APPRAISAL REPORT NO. 8
CONSTRUCTION AND
THE BUILDING MATERIAL INDUSTRY OF THAILAND

PART II
SURVEY OF BUILDING MATERIALS INDUSTRY
OF THAILAND

PREPARED FOR

ECAFE SEMINAR ON THE DEVELOPMENT OF BUILDING MATERIALS

BANGKOK, JANUARY 1968

BY

MILAN M. PAJEVIC

UNITED NATIONS EXPERT

MATERIALS OF CONSTRUCTION GROUP

TECHNOLOGICAL RESEARCH INSTITUE

ASRCT, BANGKOK 1967

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND

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ANNEXES

F O R E W O R D

This paper, which is the second part of the report "Construction and Building Materials Industry of Thailand", gives the results of the survey of existing building materials industries.

The purpose of this survey was to state the actual position of the building materials industry and provide enough basic economic and technical data for the evaluation of its development. No attempt has been made to discuss various aspects of development, as this will be the subject of Part III, "Possibilities for building materials development in Thailand".

Preparation of this report has been made possible through the cooperation of the Ministry of Industry, Economic Evaluation Group ASRCT, and Materials of Construction Group, TRI. Use was made also of some reports related to building material industries prepared by United Nations Technical Assistance advisers in Thailand.

Particular thanks are due to Dr. Porn Srichamara, General Adviser of the Ministry of Industry and his colleagues; Mr. Krit Samapuddhi, Deputy Director-General of the Department of Forestry; Major General Vichien Sutantanont, Director of Thai Plywood Company; and M.R. Rabibhand Kasemsri, Director of the Siam Fibre-Cement Company for their cooperation and help in compiling necessary data.

CONSTRUCTION AND THE BUILDING MATERIALS INDUSTRY OF THAILAND

PART II. SURVEY OF BUILDING MATERIALS INDUSTRY OF THAILAND.

By Milan M. Pajevic*

1. THE CEMENT INDUSTRY

Cement production is an industrial activity which has expanded very rapidly during the recent years in Thailand thanks to a growing demand based on a high level of private and public building.

The first cement factory in Thailand, owned by Siam Cement Company, was established more than half a century ago, in 1913. Since that time cement production has risen steadily except during the Second World War years. Combined production of all cement plants passed the one million ton mark for the first time in 1963 and it is to be expected that it will reach two million tons in 1968. Three out of four existing factories, with a total production in 1967 estimated at 1,700,000 tons, belong to the Siam Cement Company. The fourth, Jalaprathan Cement Factory is partly owned by the Irrigation Department and was established in 1953 with the main purpose to provide cement for the construction of the Bhumibol Dam.

If all additional projects now under consideration are carried out during the coming years, and available capacities are fully utilized, the production will rise in 1971 up to a total of 3,500,000 tons. The per capita consumption of cement in Thailand which amounted 21.8 in 1955, 24.2 in 1961, 29.3 in 1962 and 54.5 in 1967 will, if all plans are realized, be then increased until 1971 to about 90 kg. per capita. Total capital investment in manufacturing plants is about 50 million dollars. Accurate

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figures are not available but it is estimated that cement industry employs about 2,500 people[1/].

A. Raw materials

With the exception of the Jalaprathan factory, cement is manufactured by the wet process using as raw materials marl, clay and gypsum. The first cement factory in Thailand, built about fifty years ago in Bang Su, was in order to be as close as possible to the market, located 170 km from Chong Kae, in Changwat Lop Buri where the marl was obtained. Situation slightly improved when another marl deposit was discovered six years later in Ban Mo, Saraburi, 100 kilometres from Bang Su. The second factory at Tha Luang was in a much better position being on the inland water route provided by the Chaophraya river, and with a factory site only 10 kilometres from the marl quarry at Ban Mo. Present production of marl in Lop Buri, Saraburi and Nakhon Sawan areas is adequate for the growing production of cement. (See Table 1)

TABLE 1

THAILAND: PRODUCTION OF MARL, 1961-1966

Year	Production (Metric tons)	Value (Millions of baht)
1961	718,467	2.2
1962	936,191	2.0
1963	965,840	2.2
1964	1,058,366	2.4
1965	1,105,153	2.9
1966	1,161,716	3.3

Source: Department of Mineral Resources.

1/ Siam Cement Co. alone employs 2,059

Other raw materials include clay, silt, laterite and gypsum. Sufficient quantity of all mentioned materials are available. Clay is obtained either from company owned clay quarries or from excavations of canal and river beds. Until recently the only supplier of gypsum was the Thai Gypsum Co., Ltd. The quarry is located approximately 50 kilometres south-east of Phichit, Amphoe Bang Mun Nak. Planned expansion of the cement industry will act encouragingly on further increase in the production of gypsum. By 1971 the annual production estimated at more than 3 million tons of cement per year will require at least 120,000 tons of gypsum.

B. Production and productive capacity

Cement production in Thailand increased in the period of five years between 1961 and 1966 from 810,000 to 1,475,700 tons, i.e., an increase of 74%. (See Table 2)

TABLE 2

PRODUCTION OF CEMENT
(in metric tons)

1961	1962	1963	1964	1965	1966
810,000	870,000	956,000	1,058,000	1,270,000	1,475,700

Source: Ministry of Industry.

TABLE 3

INSTALLED CEMENT PRODUCTION CAPACITY

Owner	Location	No. of kilns	Capacity in metric tons per year
Siam Cement Company	Bang Sue	4	320,000
-do-	Tha Luang	4	600,000
-do-	Thung Song	2	400,000
Jalaprathan Cement Co.	Takhli	2	300,000

Source: Cement Factories.

TABLE 4

ESTIMATED PRODUCTION AND TREND IN DEMAND FOR PORTLAND CEMENT[1]
IN THAILAND
(in 1,000 metric tons)

Year	Total manufacturer's shipment[2]	Value of output (millions/dollars)	Foreign Trade[3]			Domestic demand[4]
			Export	Import	Net export	
1962	870	19.5	180	35	145	725
1963	956	20.0	144	20	124	832
1964	1,058	20.5	153	10	143	910
1965	1,270	23.0	156	14	142	1,128
1966	1,475	29.5	13	115	-122	1,580
1967	1,700	n.a.	n.a.	n.a.	n.a.	1,800[5]

1/ Includes Portland and Masonry Type Cement.
2/ Siam Cement Company and Jalaprathan Factory.
3/ Department of Customs.
4/ Based on Survey.
5/ Estimate by SCC.

As one can see from Table 3 the total present maximum installed capacity is about 1,600,000 tons per year. This capacity is however not fully used. The Thung Song Factory is using only about one half of its maximum capacity because of power shortage, and it is expected that the full capacity will be reached only in the second half of 1967, following the installation of factory's own generator. Jalaprathan factory originally had two kilns with a total maximum capacity of 600 tons per day. In 1966 the company's first kiln was converted from the wet process production of cement to semidry resulting in an increase in the capacity from 300 to 500 tons per day. The second kiln is undergoing the same conversion and it is expected that till the end of 1967, the total capacity of this factory will be increased to 1,000 tons cement per day.

C. Extensions under construction

In addition to the mentioned increase in the capacity of the Thung Song plant following installation of the generator, the Siam Cement Company plans to extend the production at Bang Sue, by installing an additional fifth kiln, to 520,000 tons per year by the midst of 1967.

The production at Tha Luang will be doubled in 1969 to 1,200,000 tons per year. The erection of the new 1,500 tons per day kiln will be completed in late 1968. As a result of all mentioned extensions it is estimated that the total production of cement in Thailand in 1967 will amount to 1,700,000 tons. By 1969 only the three factories of the Siam Cement Company will produce more than 2 million tons per year.

D. New plants

The Board of Directors of the Siam Cement Company has approved the fourth factory to be constructed in the North or North-east of Thailand. The maximum capacity of this factory should be about 800 tons per day.

Permission for another private cement company was granted by the Cabinet in March 1967 and the Jalaprathan Cement Co., Ltd. was given approval to build a new plant at a cost of 200 million baht. The factory will be located in Tambon Bang Na, Phra Khanong and will be capable of producing 1,000 tons of cement daily in the early stage of operation and a full capacity of 2,000 tons per day.

The National Economic Development Board has approved the Jalaprathan Cement Company's plan to set up a new cement factory in Cha-am district, Phetchaburi province, 150 kilometres south-west of Bangkok. During the first phase of operations the factory will produce 1,500 tons of cement daily. Starting from 1969, the capacity will be doubled to 3,000 tons per day. The plant is expected to start operation at the end of 1967 and will require an increase from the present registered capital of 60 million baht to 100 million baht.

The figures showing exports and imports of white cement in Table 5 appear inaccurate, considering the fact that much larger quantities are available in the market. An explanation for this may be that important portion of white cement shipment was registered by Customs Department under "cement, n.e.s." or "portland cement". High price of white cement and increasing demand have generated considerable interest for the local manufacture of this product Siam Cement Company plans to manufacture white cement in its Thung Song factory. The Board of Investment has also given approval in April 1967 for the erection of a new white cement manufacturing plant. The plant located in Thon Buri, will have an annual capacity of 60,000 tons. Registered capital is 60 million baht. Only locally available raw materials will be utilized (limestone from Saraburi and kaolin from Surat Thani and Uttaradit). It is expected that the manufacture will begin by the end of 1969.

From Table 4 domestic capacity appears to be adequate to meet present demand. If all plans for erection of above mentioned new factories are realized, the total output in 1971 should reach 3.5 million tons. It is expected that during the next five years available export surplus will substantially increase.

E. Cement brands

The Siam Cement Company produces three types of cement: ordinary Portland cement-Elephant brand, rapid hardening cement-Eravan brand, and silica cement-Tiger brand. Ordinary portland and rapid hardening cements are made by wet grinding of a mixture of marl and clay, subsequent burning in a rotary kiln at 1400°- 1500°C. into clinker, and grinding of clinker in tube mills with a small percentage of gypsum. Super-cement is ground to a fineness of 3 per cent residue on sieve 170, whereas Elephant cement is ground to a fineness of 8 per cent.

Silica cement is made by intergrinding 70 percent of Portland cement clinker and 30 percent of sand, with the addition of small percentage of gypsum.

Jalaprathan Cement Factory also produces silica cement-Cobra brand, Portland cement-Green label, and super cement-Red label.

Quality of cements is tested in accordance with ASTM and B.S. standard specifications in the laboratories of the manufacturers. There are no Thai National cement testing standards for the time being. It is expected that the recently formed Thai National Centre for Standard Specifications will begin with the preparatory work on the formation of committees and working groups for cement standards during 1967

F. Exports and imports

Table 5 gives quantity and value of imports and exports of cements for the period 1962-1966. Thailand is net exporter of Portland cement. The quantity of exported Portland cement has, as a result of rising local demand, decreased from about 180,000 tons in 1962 to about 100,000 tons in 1965. In 1966 the increase of cement consumption resulting from the intensified public and military construction could not be adequately covered by locally manufactured cement and required exceptional measures for importing portland cement and clinker. It is expected that situation will be back to normal in 1967.

Portland cement was mainly imported from Japan, and exported to Vietnam and Laos. The trade in other cement types was not significant.

