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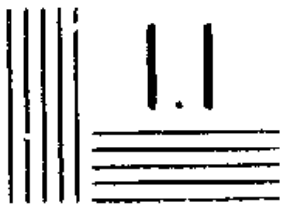
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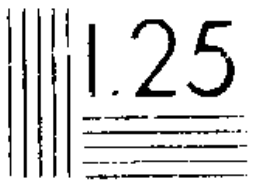
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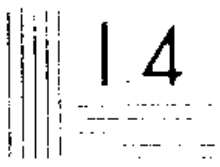
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UNITED NATIONS DEVELOPMENT PROGRAMME

Africa

LOW-COST BUILDING MATERIALS FROM AGRICULTURE AND INDUSTRIAL WASTES

UC/RAF/82/078

Terminal Report prepared by :

Adrian Zaharescu	UC/RAF/82/078/11-01
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Gheorghe Polizu	UC/RAF/82/078/11-03

Experts of the United Nations Industrial Development Organization

This report has not been cleared with the UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION, which does not therefore necessarily share the views presented.

C O N T E N T S

DESCRIPTION

From 26 September to 3 November 1983 an UNIDO exploratory mission took place to four African countries within the project UC/RAF/82/078/11-02 "Low-Cost Building Materials of Agricultural and Industrial Wastes".

The mission has been composed of :

- Adrian Zaharescu, chemical engineer - chief of the mission;
- Gheorghe Constantin Folizu, architect - councillor, member;
- Mihai Badea, Doctor engineer of building materials, specialist in the field of associated and thermal insulating materials, member.

The mission's schedule in the visited countries has been :

- Tanzania - 29 sept. - 8 oct. 1983
- Rwanda - 8 oct. - 22 oct. 1983
- Ghana - 23 oct. - 29 oct. 1983
- Mauritania - 31 oct. - 3 nov. 1983

During the mission's sejour in each country working sessions have been organized with UNIDO's residential representatives- excluding Ghana - and their collaborators, as well as with the decision factors of Ministries and other central institutions.

The expert team visited : Zaza, Rhuengeri, Giseni and Butare in Rwanda. While in Ghana in the locality of Kumasi a visit has been paid to the FOREST PRODUCTS RESEARCH INSTITUTE and the BUILDING AND ROAD RESEARCH INSTITUTE.

F I N D I N G S

As a consequence of the discussions held with the responsible factors of the visited countries, a series of common elements have been emphasized, in connection with the cheap building material production, as well as a series of elements specific to the resource availabilities in the concerned groups of countries.

All the visited countries face a serious shortage of houses, mainly in the urban areas, aggravated by the migration of the rural population in search for places of work which should secure them a better life.

All the visited countries are feeling a similar and acute shortage of fuel, while the building material industry being at the beginning of its organization, basic materials such as: cement, bricks, tiles, lime, a.s.o. are completely lacking or are obtained at high prices.

Therefore, the use of such materials is very limited.

Simultaneously the lack of national personnel is strongly felt, as well as of technical information and of financial resources which prevent the finalization of the housing programmes in good conditions.

As a common element of every visited country the local cheap building material production, turn to account the local resources and agricultural or industrial wastes. These resources are considered as the main source able to ensure the requests for mass building programmes.

This is why in Tanzania, Ghana and Mauritania there is an organizatorial nucleus able to facilitate the development of

some technologies specific to the processing of agricultural (in particular), and industrial wastes or of local raw materials for the production of cheap building materials.

Thus, in Tanzania, in Dar-es-Salaam, the BUILDING RESEARCH UNIT (BRU) has been set up; in Ghana, in the town of Kumasi, the BUILDING AND ROAD RESEARCH INSTITUTE is functioning, while in Mauritania's Nouakchott there exists a BUILDING AND HOUSE ADMINISTRATION COMPANY (Société de Construction et de Gestion Immobilière - SOCOGIM), all of them have already some results, but their activity is impeded by the lack of specialists to control the works, by the lack of financial means the failure to locally manufacture or purchase from abroad the requested installations and equipment.

