SCIENCE AND TECHNOLOGY FOR THE BUILDING AND. CONSTRUCTION INDUSTRY

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I PRESENT SITUATION OF THE BUILDING AND CONSTRUCTION INDUSTRY IN TANZANIA AND ITS BOTTLENECKS

1. INTRODUCTION: AN OVERVIEW OF THE TANZANIAN SITUATION:

Tanzania has defined development as being man-centred. The three basic needs of man in life are food, clothing and shelter for his survival and preservation of the elements. Examination of the present situation in the building and construction industry from the above facts reveals a technological dualism that has serious repercussions. Whilst on the one hand institutional housing (e.g. schools, hospitals, hotels) and industrial and commercial buildings etc in the urban areas have admitted certain standard specifications of construction which take into consideration public health and hygiene aspects amongst others, on the other hand, traditional housing in rural areas where 95% of the population lives has admitted of no known standards. The problem of rural housing is the improvement of its quality and durability. As more and more land gets cleared for agriculture, and more of it still becomes zoned forests or national parks, and considering the frequent draughts in our climate the natural building materials i.e. the building poles and thatching grass have also started to become scarce. There exists therefore at the rural level a serious demand for new technology for improving the traditional house. As will be discussed later in this paper, recent research studies have confirmed the possibilities of improving walling and flooring construction technology to within means of the villagers by using sun-dried mud bricks, soil-cement stabilized blocks or fire-cured clay bricks. Roofing material for rural housing continues to be a serious problem. Corrugated aluminium sheets are just too expensive for the average villager. If one considers for example that normally the barest minimum size of a living or sleeping room is 9m² of floor area and 2.4m in height and that an ideal family house should be a 3 or 4 bed-roomed house apportioned as one for the parents, two for children allowing for sex separation at age 10 and a spare room for visitors and guests (to allow for the extended family) the current price of corrugated sheets alone for such a family house at Dar es Salaam will not be less than Shs. 1,200/- which is equal to Tanzania's per capita GNP of Shs. 1.200/- (Approximately US \$ 150). It is obvious from the above therefore that the average Tanzanian villager cannot at the present state of the economy afford a conventional house. It follows therefore that the building and construction industry in Tanzania exists only for the monetized sector. This is a very serious situation because although housing is a basic need, an average family cannot afford a good house. Then it follows that it should be government business o provide or otherwise assist its citizens in providing themselves with housing adequate to their needs. It is true the government has already taken steps to move

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people to Ujamaa villages with the objectives of providing them with basic amenities. e.g. clean water, dispensaries, schools and when possible housing facilities. Here we run straight into problems of attitudes and institutional problems. For example even at the village level a house is only considered good when it is built of 9"-thick concrete-blocks with 6"-thick partition walls with a corrugated aluminium sheets' roof but preferably with flat concrete roof. Even a burnt brick wall has to be given a thick concrete plaster to give it respectability. The situation is even made worse because the Housing Bank also has the attitude of granting loans to build houses with high cement content.

1.2. CONSTRUCTION VOLUME AND FUTURE TREND

According to a recent study on the Local Construction Industry, a peak in construction activity was reached in 1973 when total construction accounted for Shs. 2,100 million measured in 1975 prices. In 1975 the volume was estimated to be Shs. 1,840 million which constituted 44% of Gross Capital Formation or 11% of Gross Domestic Product.

Public Gross Capital Formation (including Central Government, East African Community and Parastatals) was estimated at Shs. 2,283 million in 1975. This was 54.7% of Gross Capital Formation and 59% of Monetary Gross Capital Formation. It has not been possible to estimate the part of Public Gross Capital Formation which is construction, but it is generally expected to be high. This indicates that publicly financed construction was more than Shs' 1,000 million in 1975. If the East African Community institutions are excluded, the government and its parastatals spent approximately Shs. 800 million on construction alone in 1975.

As for composition of construction i.e. civil engineering works versus building, from 1968 to 1972 the proportion of civil works rose from 44% to 67%. From 1972 to 1975 there was a decline from 67% to 55%. This increase and subsequent decrease was due to major civil engineering works such as Tanzania–Zambia Railway (Tazara) Tanzania–Zambia Highway (Tanzam), Kilimaniaro Airport, etc.

