OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED
ID/WG. 282/108
18 October 1978
ENGLISH

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL FORUM ON APPROPRIATE INDUSTRIAL TECHNOLOGY

New Delhi/Anand, India 20–30 November 1978

WORKING GROUP No. 5

APPROPRIATE TECHNOLOGY FOR THE PRODUCTION OF CEMENT AND BUILDING MATERIALS

EVOLUTION OF THE CONSTRUCTION AND BUILDING INDUSTRIES IN INDONESIA

Background Paper

78-7296

EVOLUTION OF THE CONSTRUCTION AND BUILDING INDUSTRIES IN INDONESIA

by

Z. A. Abbas
UNIDO consultant

The description and classification of countries and territories in this document and the arrangement of the material do not imply the expression of any opinion whatsoever on the part of the secretariat of UNIDO concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries, or regarding its economic system or degree of development.

The views and opinions expressed in this document are those of the author(s) and do not necessarily reflect the views of the secretariat of UNIDO.

Mention of firm names and commercial products does not imply the endorsement of the secretariat of UNIDO.

The document is reproduced in the form in which it was received and it has not been formally edited.

282/108

C O N T E N T S

---oOo---

INTRODUCTION

As the theme of this International Forum is about appropriate technology, it seems appropriate to present first of all a brief explanation on what is conceived as appropriate technology.

It has been generally understood that technology comprises the backbone of the economic development of a country, as such enhanging the material well being of the people. However, experience has also shown that care has to be exercised to adopt that kind of technology which produces not only growth but equity as well to enable the people of the country as a whole to prosper. Thus, there has arisen the question of appropriate technology.

The criteria of appropriateness is, however, directly related to national development, which in itself is not an end, but rather a means toward an end, a process resulting in changes in the lives of the peopel. Though these changes may be harmful to some during the process, it is assumed that development can be so directed as to achieve broadly defi ed goals, such as "improving human welfare", "equitable distribution of income and wealth", and "development of individual potentialities". These goals themselves are conditoned in any society by individual and social values and these, in turn, vary with philosophical systems of thought, religious belief, historical develppment, and the like.

Thus, the socio-economic aspects prevailing in the country have considerable impact on technological factors. In Indonesia there is growing awareness that due consideration should be given to these social and economic aspects. High population growth, disproportionate distribution of the population, vast under-employment and unemployment, low levels of income, lack of capital investment in industries and tradition bound attitudes are some of the features.
This calls for intensive research and development work on a continuing basis for evolving appropriate technologies.

With all the above limitations, appropriate technology remains broad in its scope. In this paper the focus of attention is on the

construction and building materials industries. Realizing the important and increasing role of these industries in the overall economic and social development of the country, the Government is paying considerable attention towards developing the local capabilities in various technological aspects of these industries. Negligence of these limitations could become a major obstacle for present and future efforts, while indiscriminate adoption of technological innovations from industrial developed countries could make existing conditions even worse. Effective enforcement of regulatory measures and preventive as well as corrective actions are being undertaken on a cooperative basis by involving various institutions to ensure better coordinated efforts.

This paper is prepared at the request of the United Nations Industrial Development Organization (UNIDO) in connection with a techno-economic meeting on practices and application of appropriate industrial technologies. In this context the paper is presenting a review of the evolution of the construction and building materials industries in Indonesia, and the problems and attempted solutions taken by the Government. Although not all aspects of the industries is to be covered, it is hoped to have provided useful information to be discussed by the Forum.

1. GENERAL SITUATION

To understand better the problems which oppress Indonesia in its effort for development, it is necessary to take a brief look to its geography, resources and socio-economic evolution.

Indonesia is a republic whose territory is an archipelago of more than 3,000 islands extending along the equator between the mainland of Asia and Australia. It is situated between 6°N and 11°S latitude and 95°E and 141°E longitude with the greatest distance from North to South 1,888 km and from West to East 5,110 km. Much of this vast area, however, is covered by water and only 20% or 1.9 million square kilometer is land. It is the third largest country in Asia next to China and India.

The general climate condition is tropical and humid, although the fortunate division of the country into a group of land-units almost symmetrically broken up by water areas causes the climate to be relatively moderate. The daily and yearly variation of temperature is not large, and the average monthly temperature remains within the degrees of 27°C at all seasons.

There are two main seasons, the wet or rainy season and the dry season. The annual rainfall for Indonesia is generally more than 1.800 mm. Humidity values are on average high, with variations due to local conditions. The annual average humidity is 80%.

The archipelago may be considered also as one of the most volcanic areas of the world, having some 500 volcanoes of which 128 are considered active. Earthquakes, though occuring rather frequently, may not be disastrous. The country is fortunate in that it lies outside the path of typhoons on course to the Asian mainland.

The population of Indonesia is presently growing by more than 2.4 million people a year. Alternative projections for the year 2000 indicate a population of between 200 and 289 million people, depending on how rapidly fertility will decline. An acceptable estimate is the figure of 220 million, almost twice of what it is today.

Indonesia's population problem is in a class by itself. It is plagued by both overpopulation and underpopulation. At the heart of the problem is the disproportionate distribution of the people among the country's islands. This will put pressures on the available resources and considerably increase population densities, particularly in areas such as Java where in 1971 already 64% of the population lives on about 7% of the country's land area. In the year 2000 the expected density for Java will not be less than 1,000 persons per

Table 1.

Region and Population of Indonesia

Region	Area in sq. km.	% Tot. area	Population in million 1930	1961	1971	1001	Density/ sq.km.
J a v a	132 187	6.95	41.7	61.9	76.9	133.8	1012
Sumatra	473 606	24.86	8.3	15.7	20.8	47.6	100
Kalimantan	539 460	28.32	2.1	4.1	5.2	10.3	19
Sulawesi	189 216	9.93	4.2	7.2	8.5	15.0	79
Other islands	570 100	29.94	4.4	7.1	8.6	16.1	28
Indonesia	1 904 569	100.00	60.7	97.0	119.2	222.8	116

Source: Statistical Pocketbook Indonesia, 1976.
Population Censuses of 1930, 1961, 1971 and projected population for the year 2001.

square kilometer. By contrast, the density of Kalimantan (Borneo) is estimated to increase only up to 19 persons per square kilometer.

Besides population imbalance between Java and the other islands, there is also a marked disparity between urban and rural areas. The census of 1971 shows that about 20% of the population live in the urban centres and 80% are in the rural areas.

The rich soils, mostly formed by volcanic action, its exuberant tropical forests and an abundance of minerals have made Indonesia one of the countries of the world better endowed with natural resources. Thus, agricultural activities support more than 70% of the population, and there are still large areas of fertile land on the islands outside Java which are not yet under agricultural exploitation. Rice, rubber, tobacco, palmoil, tea, coffee, sugar, clove, cinchona and capok are among the most important agricultural products, some of them with well established foreign markets. In addition, timber and some mining products like oil, natural gas, tin, bauxite, nickel, copper and manganese ore, are major sources of export revenues. In the present setting, the future development of the country will depend critically on the capability to manage and utilize the available natural resources with a minimum of waste, and to the benefit of the greatest number of people.

Before independence in 1945, a typical colonial economy was developed which consisted mostly of the production of those raw materials in which the dominating country was mainly interested. The population benefitted very little. Due to political instability between 1945 and 1965, the economy of Indonesia had dropped to its lowest point and was practically disrupted. After 1965 a new Government successfully embarked upon a programme of stabilization and rehabilitation, culminating in the introduction of the First Five Year Development Plan (REPELITA) in 1968. The Government's role is to develop and maintain a climate favourable for economic development. It is to follow a more realistic and pragmatic approach in order to provide the people with the necessary basic needs as food, clothing, housing and building materials for a price within reach of the greatest part of the population. Successive Five Year Development Plans will not only provide for higher targets in general, but also for expanding employment opportunities through development of the industry and wider

distribution of the benefits of economic growth by placing greater emphasis on social development and by integrating the approach to regional development.