TABLE 5

THAILAND: IMPORTS AND EXPORTS OF CEMENTS, 1962-1966

A. QUANTITY IN METRIC TONS

Commodity	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
Cement, Portland	6,683	179,463	17,089	143,600	7,516	102,320	7,049	105,580	114,848	12,681
Cement, white	712	23	2,767	31	1,745	51	978	75	700	-
Cement, fondu	4	-	6	-	8	-	23	-	24	-
Cement, n.e.s.1/	27,486	-	282	-	168	-	31,063	-	2,905	-
Clinker, cement	-	-	-	-	-	-	-	-	139,876	-

B. VALUE IN THOUSANDS OF BAHT

Cement, Portland	3,933	62,670	7,977	54,516	4,759	35,927	4,480	40,944	47,844	3,703
Cement, white	488	26	1,782	33	1,198	54	657	72	451	-
Cement, fondu	11	-	16	-	19	-	38	-	39	-
Cement, n.e.s.1/	7,765	-	604	-	113	-	8,601	-	34,309	-
Clinker, cement	-	-	-	-	-	-	-	-	38,395	-

Source: Department of Customs.

1/ n.e.s. = Not elsewhere specified.

2. INDUSTRIES SUBSIDIARY TO THE CEMENT INDUSTRY

A. Asbestos-cement products

(1) Crude asbestos

The known asbestos deposits of Thailand are limited to Changwat Uttaradit in the region 20 to 30 kilometres east-north-east of the city of Uttaradit along the river Nan. Most of the exposed veins are slip fibre although some cross-fibre veins also occur. The fibre seems to be too brittle for good spinning grade and the attempts of the Thai Cement Co. during the World War II to produce roofing shingles by using this material, were reported to be unsatisfactory. Crude asbestos from the Bo Sam Kha prospect, Uttaradit is occasionally marketed in Bangkok for packing purposes. So far the exploitation has been limited and a smaller quantity is known to be used for the small scale manufacture of cement-asbestos pipes.

Practically all crude asbestos used for large-scale manufacture is imported from South Africa (blue crocidolite) and Canada (chrysotile). Table 6 gives value of imports.

TABLE 6

THAILAND: VALUE OF CRUDE ASBESTOS IMPORTS, 1962-1966

Year	Value (U.S. dollars)
1962	1,010,000
1963	1,380,000
1964	1,353,000
1965	1,478,000
1966	2,550,000

Source: Department of Customs.

(2) Asbestos-cement sheets

The Siam Fibre Cement Co. Ltd., was established in 1938 at Bang Sue and began working shortly before the outbreak of the Second World War. Siam Cement Company which was appointed managing agent before the war, obtained for itself in such a way, a new important customer for its cement. During the war years, the company was faced with serious difficulties as a result of a shortage of asbestos fibre. After the war production expanded and since 1960 the company runs its own business as an independent concern. The largest single shareholder is the Crown Property Bureau.

The company manufactures flat sheets, corrugated roofing sheets and tiles as well as all necessary accessories, such as ridging material, etc. Present annual productive capacity is 12 million square metres of flat sheets (4 mm thick) and 13.7 million square metres of roofing sheets.

Table 7 gives actual production and value of asbestos-cement sheets from 1962 to 1966.

TABLE 7

THAILAND: PRODUCTION OF ASBESTOS-CEMENT SHEETS 1962-1967

Year	Flat sheets		Roofing sheets	
	Production (Square metres)	Value (Dollars)	Production (Square metres)	Value (Dollars)
1962	1,000,000	480,000	5,500,000	3,450,000
1963	1,450,000	700,000	7,400,000	4,700,000
1964	2,600,000	1,271,000	7,700,000	4,900,000
1965	3,270,000	2,240,000	9,200,000	5,700,000
1966	7,600,000	3,600,000	10,000,000	6,600,000
1967 e/	12,000,000	5,800,000	12,300,000	7,400,000

e/ Estimated.

Source: Siam Fibre Cement Co., Ltd.

Though the statistics in Table 7 include both corrugated and flat sheets, the production may be regarded as dominated by the corrugated type. The purpose of the corrugations is, of course, to increase the strength of the material and it is for this reason that it is the form generally used for external work. The Siam Fibre Cement Co. has during the last years developed a large number of roofing sheets with large and small corrugations as well as coloured sheets. Present plants include six "Magnani" aggregates for production of "Roman tiles", and five "Hatschek" aggregates for production of flat sheets and corrugated sheets.

The main use of asbestos sheeting is as general purpose roofing material; in this it has largely superseded sheet iron and other tiles, particularly in urban areas. Another important use is as external cladding and roofing material for industrial and commercial buildings, particularly as standard material for roofs carried on steel frames in single-storey industrial buildings.

The figures set out in Table 7 indicate that the increase in the use of asbestos cement was substantial. Total production of smooth and corrugated sheets has increased during the period between 1962 and 1967, from 6.5 million square metres to more than 24 million square metres, i.e. almost 400 per cent.

As one can see asbestos-cement is firmly established as building material in Thailand and its use is increasing all the time. It has advantages as light cladding and roofing material and enables economics to be made in the use of iron, steel, and timber. Moreover, asbestos, the imported ingredient, accounts for only about 15 per cent of the contents of the sheets, the rest is Portland cement, a commodity produced in Thailand.

(3) Asbestos-cement pipes

From 1961 the Siam Fibre Cement Company also manufactures water pipes. In the beginning the machines were of a limited capacity and as a result of increasing demand, a new automatic high pressure pipe plant started operation in 1966. During the first year of operation the production amounted to 8,400 tons

(valued at 906,000 dollars). Production in 1967, estimated at 20,000 tons, is adequate for domestic demand. After further expansion the production will reach in 1971 an output of 40,000 tons, when a part of the production will be available for export. The pipes are produced in various dimensions up to 600 mm inside diameter.

Since 1962 asbestos cement pipes and fittings are also produced on a small scale in six plants located in the Nakhon Pathom province (3 in Kamphaeng Saen and 3 in Nakhon Pathom). Each plant produces about 200 pipes of standard length and 3, 4 and 5½ inch diameter per day, as well as a corresponding amount of fittings.

(4) Capital investment and labour

Total capital investment for all plants of the Siam Fibre Cement Company amounts to 13,350,000 dollars. All plants together employ about 600 people.

(5) Export and import

Table 8 gives quantity and value for net import of asbestos-cement products. Variable quantity of asbestos-cement pipes has been imported throughout the whole period 1962-1967. The manufacture of pressure pipes started in 1966 and already in the same year the production amounted 8,400 tons, i.e. more than double of the maximum quantity imported. With the increased output from the new factory at Thung Song, which has reached its full capacity of 1,000 tons per day during the second half of 1967, it is expected that the demand for asbestos-cement pipes will be fully met by the domestic production.

Asbestos-cement boards were both exported (mainly to Laos and Malaya) and imported. During the 1962-1966 period, the export always exceeded import, but both the value and quantities are not significant in comparison with local consumption values.

TABLE 8

THAILAND: NET IMPORT OF ASBESTOS-CEMENT PRODUCTS 1962-1966

(At the rate 20.8 baht per one U.S. dollar)

Commodity	1962		1963		1964		1965		1966	
	Quantity (Tons)	Value (U.S. dollars)	Quantity (Tons)	Value (U.S. dollars)	Quantity (Tons)	Value (U.S. dollars)	Quantity (Tons)	Value (U.S. dollars)	Quantity (Tons)	Value (U.S. dollars)
Pipe of asbestos cement, cellulose fibre-cement or the like	940.3	157,580	463.7	68.160	2,530.6	319,190	2,629.5	304,180	5,696	662,000
Asbestos building boards	-575.0	46,400	-2,296.0	4,000	-493.8	108,700	-733.8	193,800	1,846	541,000
Building materials of asbestos and mixtures with a basis of asbestos	2,590.0	390,110	2,352.8	215,000	52.6	23,200	1,451	116,200	15	96,000

Source: Department of Customs.

B. Concrete products

The largest and the most mechanized factory producing a variety of concrete products is situated in Bangkok and belongs to the Concrete Products and Aggregate Company Limited (CPAC). The promoter of the company was Siam Cement Company. Products include hollow blocks, pre-stressed posts and piles; reinforced and plain concrete pipes, pre-cast elements for prefabricated construction and pre-mixed concrete.

Concrete blocks of different sizes (mainly 14.0 x 19.5 x 39.5 cm, 19.0 x 19.5 x 39.5 cm and 9.0 x 19.5 x 39.5 cm), are made in accordance with standard requirements. Maximum capacity at present is between 3.5 and 5.0 million per year. In 1966 production amounted to 2 million.

CPAC plants also produce a large number of small and large size concrete piles (0.18 x 0.18 m, and 0.35 x 0.35 m and up, respectively), and pipes. In 1966, 300,000 metres of small size and 88,000 metres of large size piles were produced.

Concrete pipes of a diameter between 30 and 120 cm and one metre length are produced in accordance with AASHO standards.

Capital investment in the manufacturing plant is 1.8 million dollars. The Company employs 1,200 people.

TABLE 9

ACTUAL PRODUCTION AND VALUE OF CPAC CONCRETE PRODUCTS BETWEEN 1962 AND 1966

(20.8 baht = 1 U.S. dollar)

Year	Total production (Tons)	Value (Thousand dollars)
1962	24,000	1,000
1963	70,000	2,000
1964	110,000	2,500
1965	155,000	3,000
1966	235,000	5,500

Source: The Concrete Products and Aggregate Co., Ltd.

Thai Concrete Products Company started operation of its concrete plant in 1967. Products include concrete blocks, pipes and piles. Registered capital is 3 million baht. The plant located in Bangkok employs at present 40 workers.

Maximum daily capacity is 10,000 blocks, 400 pipes (30-150 cm diameter), and 200 piles (6-8 metres long and with an average diameter of 35 cm). The Company has plans to establish branches in Ubon and Sattahip.

Combined maximum capacity of CPAC and TCPC plants amounts to about 6 to 8 million blocks, 800,000 to 900,000 metres of piles and 200,000 to 300,000 pipes. Several other smaller companies are also manufacturing blocks, pipes and other reinforced and pre-stressed concrete products.

3. THE LIME INDUSTRY

Limestone is widely distributed in many parts of Thailand. Best known limestone formations are Thung Song, Kanchanaburi, and Ratchaburi. Nakhon Ratchasima series also contain thin limestone beds. No data are available on size of deposits, but it is obvious that the reserves are more than sufficient for the needs of lime industry in Thailand.

Quicklime manufacture in Thailand is still at a very primitive level. A large number of small scale producers, many of them seasonal, produce low quality quicklime.

Accurate data are not available, but one can estimate that the total production of quicklime and hydrated lime amounts to about 30,000 tons per year. Approximately twenty kilns, the majority having a capacity of about 300 tons per year, are in the Saraburi area and produce an estimated 7,000 tons per year. Larger shaft kilns producing between 10 and 50 tons per day are located in Ratchaburi (4,000 tons/year), Rangsit (15,000 tons/year), Kanchanaburi (2,500 tons/year) and Pak Chong (3,000 tons/year), and mainly produce quicklime for highway construction and masonry purposes.

Limestone extraction is mainly unmechanized. After the removal of overburden and blasting, the blocks are usually broken by hand-operated air-hammer drill and loaded by hand on trucks. The stone is separated by visual inspection into harder dolomitic type for road metal and softer type for lime burning. After burning some producers make hydrated lime by spraying quicklime lumps spread on the floor with water hose.

Hydrated lime packaged in plastic bags is sold for construction work at a price which is comparable to that of the masonry cement (400-450 baht/ton). The users of quicklime are metallurgy (as flux), sugar factories (for clarification) and paper factories (sulphite process). There is a possible application of quicklime for agriculture and horticulture. Inquiries have already been made regarding availability of lime for agricultural liming in the Rangsit area. The Land Development Department estimates that there is a need for about 40,000 tons of lime per year to combat acidity in soils.

The Lime Industry Co. is planning to install until 1969 four kilns, each with a capacity of 100 tons per day, in different parts of Thailand, The kilns will be of the shaft type and will use oil for burning. Present demand for lime in Thailand is estimated by the Ministry of Industry at about 200,000 tons per year. If plans for installation of new kilns are realized on time, Thailand will be self-sufficient in lime by 1970.