A closer examination of the buildings sector reveals a most striking feature, and that is the low priority given to residential buildings (urban monetary housing). On the average this sector increased only 0.5% per annum in the period 1968 to 1975, while the population growth for the country was in the region of 2.7% per annum (the urban rate of growth has been much higher due to better health services and migration of labour). It is however predicted that the composition of construction will continue to change in the direction of more building and less civil works. In particular it is expected that the volume of godowns, industrial buildings and office buildings will increase.

1.3 CONSTRUCTION COSTS AND CONTROL

Like any other economic commodity the construction greatly affected industry is by demand and supply. In spite of our endeavours to achieve a socialist, planned economy, the construction costs are still mainly determined by the market: Furthermore, the economy is still open to the impacts from world market price fluctuations. In recent years the cost of construction has increased tremendously. Up to 1972 construction costs increased from 5% to 10% per annum. From 1972 to 1975 the annual increase was in the range of 10% to 40% depending upon the type of construction. The main reason for this has been the worldwide increase inflation rates. In addition, the Tanzanian construction market has been in constant imbalance between requirements and construction capacities. Consequently competition has been low and this led to high pricing and high profit margins. This in turn has to some extent led to lack of incentives for improving performance and labour productivity.

Another factor which has contributed to the high cost level is the high degree of uncertainty prevailing in the industry. First there is uncertainty about contractors' long termsurvival. Secondly, there has been uncertainty about supply of construction materials and spare parts.

A strategic point for influencing construction costs is in the planning and design stage where the main decisions determining building costs are taken. Emphasis should be given to economic designs, and routines should be established so that costs of different solutions are calculated and evaluated. Another important consideration is standardization of methods of measurement of works and standardization of contract documents. This will remove much uncertainties from contractors who normally enhance their prices to cover for such risks. Furthermore, a schedule of rates should be established based on realistic calculations of various operations in construction. Lastly, but not least, there is urgent need for the government to increase the capacity of its own construction parastatals.

1.4 ORGANIZATION OF THE CONSTRUCTION INDUSTRY:

The organization and control of the construction industry is in many hands. The key ministries which are involved in construction are Works, Water, Ernegy and Minerals; Education; Lands, Housing and Urban Development; Prime Minister's Office; Industries; Capital Development; Defence and Finance and Planning. At present there is very little coordination between these ministries, and although in theory the Ministry of Works is supposed to control all construction contracts, in practice there is no such control. The effect of this is underutilization of investments, because supporting services are not provided in time of completion of projects. In other instances, this lack of control has led to some projects being carried out which do not conform to national standards.

Implementation of construction projects commences with design. At present most design work is carried out by private consultants-most of whom are foreign owned. There are a few public owned firms which carry out design work, namely NEDCO, National Housing Corporation and Capital Development Authority. In addition the Ministry of Works, Ministry of National Education and Ministry of Water, Energy and Minerals carry out some design work.

In the absence of design control, as we mentioned earlier, the presence of expatriate designers from different parts of the world results in the adoption of too many design standards. This has an adverse effect on the cost of projects.

As mentioned earlier most construction projects are carried out by contractors through competitive tendering. There are more than 120 contractors registered in Tanzania, but most of these are only capable of carrying out small projects. Contractors capable of carrying out works over Shs. 20 million number to almost 10% only, and even of these major contractors, most of them take on mostly building works which require less machinery. There are also public owned construction institutions such as MECCO, JKT (Building Brigades), National Housing Corporation, Prisons Building Brigade, C.D.A. Ujenzi Corporation Soles, Registrar of of Buildings, Maji Construction Unit and P.M.O. (Building Brigades). Construction capacity of all these is estimated to be less than 20% of the Total Construction Volume.

In spite of the large number of Local Contractors, most of the civil engineering works are exclusively taken up by foreign contractors, who have both the construction capacity and resources. Even then foreign contractors who respond to bids for civil works are very few; which makes it difficult to control pricing, and enhance chances of collusion.