There are the findings which determined the expert mission to suggest to the Rwandese Government the foundation of a pluridisciplinary research unit for building materials and of a system of territorial production network to practically turn to account the results of the researches with access to a mechanical workshop able to locally realize some simple production installations and to ensure, thus, the requested spare-parts and the necessary repairings.

The main agricultural wastes, as well as the local resources available for the production of building materials are presented in table 1, by countries :

Wastes or resources	Tanzania	Rwanda	Ghana	Mauritania
1	2	3	4	5
A. Wastes of the agricultural production				
-Rice straws and husks	x	x	x	
-Coconuts processing wastes	x			
-Coffee processing wastes	x	x		
-Cashewnuts processing wastes	x			

1	2	3	4	5
-Maize stalks and corn cobs	x	x		
-Wood wastes	x			
-Wood sawing and saw dust	x	x	x	
-Banana tree stems	x	x	x	
-Sissal fibres	x			
-Other vegetal wastes(papyrus)	x	x		xonly in the south
B. Mineral and organic local resources				
-Puzzolan	x	x		
-Clay, kaolin	x		x	x only in the south
-Limestone	x	x	x	
-Calcarous shells				x
-Plaster(gypsum)	x	x	x	x
-Sinter	x	x		
-Building stones	x	x		x only in the north
-Peat		x		

As a consequence of the discussions held with the decision factors of the visited countries a classification of the most important groups of materials was established.

A. Coverings, considered as a prioritary field in Tanzania, Rwanda and Ghana.

B. Wall slabs and blocks of local materials, fibrous agricultural wastes, puzzolanic cement bound foaming materials (Tanzania, Rwanda, Ghana).

C. Thermo-insulating wall or ceiling slabs.

Mauritania has a particular situation, since it has already identified many solutions and has carried out researches on technologies for the fabrication of cheap building materials.

For this country and in accordance with the representatives of Mauritanian institutions the opinions of the expert team are expressed in the chapter "Proposals and Recommendations".

X X X

This mission considers that for all the visited countries, the successful implementation of a cheap building material production depends on the following aspects :

A). As regards the technology

- promotion of some technologies not involving thermal processes and/or high temperatures, or for which the requested heat may be ensured by the explcitation of a non-conventional energy source (i.e. the sun, the geothermal energy, or even residual heat recovery of an other productive process);
- promotion of some simple productive installations able to be later mechanized or automatized with simple equipment, locally manufactured and for which spare-parts could be also locally ensured;
- organization with priority, of some small- or middle-production units able to cover the requirements of a small area, saving, thus, the transport means and the necessary fuel;
- utilisation of some other materials than the Portland cement as binders; which is an expensive and imported product for all these countries - or for almost all of them (Tanzania).

B). As concerns the organizational framework and the labour:

- simultaneously with the setting up of manufacturing installations, the training of the national specialists, able to control and develop any fabrication unit (training them on

the spot or in an other country) should be organized;
- securing the necessary conditions specific to each country, in order to diffuse to consumers minimum of technical information for an accurate utilisation of the manufactured products;
- setting up of some bodies to facilitate the waste or resource collection to be used in the production of building materials.

PROPOSALS AND RECOMMENDATIONS

The expert mission has made a series of recommendations, according to its findings which are presented within the country's report, as well as in the project proposals.

These recommendations - starting from the experience of the laboratory put at the disposition of Joint UNIDO Romania Center in Bucharest, by the Research and Design Institute for Building Materials in Bucharest, Romania - may be summarized as follows :

- Dispatch to Romania of some samples of agricultural wastes and specific resources whose properties are unknown in Romania in order to test their usability for the manufacture of cheap building materials (Tanzania and Rwanda).
- Finalization of manufacturing receipts or processes and of simple production equipment (designs) in Romania (for Tanzania and Rwanda).
- Presentation of the obtained results in Tanzania, Rwanda and Ghana by the Romanian UNIDO experts and granting an eventual technical assistance for the setting up of pilot-installations.
- Organisation of some international Symposia under UNIDO sponsorship for the African English or French speaking countries in order to facilitate the exchange of experience and technical information on locally produced building materials, with the participation of Romanian UNIDO experts.