2. THE BUILDING INDUSTRY

Many developing countries have embarked upon large-scale programmes of national development and construction in the implementation of economic and social objectives. As development proceeds, the standard of building and construction required by developing countries changes. A greater variety of building types is required, in greater numbers and distributed over wider areas. The traditional demand for simple shelter becomes a demand for better housing, community facilities and infrastructure projects. Population growth, general industrial development and the efforts to raise the levels of living impose increasing demands on the capacity and efficiency of the whole construction industry.

The construction industry is not only critical in the development process, but at the same time it provides a substantial source of employment. Because construction embraces such a wide variety of skills and activities, including design, component manufacture and assembly, and the management of men, materials and plant, it provides also a rich field of training and experince for a large number of people struggling to increase their standard of living. Construction is usually the second biggest employment sector in an economy, second only to agriculture in a developing country and to manufacturing industry in a developed one.

Being an integral part of all developmental activities, the construction industry has as such a vital role to play in the speedy and economical accomplishment of construction projects. In the developing countries, investment in construction is high and can account for as much as 60 to 70% of the total cost of development programmes. Its contribution to the GDP varies from 2 to 10% for the world as a whole. In most developing countries it accounts for 3 to 5% and in most industrialized countries 5 to 9%. The construction industry utilizes 50 to 55% of the output of other industrial sectors, such as timber and wood products; structural metal products; plumbing, air-conditioning and electrical equipment; paints and allied products; building machines, equipment and tools; sanitary ware and fittings; etc. The quality, supply and standard

of the products of other industrial sectors considerably influence the quality, labour productivity and economy of construction. Obviously any savings in the expenditure on construction would considerably reduce the burden on the national economy and make available more resources for development.

After a period of economic and political instability before 1965 which brought construction activities in Indonesia virtually to a standstill, the demand for construction rose rapidly since the introduction of the First Five Year Development Plan in 1969 as the economic prospect became brighter and Government spending increased.

According to "World Tables 1976" published for the World Bank, the volume of construction in Indonesia has developed as follows :

Table 2.

Growth in Production, Investment and Construction in Indonesia 1960 - 1972.
(Index 1960= 100, constants prices).

Year	GNP	GDI	Value added in Construction	Population
1960	100	100	100	100
1965	110	118	100	110
66	113	133	62	112
67	115	108	94	114
68	127	132	133	117
69	137	170	185	119
1970	146	226	217	121
71	156	264	260	125
72	167	316	292	127

Notes : GDP = Gross Domestic Product at market prices.
GDI = Gross Domestic Investment at market prices.

The construction market in Indonesia can be fairly represented by the public sector's demand for construction, since it comprises 70% of the total demand for construction. The demand for construction in the private sector has been increasing rapidly after the introduction of the Foreign and Domestic Investment Law in 1967. Both for the public as well as for the private sector, this demand for

construction is highly concentrated in Jakarta and environs. There may be a dispersion of construction demand in areas outside Jakarta and throughout the other islands in the wake of investment in oil, mining, forestry and tourism and their linkages with other industries and supporting services. However, it can be anticipated that the concentration of the demand for construction may still be disproportionately high in Jakarta and environs, especially in manufacturing and processing industries, real estates such as hotels, offices, housing and community facilities, and infrastructural projects such as roads, airport, harbour, power, etc. The magnitude of concentration is in the order of 60% of the total construction volume in Java and 40% of the total in Jakarta.

The Government has taken the necessary steps to promote regional development and industrialization to correct the imbalance in the progress of different regions not only for reasons of equity but also for the expansion of the base which can subsequently support the expansion of industrial activities. The approach to regional development will be integrated and the various aspects of development shall be treated not only individually but collectively, particularly in connection with the transmigration programme to move people from overpopulated Java to the underpopulated islands of Indonesia.

By and large, the construction industry in Indonesia can be divided into a modern segment and traditional segment with a transitional segment in between. The modern segment forms a small number of large contracting firms which are formally established and organized institutions, having all the characteristics which go with similar modern organizations in more developed countries: full-time employment of professionals, differentiation and specialization of activities and the adoption of new management methods and technology. They undertake a major share of the work in the urban centres and the large infrastructural projects.

The transitional segment of the construction industry is represented by small and medium-sized contracting firms which are basically urban-based and can be found practically anywhere in urban centres of sufficient size in the region to generate a construction demand with average performance requirements. These medium and small firms are more simpler in their management. It is also not unusual that such enterprises combine construction with building materials

retailing and even import-export business. It is not uncommon that they obtain sub-contracting packages from large contracting firms, whereby the main contractor acquires the function of a construction management unit in charge of finance, material supply, equipment leasing and operating, and general coordination of works.

A multitude of very small enterprises of an artisan character which operate in the rural and peri-urban areas belonging almost entirely to the non-monetary category of the economy constitute the traditional segment of the construction industry. They consist mostly of jobbing builders and labour-gangs which form the bulk of manpower in construction. They are not formally organized and have no legal status. Jobbing builders differ from labour-gangs in that jobbing builders can undertake work packages consisting of works for various trades. In effect they are mini-size general contractors, who are even able to build quite sizeable buildings of simple design. Labour-gangs on the other hand are specialised into certain building trades. Specialization are known to cover earth moving, masonry, wood-working, glazing, roofing, plastering, etc.

The sub-contractor as specialist is, as yet, not quite developed in the Indonesian construction industry. The requirement for registration and licensing of firms specializing in electrical installations is the only formal mechanism which has generated specialization. However, the volume of construction and the increase in demand for higher quality and performance in building permit, has noticeable impact on specialization. Specialized sub-contracting firms in mechanical systems, concrete works, roofing, etc. have made their entry in Indonesia through building material supply and manufacturing, where sub-contracting basically is an extension service to capture larger markets. Large contracting firms also show tendencies to develop specialized units within their organization. Sub-contracting firms in this category show exclusive linkages only with the modern segment of the construction industry where labour qualifications are very high.

In Indonesia three levels of construction technology can be identified, i.e. traditional technology, modern technology and conventional technology. The latter is an intermediate stage of technology between the traditional and the modern one.

Traditional construction technologies are used to a great extent

in housing construction, particularly in the rural and peri-urban areas. These technologies are almost entirely of a non-monetary character utilizing indigenous skills, local materials, and simple tools. Spontaneous and sometimes organized self-help or mutual aid is typical of this kind of technology. The traditional sector can also include the low-cost housing of rural and squatter-settlement families who generally build their own dwelling units as resources become available to them.

At the modern construction level, reasonably equipped building contractors are engaged in large scale construction operations requiring the use of expensive and more sophisticated machinery and tools, and professional, managerial and supervisory skills. An increasing mechanization of auxiliary operations is accordingly to be noted. New and heavy machinery have made their entry largely through such projects as industrial plants, public buildings, multistorey hotels and offices, and certain infrastructure projects such as highways and airports. It applies to new materials, advanced reinforced concrete technology, pre-stressed concrete, steel - and aluminium-framestructures, etc. A considerable proportion of the materials and equipment used is imported. The construction firms involved in modern technology are relatively large and well organized.

The intermediate stage of construction technology, also known as conventional technology, is usually confined to the urban areas, where small and medium size contracting firms construct family houses, community facilities and small infrasturcture projects of moderate design by using more or less permanent building materials, a mixture of simple tools along with some machinery and skills.

Recently, in order to cope with the prevailing housing shortage - some 440.000 housing units every year to meet annual population growth - a particular development in the field house building has taken place, known as the gradual industrialization of housing construction. Construction of houses by traditional methods is, by its very nature, labour intensive. The composition of parts in building a house requires a lot of manpower. It employs trades such as carpentry, masonry, tinsmith, electrical, plumbing and painting. Although each trade requires some degree of skill, each trade, in turn, employs manual workers and labour. However, to meet the demand for such a great number of houses in a short period of time it is felt that inspite of the abundance of cheap labour,

traditional methods of construction have not proved to be effective in overcoming the housing shortage. Under such circumstances, industrialization of houses can be an answer, especially when economy, speed and quality is needed.