The state-of-the-art of construction management in Tanzania is on a low level as compared to modern practice. Site Management and organisation is poor, lacking serious work schedules for day to day planning and project execution. In many cases critical activities are not identified, thus leading to overall delays in project execution. In addition, there is a general lack of adequate equipment and tools. Even where these are available, there is sometimes lack of optimal utilisation. Thus site production varies from site to site and is generally low. The reasons for this grim picture are manifold, and among these are, lack of experienced site foremen to give required supervision, low remuneration, and general lack of incentives. Training on site is almost non-existent due to the system of employing most of the labour on casual terms. In conclusion it can only be said that the problems pertaining to one site construction, Management and Technology are so many and complex that there is no easy solution to any one of them. Long-term solutions have to be worked out through government machinery and legislation. In particular there is need to set up a body which will have overall responsibility in this sector.

1.5 SUPPLY OF CONSTRUCTION MATERIALS:

Construction industry is tradionally split into two main sectors, and each sector has its own characteristics as to the demand for labour, equipment and material in-put. Civil Engineering works up more demand on equipment and spare parts and the materials generally required for this sector are cement, bitumen, quarry products, steel and explosives. The Buildings sector demands a lot of sepecialized and diversified building products. The construction materials industry is in general not well developed in terms of technology and capacity. Thus a lot of construction materials such as glass, bitumen, steel tubes, high tensile steel, pipes, ironmongery, sanitaryware, soft boards, asbestos sheets, electrical instalations, explosives, and some amount of cement etc are imported. In 1975 imports of building materials amounted to Shs. 400 million. The shortage of building materials and particularly cement shortage continues to plague the industry and this had led to delayed projects and consequent increase in costs. The cement supply situation is expected to improve early in the eighties when the extension of Wazo Hill factory and the two new factories in Tanga and Mbeya are completed. What is striking however is that with the present cement shortages one would expect an inducement for using cement more economically by increase usage of lime and mortars, use of soil cement instead of concrete where possible, use of hollow concrete blocks instead of massive ones etc but this has not been possible due to deep rooted attitudes on the part of investors. The use of burnt bricks and tiles has been encouraged but there are misgivings about it because burnt bricks and tiles are far more wasteful in their consumption of energy in manufacture than cement and cement based products. In fact bricks and tiles have tended to be more expensive than comparable cement products.

The existing industrial production of construction materials is concentrated in Dar es Salaam and a few centres up-country. The production of cement, plastic pipes, quarry products, nails and wire products, corrugated aluminium sheets, paints etc is in Dar es Salaam. Only a few products are produced up-country e.g. fibre-boards and tyres in Arusha, chip-boards and plywood in Mombo, steel, lime and plywood in Tanga. Timber is found generally in most parts of the country. The production of burnt bricks and tiles on a large scale is being tried in Dar es Salaam and Dodoma but generally bricks and even concrete blocks are usually manufactured on the construction site. The main importers of construction materials are also found in Dar es Salaam. Despite this highly centralised situation in the supply of building material, access to information about availability and prices of construction materials in Tanzania is a problem for designers and contractors. Product information from trade parastatals is unsatisfactory and generally there are no catalogues in Tanzania listing products, quality, sizes, prices and source of supply. Thus procurement of construction materials is a costly and time consuming business.

1,6 MANPOWER DEVELOPMENT

Productivity in the construction industry is hampered by lack of skilled manpower at all levels. A recent study of the industry documented the present and projected situation and the picture is an appalling one. The shortfall in citizen engineers, architects, surveyers, town planners, geologists and teachers of these professions, is projected to be of the order of 1000 by 1980; for technicians the order of magnitude is the same; Whereas the number of aspirants to be craftsmen/fundis has dramatically increased, the level of skill has likewise dramatically decreased. In the past decade the number of people tested has increased ten-fold, from an order of 600 to an order of 6000, while the percentage of passes has decreased from an order of 50% to an order of 30%. This is even more disturbing in respect of the increase of entrants from secondary technical schools. The unskilled and semi-skilled labour force semms unlikely to become skilled because of the pervasive system of casual labour, where even craftsmen and funds are employed on a daily basis. Competent foremen and super-

visors with managerial skills and the ability to read and interpret drawings and specifications appear hard to find.