The availability of good quality lime with constant, predictable characteristics, will provide a possibility for the formation of other building material industries utilizing lime as binder; such as sand lime bricks, cellular concrete, silica concrete and pozzolana-lime products.

4. THE GYPSUM AND GYPSUM PRODUCTS INDUSTRY

A. Raw gypsum

There are at present three quaries supplying raw gypsum

in Thailand. Two of them are located in the North and one in the South.

The mining rights to the largest deposit in Thailand is held by the Thai Gypsum Company, Ltd. The ore body is located about 320 kilometres north from Bangkok and contains proven recoverable reserves of 10 million tons and the probable reserves of 100 million tons[1/]. The Thai Gypsum Co., Ltd. was incorporated in 1956 with a registered capital of 2 million baht. Total capital investment so far has been 9.5 million baht. Production by open pit method started in 1958, and all raw gypsum was sold as retarder to local cement plants. Other less important uses are as fillers and agricultural gypsum. The mine employs about 200 workers. The transport of gypsum is costly and represents about one third of the raw gypsum price at cement factory in Bangkok. Gypsum is first transported by truck 50 kilometres to the Taphan Hin railway station and then 322 km by rail. During the rainy season transport by boat which is about 50 U.S. dollars per ton cheaper than truck transport is possible on the Nan river.

In 1966 two new mines started their operations, one in Nakorn Sawan, north of Thailand and the other in Surat Thani, southern Thailand. In 1966, the mine in Surat Thani, located about four kilometres from the Ban Song railroad station, exported for the first time about 2,500 tons of high grade gypsum to Malaysia. During the first half of 1967 exports amounted to 6,700 tons. The mine also supplied about 1,000 tons per month of raw gypsum for the Thai Cement Co., Nakhon Si Thammarat cement plant. The Surat mine also belongs to the Thai Gypsum Co., Ltd. Present combined capacity of the two mines belonging to the Thai Gypsum Company is 5,000 tons per month (Pichit 2,000 tons and Ban Song 3,000 tons).

1/ GARDNER, M.L. (1958). — Report of examination, gypsum deposit near Phichit, Central Thailand. (USOM/Thailand).

Planned expansion of the cement industry will act encouragingly on further increase in the production of gypsum. By 1971 the annual production estimated at more than 3 million tons of cement per year will require at least 100,000 tons of gypsum.

TABLE 10

PRODUCTION OF GYPSUM, 1961-1966

Year	Production (Metric tons)	Value (Millions of baht)
1961	12,040	4.5
1962	23,000	8.0
1963	35,000	12.0
1964	30,000	10.0
1965	35,000	12.0
1966	53,000	18.0

Source: Thai Gypsum Co., Ltd.

B. Gypsum products

Thai Gypsum Co., Ltd. operates at present a pilot calcining plant at Nonthaburi, a few kilometres from Don Muang Airport. Two kettles each with a 2-ton capacity, produce stucco plaster (gypsoplast), molding plaster (Patima B) and writing chalk. Maximum capacity of plaster production is about 16 tons per day.

The pilot plant also produces a small amount (a maximum of about 200 square metres a day) of fibrous plaster boards. About 4 per cent by weight of imported sisal is added as fibre. Capacity of production is varying depending on demand. The price is, in spite of small capacity and primitive methods of manufacture, very competitive. There are great possibilities for improvements, both from the point of view of quality (better uniformity of size and quality) and manufacturing process. The boards are mainly used for ceilings and interior wall lining.

TABLE 11

PRODUCTION OF PLASTER AND FIBROUS PLASTER SHEETS

Year	Plaster		Fibrous plaster sheets	
	Quantity (Tons)	Value (Baht)	Quantity (Square metres)	Value of sales (Baht)
1963	Nil	Nil	Nil	Nil
1964	79.2	52,000	1,880	no sale
1965	297.5	208,000	26,200	149,000
1966	307.5	283,000	26,600	345,000

C. New plaster board plant

The recently formed Thai Gypsum Product Co., Ltd. plans to commence a production of plaster boards and plaster at the beginning of 1969. Registered capital of the company is 20 million baht and total necessary capital investment is estimated at about 40 million baht (one and two million dollars, respectively). The factory will be located in Rangsit, about 30 kilometres north of Bangkok. The capacity of the plant will be about 5,000 square metres of plaster board and 15 tons of stucco gypsum per day. The equipment will be imported from Japan and the process will be fully automatic. The factory will employ about 30 skilled workers.

5. THE SHEET GLASS INDUSTRY

There is at present only one plant producing sheet glass in operation in Thailand. The Company, originally registered under the name of Glass Manufacturers of Thailand, was founded in April 1963 with a registered capital of 12 million baht and was granted promotional privileges under the Industrial Investment Promotion Act.

In July 1964, the Asahi Glass Company Ltd., of Japan purchased 50 per cent of the total number of shares from the Thai

investors. The original Thai company thus became a joint venture, changing its name into the Thai-Asahi Glass Co., Ltd., in July 1964.

The plant began operation in November 1965, and the first lot of sheet glass was delivered to the market on January 1966.

Production includes plain and ground sheet glass of 2, 3, 5 and 6 mm thickness with maximum size of 190 x 245 cm. Full capacity is 550,000 cases per annum (an equivalent of 5 million square metres). Total investment until now is estimated at about 7 million dollars (150 million baht)[1/]. The factory employs about five hundred including forty Japanese specialists. The plant operates at present only at 60 per cent of its maximum capacity and produces about 30,000 tons of sheet glass per year. From October 1966 till January 1967 the production amounted to 16,850 tons, out of which 14,150 tons were sold locally and the rest was exported[2/]. With the exception of soda ash (Na_2CO_3) and salt cake (crude sodium sulphate-Na_2SO_4) which are imported from Japan, raw materials are available locally. Glass sand is shipped from Songkhla (800 km from Bangkok), limestone from Saraburi, and dolomite from Kanchanaburi. Total value of soda ash imports for the three existing glass factories is estimated at more than one million dollars per year (other two factories produce bottles and glasses). In addition to glass factories soda ash is consumed by the waste paper factory, and the total consumption is about 100 tons per day. Present demand is not sufficient to justify the setting up of a plant producing soda ash in Thailand. The demand for glass is increasing by 10 per cent yearly and the setting up of a soda ash plant can be envisaged only in 1971, when the demand will reach 200 tons per day considerred as an economical capacity for this industry. The sheet glass factory uses the Fourcault process. There are at present six rolling machines. The full capacity of the factory is based on five (functioning) rolling machines and the sixth machine is used as a stand by.

1/ Thai Asahi Glass Co., Ltd.

2/ Ministry of Industry.

Major difficulties encountered during the first period of the operation were, mainly the high cost of raw materials, particularly glass sand and low efficiency of local labour. The sand from Songkhla delivered at the factory costs about 130 baht per ton (6 dollars/ton), due to complicated transport and frequent ore loading.

Under normal competitive conditions, the capacity of the factory is planned to fully cover the normal, constantly increasing (15 per cent per year), demand for sheet glass. A large quantity of sheet glass is already exported to Australia, Cambodia, and Laos.

TABLE 12

THAILAND: NET IMPORT OF GLASS AND GLASS PRODUCTS 1962-1966

Commodity	1962		1963		1964		1965		1966	
	Quantity (Tons)	Value (U.S.$)	Quantity (Tons)	Value (U.S.$)	Quantity (Tons)	Value (U.S.$)	Quantity (Tons)	Value (U.S.$)	Quantity (Tons)	Value (U.S.$)
Unworked, drawn or blown glass, in rectangles, including flash glass.	7,342	667,000	6,835	639,000	6,477	62,700	7,761	671,000	2,688	284,000
Cast, rolled, drawn or blown glass, in rectangles, unobscured surface ground or polished, but not further worked.	6,560	185,000	8,342	1,020,000	8,863	1,081,000	10,888	1,481,000	3,869	804,000
Unworked, cast or rolled glass.	16	3,520	42	10,140	226	23,650	156	17,380	75	9,000
Multiple, wall insulating glass.	1	785	100	12,140	252	40,750	136	19,600	20	2,770
Brick, tiles, slabs, paving blocks, squares and other constructional material, of pressed or moulded glass.	123	24,100	254	63,400	159	35,700	165	40,400	193	35,600
Safety glass, worked or unworked.	42	26,250	51	44,900	189	81,600	149	108,000	238	146,000

6. THE CLAY PRODUCTS INDUSTRY

The production of building materials based on clay is still at a low level regarding both the output and the manufacturing techniques. Building bricks, tiles, and a limited quantity of clay pipes are produced by a large number of small-scale producers. It is predominantly a seasonal home industry. Great majority of the plants are entirely unmechanized and the variations in the quality of products occur only as a result of different fuels and types of kilns used.

A. Brick

Brick manufacturing methods are rudimentary and capital investment, in a majority of cases, negligible[1/]. There are no available exact data showing the production and consumption of bricks in Thailand. Of a total of 136 brick, tile, and earthenware factories registered in 1965 with the Ministry of Industry, 122 were producing bricks. Accurate figures are not available, but one can estimate from the marketing of bricks in Bangkok (about 30 million sold per year) and average capacity of plants, that the total brick production for Thailand amounts between 50 and 60 million per annum. Only three factories employ more than ten workers. Mentioned factories produce standard size (7.5 x 10.5 x 23 cm) bricks and the total capacity is about 7 million bricks per year. The production is mainly located in one area (Pamok, Angthong province) and the management is well organized. With the exception of the pressing operation which is carried out in two stages, first by hand moulding and then using the hand operated screw press, the manufacturing process is manual. The bricks are burnt by direct contact with live wood fire in

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1/ PAJEVIC, M.M., and MAHAVAN, Bunthan (1966). — Manufacture of bricks in Thailand. Report No. 2 on Miscellaneous Investigation No. 1 (Manufacture and properties of bricks). (unpublished) Applied Scientific Research Corporation of Thailand.

beehive kilns. On special order factories also produce floor tiles and silica bricks.

Greatest part of bricks produced in Thailand (an estimated 80 per cent) are hand-made, small size bricks. The size of the brick varies even within the same plant, but it is approximately 16.8-18.8 cm by 7-8 cm by 3.6-5.2 cm.

Centre for Thai National Standard Specifications (CTNSS) has issued a draft of the Thai National Standard Specification No. 1 fixing two modular sizes of common building bricks. A larger size specifies a 9 x 9 x 19 cm, but the brick is not yet in production. Smaller specified size is 4 x 9 x 19 cm which is very close to the actual size of the small hand-made "Mon" bricks. The change of size involves only a slight, inexpensive modification of wooden forms and it is expected that the brick in the new specified size will be produced on a large scale.

Small size hand-made bricks are usually made with plastic clay from the paddy fields, or river beds, which is mixed with sand or rice husk to reduce shrinkage and improve the bonding strength of the green brick. The clay is then hand-moulded into wooden frames and the upper surface trimmed off. The bricks are sun dried and then fired in simple up draught kilns, or just covered with rice husk and fired.

The labour force consist usually of about 6 persons. Making of bricks is in most cases a family business and the workers are members of the same family. When additional labour is necessary the labour rate is based on 1,000 bricks. The moulding of 1,000 bricks is paid 5 baht (about 25 US¢), the trimming 5 baht, etc. There is also always a considerable amount of do-it-yourself labour put in by the owner himself. The equipment consist of cheap, locally made tools, such as wooden carts, wooden moulding frames, one or two shovels and a few knives for trimming.

