AV BRASIL 101	LISBON 1799		PORTUGAL
LNEC				
00142	GOMES	ROY JOSE		ING.
	AVENIDA DO BRASIL 101	1799 LISBOA CODEX		PORTUGAL
LNEC				
00324	GOUVEIA	ANTONIO		INGENIEUR
	RUA SAMPAIO E PINA 16 1	1000 LISBOA		PORTUGAL
ATP LDA				
00355	HENRIQUES	JOAO FIRMINO ALMEIDA		ENGINEER
	RUA ALEXANDRE BRAGA NO 4A	1100 LISBOA		PORTUGAL
AMADEU GAUDENCIO SARL				
00133	LOURENCO ANTUNES	MANUEL		ENGINEER
	AV 5 OUTUBRO 54 2D	1000 LISBOA		PORTUGAL
ASS. TECNICA IND CIMENTO				
00294	MARQUES	WILSON		ARCHITECT
	R.SACADURA CABRAL NO.361 1.FTE	2765 ESTORIL		PORTUGAL
GTA LDA				
00141	PAIVA	JOSE A.VASCONCELOS		ING.CHEF DIVISION
	AVENIDA DO BRASIL 101	1799 LISBOA CODEX		PORTUGAL
LNEC				
00330	VERHULST	ERIC		
	PRACA DO CAMPO PEQUENO 21 5AND	1000 LISBOA		PORTUGAL
A P LDA				
00254	SINGH	SURINDER		
	KENT RIDGE CAMPUS	SINGAPORE 0511		SINGAPORE
UNIVERSITY OF SINGAPORE				
00271	FINLAYSON	KENNETH		MR.
	PO BOX 395	PRETORIA 0001		SOUTH AFRICA
NATIONAL BUILDING RES.INST.				
00276	MARAIS	WILLEM		MR.
	VOLKSTEM LANE	PRIVATE BAG X149.PRETORIA 0001		SOUTH AFRICA
DEPT.OF COMMUNITY DEVELOPMENT				
00098	NEIL	DAVID		PROF.
	PO BOX 312	JOHANNESBURG 2000		SOUTH AFRICA
LTA				
00049	WEBB	THOMAS	M	DR.
	PO BOX 395	PRETORIA 0001		SOUTH AFRICA
NATIONAL BUILDING RES.INST.				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00344	KIM	YOUNG CHUL		DIRECTOR
	43-37 HWIKYEONG-DONG	IPO 2159 SEOUL		SOUTH KOREA
NATIONAL CONSTRUCTION RES.INST				
00002	TCHO	YEONG-MOU		ARCHITECT
	2-7,2EME-GA,MYUNG-DONG,CHUNG-K	SEOUL-100		SOUTH KOREA
INST.COREEN DE L ARCHITECTURE				
00335	APAZIN	IVAN		INGENIEUR
	MOSKWA WERNNADSKOGO 29	MOSKWA		SOVIET UNION
NIIES				
00336	ATAIEV	SERGEI		PROFESSOR
	LENIN PROSPECT	MINSK		SOVIET UNION
GOSSTROI BSSR				
00302	DROZDOV	V A		PROFESSOR
	GOSSTROY	MOSCOW		SOVIET UNION
00343	KOZLOV	KONSTANTIN		
	MARXA 4	MOSKWA		SOVIET UNION
MINSELSTZOI SSSR				
00345	LESKOV	EDUARD		
	LOKOMOTIVNY 21	MOSCOW 127238		SOVIET UNION
BUILDING PHYSICS				
00347	OTSTAVNOV	VICTOR		INGENIEUR
	MARX PROSPECT 12	MOSCOW		SOVIET UNION
GOSSTROY USSR				
00011	CASTRILLO CANDA	ANTONIO	M	TECHNICAL ARCHITECT
	PLAZA SAN JUAN DE LA CRUZ	MADRID 3		SPAIN
INST NACIONAL CALIDAD EDIFICAC				
00262	AWAD	MOHAMED EL MUSTAFA		ASSOCIATE PROFESSOR
	PO BOX 35	UNIVERSITY OF KHARTOUM		SUDAN
BLDG AND ROAD RESEARCH INST				
00086	FAGEIRI	OMER M.E.		DIRECTOR
	UNIV.OF KHARTOUM	KHARTOUM PO BOX 321-35		SUDAN
BUILDING AND ROAD RES.INST.				