Clearly a programme is urgently required to reverse the deficit trend in the manpower supply-demand relationship. At the professional level a portion of this deficit is and will be taken up by expatriate expertise, undesirable as this is in the face of Tanzania's goal of self-reliance in manpower.But the cadre below this – the so-called sub-professionals could never be filled in the same manner, not even on a short term basis. It demands an internal solution, even in the short run. The study of the construction industry, being acutely aware of this situation, advanced the following eleven recommendations:

- a. The system of casual employment on a daily basis of unskilled semiskilled workers should be outlawed. Labour legislation should be enacted to require a minimum of 1 week's notice of termination of employment, and preference should be given to contractors who can demonstrate that a reasonable proportion of their employees are employed on a continous basis.
- b. Simplified training systeHs for the semi-skilled are needed. The ILO approach of providing modules of employable skill' should be further investigated.
- c. The industry should be encouraged (or perhaps required) to empty craft apprentices. This might be achieved by a stricter control of quality standards by clients representatives, as well as giving preference to contractors who can show that they are making a contribution.
- d. The reasons for the high failure rates recorded in recent trade tests should be further investigated, particulary in respect of entrants from secondary technical schools.
- e. A supervisory training course for construction foremen should be established, covering, both technical and management aspects.
- f. Special acclimatisation training courses for expatriate professionals and graduates returning from abroad should be commenced, emphasizing local materials and skills. A manual underlining these points should also be prepared
- g. A university-level architectural education should be made available in Tanzania, emphasizing the extraction and manufacture of local building materials. The forecast need for profession architects appear to be considerably understated.
- h. The DiploHa of Engineering course at the Dar es Salaam Technical College should cease, and the College should concentrate on providing a technician level education.
- i Post employment courses in practical construction management should be established, with particular emphasis on cost control.

- j. The registration of Engineers, Architects and Quantity Surveyors should be the responsibility of the board and that of contractors of another board.
- k. The Institution of Engineers (Tanzania) should be encouraged and strengthened as a focus for professionals in engineering and related subjects, with a view to providing advice on the achievement of acceptable levels of professional competence by individuals.

2. BUILDING REGULATIONS

The legal basis for physical planning and building regulations in Tanzania is the "TOWN AND COUNTRY PLANNING ORDINANCE" of 1956, with some amendments of 1961. This Ordinance has replaced the "TOWNSHIP ORDI-NANCE" of 1930. However, since no regulations have been made under the Ordinance of 1956, the "TOWNSHIP RULES" and particulary the "TOWNSHIP BUILDING RULES" under the Ordinance of 1930 are still in use. In fact, the "TOWNSHIP BUILDING RULES" of 1930 are the only legal building regulations existing. These rules cover technical matters in a very simple way and this entails that for modern high rise building regulations. Consequently, each consulting firm uses its own regulations. Since most consultants are expatriates, regulations for various countries are in use in Tanzania. For low rise buildings the "TOWNSHIP BUILDING RULES" of 1930 are still valid but they are not appropriate to the present situation in Tanzania.

It is quite clear that the "TOWN AND COUNTRY PLANNING ORDI-NANCE" of 1956 is no good basis for the physical planning or building control. There are a lot of problems concerning administrative matters like responsibilities. and authority as well as significant tecnnical requirements. This means that the planning authorities are not able to provide sufficient plans or space for the infra-structure or plots for housing. It also means that, concerning low cost housing, the clients have problems getting building permits or loans for houses of a standard that low income people can afford. The work of making new national set of laws and regulations is going on, but it will take some years before Tanzania will have this important tool. At present the following drafts are prepared:

At present the following drafts are prepared:

- Town and Country Planning Act
- Regulations for Simplified Building Control
- Technical Rules for one storey houses on surveyed plots
- Short code of practice for design and construction in reinforced concrete
 Short code of practice for design in earthquake areas.