Under these conditions the brick-making industry requires virtually no financial investment and the raw material is also cheap and easily accessible. The manufacturing cost of 1,000 bricks is about 40-60 baht and the market price in Bangkok between

120 and 160 baht per 1,000. In view of the high transport cost and middleman's share, profit margin is small. This type of output represents another form of hidden seasonal unemployment and has certain repercussions on the development of the mechanized plants. In spite of the complete lack of mechanization, small capital investment and cheap labour producers of well fired standard size brick have difficulties in adjusting their prices to compete with small-size "Mon" bricks. In Bangkok, for example, 1,000 standard size bricks sell at the price between 950 and 1,000 baht. The same number of small size bricks costs between 120-125 baht, i.e. eight times cheaper. In spite of its smaller size (about four times smaller in volume) and poor quality, cottage type industry bricks remain competitors hard to beat in the brick market. One of the reasons for the popularity of small bricks lies in the type of their application for housing construction in Thailand. Traditionally, houses have a wooden or concrete structural framework and small size bricks provide a non-bearing exterior panel or partition, where bricks act as a cheap filler or aggregate held together with cement mortar. Standard-size bricks are mostly used for decorative purpose and the designs are rarely if ever carried out in such a way as to utilize the mechanical strength of the brick for load bearing purpose.

B. Ceramic tiles and pipes

In addition to bricks, clay product manufacture also includes a small production of roofing and flooring tiles, hand-moulded drainage pipes, facing glazed bricks and decorative ceramic details but this is not significant. The tiles, made in Chon Buri, Ratchaburi, Chanthaburi, and Chiang Mai provinces are mainly used on religious and representative administrative buildings. The output varies and a big part of production is made on order. The tiles are notable for brilliant glazes and a noticeable example of their application is in the roofing of the Siam Intercontinental Hotel in Bangkok. Manufacturing method is almost exclusively manual and improvements and extensions are planned mainly through the use of better firing methods and replacement of wood with gas fuel. Labour is almost exclusively female and there is a high

proportion of child labour. Accurate production figures are not available. Total maximum annual production capacity is roughly estimated at 60 million roofing tiles, and 5 million floor tiles.

The Board of Investment has granted in July 1967 promotional privileges in the category "C" to the Construction Materials Industry Co., Ltd. to produce floor and wall ceramic tiles in Pathum Thani with an annual capacity of 15,000 tons. This project will involve a total investment of 4.8 million baht.

Salt glazed drainage pipes are made manually in a limited quantity. The quality is very poor, CTNSS Technical Committee on Stoneware Pipes is preparing a Draft Thai National Standard Specification for Glazed Vitrified Clay Sewer Pipes.

C. Porcelain sanitary ware

Porcelain sanitary ware is at present all imported. The survey conducted by Peter J. Darragh, United Nations non-metallic minerals expert has indicated that no deposit of true ball clay or flux necessary for the production of high quality ware, has been reported so far. If the prejudice against using ceramic sanitary ware which is not truly white in body could be overcome, it would be possible to make cheap round ware[1/].

The quantity of imported sanitary ceramic products has doubled in the period between 1962 and 1966. The value of imports has passed the one million dollar mark in 1965 and continues to increase.

1/ DARRAGH, P.J. (1967). — The ceramic industry in Thailand: present situation and future prospects. Appraisal Report No. 4, Applied Scientific Research Corporation of Thailand. (unpublished)

TABLE 13

THAILAND: IMPORT OF PORCELAIN SANITARY WARE, 1962-1966

(Thousands of U.S. dollars)

1962		1963		1964		1965		1966	
Quantity (Tons)	Value	Quantity (Tons)	Value	Quantity (Tons)	Value	Quantity (Tons)	Value	Quantity (Tons)	Value
902.1	481	1,305.0	694	1,357.5	742	1,754.7	1,030	2,430	1,300

Source: Department of Customs.

Under the circumstances, it would seem highly advisable to study forms of assistance which could be given to the manual clay products industry. Loans for the purchase of simple equipment, particularly these needed for preparation of clay; demonstrations and short courses; introduction of new sizes recommended by new Thai National Standard Specifications and codes of practice specifying proper use of bricks could all help to produce a better and more uniform product. Formation of cooperatives or other forms of association of small operators would also probably help in decreasing the present high profits of the middlemen and provide means for improvement of production methods and purchase of simple utensils.

It is expected that the work of organizations such as Department of Science, Department of Mineral Resources, and Technological Research Institute of the ASRCT will contribute to the development in this field in the future through the clay surveying work, ceramic research and preparation of standard specifications and codes of practice. Small Industries Service Institute, which is expected to become operational in the near future should also be able to render valuable services to this industrial sector.

7. THE WOOD INDUSTRY

A. Timber

Thailand has extensive forest resources rich in timbers of high commercial value. About 27 million hectares or 51 per cent of the total area of the kingdom is under forest. Teak, yang and other hardwood and softwood species, have been traditionally used for housing and other construction, particularly in the northern part of Thailand where not so long ago whole houses have sometimes been built of teak. The value of teak and yang as export commodities and the rapid increase of wood prices in general, have encouraged during the last ten years the introduction of new secondary species. Takhian-hin (Hopea ferrea), si (Vatica odorata), mafaen (Protium serratum), and many other secondary species have been successfully introduced[1/].

Following table gives some of the species preferred for house building and their application.

TABLE 14

PREFERRED TIMBER SPECIES FOR HOUSE CONSTRUCTION

Local name	Botanical name	Application
Kabak	Anisoptera sp.	Concrete forms.
Daeng	Xylia kerrii	Flooring, siding, boards.
Phluang	Dipterocarpus tuberculatus, Roxb.	Floorings, siding, shingles, temporary structures.
Ráng	Pentacone siamensis	Posts, beams, structural elements.
Sak	Tectona grandis	Doors, windows, floorings, furniture, etc.
Saya	Shorea sp.	Panelling, partition boards, flooring, doors and windows.
Takhian	Hopea odorata	Panelling, partitions.
Teng	Shorea obtusa	Posts, beams, structural elements.
Yang	Dipterocarpus Spp.	Floorings, siding, shingles, temporary structures.

1/ SAMAPUDDHI, Krit (1958). — Some secondary species recently introduced into the Thai timber market. Royal Forest Department Report No. R. 27 (Ministry of Agriculture : Bangkok)

Abusive practices such as shifting cultivation practised by the hill tribes, illicit clearing of the forests for cash crops by local villagers, timber stealing, and uprooting of hardwood trees for conversion into charcoal have all seriously impeded the development of forest resources. In order to increase the yield of forest and improve protection, the Government of Thailand has included the forestry development programme as an integral part of the National Economic Development Project (for the period from 1960 to 1965 and subsequent periods). Forest reservation, forest inventory, forest improvement, reforestation and research work in forestry have been given strong support and encouragement.

Table 15 gives total production of timber and production per capita in Thailand. Production figures should be considerred only as an indication of the trend. High percentage of error should be taken into account as a result of illegal and not registered exploitation. According to Dr. F. Loetsch, FAO Forest Inventory Expert, illicit removals over the previous 20 years amounted to 150 per cent of the legal fellings planned for sustained field[1/].

TABLE 15

THAILAND: TOTAL AND PER CAPITA PRODUCTION OF TIMBER, 1961-1965

	1961	1962	1963	1964	1965
Total production[2/] (Thousand m^3)	1,282	1,358	1,683	1,816	2,067
Production per capita (m^3)	0,046	0,046	0,056	0,058	0,064
Production per capita including fuelwood (m^3)	0,093	0,096	0,106	0,104	0,109

Source: Production figures: Ministry of Agriculture
Poppulation: Estimate based on 1947 and 1960 Census and Gille and Thip Projection I 1965 and 1970, and made by fitting a curve to four points. National Income of Thailand, p. 111.

1/ SAMAPUDDHI, Krit (1962).— Thailand special national progress report on reconsideration of trends in wood supplies and requirements. Royal Forest Department Report No. R. 50 (Ministry of Agriculture : Bangkok).

2/ Does not include fuelwood.

During the period between 1961 and 1965 total production of timber, not including fuelwood, has increased over 60 per cent. The per capita production not and including firewood also increased 40 and 16 per cent, respectively. Production in Thailand, is relatively low when compared to the world per capita production which in 1965 amounted to 0.67 m^3.[2/] High local demand for wood, resulting from intensified construction activities, increased number of wood using plants and population increase, considerably exceeds the production increase. As a result timber prices are steadily increasing and the quantity of timber available for export is decreasing.

TABLE 16

THAILAND: EXPORT OF MILLED TIMBERS, 1956-1965
(Quantity in cubic metres; value in 1,000 baht)

Year	Teak		Other timbers		Total value
	Quantity	Value	Quantity	Value	
1956	81,246	268,392	86,550	76,912	345,305
1957	57,382	201,048	90,604	85,373	286,421
1958	57,149	182,583	90,333	68,265	250,848
1959	54,373	176,264	63,205	51,124	227,390
1960	70,660	239,205	112,572	95,337	334,542
1961	56,450	222,645	66,425	65,832	288,478
1962	34,501	143,927	59,344	57,084	201,012
1963	27,552	117,691	68,515	67,883	185,575
1964	31,884	140,975	79,026	77,852	218,828
1965	26,399	112,144	63,908	64,080	176,225

Source: Department of Customs.

2/ FAO World Forest Inventory Statistics, 1965.

The value and quantity of exports is fluctuating but it is evident that there is a tendency of decrease over a longer period of time. With the exception of 1960 and 1961, exports have been reduced and the total value of exports in 1965, was almost 50 per cent lower than that in 1956.

TABLE 17

THAILAND: PRICE OF LUMBER 1961-1967

Description	Unit	1961		1963		1965		1967	
		Price in baht	%	Price in baht	%	Price in baht	%	Price in baht	%
1. 5"Ø x 5.00 m wood pile	ea.	13	100	16	126	17	144	19	146
2. 6"Ø x 6.00 m wood pile	ea.	25	100	28	112	28	112	30	120
3. Hard wood (Teng)	m^3	850	100	1,080	127	1,270	149	1,530	180
4. Soft wood (Yang)	m^3	510	100	650	128	790	156	935	184
5. Teak (Window frame, etc.)	m^3	2,270	100	2,830	125	3,400	150	3,680	162
6. Kabak (Form works)	m^3	425	100	510	120	623	147	935	220

In order to prevent further increase of prices and relieve present high demand and resulting pressures, the Government has decided to reduce by 20 per cent the import duties for timber. It is expected that this measure and increased import of timber from Malaysia will have a beneficial effect on the stabilization of the timber market.

TABLE 18

PRODUCTION AND VALUE OF TIMBER, BAMBOO AND RATTAN

(Quantity: timber in m^3; bamboo and rattan in 1,000 stems; value in 1,000 baht)

Year	Teak		Yang		Other timber		Bamboo and rattan	
	Quantity	Market value	Quantity	Market value	Quantity	Market value	Quantity	Market value
1956	200,295	230,339	340,044	142,818	960,696	351,367	5,258	22,609
1957	187,691	219,452	379,582	171,951	1,019,623	397,889	7,950	34,822
1958	181,261	203,919	418,326	168,585	1,101,295	434,607	9,234	40,448
1959	163,530	286,177	316,393	111,687	733,420	227,546	11,300	45,539
1960	153,664	361,110	320,833	128,012	790,857	307,406	12,621	50,863
1961	105,665	248,313	319,482	178,271	857,781	365,838	13,942	56,186
1962	123,324	295,978	377,959	188,224	856,812	326,994	22,607	91,106
1963	143,977	295,153	462,039	232,868	1,077,056	446,297	16,282	65,600
1964	143,199	415,277	536,723	250,650	1,136,586	430,709	3,475	14,900
1965	219,486	585,260	540,228	253,907	1,308,000	413,036	5,253	22,064

Source: Ministry of Agriculture.