The transition from traditional to industrial construction methods is, however, a long and complex process. Industrialization means building homes in factories to be transported by trailer - trucks in sections or completed modules and assembled using cranes and other heavy equipments. The plants that build these modules would, in turn, be capital-intensive, requiring heavy importation of machinery and using a minimum of manpower. In Indonesia, industrialization will call for the introduction of new construction systems based on modern techniques; mechanization of the production process; rational planning and designing; the use of standardization and modular co-ordination; and training facilities for labour and technical personnel.

Although admittedly, the traditional method would employ more men and help alleviate the employment problem, it is, however, retrogressive. On the other hand, full industrialization is detrimental and not applicable to the economy, and therefore should not be pursued. In view of the magnitude of the housing need and the importance of the construction industry as a provider of employment, a workable solution is found by introducing gradual industrialization of housing construction.

In developed countries, the ratio of costs between labour and materials is more or less 70 per cent labour, 30 per cent materials. In Indonesia, it is the exact opposite. It is therefore imperative that efforts should be made in saving on material costs by the proper use of indigenous materials and the application of technological advances in the proper use of locally produced materials. The following steps are considered for implementation in gradual industrialization :

(1) rationalization;
(2) improved production of building materials and building elements;
(3) production of non-traditional, non-conventional and new building materials, elements and components;
(4) introduction and utilization of effective hand tools, light machines and site equipment.

Rationalization represents an important step to achieve increased

productivity, higher speed of operations, improved quality and better economy. It is characterised by improved organization, planning and control, and by effective used of materials, tools, machines and equipment. The application of rationalization measures does not require considerable investments and substantial changes in the existing construction techniques.

Improved production and the production of non-traditional, non-conventional and new materials with better or specific physical, mechanical and other properties is indispensable for the development of industrialised construction methods.

The extent to which it is worthwhile to carry mechanization naturally depends on the ratio of capital costs to labour costs - relatively low labour costs make a high degree of mechanization uneconomic, while relatively high labour costs make mechanization economic. In this connection, the special position of Indonesia as regards mechanization of the construction industry deserves serious attention. It should be noted that in Indonesia labour is abundant, however there is an acute shortage of construction labour, especially skilled labour, causing a.o. a low productivity of housing construction and a high cost of construction. In 1961 the amount of construction labour was about 1,81% of the total labour force, and in 1971 it decreased to 1,7%. Therefore, mechanization is an important step to increase the productivity of housing construction, thereby absorbing a large proportion of unemployed labour.

The above steps are the key concepts involved in the gradual industrialization of housing construction. It leads to partial prefabrication as an important phase from traditional to industrialized housing construction. By partial prefabrication is understood, that the construction of a house is still carried out according to traditional methods but is using some prefabricated elements and components such as blocks, beams, columns, lintels, trusses, purlins, rafters, doors, windows, floor-beams, floor and wall panels, etc.

During this first phase of industrialization the following policies and measures will be established by the Government :

(1) Inclusion of housing construction and related activities in national economic development plans;

(2) Well established national policies on housing; land-use; housing finance; town planning; new settlement and resettlement;

(3) Development and expansion of the building materials industries;
(4) Development and strengthening of the existing construction industry;
(5) Establishment or improvement of the administrative set-up for housing construction at the national, regional and local levels;
(6) Revision and enforcement of existing building regulations;
(7) Gradual improvement and upgrading of existing standards for housing and building materials and the promotion of modular co-ordination;
(8) Extensification and intensification of research and development activities in the field of housing and building materials;
(9) Extension and improvement of existing educational and training facilities in the field of building construction and building materials manufacture.

It is expected that the activities following up these established policies and measures are to promote the creation of the prerequisites for further progress in the industrialization of housing construction.

3. THE BUILDING MATERIALS INDUSTRY

The building materials industry is closely related to the development of the construction industry, which consumes practically almost all the building materials and components produces or imported. The size and technology of the construction industry, the type, location and standard of construction and the extent of the assurance construction gives over time as a market for building materials and components will largely determine the range of possibilities for the domestic production of building materials and components. A programme predominantly consisting of civil engineering works is likely to require essentially cement, reinforcing steel, aggregate and piping, while a programme consisting predominantly of dwellings and other buildings will require a greater range of structural products, fittings, equipment and finishes.

The importance of the building materials industry in the ESCAP Region was stated in the Seminar on the Development of Building Materials held in Bangkok in 1968. It noted among others that the importance of the building materials industry in the economy flowed not only from its share in the national product, but also from the

fact that it was an important link in the chain process culminating in an increase in GDP. Nearly one-half to two-thirds of the investment in developing countries went into buildings and construction works and about 60 to 70 per cent of this investment was accounted for by building materials and components. Thus, depending on the stage of development, about 4 to 12 per cent of the GDP was devoted to the production of building materials and components, which indicated the crucial role of building materials industries in the growth process industry had important multiplier effects, both on income and employment. The industry therefore had a dynamic role to play in developing economies.

Thus, it should be recognized that the success of any building programme depends on the availability of building materials and components of the right type in the required quantities and at the proper time. In Indonesia too, large-scale construction programmes that go with industrialization make heavy demands on construction materials, while the building materials industry which is in the process of development, is not able yet to meet the demands on it satisfactorily. Imported building materials still represent a significant procentage of total imports. It is estimated that 50-70%

Table 5.

Import of Cement and Iron and Steel Pipes and Bars,

1971 - 1975.

(Gross Weight : x 1.000.000 kg. and

C.I.F. Value : x US $ 1.000.000).

	1971	1972	1973	1974	1975*
Cement :					
Gross Weight	898,6	1.200,4	1.496,8	1.737,8	1.609,2
C.I.F. Value	17,0	22,0	32,8	68,3	69,4
Iron and Steel Pipes:					
Gross Weight	74,4	128,3	176,3	163,1	104,9
C.I.F. Value	22,4	40,4	67,5	81,9	223,5
Iron and Steel Bars :					
Gross Weight	89,0	133,0	409,3	422,5	351,2
C.I.F. Value	16,2	19,2	76,7	127,9	101,1

*) Since 1975 in Net Weight.

Source : Statistical Pocketbook Indonesia, 1976.

of the total construction cost of buildings is for building materials and expenditure on building materials is 3-5% of the GDP. Therefore it is clear that building materials imports, compared with imports for other industries, can consume a disproportionate share of foreign exchange. Import figures of cement and iron and steel pipes and bars are given in Table 3.

For instance, import of Cement and Iron and Steel Pipes and Bars, 1971 - 1975 in Table 3.

A comprehensive policy for co-ordinated efforts in the development of the building materials and components industries based on long-term plans for the development of the construction industry, is therefore necessary. The present policy reflects a direct involvement of the Government in the development of the building materials and components industries. Accordingly, different measures are introduced, such as :

(1) Long-term loans at low interest to establish or expand the production of key building materials;
(2) Increased import duties on building materials and components which can be substituted by nationally produced commodities;
( ) Provision of subsidies and assistance for the establishment of workshops for the production of building elements and components and for the purchase of machinery and equipment; and
(4) The promotion of research and development of "new" i.e. non-traditional and non-conventional building materials and construction techniques.

Before 1966 it can be concluded that a building materials industry in the proper sense did not exist. Since then it is developing along the lines as stipulated in the Government's Five Year Development Plans. At present the following situation exists.

The building materials industry in Indonesia at present can be broadly classified in two categories :

(1) The large-scale industry, which caters for the demand of high quality, high performance and expensive products. It is in general an organized and capital-intensive industry, using modern technology and modern management for its production processes. Many factories in this category have made their entry recently, both as joint ventures as well as straight foreign and domestic enterprises under the Foreign and Domestic

Investment Laws. They cover a spectrum of products which is already impressive in a relatively short time, such as ceramic tiles and sanitary ware, hardware, aluminum extrusions and mouldings, gall sheets, weather resistant paints, electric wares and cables, wood products such as plywood, woodwool boards, particle boards and furniture, cement and cement products such as asbestos cement sheets (flat and corrugated), ready mixed concrete, concrete iron mesh and iron bars, steel structures and components, linoleum sheet and tiles, high quality structural clay products, etc. These products are of controlled quality and conform to set standards. Most of the factories are located in and around the big cities.