00001	ANDERSSON	SVEN AKE	M	LAENSBOSTADSDIREKTØR
	SOEDRA SJOETULLSGATAN 3	BOX 785 80129 GAEVLE		SWEDEN
BYGGFORSKNINGSINSTITUTET				
00004	ANTONI	NILS	M	PROFESS
	BOX 785	80129 GAEVLE		SWEDEN
STAT INST F BYGGNADSFORSKNING				
00024	DAHLGREN	STEFAN	M	
	BOX 785	80129 GAEVLE		SWEDEN
NAT SWEDISH INST FOR BUILD RES				
00146	ELMROTH	ARNE		ASS PROF
	SVEAVAEGEN 166	10044 STOCKHOLM		SWEDEN
ROYAL INST.OF TECHNOLOGY				
00044	ERIKSSON	RUNAR	M	ENGINEER
	BOX 785	80129 GAEVLE		SWEDEN
BUILDING RESEARCH INST.				
00325	FLEETWOOD	AKE G J		DR TECH
	SVEAVAEGEN 166	10044 STOCKHOLM 70		SWEDEN
ROYAL INST OF TECHNOLOGY				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00174	FLODIN	STEN		SENIOR RESEARCH OFF.
	ST. GOERANSGATAN 66	11233 STOCKHOLM		SWEDEN
COUNCIL FOR BUILDING RES.				
00045	FREDRIKSSON	GOESTA	M	PHD
	BOX 785	80129 GAEVLE		SWEDEN
BUILDING RESEARCH INSTITUTE				
00046	HJAERNE	LARS	M	PROJECT LEADER
	BOX 785	80129 GAEVLE		SWEDEN
INST. FOR BUILDING RESEARCH				
00175	JOHNSON	BERTIL G.		INFORMATION DIRECTOR
	ST. GOERANSGATAN 66	11233 STOCKHOLM		SWEDEN
SWEDISH COUNCIL FOR BUILD.RES.				
00148	KARLEN	INGVAR		DR TECHN
	SVEAVAEGEN 166	11346 STOCKHOLM		SWEDEN
ROYAL INST.OF TECHNOLOGY				
00199	KARLSSON	HENRY		HEAD,TECHNICAL DEPT
	BOX 7853	10399 STOCKHOLM		SWEDEN
SWEDISH BUILDING CENTRE				
00176	LAGERWALL	BRITTA		ASSISTANT
	ST GOERANSGATAN 66	11233 STOCKHOLM		SWEDEN
BYGGFORSKNINGSRADET				
00200	LINDGREN	JAN		MANAGING DIRECTOR
	BOX 7853	10399 STOCKHOLM		SWEDEN
AB SVENSK BYGGTJAENST				
00062	LINDQUIST	MARGARETA	F	ARCHITECT
	BOX 785	801 29 GAEVLE		SWEDEN
SIB				
00177	LUNDQVIST	BENGT		SENIOR RESEARCH OFF.
	ST. GOERANSGATAN 66	11233 STOCKHOLM		SWEDEN
SWED.COUNCIL FOR BUILD. RES.				
00145	LØGDBERG	ARNE		CIV.ING.
	SVEAVAEGEN 166	10044 STOCKHOLM		SWEDEN
THE ROYAL INST. OF TECH.				
00038	MANDORFF	SVEN	M	ENGINEER
	BOX 785	80129 GAEVLE		SWEDEN
SIB				
00040	NORD	LARS	M	DR.
	BOX 785	80129 GAEVLE		SWEDEN
SIB				
00037	NORLEN	URBAN	M	PHD
	BOX 785	80129 GAEVLE		SWEDEN
SIB				
00147	OTTOSON	GOERAN		LIC. ENG.
	SVEAVAEGEN 166	10044 STOCKHOLM		SWEDEN
THE ROYAL INST OF TECH				
00106	SCHLYTER	ANN		ARCHITECT
	TUNAVAEGEN 35	22363 LUND		SWEDEN
SIB				
00210	SHEPPARD	BIRGITTA		ACT.DIR.INTERNAT.PRO
	ST. GOERANSGATAN 66	11233 STOCKHOLM		SWEDEN
SWEDISH COUNCIL FOR BUILD.RES.				