In 1965, there were 520 registered sawmills in Thailand. With the exception of three larger saw mills which belong to the Forestry Industries Organization, they are very small. Great majority operates with a capital of a few million baht and with steam or diesel engines under 100 hp[1/]. Consuming capacity of saw mills and wood working shops is in excess of the actual production.

In addition to plywood, particle board and wood-wool industries, which are desribed later, following are the registered wood-using factories:

TABLE 19

THAILAND: WOOD-USING FACTORIES

Item	Location	Number	Remarks
Wood-working and furniture factories	Bangkok and Thon Buri	285	
	Other provinces	88	
Paper mills	Bangkok and Thon Buri	6	2 Government owned 4 Private enterprises
	Other provinces	5	2 Government owned 3 Private enterprises
Match factories	Bangkok and Thon Buri	7	
	Other provinces	6	
Dry-kiln plants	Bangkok and Thon Buri	24	
	Other provinces	2	
Impregnation plants	Bangkok and Thon Buri	2	About 7 more under consideration
	Other provinces	5	
Parquet-flooring plants	Bangkok	2	

Source: Ministry of Industry and Forest Products Research Division.

The largest paper mill in Bang Pa-in has a capacity of 40 tons a day. One Kraft paper mill with a capacity of 150 tons per

1/ SAMAPUDDHI, Krit (1966). — "Forestry Development in Thailand". p. 30 (Royal Forest Department : Bangkok).

day is under construction.

Four wood curing and impregnating and wood parquet plants which are in operation received promotion privileges during the period 1955-1965. Registered capital amounted to 9,5 million baht.

The effects of the rapid development of wood consuming industries on the supply and prices of timber will be increasingly felt, particularly after completion of all fibre board, particle board, paper, and other factories which are under construction.

Serious effort will be needed in conducting research aimed at increase of production, rationalization of wood use, and replacement of wood as material of construction with other suitable materials.

B. Production of plywood

Plywood is the most important wood-based panel at present in Thailand. Two manufacturing plants are operating at present, one in Bang Na (16 km from Bangkok) and one at Phra Pradaeng (20 km from Bangkok).

The larger of the two is Thai Plywood Company Ltd., owned by the Thai Government Forest Industry Organization. The Company was until recently the sole producer and an exclusive supplier of plywood products in Thailand market. The Company started working in 1957 and the production has increased steadily. The plant includes four production units: 2 plywood mills, 2 veneer mills, a flush door mill and a saw mill for boards and miscellaneous saw mill products. Plywood is by far the most important product. In 1966 the total value of Thai Plywood Company sales amounted to 155 million baht out of which plywood sales contributed 122 million.

Table 20 gives production and sales figures of the plywood manufacture during the period 1957-1966. In two shifts the capacity is at present about 5,000 sheets per day. An extension of the capacity is underway which will raise the output to 10,000 plywood sheets per day, i.e. about 3 million sheets per year. Total capital investment in the Thai Plywood plants amounts to

approximately 100 million baht, or 5 million U.S. dollars (80 million baht in 1957). The total number of employees is 1,370 including clerical personnel.

Of the raw material, 39 per cent is obtained from the mill's own concessional area in the Uthai Thani Forest, about 350 km from the factory; 20 per cent from the Forest Industry Organization and 41 per cent from independent dealers[1/]. Main

TABLE 20

THAILAND: PLYWOOD MANUFACTURE 1957-1966[2/]

Year	Production			Sales	
	No.	m^2	m^3	m^3	Value (Thousands of baht)
1957	123,309	343,298	1,881	84,643	5,139.1
1958	289,096	797,345	3,862	289,346	14,790.4
1959	591,724	1,634,583	8,084	467,223	29,819.3
1960	830,243	2,287,316	10,469	662,414	42,858.8
1961	901,242	2,515,946	12,422	1,000,509	45,146.0
1962	1,159,756	3,206,246	15,815	1,280,288	61,575.1
1963	1,361,133	3,795,270	18,385	1,285,768	73,587.1
1964	1,707,017	4,807,933	23,828	1,605,542	98,730.9
1965	1,743,569	4,916,262	25,653	1,806,868	103,175.0
1966	1,780,926	5,082,837	26,849	1,659,885	122,609.7

Source: Thai Plywood Co., Ltd.

1/ TRESSEL, M. PREMRASMI, Thanom, and INDEGRAND, P. (1965). — Plywood and board products in Thailand. In "Plywood and Wood-based Panels". Vol. II. FAO/PPP CONS/PAPER 3.5 p. 2 (Food and Agriculture Organization of the United Nations : Rome).

2/ Based on 4 ft x 8 ft sheets, average thickness 4.3 mm.

transport is floating by raft along the Chaophraya River, especially for the logs from the Uthai Thani area. Transport from other areas is mostly done by truck. Teak from the north is sometimes transported by railway.

The most important species for plywood production is yang wood used for face and core. In 1966 a total of 76,955 m^3 of timber was used, and 56.3 per cent was yang. The logs from the concessional area are considerably cheaper than those supplied by the Forest Industry Organization and individual suppliers, due to the fact that profits are not added. In 1966 average price for timber from the concessional area was 319 baht per m^3, compared to an average price of 458 baht per m^3 for timber supplied from other sources[1/].

The main species used for plywood manufacture, their prices in 1966 and application are given in Table 21.

TABLE 21

MAIN SPECIES USED IN PLYWOOD MANUFACTURE

Local name	Botanical name	Baht per m^3	Used as
Sak	Tectona grandis	3,342[2/]	Face veneer only
Yang	Dipterocarpus spp.	560[3/] - 608[2/]	Face and core
Saya	Shorea spp.	560	Face and core
Kabak	Anisoptera glabra	470[3/]	Core mostly

Source: Thai Plywood Co., Ltd.

The prices of all wood species are increasing steadily, but the most important is the increase in the price of teak, which is 137 per cent during the period 1957-1966 (1,400 baht/m^3 in 1957

1/ Thai Plywood Co., Ltd.

2/ Supplied by Forest Industry Organization.

3/ Supplied by individual suppliers.

and 3,342 baht/m^3 in 1966).

Two kinds of plywood boards are produced-exterior and interior plywood. The thickness of 4 mm and size 4 by 8 feet takes about 80 per cent of the total production. Exterior plywood using phenol formaldehyde adhesive is about 20 per cent of total production. Interior plywood (urea formaldehyde adhesive) represents the remaining 80 per cent. Almost all adhesives and chemicals are imported, except cassava (tapioca) flour filler. The value of imported adhesive and hardeners only, amounts to more than one million U.S. dollars per annum. The Technological Research Institute of the ASRCT has started the work on a research programme aimed at the replacement of the part of imported adhesives with locally available materials.

A second sizable plywood plant, the Bangkok Plywood Factory has been established in 1966. The reported capacity is 7 - 8,000 sheets of 4 ft. x 8 ft. plywood per 8-hour day, but present output is about 2,000 sheets per day. Most of plywood manufactured in this factory uses hardwood of Shorea species.

Both plywood factories face difficulties in the full utilization of their capacities as a result of raw material supply.

An estimated 60 to 70 per cent of plywood is sold in Bangkok. The main use is for house building, for ceilings and side walls. Evenly coloured yang plywood is widely applied for covering of interior side of the walls. Teak, yom-hin and mamuang are increasingly popular as highly decorative materials for surfaces. Plywood is also used for furniture manufacture and wood working. From Table 20 one can see that manufacture considerably surpassed sales during the starting period between 1957 and 1960. The reason for this was partly due to the quality of the plywood as well as the usual resistance of the public to new and insufficiently known materials. The sales promotion action which was organized in 1961 has given excellent results and resulted in the demand which was during the 1961-1962 period considerably higher than the output.

Until 1967 Thai import regulations served to protect locally made plywood by only permitting the entry of plywood products which are more than $\frac{1}{2}$ inch in thickness. As the local supply could not cope with increasing demand this barrier was lifted and there is an increased import of Finnish and Swedish type plywood.

TABLE 22

THAILAND: NET IMPORTS OF BUILDING BOARDS, 1962-1966
(Thousands of dollars)

Commodities	1962	1963	1964	1965	1966
Veneer sheets and sheets for plywood	-44.5	-18.3	-12.1	-	2.1
Plywood, blockboard, laminated board, batten-board & veneered panels	39.3	15.1	- 4.9	- 8.4	450.2
Hard boards	15.4	64.3	50.7	57.5	140.0
Soft board or insulating board	63.0	111.0	69.8	116.7	267.0

Source: Department of Customs.

C. Manufacture of doors and windows

The greatest part of wooden doors and windows are made in Thailand by methods of craftsmanship. They are normally made to order, in carpenter's workshops and in a great variety of dimensions.

Substantial economics could be achieved by adopting standard, if possible modular, sizes and by reducing the varieties of doors and windows produced.

The only factory so far producing flush doors in a mechanized plant and in a large number, is the Thai Plywood Co., Ltd. Table 23 gives the number and value of doors produced during the period 1957-1966. From the beginning in 1957 until 1966 the value of production has increased almost twelve times, and the number of doors more than eight times.

TABLE 23

THAILAND: MANUFACTURE OF FLUSH DOORS

Year	No.	Value (Thousands of baht)
1957	7,688	1,114.7
1958	11,766	2,086.9
1959	9,554	1,913.3
1960	9,833	2,100.6
1961	9,378	1,785.2
1962	17,571	3,061.4
1963	35,564	6,477.5
1964	39,770	6,578.1
1965	40,421	6,735.4
1966	65,217	12,933.5

The doors are of hollow core system covered with two layers of veneer on both sides. Standard thickness is 3.5 cm. The door price depends on the size, number ordered, type of face (teak, yom-hin or yang), and whether the door is for interior or exterior use. Exterior doors (phenol resin glue) are about 30% more expensive than interior doors. The maximum capacity of the plant is not always used mainly as a result of orders specifying out of standard sizes.

D. Particle board

The particle board factory under the name "Sriraja Shaving Board Co., Ltd", is located 120 km south-east of Bangkok. It is connected by Sukhumwit highway and shipping facilities with the Bangkok market. Particle board company is a sister company of the Sri Maharaja Company Ltd., which is a subsidiary company of the Crown Property and runs one of the largest saw mills in the Far East. Sri Maharaja Co. has its own forest with a total area of approximately 400 km^2. Monthly output of the saw mill is about 2,000 tons of planks and boards, mainly yang (Dipterocarpus alatus)

and takhian (Hopea odorata), 50 per cent of which is provided for export. Huge quantities of residues as waste wood (about 200 m^3 per day) are available daily for the production of particle board.

The particle board industry was started in 1958. Total capital investment amounts to 30 million baht. The daily output of the plant is 22 tons of finished boards (trade name phenoboards) of 5 to 22 mm thickness and in the standard sizes 1.25 x 2.50 m and 4 ft x 8 ft. In addition to standard particle boards the factory manufactures decorative laminated boards finished with melamine resin (teakoboard). Teakoboards are produced in the standard size 4 ft x 8 ft, 8 and 19 mm thick and their daily output is 350 boards in one shift. Production also includes parallel grooved acoustic board (0.60 x 1.20 m, 10 mm thickness), and plyboards (1.25 x 2.50 m, 5-25 mm thickness), as well as rubberized coconut mattresses.

Daily raw wood requirement is about 100 m^3 (piled), half of which is supplied as saw mill offcuts and the rest from match factory and outside suppliers.

Table 24 gives hard and soft wood at disposal for the particle board manufacture.