The place, date and topics of the Symposia are to be later established, subject to the UNIDO approval and the concerned countries' Governments agreement.

- Organization of training courses or programmes in Romania for Rwandese and Ghanese technicians in the field of building material manufacture technologies, researches and testing.

- Erection in Tanzania, Rwanda and Ghana of some illustrative buildings, to test the specific qualities of the materials manufactured under original constructive systems.

For Mauritania, in accordance with the representatives of Mauritanian institutions, the expert mission suggests the following main actions :

- An interdisciplinary mission of UNIDO experts which, collaborating with the local specialized bodies, should draft a preliminary study on necessities, ways and conditions which may ensure the premises for the implementation of the actual Five Years Plan tasks of building at least 2,000 houses until 1985 (1986).

- Technical assistance for the training of national specialists able to run, control and develop the production units, as well as the sites for the above mentioned dwellings.

- Collaboration with UNIDO or other international organizations or Governments providing international financial sources for the respective researches, installations and production equipment, for the work control and house constructions.

Within this programme, an essential aspect is the promotion of some solar installation of gypsum dehydratation and the manufacture, by this way, of the plaster - a specific binder for the Mauritanian on an industrial scale.

CLIMATIC CONDITIONS

The report and the project proposals present detailed information in support of the above stated recommendations. The project proposals present the estimated contributions of the Romanian Government and of the visited countries.

NATIONS UNIES

ORGANISATION DES NATIONS UNIES POUR LE DEVELOPPEMENT INDUSTRIEL

ONUDI le 28 Septembre 1982

DESCRIPTION DE POSTE
UC/RAF/82/078/11-01/32.1.K

Désignation du poste

Chef de mission d'exploration dans le domaine des matériaux de construction

Durée de la mission

Deux mois

Date d'entrée en fonctions

Dès que possible

Lieu d'affectation

RWANDA
~~Cameroon~~, Ghana, Mauritanie, Tanzanie

But du projet

Mission exploratoire dans le cadre du Programme dans le domaine des matériaux de construction bon marché à partir de déchets industriels et agraires en vue d'orienter les activités du Programme.

Attributions

Le chef de mission aura pour tâches de:

1. Sensibiliser les organismes d'Etat pour le Programme en évaluant les possibilités pratiques de leur participation à celui-ci;

2. Etablir dans chaque pays avec les organismes d'Etat et les institutions spécialisées le programme détaillé de travail de la mission;

3. Coordonner l'activité des deux experts participants à la mission exploratoire en organisant sur place les détails de chacune des tâches leur incombant;

4. Etablir un rapport final exposant les conclusions de la mission et les recommandations à l'ONUDI, aux gouvernements de pays en développement ainsi que au Centre Commun ONUDI-Roumanie en vue de développement du Programme.

..../..

Toutes candidatures ou communications relatives à cette description de poste devront être adressées à:

Section de recrutement du personnel affecté aux projets, Division des opérations industrielles
ONUDI, Centre International de Vienne, B.P. 300, A-1400 Vienne (Autriche).

Formation et expérience requises	Ingénieur ayant une vaste expérience dans l'organisation de projets et des aptitudes organisationnelles en matière d'industrie.
Connaissances linguistiques	Français ou/et anglais.
Renseignements complémentaires	Un vaste programme s'étendant sur plusieurs années et tendant à développer des technologies pour la fabrication de matériaux de construction bon marché en employant des ressources locales de pays en développement y inclus des déchets industriels et agraires a été élaboré par l'ONUDI et dont la coordination a été confiée au Centre Commun ONUDI-Roumanie. Le Gouvernement roumain a mis à la disposition de ce Programme des laboratoires spécialisés où des technologies appropriées aux possibilités et besoins des pays en développement seront élaborées en vue d'obtenir des matériaux de construction bon marché. Des cadres techniques provenant des pays en développement prendront connaissance de ces technologies en faisant des stages dans ces laboratoires. Des spécialistes accorderont une assistance technique à la réalisation de ces technologi à léchelle industrielle des pays en développement. La mission d'exploration devra permettre de mieux connaître les besoins des pays en développement, les ressources locales en matière de matériaux de construction y inclus les déchets ainsi que les cadres techniques susceptibles de participer à l'implémentation du programme.