(2) The small-scale industry, which produces traditional and conventional building materials such as bricks, roofing tiles, clay pipes, lime, cement products such as floor tiles, pipes, blocks and ceiling sheets, bamboo mats, timber components, extracture products such as stone, gravel and sand, pozolana-lime blocks, etc. The small-scale industry is mostly an unorganized and labour-intensive cottage industry, run on traditional lines in small units. They may work occasionally or seasonally but generally they have a volume of production adequate for current local consumption only and would not be able to meet increased demand created by an accelerated programme of construction activity. Its products are generally irregular and uneven in shape and quality and do not comply with the accepted standards and norms. Prices of their products are way below those produced by modern plants. There is no competition here between products of modern plants and these small industries, since they serve different quality and product performance needs. In this context the Government is playing an important role to keep a balanced development of the large - scale and small - scale building materials industries. Small-scale building materials industries can be found widely all over the country, in rural villages as well as in and around urban cities and towns.

Most of the building materials used in Indonesia fall into the second category. They account for a major share both in the material quantity and in the financial outlay in the house building activity

in Indonesia, particularly in the rural areas. Of the total housing stock of about 19,700.000 dwellings in 1961, only 6% can be considered of permanent construction - using durable building materials - 60% of semi-permanent construction - using a mixture of durable and non-durable building materials, and 34% of temporary construction using non-durable building materials. In 1971 the housing stock was estimated at about 22,500.000 dwellings with no considerable improvement in the qualitative condition of the materials used.

The slow development of the small-scale industry in coping with increasin demand for more and better quality materials is due to the following factors :

(1) The lack of capital needed for investment to improve and increase production;
(2) The use of traditional technology in the production process;
(3) The low level and unsteady demand for building materials resulting from the vey limited purchasing power of the population and the fluctuation of construction programmes;
(4) The lack of managerial skills required for efficient operation of small-scale industries;
(5) Marketing procedures that are detrimental to both consumer and producer and only yield good profit to dealers and middlemen;
(6) The disorganized system of transportation and marketing of building materials ; and
(7) The scarcity of or the difficulty to obtain fuel and electricity.

With the increase in the tempo of industrialization, the demand for traditional as well as modern building materials has been increasing and more exacting demands as regards quality and performance of materials are being made on the industry. This has necessitated the expansion and modernization of traditional building materials industries. Improvements in the production of bricks have to be effected to manufacture better quality of bricks; scientific methods of lime burning must be adopted to produce a reliable quality of lime; better methods of extracting timber from forests need to be developed to avoid wastage in tree felling and cutting, etc.

In such a situation there is even greater need for rationalization in the building materials industry. But, where there is a shortage of capital goods, managerial skills and competition as well as priorities in Government policies, rapid improvements cannot be

expected. If, however, a reduction in the costs of manufacturing building materials could be effected, and if, by the production of improved building materials and the introduction of improved construction techniques, substantial savings could be achieved, then more capital would be available for the construction of more houses of a more durable nature. Greater durability would result in lower costs for maintenance and repairs. Hence the quality of the building materials used is of great importance. For improving the quality, for effecting economy in the cost of production and in making available building materials suitable for specific purposes, research in building materials is the only way.

4. R AND D ACTIVITIES IN BUILDING AND BUILDING MATERIALS

In the following paragraphs brief information will be given on some of the building materials used in large quantities and which are the mainstay of building construction in Indonesia. It will consider also the extent of R and D activities on the building and the building materials industry in Indonesia.

Cement and Cement Products

The importance of cement to the economic and industrial growth of Indonesia cannot be over emphasized. As it is one of the basic industries to support development, the Government has given high priority to the development of the cement industry in Indonesia. It is now one of the major building materials industries in Indonesia. The map on Fig.1 shows the location of existing and future cement factories and their estimated capacities up to the end of Pelita III, the Third Five Year Development Plan (1983/84). According to the Ministry of Industry, in 1979 the national production of the cement industry will be able to supply the demand of the Indonesian market.

Demand for Indonesian cement according information had already been received from Nigeria, Lybia, Egypt, Papua New Guinea and Australia. Each of these countries has asked for 200.000 tons. The export allocation for 1979 is 500.000 tons. This year 50.000 tons portland cement will be exported to Thailand.

The cement consumption in Indonesia is however still low, only 25 kg per capita, although Jakarta consumes 125 kg per capita per year.

The largest consumption of cement is in concrete and during recent years the use of concrete in construction has been steadily increasing in Indonesia, and the demand for high quality concrete is steadily rising. The difficulties experienced in attempting to have the 1971 concrete specifications accepted and enforced reveal clearly that the quality requirements are often higher than the average contractor can meet. This is partly due to insufficient knowledge at all levels on concrete technology, ranging from civil engineers to the contractor, and mixer operators to the foreman. This is also caused by sustantial variations in the quality of cement and aggregates as well as by incomplete field inspection facilities.

The primary physical causes of poor concrete are : variations in the consistency of concrete, variations in the grading of aggregate, variations in the mix proportions and in the quality of cement, combined with the poor organization of the crew engaged in concreting operations, such as charging the mixer-hopper and placing and congealing the concrete. The appropriate solution is to correct these variations by proper instruction and some improvements in the equipment used. It has to be realised that the costs of proper instruction and improvements in equipment will be substantially covered by the 20 - 25 per cent in cement saving, which can be achieved by using proper concrete technology. In addition to this, more uniform and therefore more durable concrete will be produced. The emphasis of the solution is on the education and training aspects.

To economize further in the use of cement, ready-mixed concrete is introduced on big construction projects and for the construction of tall buildings in the big cities.

Ways and means have also been explored to economize in the consumption of cement by developing different techniques of concrete construction. Such techniques that have been developed are precast and prestressed concrete construction, which have brought great economies and improvements in the construction of bridges, pile - foundations and prefab building elements.

At present only ordinary Portland Cement (ASTM Type 1) is produced in Indonesia, but researches and market studies is going on to develop and produce other types of cement for specific purposes,

such as :

- portland pozzolana cement and sulphate resisting cement for marine structures;
- lime-pozzolana cement for low-cost housing;
- white cement for architectural concrete; and
- low heat cement for mass concrete.

Asbestos cement sheets - flat and corrigated - are mostly used in factory building as they withstand industrial fumes, gasses and corrosion. Recently, corrugated asbestos cement sheets are being used also for mass housing construction as it is a comparatively cheaper roof covering than other types of roofing, while the local production of clay roofing tiles is not sufficient to meet the demand of a large mass housing construction project. The growth of the industry is, however, hampered by the non-availability of the asbestos fibre, which have to be imported. To replace the asbestos fibre, research is being carried out to use organic fibres in the manufacture of fibre cement products, a.o. for making pulp cement boards. There are already many small plants in Indonesia producing fibre cement sheets, making use of waste textile fibres from the many existing textile factories. Research on the development of cement bonded particle board with various kinds of agricultural waste material is also being carried out by the Directorate of Building Research.

Building products made of cement like concrete blocks and panels; roof and floor tiles; concrete pipes and gutters, latrine slabs; plants. A small pilot plant for manufacturing prefabricated concrete building elements and components is now in operation for use in up to 4-storey housing construction. It shows a 15-20% reduction in the building cost as compared to the conventional method of construction. A still greater variety of cement products, more suitable to requirements, could perhaps be developed through more research.

L i m e

Lime is a traditional building material in Indonesia which has been used very successful in the past, but today its quality is found deteriorating over the years. Yet, lime is still being used in large quantities, as portland cement is in high demand for heavy structural work and sometimes not available and expensive as well.

The lime is produced in numerous types of kilns that range from the very primitive scove kilns to the semi-modern vertical shaft kiln, using limestone or coralstone as raw material and mostly wood as fuel.

The majority of the lime industry is located in Java, although other regions of Indonesia have good potential of lime deposits. In Java there are approx. 3,200 lime burning kilns with a total production of about 3.3 million cub.m. slaked lime per year and a number of labour employed is about 12,200 men.