In "Regulations for Simplified Building Control" four levels of regulations and control are proposed:

- a. No rules except fire spacing for bouses outside planned areas.
- b. Regulations for Simplified Building Control for houses not more than two storey high and ten metres wide in planned areas.
- c. Building Regulations for buildings from three to eight storeys.

d. A Central Building Control Board of experts should control special projects which are not expected to be handled by the ordinary inspectors in the districts or regions. Within level 2 the majority of houses being constructed are very simple one storey houses. To help the building inspector as well as the client, a simple set of technical rules has been extracted from the Regulations for Simplified Building Control. Houses constructed according to these "Technical Rules for one storey houses on surveyed plots" should qualify for a building permit as well as a loan in the Tanzanian Housing Bank. Appropriate planning laws and building regulations are important to public efficiency and individual security and this field should be strongly highlighted.

3. RESEARCH IN THE DEVELOPMENT OF BUILDING MATERIALS FOR TANZANIA

Research on local building materials can be divided into two groups. First research on materials that can be produced in Tanzania to reduce import, and secondly research on local materials in the sense of local to the building site.

Research on building materials in the first group has not been emphasised in Tanzania. Tanzania imports large quantities of building materials e.g. sanitary chinawere, iron, bitumen and asphaltic products, electrical equipment and hardware, soft-board, ironmongery, sheet glass, white cement, insulating materials, explosives etc. etc. It is therefore vitally important for Tanzania to manufacture materials for construction from locally available raw materials so as to promote self-reliance. alleviate foreign exchange problems and advance local industries. The lack of emphasis in research in this field can simply be explained by the fact that the development of building materials in the country has been in the hands of too many authorities and there was little if any co-ordination between them. The type of research required under this category can be divided into two stages. First stage research work to establish the main raw materials occurrences in the country. The raw material potential for construction purposes in Tanzania is said to be high. There is an abundance of clay and limestones in Tanzania suitable for burning to obtain bricks, tiles, cement, calcium-silicate bricks and other products. Kaoline is found in abundance in Kisarawe. Gypsum and vermiculite are found in several places. Aggregates for concrete etc are found in several parts of the country. Iron and coal are found in Mbeya and Iringa regions. Structural timber and wood suitable for wood based industries are said to be excellent in Tanzania. Having surveyed the main raw material occurrences, extensive testing of the materials is required to establish their fine qualities and hence determine proper production technologies. There are a few research works seriously being carried out at this level and they include the development of the iron industry, pulp and paper, gas from Songo Songo and the development of cement factories in Mbeya and Tanga, to mention but a few.

The second stage consists of research work aimed at answering such questions as to what to manufacture, where and in what scale. There is a lot of literature on the subject of production criteria e.g. UNIDO Monograph on Industrial Development No. 3 which outlines clearly some of the major factors for consideration and optimisation. It is important to mention here however that probably it is at this stage when serious consideration ought to be given to products – innovation and production

The Building Research Unit for example is working on sisal-reinforced concrete, which can be used for various purposes e.g. ceiling, roofing and even walling. This is the type of research work that can entail industrialised production. There is a lot of saw-dust and wood shavings being burnt into waste in many parts of the country. These items can actually be glued, compressed, or mixed with gypsum to make excellent ceiling and partition material Probably the lack of interest in this field reflects the fact that most of our research personnel are expatriates, and therefore, they too have not shown keen interest in this area because the type of research required in this group is mostly a question of transfer of technology than the development of new technology. The main reason however is that until recently, when a separate Ministry of Industries was established, there was not in this country clearly formulated industrial plans and programmes. In the Third Five Year Development Plan, expansion of the industrial sector has been given priority. It is expected therefore that in the coming years research in this group will definitely increase. In fact one healthy sign has already emerged by the creation of the Tanzania Industrial Research Organisation. Before Arusha Declaration, industries were established here in Tanzania as appendages of their parent bodies overseas. While they were thus owned most research and development was carried out in the parent laboratories. Now that the State has taken over the major manufacturing concerns, we can no longer, expect to rely entirely on the research carried out elsewhere. It remains to be seen what this institution can do to live up to its responsibilities. There are feelings that like the East African Industrial Research Organisation, which was for obvious reasons based in Nairobi, it may end up being just another trouble shooting organisation.

The second group, that is research on local building materials, in the sense of local to the building site, has received much more emphasis in Tanzania. This has been so probably because of the following reasons:—

(a) The majority of our population (95%) is found in the rural areas. Available statistics show that $\frac{2}{3}$ of the families who own the house they live in earn less than Shs. 500/- per annum. Evidently majority of families can only set aside very little money tor building purposes. Hence the need for research on materials for very low-cost housing.