NATIONS UNIES

ORGANISATION DES NATIONS UNIES POUR LE DEVELOPPEMENT INDUSTRIEL

ONUDI le 28 Septembre 1982

DESCRIPTION DE POSTE
UC/RAF/82/078/11-02/32.1.K

Désignation du poste Expert en matériaux de construction

Durée de la mission Deux mois

Date l'entrée en fonctions Dès que possible

Lieu d'affectation Rwanda, Ghana, Mauritanie, Tanzanie

But du projet Mission exploratoire dans le cadre du Programme dans le domaine des matériaux de construction bon marché à partir de déchets industriels et agraires en vue d'orienter les activités du Programme.

Attributions Sous la direction du chef de la mission l'expert devra réaliser les tâches suivantes:

1. Evaluer les ressources locales de matières premières y inclus des déchets industriels et agraires disponibles pour obtenir des matériaux de construction bon marché;

2. S'informer sur les capacités de fabrication et de consommation des matériaux de construction ainsi que des plans d'avenir dans ce domaine;

3. Evaluer des systèmes constructifs les mieux adaptés à l'emploi des matériaux et des déchets envisagés;

4. Collecter des échantillons en vue d'analyses (matières premières et déchets);

5. Evaluer les possibilités locales de fabrication des matériaux de construction tenant compte de l'énergie électrique et du combustible;

6. Etablir les problèmes et les systèmes utilisés pour assurer la protection contre les incendies;

7. Recueillir des renseignements sur les facteurs climatiques etc qui peuvent affecter la performance des matériaux de construction;

8. Etablir les préférences pour les bâtiments, pour les éléments sandwich;

..../..

.butions - continuées	9. Evaluer les possibilités locales de la réalisation des unités industrielles des matériaux de construction préfabriqué
	10. Etablir les possibilités en matière de cadres techniques des pays visités en vue de leur participation à la réalisation du Programme;
	11. Collaborer avec le chef de la mission en vue de l'élaboration du rapport final exposant les conclusions de la mission.
Formation et expérience requises	Ingénieur, ayant une vaste expérience dans la recherche, le développement des techniques de fabrication des matériaux de construction et leur mise en oeuvre dans les construction industrielles et civiles.
Connaissances linguistiques	Français ou/et anglais.
Renseignements complémentaires	Un vaste programme s'etendant sur plusieurs années et tendant à développer des technologies pour la fabrication de matériaux de construction bon marché en employant des ressources locales de pays en développement y inclus des déchets industriels et agraires, a été élaboré par l'ONUDI et dont la coordination a été confié2 au Centre Commun ONUDI-Roumanie.
	Le Gouvernement roumain a mis à la disposition de ce Programme des laboratoires specialisés où des technologies appropriées aux possibilités et besoins des pays en développement seront élaborées en vue d'obtenir des matériaux de construction bon marché.
	Des cadres techniques provenant des pays en développement prendront connaissance de ces technologies en faisant des stages dans ces laboratoires. Des spécialistes accorderont un assistance technique àlla réalisation de ces technologies à l'échelle industrielle des pays en développement.
	La mission d'exploration devra permettre de mieux connaître les besoins des pays en développement, les ressources locales en matière de matériaux de construction y inclus les déchets ainsi que les cadres techniques susceptibles de participer à l'implementation du programme.

BUILDING RESEARCH INSTITUTIONS IN DEVELOPING COUNTRIES

BRU AN EXAMPLE

A.L. MTUI
DIRECTOR
BUILDING RESEARCH UNIT
P.O. BOX 1964
DAR ES SALAAM - TANZANIA.