00063	SKOELD	ANDERS	M	HEAD OF SECTION
	HANTVERKARGATAN 25	10422 STOCKHOLM		SWEDEN
STATENS PLANVERK				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00069	STERN	ADOLF		
	HAELSINGEGATAN 49	11331 STOCKHOLM		SWEDEN
BYGGDOK				
00292	SVENSON	GOETE		GOVERNOR
		LINKOEPING		SWEDEN
00042	SVENSSON	ANDERS	M	CIVILING.
	BOX 785	80129 GAEVLE		SWEDEN
STAT.INST.FOR BYGGNADSFORSKN.				
00008	WALLIN	STEN	M	PROFESSOR
	POB 725,LUND INST.TECHNOLOGY	220 07 LUND		SWEDEN
CONSTRUCTION MANAGEMENT				
00039	WALLMEN	OLOF	M	INTERNATIONAL SECR.
	P.O.BOX 785	80129 GAEVLE		SWEDEN
NAT. SWED.INST. F. BUILD.RES.				
00043	WESTERBERG	ULLA	F	ARCHITECT
	BOX 785	801 29 GAEVLE		SWEDEN
SIB				
00041	WYON	DAVID	M	DR.
	BOX 785	801 29 GAEVLE		SWEDEN
SIB				
00019	AGREN	INGEGERD	F	LAENSARKITEKT
	40340	GOETEBORG		SWEDEN
LAENSSTYRELSEN I GOETEBORG				
00068	ASTEDT	ARNE		
	HAELSINGEGATAN 49	11331 STOCKHOLM		SWEDEN
BYGGDOK				
00183	BORNAND	MARTIN		ARCHITECT
		4249 BLAUEN		SWITZERLAND
SCHWEIZER BAUDOKUMENTATION				
00053	BRYL	STANISLAW	M	DIPL.ING. AGH-SIA
		WINTERTHUR CH-8401		SWITZERLAND
GEILINGER AG				
00082	CSILLAGHY	JOSEPH		ECONOMISTE PROF
	AV.DE L EGLISE-ANGLAISE 14	1006 LAUSANNE		SWITZERLAND
IREC-EPFL				
00293	KUKULSKI	W		
	PALAIS DE NATIONS	1211 GENEVE 10		SWITZERLAND
ECONOMIC COMMISSION FOR EUROPE				
00326	REINER	BEN		FORMER SECRETARY
	26 AVENUE KRIEG	1211 GENEVE		SWITZERLAND
00266	VAALER	STEIN		DIPL.ARCHITECT
	ETH-HOENGGERBERG	8093 ZUERICH		SWITZERLAND
EIDGENOESSISCHE TECH.HOCHSCH.				
00246	LEMUNGE	NISEPHOR		GENERAL MANAGER
	PO BOX 720	DAR ES SALAAM		TANZANIA
NECCO				
00248	MBILIKIRA	MAHMOOD		GENERAL MANAGER
	UPANGA ROAD PLOT NO. 106	DAR ES SALAAM PO BOX 567		TANZANIA
NEDCO				

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00060	MSANGI	MELCHIZEDECK PETER	M	GENERAL MANAGER
	PO BOX 2977	DAR ES SALAAM		TANZANIA
	NATIONAL HOUSING CORPORATION			
00261	MTUI	A.L.		DIRECTOR
	PO BOX 1964	DAR ES SALAAM		TANZANIA
	NATIONAL HOUSING AND BLDG RES			
00096	MWAMILA	BURTON		ASS.LECTURER
	DEPT. OF CIVIL ENG.	PO BOX 35131 DAR ES SALAAM		TANZANIA
	UNIVERSITY OF DARESSALAAM			
00277	TOWO	MECKY		SOCIAL PLANNER
	MWENGE	DAR ES SALAAM		TANZANIA
	BUILDING RESEARCH UNIT			
00025	OVERGAARD	JENS	M	CIVIL ENGINEER
	RAJADAMNERN AVENUE	BANGKOK 2		THAILAND
	UNITED NATIONS E.S.C.A.P.			