(b) Majority of the people in rural areas build their houses themselves. Hence need for research on simplified technology for improving traditional housing.

(c) A survey made in 1969 showed that 85-90% of the rural houses were built entirely of local materials (i.e. soil, wood and grass). This situation has not changed much since 1969. Extensive use of local materials for building is still the only realistic alternative to many, and hence need arises of research into ways and means of improving the structural qualities of local materials for building durable houses.

(d) The other reason that has spurred research on local materials (local to the building site) is the very fact that Tanzania, is neither homogenous to traditional design and construction technology nor to raw material resources. This situation, coupled by the fact that building materials are bulky and have a low value/weight ratio, which means that transport may add considerably to costs, and considering that the transport system in the country is not sufficiently developed, it is therefore, logical to utilize as far as possible those raw materials which are available locally.

Before dealing with some of the research work that has been done and is still being done on local building materials let us first deal with a few facts that have been revealed by several studies and surveys:—

(1) According to the Household Budget Survey in 1969, $90-95^{\circ}_{00}$ of all rural houses had no foundation at all. This is a very serious problem that exists to this date. Walls with no foundation are too easily damaged at the base by rain and moisture from the ground; and the soil that supports the wall can also be erroded away and cause the house to crack or even collapse.

(2) Most rural houses have floors made simply of tamped soil, and sometimes plastered with cowdung or ant-hill soil as a binder. Further most floor levels are usually on level with, or even below, the surrounding ground level outside the house.

- (3) Three main types of traditional wall constructions exist:
- (a) Walls entirely made from organic materials such as poles, branches, reeds and grass. $(40^{\circ}_{20} \text{ of all rural houses in 1969})$ (Decay fast due to insect and fungi attack).
- (b) Mud-and-pole walls (40% in 1969) (The only alternative for many years to come. Ways of improvement known and will be mentioned later).
- (c) Walls made from soil only (15% in 1969) (with proper construction and maintenance can live up to 50 years)
- (4) In the rural areas thatch is the most common roof covering (80_{0}° in 1969).
- (5) Very few houses in rural areas have any kind of ceiling.

With these few facts it is obvious to see why the research work done by mostly the Building Research Unit has concentrated on two aspects namely rural building technology, and rural materials. On building technology, several ways of constructing foundations using local materials have been advanced. It has also been shown that with proper siting of the houses, and by constructing longer eaves to protect walls from rain water many of the traditional houses can live longer. Soil is a traditional and still important building material available at the building site all over Tanzania. Extensive research work has been done on soils and only a few projects will be mentioned here.

SUN-DRIED SOIL BLCCKS:

The best material for pure soil construction is sun-dried soil blocks. Research work has shown that soils with 80°_{0} clay and silt and 20°_{0} sand is ideal. The block can be moulded by hand or for even much better results with block-making machine. The size of block (30x45x15xcm or less), proper curing, and protection from rain by roof overhang are the essential factors to watch.

BURNT-BRICKS:

How to make a proper clay and proper burning in-field kiln by using wood or coal has also been investigated. Correctly produced, burnt clay bricks are very strong, durable and water resistant material, which have proved their suitability under different climatic conditions throughout the world. The problem with burnt bricks is that they require plenty of fire-wood. approximately 2 m³ per 1000 bricks of standard size (65 x 110 x 230 mm). For low cost production firewood is the only realistic fuel, but there are only few areas of Tanzania where the access to firewood is unlimited. Modernized large scale production in centralised localities appears the only viable way of producing reasonably-priced-bricks.

STABILIZED SOIL:

Tests on soil stabilization by adding cement, lime or liHe with pozzolana have been carried out. Cement as a stabilizer gives the best result. Almost any soil with a content of fines (clay and silt) between 10% and 45% is fitted for cement stabilization. Mix ratios of as low as I part by volume cement to 22 parts by volume soil will yield strong material even for walls. Suitable soil can be found in most parts of Tanzania, and because very little cement is required it appears this is the ideal solution to many problems in rural housing. To secure a satisfactory block strength, the soil-cement mix must be thoroughly mixed when dry and well compacted when the blocks are made; and then water cured for at least seven days after allowing one or 2 days for hardening after moulding. The soil-cement mix can also be used for insitu-cast structures e.g. floor.