SUMMARY

The aim of this paper is to highlight an example of a Building Research Institute in a developing country. The particular reference is the Building Research Unit at Dar es Salaam Tanzania. (BRU)

It starts with the background of visualizing a research institute in Tanzania in 1969, sighting different government plans and actions. The definition of the terms of reference including set up, organisation, and research philosophy are also clearly presented.

Research objectives for BRU have been those difined in the National goals and priorities. They have always been down to earth and geared to solving different everyday problems in housing. Its results have to be put into practical use by the intended users. Different methods used to disseminate research findings are described.

Present and possible future problems for the BRU are highlighted. It is likely that similar problems may exist in other building research institutions in the developing countries although BRU is still a young institution.

The need to establish building research institutions in developing countries is of a high priority. These may take the form of country, region or subregion co-operation depending on financial and economic capacities. Research results from industrialized countries have been of some benefit to developing countries, but they cannot replace the need for research within the developing countries. Furthermore due to the great variations in different countries imported solutions must be adopted to local conditions.

BUILDING RESEARCH INSTITUTIONS IN DEVELOPING COUNTRIES - BRU AN EXAMPLE

A.L. MTUI
DIRECTOR
BUILDING RESEARCH UNIT
DAR ES SALAAM
TANZANIA.

1.0 BACKGROUND

Immediately after independence in 1961 Tanzania found itself in a situation of an acute housing shortage. Like most developing countries the shortage was first felt in the urban areas where for the first time the familiar pattern of rural - urban migration was experienced at a large scale. People migrated presumably in pursuit of employment and a better life assumed to be found in the urban areas. In this situation an ever increasing need for new housing was created. In rural areas much of the then available housing units were ill constructed, unsafe and temporary. Faced with this situation the government first acted on the pressing need to increase urban housing units in Dar es Salaam by creating self help building schemes and later on in 1962 a National Housing Corporation was established. From then on the need for both better and more housing increased as more and more urban areas became attractive to job seekers.

In the Second Five Year Plan the Tanzania Government defined housing as a basic need and that every person was entiled to a decent dwelling. It was then necessary that the housing problem in the country had to be analysed in the context of the actual state of its condition and the desired state as expressed by the national housing objectives. Once this was done one realised the general objectives provided insufficient basis for which to assign resources for the improvement of housing, and morever such objectives could hardly be used as a measure of performance. For this reason specific bodies had to be established to deal with specific problems in order to implement the housing objectives as outlined in the plan. One of the greatest problems was the high cost of house construction.

2.0 THE ESTABLISHMENT OF THE BUILDING RESEARCH UNIT

Research in housing and building materials was envisaged and recommended in order to carry out research in local resources in an effort to reduce the cost of construction in the country. It was recommended that such research should aim at the development of an efficient building materials and construction industry based on locally available building materials. Research was also intended to improve the use of traditional materials and layouts of buildings that will offer a more hygenic standard and greater durability, thus making possible to build good houses at the lowest possible cost.

In 1969 preliminary discussions were held between representatives of the Ministry of Lands, Housing and Urban Development and those ministries and parastatals mostly concerned with building works and it was agreed that a "National Housing and Building Research Unit" be formed within the Ministry of Lands, Housing and Urban Development. In the same year this proposal was submitted to the government of the Kingdom of Norway as a project for possible assistance. The Director of the Norwegian Building Research Institute Mr. Ø. Birkoland was sent to Tanzania to investigate the feasibility of such a project. Mr. Birkoland's report supported the idea of establishing the Research Unit in Dar es Salaam and the Government of the Kingdom of Norway concured with his recommendation and agreed to finance the project. In 1971 the National Housing and Building Research Unit was started by a group of three Norwegians, two Architects and an engineer, and a few Tanzanian members of staff.

3.0 BRU's SET UP

The Building Research Unit is set up as a special division in the Ministry of Lands, Housing and Urban Development. It is headed by a Director and organized into five sections. At present there are 72 staff member with different qualifications. (See appendix 1 - Organization chart).

3.1 Technical Section

This section deals with the development and testing of materials and structures particularly those based on local materials and traditional technology. It also deals with scientific annotation of relevant

soils, concrete, organic materials, agricultural wastes, binders (lime, cement, gypsum etc.) and any topics of interest in the field of building materials industry in their production, use, maintenance, and protection. Building codes and regulations are also handled by a special branch of this section.