TABLE 24

THAILAND: WOOD USED FOR PARTICLE BOARD MANUFACTURE

Type	Local name	Botanical name
Hardwood	Yang	Dipterocarpus alatus
	Takhian	Hopea odorata
	Tabaek	Lagerstroemia calyculata
	Krathon	Sandoricum indicum
	Chumphraek	Tarrietia javanica
Softwood	Ngiv-pa	Salmalia Sp.
	Oi-chang	Sterculia campanulata
	Songsalung	Solenospermum duperreanum

Sriraja Shaving Board factory was one of the first particle boards put up in a tropical country and one of the major problems encountered in starting the plant was the wood composition. High moisture content and relatively short storage life of soft wood required special attention. The surface of particle boards is at present mainly composed of yang and softwood, and the core of takhian and softwood or tabaek and softwood, depending on thickness.

Two types of shaving boards are produced, for interior and exterior use. Indiscriminate use of interior type boards and qualitative and quantitative fluctuations due to irregularities of raw materials and climatic conditions during the starting period, have defamed particle boards to a certain extent. As a result, the demand for interior board has declined, and at present major part of the production is exterior type board using phenol-formaldehyde as adhesive. Factory consumes about 40 tons of phenolic resin glue per month. With the exception of the tapioca filler all components of the glue are imported and the value of imports for this purpose is about 200,000 dollars per annum.

The Board of Investment has recently granted promotional privileges in the Group C to a new chipboard factory which is expected to start production in April 1968. The capacity based on 2 cm thick board will amount to approximately one million square metres per year. The factory will use OKAL extrusion process and use wood waste as raw material. The boards will be applied for furniture manufacture, partitioning and lining, and measures have also been taken to work out standard housing designs which would utilize this board a large scale for low-cost housing.

E. Fibre board

In order to reduce the shortage of building materials for linings and introduce a replacement for lumber which was until recently extensively used for construction work, decisive measures have been taken for starting the fibre board industry.

Two fibre board factories are planned to begin manufacture in the near future. The first of them, a project of the Sri Maharaja Co., Ltd., is already under construction in Si Racha and

is expected to be in full production by July 1968. The total investment in the factory will be about 45 million baht. The guaranteed capacity is 65 tons per day. Dry method of production will be used, with an adhesive additive of 2 per cent, giving a hardboard of a density 1.0 - 1.1. It is expected that the hardboard will take over a part of the thinner shaving board market (5-6 and 8 mm).

The second fibre board factory, financed by the Thai Plywood Company (Ministry of Agriculture) is expected to begin operation in 1969. The maximum capacity of the plant will be 90 tons of hardboards per day, based on 125 cm by 490 cm, and a thickness of 3.5 mm, and the total capital investment needed is estimated at 74 million baht. Wet process will be used. The fibre board plant will be located in Bang Na and use the existing facilities of the plywood plant. Raw material will be log core waste and veneer waste of the plywood plant and the quality of the product will conform to requirements for medium hardboard specified by British Standards.

If the construction of both fibre board factories is carried out as planned, the board market will have by 1971, when full capacities are expected to be utilized, an additional 150 tons of fibre boards per day, or an equivalent of about 8 millions square metres of lining and partitioning sheets per year.

F. Wood-wool board

There is only one factory producing wood-wool boards in Thailand under the trade name cellocrete. The plant was established in 1956 with a capital of 2.7 million baht and is located in Bangkok.

Until now the only raw material used was somphong (Tetrameles nudiflora). Experiments are made in order to replace somphong with yang Phara (Hevea brasiliensis) or cheap and easily available khinon. Timber is supplied mainly from the central region, 100-200 km from Bangkok. Main problem is lack of raw material because of transport difficulties. Splitted wood pieces

are first stored in water tanks for about 4 weeks, with copper sulphate and "Bittan" added in order to prevent decay of wood. Splitted pieces of 40 cm length are fed to wood-wool making machines where a wool of 2 by 0.5 by 400 mm is made. Portland cement which is used as bonding agent, is mixed with wood-wool in a mixing drum. Boards are formed in a mechanical spindle press, clamped for two days and air-dried for another two days.

There are altogether 78 employees, working in one shift. Maximum daily capacity is 300 boards. Based on 1 by 2 mm, $\frac{1}{2}$ inch thick.

Cellocrete boards are used as partitions, linings, insulating structural roof decks and pitched roofs as well as insulating shuttering. As a lining or partition material cellocrete comes between the light concrete blocks and slabs and the boards and panels such as asbestos cement, fibre board and shaving board. It is primarily a partition material and has the fire resistant qualities of most cement products.

TABLE 25

THAILAND: MANUFACTURE OF WOOD-WOOL BOARD (CELLOCRETE)

Year	Value of production (baht)	Quantity 1/ (m^2)
1962	1,512,894	52,200
1963	1,389,440	47,800
1964	1,617,966	55,600
1965	1,816,370	62,500
1966	2,260,813	78,000

Source: Cellocrete manufacturer.

1/ Based on 1.00 x 2.00 x 0,025 m boards.

8. STONE

A. Building and decorative stone

(i) Sandstone of the Khorat series which comprises most of the Khorat plateau and crops out in other areas of Thailand was used in the past for both building and ornamental stone. It is fine-grained and has a red ferruginous cement. As it is generally friable and not resistant to wear, it is at present quarried only for grindstones and other abrasive stone.

(ii) Granites suitable for building, occur throughout Thailand, but few building stone quarries have been opened in them.

(iii) Despite the abundance of suitable limestone it has not been quarried for building stone.

(iv) Lateritic ironstone is widely distributed. Of the two types of latterites, pisolitic and spongy, the latter is used for building purposes.

(v) The only producer of marble in Thailand is the Government owned, Thai Marble Corporation. The plant a part of NEDCO, under Ministry of Finance, is located 10 km of Saraburi and the main product is marble tile 3/4 inch in thickness.

The plant includes a marble quarry as well as a cutting and polishing plant. Maximum production is 1,500 m^2 of 3/4 inch marble tile per year. The management estimates the marble deposit to be arround 100 million cubic metres. The appearance of the marble makes a good impression and an expansion and modernization of the plant seems to be desirable. Present capacity appears insufficient and the Cooperation has since 1962 operated with a loss[1/].

1/ ARTAMONOFF, G.L. (1965).— "State Owned Enterprises of Thailand" (United States Operations Mission/Thailand : Bangkok).

B. Road-metal

The greatest part of the road-metal used in Thailand is limestone, which is preferred as a railroad ballast and highway construction. There are many small quarries along the highways of Thailand. The limestone generally used is the widely distributed Ratchaburi limestone.

In addition to limestone, the following stones have been, or are still used as road-metal.

TABLE 26

NAMES AND OCCURRENCES OF STONES USED AS ROAD-METAL

Name of stone	Occurrence
Tin-bearing granite	Nam Noi hill, near Songkhla
Green porphyry	Chon Buri
Rhyolites	Nakhon Nayok area
Porphyries	Nakhon Nayok area
Vein quartz	Khao Sam Muk
Hematite	Khok Kathiam, Lop Buri
Diorite	Khok Kathium
Slate	Petchaburi and Fang
Quartzite	Chiang Rai

9. ASPHALT

The first asphalt plant in Thailand - Thai Asphalt Manufacturing Company (TAMCO), was established in 1965. The factory located in Si Racha, southeast of Bangkok on the Gulf of Thailand is a part of the crude oil refinery plants. Present capacity is 7,000 barrels a day. AMC was a part of the Summit Industrial Corporation until the midst of 1967, when the factory was sold for 12 million dollars to Esso Standard (Thailand) Ltd.

Esso Company plans to expand fivefold its present capacity (to 35,000 barrels per day) until 1970, by investing

additional 20 million dollars. Since 1965, when TAMCO plant began operation, Thailand is self sufficient in this material, and imports here been discontinued.

10. STEEL PRODUCTS

A. Iron ore

Best known deposits of iron ore from commercial point of view are at Khao Thap Khwai about 20 km from the city of Lop Buri and in Nakhon Si Thammarat, south Thailand. Recent investigations of the Lop Buri deposit have revealed a total reserve of seven million metric tons of high and medium grade ore. Two sizeable deposits of iron ore have also been found in Loei, north-eastern Thailand, and contain an estimated 27 million metric tons of mineable ore. The last mentioned deposits have not been developed, due to transportation problems and lack of good coking coal. The production of iron ore which in 1961 amounted to only 55,793 tons rose to 750,474 tons in 1965 and 691,700 tons in 1966. The greatest part of iron ore is exported to Japan mainly from Nakhon Si Thammarat, while the remaining small amount supplied from Khao Thap Khwai is smelted at Saraburi into pig iron. Even though the production decreased by 8 per cent from that of 1965 due to temporary closure of Nakhon Si Thamarat mine, iron ore ranked second in the 1966 earnings among the indigenous mineral products (Tin concentrates first).

TABLE 27

THAILAND: PRODUCTION OF IRON ORE, 1961-1966

Year	Production (Metric tons)	Value (Millions of baht)	Export (Metric tons)	Local consumption (Metric tons)
1961	55,793	7.1	19,437	16,779
1962	45,308	6.4	49,238	7,696
1963	15,741	1.2	7,280	12,134
1964	190,955	31.5	110,641	8,118
1965	750,474	126.5	723,405	9,069
1966	691,700	115.7	717,834	15,968

Source: Department of Mineral Resources

B. Mild steel

There is an extensive demand for iron and steel concrete reinforcement in Thailand, which is almost exclusively met by imports.

TABLE 28

THAILAND: IMPORTS OF CONCRETE REINFORCEMENT ROUND AND SQUARE, OF IRON AND STEEL 1962-1966

Year	Quantity (Metric tons)	Value (Thousands of dollars)
		(20.8 baht = 1 U.S. dollar)
1962	77,456	7,460
1963	45,308	8,760
1964	87,315	8,690
1965	135,964	14,240
1966	135,264	14,200

Source: Department of Customs.

As one can see from Table 28, value of concrete reinforcement import is expected to reach the 15 million dollars mark in 1967.

Since 1950, Siam Iron and Steel Company, an affiliate of Siam Cement Company Ltd. operates a foundry producing at present 20 tons of iron and steel products a day, partly from ore and partly from scrap. Its products are sold to the Siam Cement Company, the State Railway of Thailand and various other consumers. The plant employs 900 workers. The foundry will increase daily production to 40 tons a day in August and to 60 tons a day in September 1967. The output will be thus increased from estimated 7,000 tons in 1967 to 20,000 tons in 1968. The described foundry will be used as nucleus for a new iron smelting plant to be set up at Tha Luang, Saraburi. The mill will be operated by a new company, the Siam Steel Co., Ltd., with a registered capital of 205 million baht. Siam Cement Co. will be the major shareholder

and the total cost is estimated at 650 million baht. The company has been granted promotional privileges by the Board of Investment.

The company will initially have two rolling mills and two furnaces with a capacity of 25 tons each. Following this first stage, the company will be equipped starting 1971 with two electric "low-shaft" smelting furnaces of 200 tons per day capacity each. The factory will smelt about 400 tons per day of iron ore, mainly from Khao Tap Kwai, about 70 km from factory site. By 1971 the output will be raised to 150,000 tons of round steel bars, from 6 to 28 mm in diameter. The plant will employ about 1,200 workers.

Reinforcing steel is also manufactured by Thai Steel Co., Ltd. The factory is located in Samut Prakan 24 km from Bangkok and produces 4,000-6,000 tons of reinforcing steel per year. Registered capital is 3 million baht.

Bangkok Iron and Steel Company in Phra Pradaeng at the outskirts of Bangkok has two are furnaces of 6 tons capacity each, and manufactures about 30,000 tons of smooth and ribbed hot rolled reinforcing steel per year. Raw material is scrap iron.