00072	BAYTIN	DENIZ		RESEARCH ARCHITECT
	BILIR SOK NO 17	KAVAKLIDERE-ANKARA		TURKEY
	BUILDING RESEARCH INSTITUTE			
00074	BINDAL	MINE		ASSISTANT PROFESSOR
	TECHNICAL UNIVERSITY	ISTANBUL		TURKEY
	ITU BUILDING RESEARCH CENTER			
00352	COPUR	ULKER		ASS.PROF.ARCHITECT
	DEPARTMENT OF ARCHITECTURE	ANKARA		TURKEY
	MIDDLE EAST TECHNICAL UNIV.			
00085	ERTURK	ZAFER		DR
		TRABZON		TURKEY
	KTU MIMARLIK BOLUMU			
00346	OEZEN	OEZDEN		ARCHITECTE INGENIEUR
	BILIR SOKAK 17 KAVAKLIDERE	ANKARA		TURKEY
	INST.DE RECHERCHE DU BATIMENT			
00101	OEZSOY	AHSEN		ASS.PROF.
	TECHNICAL UNIVERSITY	ISTANBUL		TURKEY
	ITU BUILDING RESEARCH CENTER			
00255	OKAN	AKTAN		DR.ARCH,DEPUTY DIR.
	BILIR SOKAK 17.KAVAKLIDERE	ANKARA		TURKEY
	BUILDING RESEARCH INSTITUTE			
00264	PULTAR	MUSTAFA		DR.
	MIDDLE EAST TECHNICAL UNIV.	ANKARA		TURKEY
	FACULTY OF ARCHITECTURE			
00105	SAGLAMER	GULSUN		ASS. PROF.
	TECHNICAL UNIVERSITY	ISTANBUL		TURKEY
	ITU BUILDING RESEARCH CENTER			
00356	YAVUZ	SEVINC		ARCHITECT
	DEPARTMENT OF ARCHITECTURE	ANKARA		TURKEY
	MIDDLE EAST TECHNICAL UNIV.			
00245	YENER	CENGIZ		DR.
	BILIR SOKAK NO 17	KAVAKLIDERE ANKARA		TURKEY
	BUILDING RESEARCH INSTITUTE			
00116	YUREKLI	HULYA		ASS.PROF.
	TECHNICAL UNIVERSITY	ISTANBUL		TURKEY
	ITU BUILDING RESEARCH CENTER			

REGNO	FAMILY NAME	FIRST NAME	SEX	TITLE
	STREET	CITY	ZIP	COUNTRY
00278	WALAKIRA	CHRISTOPHER		ENGINEER IN CHARGE
	PO BOX 7188	KAMPALA		UGANDA
BUILDING RESEARCH UNIT				
00301	KANDASWAMY			DIRECTOR
	U N	NEW YORK		USA
UN CENTRE FOR HUMAN SETTLEMENT				
00035	SHAFFER	LOUIS	M	TECHNICAL DIRECTOR
	PO 4005	CHAMPAIGN ILLINOIS 61820		USA
USA CERL				
00111	URAL	OKTAY		PROFESSOR
	PO BOX 340254	MIAMI CORAL GABLES FLA 33134		USA
FLORIDA INT.ASSOC.FOR HSG SCI				
00067	WRIGHT	DIRECTOR		DIRECTOR,CENTER FOR.
	NATIONAL BUREAU OF STANDARDS	WASHINGTON,DC 20234		USA
CENTER FOR BUILDING TECHNOLOGY				
00259	GUEVARA	LUISA TERESA		ARCHITECT
	ESQ CRUZ VERDE EDIF CRUZ VERDE	CARACAS 1010		VENEZUELA
INAVI SECCION INVESTIGACION				
00189	DIMITRIJEVIC	RADOVAN		INGENIEUR CIVIL
	BULEVAR VOJVODE MISICA 43	11000 BEOGRAD		YUGOSLAVIA
INSTITUT ZA ISPITIVANJE MATER.				
00323	LONCARIC	ELISABETA		MASTER OF SCIENCE
	JANKA RAKUSE 1	41000 ZAGREB		YUGOSLAVIA
GRADEVINSKI INSTITUTT				

1 TOTALT ANTALL PERSONER = 299