3.2 Building Economy Section

This section consists of Economists and Engineers. The economists deal with building economy in general, such as the building cost index, statistical analysis of the construction industry and related economic development of the country. The engineers deal with building technology on the site and research in such fields as site management and the rational use of equipment.

3.3 Human Requirement Section

The development of design criteria for low cost housing in the main task of this section. This includes the design of house types in accordance with settlement patterns, climatic conditions, family structure and family backgrounds. This section also collaborates with the National Bureau of Statistics in the analysis of housing data resulting from Census and household budget surveys.

3.4 Information Section

This section is responsible for the preparation and distribution of research publications. They also follow up institutions which receive our publications and those who use the research results in order to obtain the necessary feedback for our researchers. They also conduct building seminars and maintain the library.

3.5 Administrative Section

This section consists mainly of administators and the necessary support staff to serve the unit as a whole.

3.6 Terms of Reference

The National Housing and Building Research Unit operates under the following terms of Reference:-

- To identify and clarify the countries' problems in housing and

- As far as possible to find ways of solving these problems.
- To coordinate efforts in research and facilitate an appropriate distribution of tasks regarding economic utilization of manpower, equipment and other resources from existing research bodies and institutions.
- To ensure that the results of local and foreign research are disseminated within Tanzania.
- To collaborate with Government, parastatals and others in the purpose of getting practical utilizations of research results.
- To undertake research for government and other bodies in the construction sector and to give statements on research matters.

4.0 RESEARCH OBJECTIVES

The general way of initiating research is to take up actual problems from the society according to the defined national goals and the priorities set up in the countries development plan. This way people's needs are emphasized and the research for technical solutions and improvements is guided by the aspirations of the people and society. For this reason research in the unit was initiated with a strong emphasis on housing problems in rural areas, permanent village housing and housing problems for low income groups. For practical reasons research topics are grouped according to their main characteristics and methods needed for analysing them, to ensure the maximum use of the limited funds and trained personnel. (for list of research topics see Appendix II).

Initially the Research Unit started by identifying the properties of local building products, a knowledge that was necessary for the planning and construction of buildings. Laboratory testing is conducted through-out in order to learn the properties of such building materials together with methods of improving or protecting them. Elements of buildings are constructed and tested such as in floor, wall and roof components of different local materials. Stabilized soil, natural stone, bricks, pozzolime, clay etc. have been researched as low cost building materials for different parts of house construction.

The Research Unit has also began a compilation of building costs indices and is now in the course of preparing a cost index for the

whole country. Building site management has been studied in the field of efficiency, procurement, time, labour, storage etc. Many housing co-operatives thoughout the country have benefited from this study. Simple site prefabrication and block making, on site training and simple fool-proof technologies have been demonstrated to varions construction teams.

Research in human requirement is conducted in the context of improving the existing standard of living. This is so because the quality of life has a strong relation to housing and its surroundings. Sudden and big changes in housing conditions may have a negative effect on the social life and vice versa. In order to have people motivated for improvement and changes the Building Research Unit has undertaken the task of developing new solutions on the basis of traditional housing. This means studying problems of household activities, social life, housekeeping, cooking, food storage etc. This will result into homogenizing building design with traditions, social life, existing building materials and economic conditions in the country.

The Building Research Unit started off by studying traditional housing throughout the country. Such details as shape of houses, materials used, solutions for architectural details, use of space and facilities were thoroughly researched into as a basis for further improvement. Representative housing surveys in rural areas were conducted in order to provide information on consumer preferences in the quality of housing, and ability and willingness to pay for housing. At this stage the unit was able to produce the first recommendations for rural house designs including literature on the utilization of local building materials, construction methods and skills.

5.0 DISSEMINATION OF RESEARCH RESULTS

As mentioned earlier research findings from the unit have to be of immediate use, a policy advocating the delivery of the research findings to the users. Faced with an expansive, highly rural country with minimal infrastructure and a low rate of literacy the Research Unit had to look around carefully in order to find effective techniques of disseminating its research findings. So far five ways of fulfilling this aim have been practised and proved effective.