If the quality can be improved, an increased demand for lime be expected as lime can still be utilized profitably as a binding material instead of portland cement. In spite of the competition of portland cement, the utilization of lime as a structural material has continued to play an important role in Indonesia. Lime is used as an ingredient in mortar for laying masonry units. The use encompass all types of exterior and interior walls. Its greatest value in mortar is the high degree of plasticity that it imparts. Close related to the use of lime in masonry, is its usage as a component for interior and exterior plaster. In Indonesia, the plaster is directly applied to the masonry wall, providing the wall possesses adequate porosity or contains enough irregularities to develop a strong keying action. Lime is also widely used for whitewashing plastered walls.

Apart from its uses in mortars, plasters and whitewashing, lime can also be used in the manufacture of lime-based building materials such as pozzolana-lime blocks, for soil stabilization in road construction, to neutralize acidic soil and for the chemical industry. Especially in areas where portland cement is still expensive and where lime and pozzolana are available, the use of pozzolana-lime blocks and pozzolana-lime cement is now being introduced for housing construction. Lime aan also be used as a binding agent in other lime-based building materials such as aerated concrete, sand-lime bricks and laterite-lime blocks. However, the availability of good quality lime with constant, predictable characteristics in a precondition for the development of these non-conventional materials.

Thus, while on technical grounds the modernization of the lime industry is desirable, it is necessary to examine the social problems which the change might bring about before taking such a

decision. As whole-scale modernization of the industry will take time, immediate results can be obtained by improving existing practices in burning and slaking processes. What is needed is technical assistance in the form of more efficient kiln design, better constructional techniques and advice on kiln operation using locally available materials and fuel. Such improved methods of lime burning and slaking can produce better quality lime at competitive prices.

Researches have led to the development of a newly designed and appropriate but highly efficient 10-tons lime kiln and an improved simple 6-tons kiln. Two 10-tons and two 6-tons demonstration kilns are now in operation in different locations of the country to promote the necessary transformation of the existing lime industry so as to bring it into accordance with modern requirements.

Structural Clay Products

Clay bricks and roofing tiles have been used extensively for years in Indonesia. In Java, for instance, even the simplest shelter is traditionally roofed with clay tiles. There is, however, much scope for improved methods in the production of these products, the bulk of which is manufactured in small and inefficient kilns, operated by families of on a village co-operative basis. They are scattered all over the country and they may be classified as "cottage" industries. Many of them are clustered in districts where the raw materials are found.

The manufacture of these clay products is a very old tradition and the same old artisan methods are persistent, even now after modern industrial methods have been introduced. The produced bricks and tiles range from poor to acceptable quality, but most of them cannot be classed of good quality in shape, porosity, size or hardness. The extensive use of wood as fuel, and the inconsiderate use of clays from rice-fields causes serious interference in the forests and in the rice-fields. Due to the rapid growth in the housing sector, the qualitative and quantative requirements of bricks and roofing tiles have been increasing and they can not be met by the existing industry.

Thus, there is great scope for bringing about improvement in the quality of clay products and economy in production. Method of selection of the clay material based on scientific investigations, bringing about improvement in the quality of soil, better method

of moulding, economical and scientific method of burning are some of the subjects in which researches have been carried out in the country. The utilisation of the results of researches in greater measures would go a long way in contributing very substantially in improving the efficiency of production and quality of the products.

As a structural unit, the solid brick offers scope for improvement in many forms - shape, size, type, etc. Perforated and hollow bricks have great potentialities of use in Indonesia, and researches are being directed to establish their use, application, advantages and production in the country.

There is also a case for introducing mechanization to certain extent in the manufacture of bricks for which it is necessary that machines for pugging the clay, moulding the bricks and extrusion equipment for producing perforated bricks should be evolved and indigenously manufactured.

In recent years, larger factories with modern equipment have been erected and their products are of good quality. To obtain a balanced development in the structural clay sectors between large-scale capital-intensive productions and small-scale labour-intensive productions, a through analysis of the functional requirements of structural clay products is needed and has been initiated. Based on this, an appropriate development plan will be established to provide the basis for a sound and balanced development.

Timber and Timber Products

Indonesia is gifted with sufficient forest resources providing it with an average forest density of one hectare per capita. Timber is therefore the most important organic building material in the country, but even though people are still not in a position to make full use of it. According to reports of the Ministry of Agriculture there is in 1974 a total of 122.227.000 hectare of forest available. Of the total forest are only 39.355.000 hectare is designated for production and only approximately 70% or 28.000.000 hectare is available for consumption. The annual consumption of wood per capita is estimated at 0.06 cub. meters roundwood for construction and 0.8 cub.meters for firewood. Approximately 4,000 timber species are known in Indonesia, but only 120 species are suitable for building and construction or for other industrial purposes. Timber is also

important for the economical development of Indonesia, as it is after oil one of the main export commodities.

For soil conservation purposes and to avoid flooding in the low lands, it is utmost important to preserve the existing forest resources of the islands. In order to increase the yield of the forests and improve their protection, the Government has included a forestry development programme as an integral part of the economic development of the islands. Forest reservation, forest inventory, forest improvement, reforestration and research work, have been given strong support and encouragement.

Since the first class timber species are export commodities, it is important to promote the use of secondary and less durable timber species for building and particularly for housing construction. Measures should therefore be taken to extend the functional life time of the semi-durable and non-durable timber species through proper seasoning and chemical treatment or preservation. However, timber processing is not yet an integral part of the forest products industries in Indonesia. Generally, seasoning and preservation of organic building materials is something new. Seasoning and preservation of timber adds to the cost of wood, which is already high. Careful explanation, information and dissemination of its serious need if using less durable species of wood, must be given to the people, that this extra investment of money is not lost, but really will repay with much profit in the long run. People will have to be confinced that investment of some ten or twenty per cent of the price in timber for seasoning and preservation, may increase its life by 2 to 3 times or even longer and that the annual cost will thus be greatly reduced. In addition, seen from the national point of view, the increased life will ultimate save vast amounts of timber.

Due to the measures taken in this field, lumber drying kilns and preservation plants are now in operation in and around the big cities. But due to the high cost of investment and the chemicals - most of them have to be imported - airdrying and dipping or painting of the timber are still general practices in Indonesia. The main difficulty is not so much the education of people in the use of such scientific practices, as much as one of providing them with elementary facilities for carrying out processing of their timber. The problem is that the timber industry is handled by hundreds of small timber workshops scattered throughout the country. These small work-

shops do not have the means to set up their own processing units and considering the large distances in this country no one, however educated, will spend money for having his timber carried all the way to a processing unit hundreds of kilometer away in Order to have it treated and seasoned - it would be very expensive to do so. The solution lies partly in the development of small scale processing units located at feasible points, set up and managed co-operatively and partly in the development of mobile timber treatment plants and portable seasoning kilns. Researches to design and develop such plants are now in progress.

The use of plywood, fibre boards and particle boards as building elements in housing, in joinery and furniture making, and in the construction of formwork has increased considerably in Indonesia. The manufacture of these boards makes among others possible :

- fuller use of forest crop and
- economic exploitation of forest resources by utilizing forest and agricultural residues, industrial wastes and timber of inferior species, which cannot otherwise be used profitably.

As the construction industry in Indonesia will follow modern trends and multistorey buildings will replace the present single storey buildings, especially in the urban areas, the demand for these boards will certainly increase further. This, coupled with the prohibition of the export of certain hardwood timber and first-class timber as logs, strongly favours a rapid development of the board industry in Indonesia. About 14 plywood factories, one particle board plant and one fibre board plant are now in operation in Indonesia. Statistics about their production capacity and output is however not available. Researches are going on to develop cement bonded particle board and pulp cement boards.

Bamboo and Allied Building Materials

Almost seventy per cent of all houses in Indonesia use bamboo to a more or less extent, because it is easy to obtain and comparatively cheap, demanding less skill and workmanship. Bamboo houses are comfortable to live in as they provide adequate protection from heat in hot climates. As the material is light weight, bamboo houses suffer little loss due to earthquake.