The Board of Investment has granted promotional certificates to about ten other companies to operate iron and steel plants. One of the biggest is G.S. Steel Co., Ltd., a joint Thai-Japanese venture. Total cost of the factory is estimated at 320 million baht. The factory, located in Samut Prakan Province, is to be completed in September 1967. The company will produce round steel bars 6 to 25 mm in diameter and will use scraps as its main raw material, 20 per cent of which is expected to be obtained locally. The company will employ 320 workers. The capacity, which will be 90,000 tons of round steel bars per year initially, is expected to increase up to 130,000 tons in 1970.

The combined capacity of the G.S. Steel Co., Ltd. and Siam Iron and Steel Co., Ltd., plants is expected to reach, by 1971, 280,000 tons of mild steel reinforcement bars, which will adequately cover domestic demand and may leave a smaller quantity available for export.

C. Galvanized steel sheets

There are at present four factories manufacturing galvanized steel sheets in Thailand: Far East Iron Works Ltd., Thai Zinc Ltd., Thai Galvanized Steel Ltd., and Thailand Iron Works Ltd. Two are located in Pak Chong, Nakhon Ratchasima (180 km from Bangkok), and two in Samut Prakan, 22 km from Bangkok, on the Sukhumwit Highway.

Following Table 29 gives type of products and annual output for each of the four factories.

TABLE 29

THAILAND: MANUFACTURE OF GALVANIZED STEEL SHEETS

Name of producer	Operation started	Capital invested (baht)	Product	Capacity (tons)
Far East Iron Works Ltd.	1964	10,000,000	Corrugated galvanized	10,000
Thai Zinc Ltd.	1960	6,500,000	Corrugated g.s.s. flat g.s.s., colour coated flat g.s.s.	 47,000 35,000
Thai Galvanized Steel Ltd.	1960	8,700,000	Galvanized (tin) steel sheet	22,000
Thailand Iron Works Ltd.	1962	n.a.	Corrugated and flat s.s. Hot rolled s.s. Cold rolled s.s.	 10,000-20,000 40,000-60,000

Source: Ministry of Industry.

D. Steel pipes and tubes

Two companies are producing steel pipes and tubes in Thailand: Thai-American Steel Works Co., Ltd., and Thailand

Steel Pipe Co., Ltd. Both factories are located in Pra Pradaeng, in the outskirts of Bangkok.

Thai-American Steel Works Co., Ltd. is a joint Thai-American venture and was established in 1963 with a paid up capital of twenty million baht. Production of Marketing started in 1965. The factory has two pipe production lines. One is BEMAG-ETNA type 4 KU. 4" pipe mill from West Germany, while the other is a YODER type W-20 2" pipe mill from the United States. Both mills employ the latest radio frequency induction welding process. Galvanizing equipment employs the dry hot-dip process.

The factory employs about 180 workers. Production capacity is 2,000 tons of pipes and tubes per shift per month depending on the size. Each of the pipe mills can produce 3.6 kilometres of pipes per hour depending on size. Paid up capital was 20 million baht. Total capital investment is estimated at 50 million baht.

Production includes gas and water pipes from $\frac{1}{2}$" to 4" nominal diameter, black or galvanized furniture tubes and mechanical tubing from $\frac{1}{2}$" to 2" outside diameter by 0.9 mm up to 3 mm wall.

The line producing water pipes $1\frac{1}{2}$-4" works at present only in one shift. Smaller line manufacturing pipes 1-$1\frac{1}{4}$" which are used for water pipes and for furniture tubes operates in three shifts.

In addition to the mentioned company, steel water pipes are also produced by Thailand Steel Pipe Co., Ltd. It is a joint Thai-Japanese venture and the factory is also located in Pra Pradaeng.

The production is carried out in a way similar to the one already described (smaller and bigger diameter lines). Combined capacities of the two mentioned factories appear to be adequate for demand in Thailand. The production of larger diameter pipes $1\frac{1}{2}$-4" can easily be tripled if necessary.

The import of steel pipes which reached in 1963 a five

million dollars mark is on the decline and will from 1967 be substantially reduced.

TABLE 30

THAILAND: VALUE OF IRON OR STEEL TUBES AND PIPES IMPORTS
(In thousands of dollars)

1962	1963	1964	1965	1966
3,585	5,260	4,890	3,595	3,220

(20.8 baht = 1 U.S. dollar)

Source: Department of Customs.

11. PAINTS AND VARNISHES

Practically all paint components and the greatest part of prepared paints are imported. Table 31 gives quantity and value of imports for paints, varnishes, lacquers and pigments.

TABLE 31

THAILAND: IMPORTS OF PAINT, ENAMEL AND VARNISH 1962-1966
(Quantity in metric tons; value in thousands of baht)

Commodity	1962		1963		1964		1965		1966	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Paint, prepared	3,777	40,640	4,441	48,293	5,473	56,509	6,003	64,166	8,060	80,541
Enamels	760	12,032	923	14,145	1,187	17,551	1,310	17,438	1,665	20,923
Lacquers	567	16,806	680	10,838	902	13,362	977	13,637	1,106	23,974
Varnishes, oil cellulose and	240	3,967	270	4,275	320	4,798	481	6,045	480	6,274
Distempers	129	531	70	262	118	439	21	105		

Source: Department of Customs.

Both the quantity and value of imported prepared paints,

enamels, lacquers and varnishes have doubled within the period of five years. The increase has been steady and amounted to approximately 20 per cent every year.

Table 32 gives quantity and value of the more important materials used for the manufacture of paints. With the exception of soya bean, castor, and tung oils, which are also exported, all other materials are imported.

Lithopone is the most important material used as white paint solid. Titanium dioxide, zinc sulphide, and red iron oxide are also imported in large quantities.

TABLE 32

THAILAND: NET IMPORTS OF SOME MATERIALS USED IN PAINTS 1962-1966
(Quantity in metric tons; value in thousands of baht)

Commodity	1962		1963		1964		1965		1966	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Pigments	390	2,562	319	2,297	442	2,827	272	2,270	88	840
Lithopone (zinc sulfide & barium sulphate)	718	2,084	546	1,554	664	1,930	927	2,814	898	2,706
Clay & kaolin	1,234	1,608	2,851	3,870	1,628	2,063	2,346	3,634	2,476	2,982
Ultramarine blue	161	931	41	255	101	603	123	712	70	439
Copper & aluminium powders & flakes	20	560	22	669	21	586	20	520	6	204
Linseed oil	34	324	33	268	96	807	264	2,269	11	79
Linseed oil, oxidized blown or boiled	502	4,734	606	5,314	520	4,610	447	3,775	603	4,824
Tung oil	-13	390	-67	-187	-36	-124	-30	-70	-2	66
Soya bean oil	2	21	9	72	30	238	110	939	4	29
Castor oil	-9	39	-25	-20	-25	-84	-11	25	21	286
Driers prepared	8	156	34	303	20	228	17	158	3	58
Putty, filling & stopping materials	127	1,240	202	1,978	351	3,241	455	5,104	899	7,530

Extender pigments — gypsum, calcium carbonate, and kaolin — are also imported. All mentioned materials are available locally, but are not used due to variable quality.

Linseed oil is used in large quantities as drying oil.

Other available drying oils include tung oil and castor oil. The main obstacle for the use of these oils is, as in the case of pigments, variable quality and lack of standardization.

Thailand is exporting large quantities of natural resins which have been used from ancient times in paint and varnish. Most interior paints use varnish as a vehicle because of its faster drying and better leveling qualities. Varnish is used as a clear finish for furniture, floors, woodwork, etc. but is not used in exterior paints. Table 33 gives quantity and value of some natural resins mainly exported from Thailand. The most important export commodity is gum dammar and sticklac. Next to India Thailand is the second largest lac producing country, Figures for 1966 show that Thailand exported 12,405 tons of seedlac and only 663 tons of shellac. Seedlac is obtained from sticklac cuttings by heating and after further treatment with chemicals gives shellac. Seedlac is more suitable as export commodity than shellac due to its longer storage life. Lac producers are facing difficulties as a result of fluctuating and decreasing prices which are influencing the farmers to cut down their trees and grow other crops. It is believed that strict quality standards would result is in increased value of exports.

TABLE 33

THAILAND: NET EXPORTS OF NATURAL RESINS USED IN PAINTS, 1962-1966

(Quantity in metric tons; value in thousands of baht)

Commodity	1962		1963		1964		1965		1966	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Gum dammar	1,163	3,440	1,427	3,977	1,481	3,730	1,747	3,616	875	1,634
Shellac, crude	0.1	1	0.2	-46	57	490	975	6,342	663	5,020
Lac, seed	13,168	51,193	8,279	26,342	8,100	30,290	14,424	53,270	12,405	46,307
Sticklac	1,469	5,062	3,121	9,231	2,873	9,262	2,802	10,547	3,005	10,019
Natural gums, resins, balsam & lacs, n.e.s.	19.2	52	-50	-816	-14	-568	-52	-1,186	-128	1,885

Source: Department of Customs.

The demand for solvents and thinners appears to be still too low to justify local production. The production cost of petrochemical solvents is higher than the cost of mineral solvents and it can be produced economically only on a large scale. Dr. H. Thate in his report[1/] is of the opinion that the total amount of chemical solvents, imported as such or imported in any form of prepared paint, will not exceed 3,000 tons per year and that local production is therefore not possible. Approval has been given by the Board of Investment to three companies to produce by fermentation of bagasse 1,800 tons per annum of butanol, 1,000 tons per annum of acetone and some ethyl alcohol. The most important one is Bangkok Chemical Industry Ltd. with a registered capital of 34 million baht. As synthetic resin local manufacturers mainly use alkyd resins and polyvinyl acetate. An application to produce 1,200 tons of polyvinyl acetate by polymerization from monomer is under consideration. Local production of monomer is not yet considerred.

Paint is manufactured on a small scale in a large number of manufacturing shops. There are twenty eight paint factories registered with the Ministry of Industry. Twenty-two are located in Bangkok and Thon Buri. Only four employ more than ten workers and a majority employs between two and six. Total reported capital investment in this industry amounts to about 30 million baht.

The only plant producing paint on an industrial scale is the Metropolitan Paint Factory located 28 kilometres from Bangkok on the Nakhon Pathom highway. The factory's registered capital is 16 million baht and products include synthetic enamels, emulsion and ready mixed paints, primers, and varnishes.

1/ THATE, H. (1965). — "Report on Possibilities of Manufacturing Petrochemical Products in Thailand". p. 12 (Board of Investment: Bangkok)

Maximum capacity per year is:-

Enamel paint, 120 tons
Undercoat paint, 420 tons
Distemper paint, 420 tons
Oil base paint, 120 tons
Emulsion paint, 120 tons
Synthetic paint, 120 tons

12. PLASTICS

A. Imports

There is no local manufacture of plastic raw materials, and semi-manufactured and compound materials from plastics are imported in Thailand at the high rate. The percentage of quality and value increase during 1965 were 27 per cent and 26 per cent respectively, and during 1966, 41 per cent and 33 per cent. In absolute figures, imports during 1966 were 36,000 tons, valued at 337 million baht. These figures included all plastics and compounding material. Table 34 gives quantity and value of plastics materials mainly applied for building (plastics fibres and textiles are not included).

B. Plans for plastic industry

Many plastics products such as flooring, down pipes and guttering, thermal insulating materials, and corrugated roofing are already well known in Thailand. Imports of basic plastic materials are constantly increasing and steps have already been made to examine the possibilities for the installation of manufacturing plants. So far, a 5,000 tons PVC plant has been approved by the Board of Investment in 1967 and a feasibility survey has been initiated by the Union Carbide Company for a production of polyethylene.