In areas with plenty of stones it has also been shown that excellent stone walls can be erected, but unfortunately the construction of rubble walls requires a high standard of workmanship.

In short it can be said that research work has now shown that in almost all rural areas of Tanzania it is quite possible to modernize the housing situation at a very low-cost using locally available materials. The only problem, is that many people are not aware of these reserves findings.

It must be pointed out however that cheap roofing materials are still a big headache. Thatching, whether of grass, reeds. palm leaves, or banana leaves, has a good thermal insulation, is cheap, and the necessary skills to erect, maintain, and replace are fairly well known by the people. It will remain the only realistic solution for the majority of the rural population for many years to come. If well laid and maintained thatched roof can last 5-10 years. What is actually required now is to find cheap suitable ways of chemical treating to make them water-proof, insectproof, snake proof and even possibly fire-proof.

Other alternatives of roofing using local Haterials e.g. mud-roof (tembe), soil-cement roofs etc have also been investigated, but the main disadvantage has been the necessity for strong supporting structures, to hold the soil when wet.

In some parts of Tanzania natural stone slates, excellent for roofing are abundant, but these have not been used much because the heavy slates require a strong supporting structure, which can be costly because of the high cost of timber in the country.

DISSEMINATION OF RESEARCH FINDINGS

When discussing dissemination of research findings, it should be recognized that developing countries are developing on two quite different levels, at the same time. The first is the development of a little but important industry which is run by professionals on a high technological level. Here the relationship between research and the users of research findings is almost similar to that one in developed countries.

The second is the low-technology, own account development for the masses. There is no economic basis for high technology and the consumers are not professionals. The most important field of rural development is housing which also is the main task of Building Research Unit. The problem is dissemination of research findings for development in rural areas. Experience from BRU may be an example. The rural housing is mainly based on self help building and consequently the target group for the research findings should be the individual house builder. It is obvious that BRU cannot reach each individual directly. Mass media like radio and newspapers may be used but even these reach a very few and the impact is limited.

Information through primary and secondary schools will reach everybody since the school system is well developed. Even though the system is overloaded with information to be taught. It is recommended that information on housing should be given some priority.

BRU is disseminating a lot of publications, but they do not reach the individual or the ones directly involved in the construction work. It is also a problem that villagers, generally speaking, are not able: to transfer writings or drawings into practice. The best way of implementing research results is by deHonstrations on actual projects. BRU has however not the capacity itself and has to rely on local bodies who have the professional skills to implement the research findings.

There exists no housing officers in the districts or regions, but there has been established "Rural Field Construction Units" in 45 districts and the remaining 35 districts are supposed to get one each. The task of these units is to supervise the villagers and support them with skilled manpower and equipment. The Field Construction Unit is a target group for research findings on rural housing, but unfortunately this relationship has not been sufficiently established.

Parastatals and other institutions operating in rural areas have often their own housing programmes. Research findings implemented in their houses will serve as deHonstrations, like demonstration houses constructed by Site and Services and the Housing Bank'

5. COMMUNICATION PROBLEMS FOR THE LOCALLY PRODUCED MATERIALS

The communication problems may be divided into problems concerning production information, marketing and distribution.

The product information is poor in Tanzania like in all developing countries. Producers of local" materials are often small scale industries without capacity for this kind of work. The most important problem is that most design work is made centrally and often the designer know very little about which materials and components are available in the area concerned. Building Research Unit has made a survey on available building materials in the different regions and made a "Building Product Catalogue". It has however been difficult to collect the relevant information and it is being outdated very fast. Marketing is not a problem since there is a shortage of materials. Distribution is a problem because transport is a general problem. The idea of local production of materials is however to reduce transport costs. The local small scale production of building materials should therefore be strengthened. Moreover the decentralization of the production is not only an economic matter, it is also a most important factor for the general technological development all over the country.

The importance of developing local production of building materials is recognised, and financial support is offered by the government. The development of local small scale industries varies from region to region, but in general terms it may be assumed that there is a demand for further development.