However, bamboo being a forest product starts decaying and rotting after some time due to rain, dampness and humidity and also it can be easily attacked by termites, borers and other insects. Besides, after a certain time, the strength of bamboo decreases, causing the short life of bamboo houses. On drying, bamboo also shrinks, consequently its volume changes, which may have an ill-effect on bamboo constructions and the use of bamboo for reinforced concrete, as suggested by researchers. In addition dry bamboo catches fire very quickly and may burn to ashes in no time. Bamboo houses, therefore, need fire protection treatment.

Some of the shortcomings of bamboo mentioned above can be minimized to some extent by proper treatment before use in construction. It should be first sufficiently old and dry enough before use. Common practice for drying is air-seasoning. The service life of bamboo when treated can also be increased and the use of treated bamboo in construction may last for quite some time. Chemical treatment of bamboo is not practised yet in Indonesia due the high cost of the chemicals. The common practice to preserve the bamboo is by :

- soaking in running water, mud or in seawater;
- coating with a whitewash or with tar;
- plastering with mortar, with or without fibres in the mortar.

Various products allied to bamboo like reeds, grass, tahch and palmyra leaves, are extensively employed in rural housing. Researches in evolving preservative treatment to extend the service life of these materials at cheap cost are also being carried out.

When using bamboo and the various allied products as building materials, adjustment of construction methods and maintenance should have first priority to preserve such building materials.

Pozzolanic Meterials

The incorporation of pozzolanic materials with lime has been practised in this country before the introduction of portland cement, among other the world famous temple "Borobudur" is using pozzolanic material in its construction. Pozzolanic-lime mixtures are therefore considered as traditional materials and its uses in mortars, plasters and concrete are defined and dictated in building regulations.

However, the use of pozzolanic-lime mixtures have been declining due to competition with portland cement and partly due to the deterioration in the quality of both lime and pozzolanic material. In

recent years the problems of pozzolanic-lime have been taken up again and given due attention for its proper use in low-cost housing in order to find a cheap substitute for the portland cement which is becoming too expensive. Both lime and natural pozzolanic material is in abundance, particularly in Java where both material are found at locations close together, which is the more advatageous for its development.

Pozzolanas are defined as materials which, though not cementitious in themselves, contain constituents which will combine with lime at ordinary temperatures in the presence of water to form stable insoluble compounds possesing comenting properties. In Indonesia two types of this material meet the definition, the so-called "tras" which is a natural product of volcanic origin and the so-called "red cement", which is artificially obtained by crushing soft-burned red bricks.

Pozzolana mixed with lime gives a hydraulic cement. The disadvantage of the mixture is the slow setting time and binding and the high shrinkage and wet dry movement. Methods of reducing these disadvantages have been investigated. The setting time can be shortened to a value comparable to that of cement by adding sodium hydroxide. So much sodium hydroxide is necessary, however, that the mortar will become expensive. When fast setting is required, it is better to add some cement to the mortar. It has been proved that this method is not only cheaper, but also gives a stronger mortar after binding.

Shrinkage of the tras mortar can be reduced by the addition of some gypsum, which also achieves a certain increase in strength. Gypsum, however, is like other additives too expensive to be more commonly used. Another way to reduce shrinkage is by adding some concrete sand. The amount of sand that should be added will depend on the distribution curve for the tras. Other chemical additives have also been investigated, but in no case have the results encouraged their use. One must keep in mind, that tras from various deposits can have quite different properties, and therefore no general conclusion should be drawn from these results.

In addition to its uses in mortars and plasters, pozzolana-lime mixtures are also extensively used for making relatively good quality tras-lime blocks, solid or hollow blocks, machine or handmade. Tens of labour intensive block making home industries are now in operation

in and around Bandung providing bricksize or blocksize building elements for low-cost housing projects. This method of blockmaking with tras-lime is now being practised all over Indonesia where tras deposits are available. It is also possible to make floor tiles of tras-lime mixtures on the same process for blockmaking. A cement layer is however necessary for the top of the tiles.

Another possibility is still being investigated to make high-quality pozzolana-lime cement by intergrinding the tras with partly slaked lime to a fineness comparable to that of portland cement. By adding some additives the strength and setting properties of the mixture can be adjusted. A pilot plant for making this kind of binding material is still under investigation. If successful such a plant will be of great importance to meet local demand for binding materials, and thus would save the use of portland cement.

Red cement or redbrick powder is an artificial pozzolana made by crushing soft burnt clay bricks. As long as this material is made from bricks that have been spoiled during transportation or handling.

Lightweight Aggregates

Due to the rapid development of the construction industry in Indonesia, particularly in the housing sector, the demand for non-traditional and non-conventional and also more industrialized building materials and components is increasing. Consequently, research and development activities for producing lightweight concrete elements for high-rise building and for prefabricated elements for mass-housing has become one of the main activities of the Directorate of Building Research. The use of lightweight concrete in multi-storeyed buildings is receiving special attention because its low unit weight considerably reduces dead loads in buildings, resulting in savings in cost of foundations and structural members. Savings in reinforcement steel alone justify the choice of lightweight concrete for highrise buildings.

One of the achievements in the development activities in the construction of a pilot plant for producing lightweight concrete panels, beams, and window- and door-frames with pumice as an

will also be tried out at that pilot plant, a.o. expanded clay produced on a small scale laboratory rotary kiln. Thin reinforces wall panels and hollow blocks have been produced utilizing the expanded clay.

Besides on building materials, researches, investigations and studies have been carried out or are in progress on problems relating to various fields of the building industry such as building environment, building economics and management, low-cost housing development and planning, etc.

Other fields covered in the research activities include standardization, legislation, environmental sanitation and social aspects. The eventual adoption of international building standards would require through research on the applicability of those imported standards to local building materials that are used in the country, taking into account national customs and traditions. Building regulations and by-laws are also a field of concern as the existing codes which date from colonial times are not appropriate to present conditions.

5. TRANSFER OF RESEARCH RESULTS

The institutional framework of research organizations depends on the economic structure in the country. There are basic similarities, however, in the way research institutes are organized and function. They may function :

a. As an integral part of a government department or as a semi-autonomous institution linked to a government agency;
b. Within a university or as a semi-autonomous body linked to a university;
c. As an incorporated, private, non-profit organization; and
d. As a technical arm of an industrial establishment or an industrial association.

In Indonesia R and D activities on building materials and its application in the construction industry are being carried out at all the levels of research organizations mentioned above, but in particular in the specialized research institutes belonging to the Ministry of Industry and the Ministry of Public Works. These ministries are respectively responsible for the proper development of the building materials industry and the construction industry. R and D activities having some relation to these industries are also being carried out by institutes under the Ministry of Mining and Energy and the Ministry of Agricultute to cater for the raw materials required in the development of the building materials and the

construction industries.

The practical application of the results of all these researches is the ultimate goal of building and building materials research. Thorough documentation and systematic dissemination of useful research information are integrated parts of research activities. However, most of the information is often disseminated in such a way that it does not reach those who need it, nor does it reach those for whom it is intended. Moreover, the research information is often received in a form which makes its use difficult. One of the prime difficulties is that institutions established for the purpose of research and documentation do not communicate well with users; a practical system for dissemination is lacking.

If thus full advantage is to be taken of all the researches that are going on, it is very essential to have an organization to co-ordinate building and building materials research, integrate and interprete the results of researches and to make them available in a form which may enable their effective and speedier application by the industries concerned. In Indonesia this problem has been overcome by establishing a Co-ordinating Body which is responsible for maintaining operational effectiveness in the development of the industries, particularly the small scale sector of the industries.