5.1 Building of demonstration houses

In Tanzania the great majority of the population live in the rural areas where the housing problem consists mainly of substandard housing which also lacks adequate community facilities. These houses are built mostly by peasants who lack the knowledge of modern construction techniques. There are plenty of traditional building materials available such as clay, wood, stone, straw, mud etc. The role of the Research Unit has been to demonstrate the techniques of improving the quality of the available building materials, introducing production planning and raising the standard of workmanship. In such projects, research technicians work side by side with the would be dwelling builders so that they leave the technology behind. Such a method although highly time consuming and expensive has proved to be very successful. Ten (10) such houses have been erected in different parts of the country to demonstrate the use of improved locally available building materials. These houses are built of mud blocks with plaster, soil cement, burnt brick, pozzolime blocks, sisal reinforced cement roofing sheets etc. to demonstrate that although cheap, these materials can be used in the construction of permanent houses. Backed with this experience, the Research Unit was able to publish a small booklet on Building Regulations for One Story Houses on Surveyed plots. This is the first attempt towards the development of local codes and building regulations to replace the inherited ones which are imported and highly irrelevant.

The development of self-help building techniques that can be used by the rural population with a minimum of guidance has been another great preoccupation.

5.2 Data Sheets

The use of data sheets is an effective method for the dissemination of research results. This method was used right from the beginning of the Unit. The main receipients so far have been government departments and institutions, schools, colleges and the University. The objective has been to supply these institutions with new data sheets once they are published. It is envisaged that in the near future, rural construction units would be formed in every district

of the country. It is necessary therefore, that the Unit cooperates with these rural construction units, so that it may provide them with the necessary technical advice. The use of data sheets will be one way of fulfilling this objective.

5.3 Seminars on Better Housing

Sometimes a considerable amount of labour is available from people who are willing to construct their houses if given just a fair amount of knowledge in building. In such cases the Research Unit organizes seminars on better methods of materials production, utilization, construction, upgrading etc. In such seminars it is also intended to introduce to the people some of the relevant research findings that can be applied at their locality. So far, seminars have been conducted at various levels in the country, but the main target has been in the rural areas. In such seminars participants are also supplied with publications and data sheets from the research Unit.

5.4 Book-lets

Publication of book-lets in simple and straightforward language is another way of disseminating research results. Today more and more people are asking for these booklets on such subjects as Climate and Design in Tanzania, Rural Low-cost Houses, Rural Housing in Tanzania etc. Efforts are being made to produce more booklets in the future where more drawings and diagrams will be included such as Small Expandable Houses, Urban Low-cost Houses etc.

5.5 Local Newspapers

Another way of publicity has been through the local newspapers. The Research Unit in collaboration with the local paper has been awarded space for publication of research findings whenever they are available. This is also an effective way of disseminating results. As it has been observed more response and telephone calls are received after an article in the daily paper than from any other form of publicity.

6.0 PROBLEMS OF BUILDING RESEARCH IN TANZANIA

Like in most developing countries building research in Tanzania has been confronted with common problems resulting from the economic and social situation of the country. The Building Research Unit however, has been given all the necessary moral and material support by government and parastatal institutions. The population has always been very responsive to the research findings. The main problem for the research Unit is to be able to reach them either by demonstration houses, seminars, publications, radio etc. There is a need to strengthen the Information Section in order to be able to get out the necessary information to building clients. At the international level the Unit receives, all the necessary support from many CIB member institutions.

As far as manpower is concerned, there is a critical shortage of trained research specialists required to put up the necessary work to meet the demand for improved housing in the country. This problem is nation wide and has no short cut solution. The Unit has developed a training programme for its staff to meet this shortage of manpower and meanwhile expatriates are recruited to fill the gaps.