The Government is well aware that the small scale industry occupies a significant place in the industrial set up of the industry, especially in view of its large employment potentiality. The development of the small industries may alter to a great extent the increasing labour force and the large volume of unemployment and underemployment. Particularly the small scale building and building materials industries can play an important role in the social and economic development in the rural areas, if they are able to secure the necessary financial and technical assistance. Medium and large scale industries are often able to obtain assistance from their banks, suppliers and consultants. Small scale industries are often unaware of their needs or unable to identify them and sometimes also reluctant to request or even to accept assistance for reasons ranging from ignorance and prejudice to fear that their information might be channelled to the tax authorities. Besides they are generally not able to pay for the services rendered. They are obliged to look to the Government for securing assistance. In such circumstances public

agencies should assume the main responsibility for providing the services and play a particular positive and dynamic role in the stages of the development of this industrial sector.

Realizing the relationship between the development of the construction industry and that of the building materials industry, the Co-ordinating Body is thus composed of officials from various institutes and agencies under the Ministry of Industry and the Ministry of Public Works. It is an advisory board to the two ministries for the development of the small-scale building and building materials industry, particularly the small-scale building materials industry. It has also the task of investigating and studying problems related to these industries in order that they develop in accordance to the social and economic development of the country. The necessary interaction and linkages of R and D activities is thus provided in the structure of the Co-ordinating Body. This interaction is capable of functioning from the central body to the local levels through the network of regional offices and field offices of the two participating ministries and their close contact with local manufacturers and builders.

Regional offices and field offices have been established by both ministries to render extension services to local manufacturers and builders. The Ministry of Public Works has for instance set up Building Information Centres around the country manned by technology transfer professionals in order to provide information on existing local building materials industries and on the proper use of these local building materials in housing and building construction. These Building Information Centres are also arranging regional workshops, exhibitions and training courses for local instructors, supervisors, builders and workers, who are also informed with the results of the researches.

Since 1974 the Ministry of Industry is also increasing its active role in assisting the small scale industry by implementing small scale industrial extension services and development programmes through "BIPIK Project" activities, in which the development of the building materials industry is given top priority in the program. The BIPIK project is a nation-wide project and it is providing training in both the technical as well as the managerial aspects to small scale manufacturers.

Thus, though printed technical information is widely used, this simple approach to transfer the results of research is found less productive. In Indonesia's experience, the most effective transfer system for information is to provide the relevant information along with auxiliary services, information adaptation and modification, or interpretation directly to the potential user in a person-to-person interchange. Under this system one of the functions of the regional office is to arrange training courses on the development, production and application of building materials much in use in that region for building and construction purposes. In these courses the small manufacturers and builders of the region are invited to get free on-the-job training or upgrading courses in order to attain some technical level and skills and become competent and acquainted with new daveloped or improved production processes and construction techniques. In this connection the existence of demonstration plants and demonstration houses have shown its great usefulness in that they directly illustrate a variety of practical means for dealing with problems on the processing and utilization of building materials. This approach to demonstrate the results of researches will establish confidence among the manufacturers and builders. Besides, a forum is established to bring producers and consumers in the region together to discuss and interchange problems of common interest with research workers and inforamtion officers and to find the appropriate solutions and improvements that research can bring about. Field officers are also visiting regularly the manufacturers and builders on the spot to see and discuss their problems in the execution of their work. Field officers should be able to advise and to provide anny assistance that may be required after the appropriate technology has been utilized. If solutions cannot be provided on the spot, the problem can be referred to the regional office or to the research institute concerned to get the answer.

Although the system has achieved a much higher frequency of effective technology transfer than through simple provision of printed literature, the success of assistance depends not just on the role of the Government, but is really decided by the extent of participation of the manufacturers and the builders themselves, and what is more important by the competence and the capability of the information officer or the field worker to transfer the technology needed. Thus,

manpower training at all levels is essential. Demonstration plants, demonstration houses, rural housing improvement projects by aided self-help or mutual aid, and urban low-cost housing projects, have proofed to be useful training grounds for the small manufacturer and small contractors, for the skilled and unskilled workers as well as for field workers to get familiar with conventional and new production processes, design and construction techniques.

6. INTERNATIONAL CO-OPERATION

An important task in all research is to make full use of the possibilities of international cooperation. International cooperation in research to-date has come about through exchanges of experience at meeting and conferences, through dissemination of information and through technical assistance. The collation of information has to embrace both developed and developing countries; developed countries because of their collective experiences, and developing countries, because some of them have similar problems or even identical problems For developing countries transfer of technology and evolution of appropriate technology to suit the local conditions are very important factors and the technological evolution can profitably be undertaken when they have the means at their disposal. This is not always the case. Close international cooperation both amongst the developed and developing countries is therefore of utmost importance for an all round improvement.

Besides international cooperation in the field of documentation and information exchange, the following cooperation activities are recommended to be taken into consideration. Assistance from international organizations should be sought, not only to implement research and development programmes but also to make it possible for a developing country to carry out joint research projects and conduct multinational training courses. It would be highly beneficial for institutions in developed countries. Cooperation should also be established between two or more institutions in developing countries, with or without the assistance of an international organization, and in this context Technical Cooperation among Developing Countries (TCDC) programmes to formulate and conduct collaborative research projects would be more feasible.

Particularly in the development of the building materials industry and in order to secure a continuous supply of ever - improving building materials for the construction industry, the Government of Indonesia has obtained assistance from United Nations through the establishment of a UNDP/UNIDO project. The immediate objective of this project is assisting in R and D activities in the building materials and housing field in which a large number of senior experts, associate experts and consultants in the field of building materials and construction are involved.

Joint research projects are also being carried out in specific building materials and construction techniques based on bilateral agreements between Indonesia and developed countries.

CONCLUSION

Having reviewed and analyzed the general situtation, the evolution of the construction and the building materials industries, and the relevance of R and D activities in these industries for national development, the following general conclusions can be drawn :

a. The choice of technology will primarily be determined by the policy of the country to its industrial development and many factors have to be taken into consideration in the process of decision-making, which should be based on the actual conditions of the industry and related fields with its limitations and potentialities.

b. In view of the conditions on Indonesia, it is acpected, that for a long time to come, expecially in the rural level, traditional technology with a relative high need for unskilled labour has to be used. On the other hand where the need is evident, as in high-rise building and in the basic building materials industries, advanced technology should be introduced, even if it is capital-intensive and labour-saving. The solution would therefore be that Indonesia should develop a balanced plural technology, where traditional, intermediate and advanced technology should have its place in accordance to the needs.

c. Technology development plan should be incorporated in the national development program in order to create technological independence for self-sustaining development.

d. National, regional and local level efforts are required to organize the construction and the building materials industries, and to regulate the investment in construction activities and in the production of building materials. A national policy in this respect is required to guide the private as well as the public sector if the cost of building is to be reduced substantially. Such a policy will have to be implementation-oriented and not merely advisory.

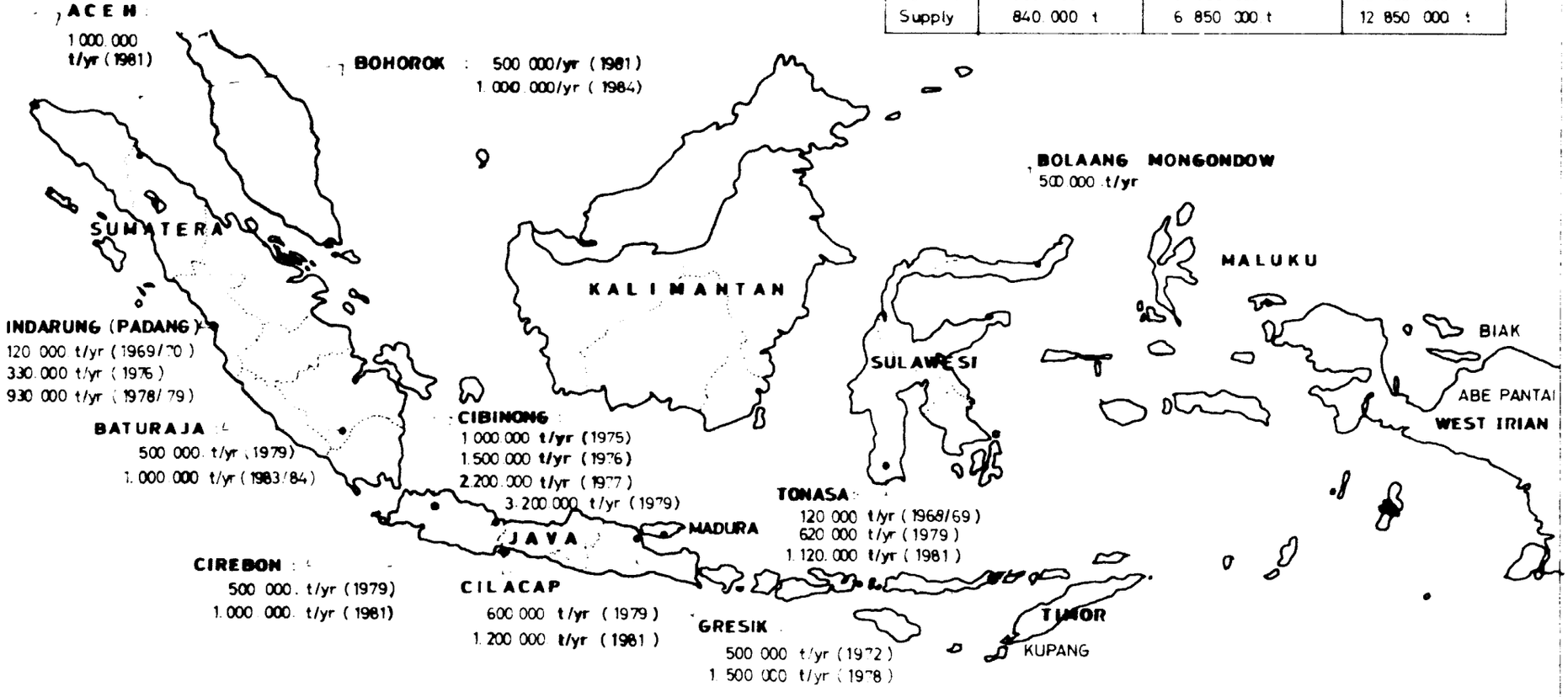
e. The relevance of some construction and building materials technological activities for national development should be considered in identifying appropriate technology.

f. Major issues relevant to local technology development are the technological manpower development, building up of technological infrastructure, technology dissemination and international co-operation.

Figure 1

EXISTING AND FUTURE CEMENT FACTORIES [1] IN INDONESIA

	End of Pelita I [2] (1973/74)	End of Pelita II (1978/79)	End of Pelita III (1983/84)
Demand	1 960 000 t	5 900 000 t	12 700 000 t
Supply	840 000 t	6 850 000 t	12 850 000 t



NOTE : 1). Location of Cement Factories with a minimum capacity of 500.000 ton/year
2) Pelita = Abbreviation for Five Year Development Plan

SOURCE : Directorate General for Chemical Industries, Ministry of Industry

ANNEX I

LIST OF LITERATURE

(1) Economic Commission for Asia and the Far East;
"Survey of housing and Building Materials in Asia and the Far East, 1956".
(E/CN/.II/432 - November 1956) Bangkok, 1956.

(2) Economic Commission for Asia and the Far East;
"Report of the Seminar on the Development of Building Materials"
(E/CN.II/I&NR/BM/L.3 - 24 January 1968) Bangkok, 1968.

(3) "Housing and the Construction Industry".
By Hasan Poerbo; Institute of Technology Bandung,
Bandung, 1973.

(4) "The Development of Building Materials for Housing in Indonesia"
By Z.A. Abbas; Directorate of Building Research,
Bandung, 1974.

(5) UNIDO Project Document INS/74/034
"Assistance to Industrial Development of Building Materials Manufacture".
Bandung, 1976.

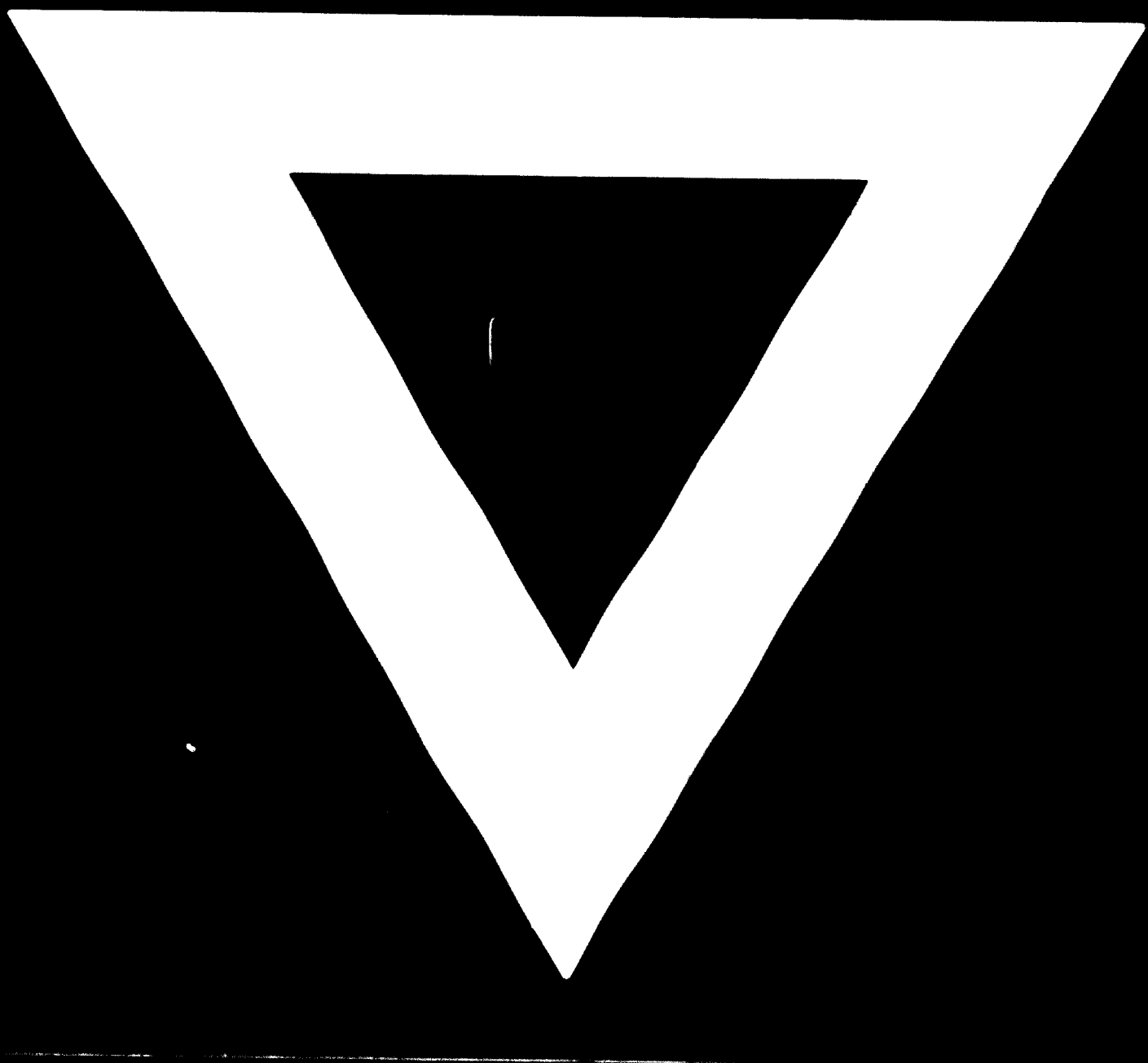
(6) "The Gradual Industrialization of Housing Construction in Indonesia".
By Albert Kartahardja; Directorate of Building Research,
Bandung. 1976.

(7) "Development of the Building Materials Industry in Indonesia"
By Albert Kartahardja; Directorate of Building Research,
Bandung, 1978.

(8) "Role of Building Material, Building Research, the Construction Industry and Manpower Training on the Development and Improvement of Human Settlements"
By Albert Kartahardja; Directorate of Building Research,
Bandung, 1978.

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

C-36



79.12.04