A foreseable problem is one of shifting of manpower due to insufficiently attractive salaries for research staff. As the Unit exists as a government department the salaries for researchers are in the civil service scheme. At present, these salaries are slightly lower than those in the parastatal organisations a tendency that may create a drift from research to the construction industry or to other organizations where specialists are offered a better pay.

Financing for the Unit is divided into two categories i.e. local and foreign. Every year the Unit receives a sufficient budget of local funds for salaries and day to day running of the department. If however the present short supply of foreign exchange persits after the fairly new technical equipment and laboratory facilities are worn out, then the problem of providing the necessary replacement will arise since most of it will have to be imported. A similar situation will be encountered should expansion of technical

facilities be envisaged. The problem of lack of foreign exchange however affects all sectors of the national economy irrespectively. Other problems related to the lack of foreign exchange for the unit are the inability to purchase up to date literature and publications in building research together with the limited personal contact of researchers from other institutions either in the Eastern African Region or internationally.

7.0 CONCLUSIONS

The practical application of the results of research should be the ultimate goal for building research in the developing countries. Research institutions should also be aware of the need to ensure maximum use of the limited resources of funds, personnel and foreign exchange at their disposal. Costs can be reduced through mutual collaboration where research institutes in developing countries coordinate research programmes at national and regional levels, in order to avoid overlapping and duplication of work and to reach a more effective application of research results. Furthermore research institutions in developing countries must find a systematic way of disseminating their results in a way that they will reach those who need them or those for whom they are intended. In this way there is a need for the reasearch institutions to be in direct contact with the users. Tendencies of isolating the researchers from users should be avoided since the effectiveness of research results in developing countries must be communicated through training, demonstration and direct assistance to builders.

The construction industry in most developing countries varies in many respects. This is true even for countries which are close geographically, even if they share the same economic systems. It is necessary therefore, that each developing country should establish its own building research institution to enable it to deal with its down to earth problems for its housing needs by using available natural resources. Efforts must be made to ensure that those research institutions do not slacken after taking off.

Despite limited resources building research in Tanzania is very active. It has an overwhelming popular support particulary in the field of technical research such as the properties and durability of

facilities be envisaged. The problem of lack of foreign exchange however affects all sectors of the national economy irrespectively. Other problems related to the lack of foreign exchange for the unit are the inability to purchase up to date literature and publications in building research together with the limited personal contact of researchers from other institutions either in the Eastern African Region or internationally.

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Despite limited resources building research in Tanzania is very active. It has an overwhelming popular support particulary in the field of technical research such as the properties and durability of

local building materials, general design and construction problems of low cost and rural housing.

Lastly there has been a tendency for research institutes in the industrialized countries to specialize in housing problems of developing countries. These institutions conduct research on such topics as durability of building materials, thermal comfort in tropical climates, low cost houses etc. in order to provide assistance to developing countries.

Although this kind of collaboration is welcome, it cannot replace the need for carrying out research in the developing countries themselves. The great variety of factors influencing the local construction industry, such as climate, technology and available resources, cannot always be successfully simulated in European or North American laboratories. There is and always will be a need for adaptation of foreign research results to local conditions.

APPENDIX II

SOME RECENT BRU PUBLICATIONS

BRU D.2.1	Stabilized soil floors
BRU E.3.1	Solid soil walls
BRU E.4.1	Stabilized soil block walls
BRU E.6.1	Burnt clay brick walls
BRU F.7.1	Wooden roofing materials
BRU C.2.1	Stone foundations
BRU C.1.1	Site planning and preparation
WR No. 17	Pozzolanes and Pozzolime
WR No. 16	Surface treatments for mud walls
WR No. 15	Building cost indices
WR No. 14	Sisal reinforced concrete roofing sheets.

SOME ONGOING PROJECTS

R 0.03	Tanzanian building standards and codes
R12.01	Gypsum products for low cost housing
R14.02	Burning bricks with coal at village level
R19.01	Use of cashewnut waste as building materials
R19.02	Use of coffee husks as a building material
R25.03	Light weight concrete tiles
R46.00	Building equipment and tools
R60.11	Climate and design in Tanzania
R60.13	Compost latrines
R76.01	How to build a better house - A book.

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