The PVC project is based on carbide and includes an electrolysis unit. On condition that there is surplus ethylene

TABLE 34

THAILAND: IMPORT OF SOME PLASTICS MATERIALS 1962-1966

Commodity	1962		1963		1964		1965 1/		1966 2/	
	Quantity (Tons)	Value (Dollars)	Quantity (Tons)	Value (Dollars)	Quantity (Tons)	Value (Dollars)	Quantity (Tons)	Value (Dollars)	Quantity (Tons)	Value (Dollars)
Synthetic plastic materials, n.e.s.	4,906,626	2,175,000	7,426,412	3,090,000	12,425,449	4,860,000	16,678,639	6,750,000	20,832	7,706,950
Synthetic resins & hot hardener prepared as glues for industrial use.	1,203,143	446,000	2,091,574	682,000	2,569,058	784,000	2,044,098	724,000	1,096	365,000
Plastic, semi-manufactured, tubes and pipes, rods, bars, sheet a film, etc.	2,331.0	1,671,062	2,651.7	1,825,020	2,617.4	1,785,000	2,220.4	1,540,000	1,205	876,000

Source: Department of Customs.

1/ Does not include fibres and textiles.

2/ January till September, only.

available, the extension of production in the future may be based on dichloroethane, which after cracking yields vinyl ehloride and hydrochloric acid[1].

1/ THATE, H. (1967). — "The Chemical Industry of Thailand" (Board of Investment : Bangkok)

ANNEX 1

INDEXES

Year	Consumer Price Index	Wholesale Price Index	Construction Material Index	Implicit GNP Deflator
	1962 = 100	1962 = 100	1962 = 100	1962 = 100
1957	96.5	90.06	91.36	93.77
1958	102.1	94.37	89.58	96.81
1959	97.2	88.27	89.71	93.81
1960	96.4	87.07	90.09	93.87
1961	97.6	94.07	90.21	96.77
1962	100.0	100.00	100.00	100.00
1963	100.9	93.68	99.06	96.21
1964	102.9	88.11	99.66	95.63
1965	103.7	89.57	99.52	96.33

Source: OFFICE OF THE NATIONAL ECONOMIC DEVELOPMENT BOARD (1966). — "National Income of Thailand. 1965 Edition". (Officer of the Prime Minister : Bangkok).

ANNEX 2

LABOUR, MATERIAL, AND JOB COSTS[1/]

A. Labour rates

Worker	Rate, baht per hour	
	Bangkok	Up country
Mason	7 - 10	9 - 15
Carpenter	6.20 - 7.50	8 - 10
Electrician	7 - 10	9 - 15
Plumber	5 - 6.50	6 - 9
Glazier	4 - 5	5 - 7
Painter	5 - 6	6 - 8
Steel bender	4 - 6	4 - 6
Concrete mixer	4	4
Welder	6.25 - 10	8 - 12
Equipment operator	4	6
Mechanic	4	6
General workman	2 - 3	1 - 2

B. Material prices

Material	Unit	Unit price in baht
Silica cement	ton	465
Portland cement	ton	530
Super cement	ton	560
Coarse sand	m^3	45
Fine sand	m^3	38
Reinforced steel	ton	2,950
Crushed aggregate No. 1	m^3	76
Crushed aggregate No. 2	m^3	83
Crushed aggregate No. 3	m^3	70
Gravel aggregate	m^3	95

1/ Compiled by Department of Building Technology, Bangkok Technical Institute.

Material	Unit	Unit price in baht
Soft wood	ft^3	33
Hard wood	ft^3	44
Quick lime	m^3	250
Hydrated lime	ton	400
Water	m^3	1.50
Steel profile	ton	3,500

C. Job costs

Job	Unit	Cost in baht
Excavation		
Excavate over site to remove top soil	m^3	8
15 cm deep and get out (scraping)	m^2	2
Excavate over site to reduce levels and get out (cut)	m^3	10 - 15
Excavate surface trench not exceeding 1.5 m deep and get out (cut)	m^3	10 - 15
Return full in and well ram excavated material around foundations (fill)	m^3	5
Load and cart away from site surplus excavated material (cut and haul)	m^3	6
Reinforced concrete (1:2:4) (labour and materials)		
15 cm concrete slab (unreinforced)	m^2	57
15 cm concrete slab reinforced with mesh	m^2	92
Wall construction (labour and materials)		
15 cm solid concrete block wall in cement mortar (1:4)	m^2	80
20 cm hollow concrete block wall in cement	m^2	87
15 cm reinforced concrete (1:2:4) wall including formwork and reinforcement	m^2	160
10 cm Mon brick wall including formwork	m^2	64
14 cm fired brick wall (no plastering)	m^2	110

Job	Unit	Cost in baht
25 cm wood wool wall including formwork	m^2	58
12.5 cm wood wool wall including formwork	m^2	50
0.6 cm teak plywood wall including formwork	m^2	90
10 cm hollow concrete block wall in cement mortar (1:4)	m^2	72
15 cm hollow concrete block wall in cement mortar (1:4)	m^2	80
"Roman Tile" asbestos wall including formwork and accessories (1.00 x 1.20 m)	m^2	55
Asbestos Louver Sheets wall including formwork and accessories	m^2	60
Soft wood wall	m^2	45
Hard wood wall	m^2	53
Bamboo Mat-Lime Plastered	m^2	45
Wall and ceiling finishing (labour and materials)		
Internal or external rendering (cement and sand 1:4) including all sundry labours on block walls or concrete walls including raking out joints or hacking for key	m^2	18
Internal rendering as last on concrete soffits including hacking for key	m^2	15
Coloured Tyrolean external rendering, including all arrises and sundry labours on block walls or concrete walls including raking out joints or hacking for key	m^2	15
$\frac{1}{2}$ inch termite-proofed insulating boarding to soffits and fixing to timber joints including all cutting and waste	m^2	58
$\frac{1}{2}$ inch acoustic tile 24 inches x 24 inches to soffits and fixing to timber joists	m^2	100
$\frac{1}{4}$ inch x 6 inches white glazed wall tiling on and including $\frac{1}{2}$ inch cement and sand (1:3) screed	m^2	85
$\frac{3}{4}$ inch x 3:16 inches ceramic mesaic on and including cement and sand (1:3) backing	m^2	100

Job	Unit	Cost in baht
Roof construction (labour and materials)		
Single pitch roof with timber trusses and purlins and independant rafters up to 6 m span and 1.20 m rise (no roofing cover)	m^2	55
Double pitch roof with steel tabular trusses to 12 m span and 1.20 m rise	m^2	300
Roof covering (labour and materials)		
Standard corrugated asbestos (large size) roofing fixed to timber purlins (Sheet rises 102 x 120 cm)	ea	
102 x 150 cm		50
102 x 180 cm		65
102 x 240 cm		86
Standard (small size) corrugated asbestos roofing fixed to timber purlins (sheet size 54 x 150 cm)	m^2	45
"Roman tiles" corrugated asbestos roofing fixed to timber purlins (size 50 x 90 cm)	m^2	34
50 x 120 cm)		35
50 x 150 cm)		32
50 x 180 cm)		32
Three-layer felt roofing laid on and including (av.) $1\frac{1}{2}$ inches cement and sand screed	m^2	60
Corrugated (protected) steel sheet 22 SWG	m^2	30
Corrugated plastic sheeting (translucent sheets)	m^2	60
Concrete tiles plain	m^2	100
Clay tiles	m^2	200
Prepare and two coats of cement paint on rendered walls	m^2	12
Ditto on rendered ceilings	m^2	12
Prepare and two coats of emulsion paint on rendered wall	m^2	14
Ditto on rendered ceilings	m^2	14

Job	Unit	Cost in baht
Prepare and three coats of oil colour on metal work	m^2	20
Knot, prime, stop and two undercoats and one finishing coat on woodwork	m^2	18
Prepare body in and two coats wax polish on woodwork	m^2	6
Floor finishing (labour and materials)		
5 cm cement and sand paving troweled hard and smooth	m^2	29
5 cm granolithic paving (1:1:2) troweled hard and smooth	m^2	45
2.5 cm terrazzo tile paving 20 cm x 20 cm with marble chippings	m^2	50
2 cm thermoplastic tiles bedded and jointed (asphalt tiles)	m^2	70
2 mm vinyl tiles bedded and jointed	m^2	60
($\frac{1}{2}$")..... wood block tongued and grooved flooring	m^2	40
2.5 cm cement and sand (1:7) floated bed for pavings	m^2	10
2.5 mm cement and sand (1:4) floated bed for pavings	m^2	13
Clay tile	m^2	50
Concrete tile	m^2	40
Linoleum	m^2	125
Vinyl asbestos	m^2	55
Asphalt (in situ)	m^2	15
Rubber sheet	m^2	180
Parquet (teak)	m^2	120
Plumbing and drainage (materials only except as noted)		
$\frac{1}{2}$" galvanized mild steel tubing including screwed lead joints	lm	7.5
$\frac{3}{4}$" ditto	lm	9
1" ditto	lm	12

Job	Unit	Cost in baht
Extra for 1" elbow	ea	2.50
Extra for $\frac{3}{4}$" tee	ea	2
Extra for 1" tee	ea	3.5
(4") .... diameter asbestos cement drain pipes including all joints and laying in trench	lm	20
6" ditto	lm	40
4" diameter cast-iron drain pipes including all joints and laying in trench	lm	48
6" ditto	lm	92
Toilet seat, oriental type	ea	
1) Cement		35
2) Ceramic		120
Toilet seat, flush type	ea	
1) European made (plus installation)		1,300
2) Japanese made (plus installation)		900
Wash basin	ea	
1) European made (plus installation)	ea	500
2) Japanese made (plus installation)	ea	400
Door and window (materials only)		
Door Window	ea	
1) Plain wooden door		
a) soft wood 100 x 200 cm		85
b) hard wood 100 x 200 cm		120
2) Plywood door (teak)		
a) 70 x 200 cm		190
b) 80 x 200 cm		200
c) 90 x 200 cm		220
d) 100 x 200 cm		230

Job	Unit	Cost in baht
Door Window		
3) Glass door		
a) plain glass 100 x 200 cm		370
b) filter glass 100 x 200 cm		550
Piling (labour and materials)		
Wood pile		
ø4" x 4.00 m	ea	14
ø5" x 5.00 m	ea	22
ø6" x 6.00 m	ea	43
ø8" x 8.00 m	ea	115
ø10" x 10.00 m	ea	670
ø12" x 10.00 m	ea	670
ø14" x 14.00 m	ea	670
Prestressed concrete pile (labour and materials)		
18 cm x 18 cm x 7.00 m	ea	330
18 cm x 18 cm x 6.00 m	ea	290
18 cm x 18 cm x 8.00 m	ea	370
35 cm x 35 cm x 16.00 m	ea	3,400
35 cm x 35 cm x 17.00 m	ea	3,550
35 cm x 35 cm x 18.00 m	ea	3,700
35 cm x 35 cm x 19.00 m	ea	3,850
35 cm x 35 cm x 20.00 m	ea	4,000

ANNEX 3

VALUE OF EXPORTS AND IMPORTS OF BUILDING MATERIALS 1962-1966

All prices calculated in U.S.$ ($ 1 = 20.8 baht)

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Teak	20,950	8,180,000	20,900	6,570,000	-	5,590,000	100,500	9,630,000	-	11,680,000
- Wood, yang	26	2,550,000	4,810	3,025,000	-	3,295,000	9,370	2,705,000	-	1,678,000
- Wood other than teak and yang	8,460	392,000	40,900	671,000	-	724,000	37,450	1,044,000	-	948,000
- Cement Portland	189,000	3,010,000	384,000	2,620,000	219,200	1,118,000	215,000	1,966,000	2,200,000	178,000
- Clinker, cement	-	-	-	-	-	-	-	-	1,850,000	-
- Lime, ordinary	200	344	10	396	-	-	245	335	-	-
- Cement, white	23,300	1,265	85,800	1,590	57,000	-	31,600	3,445	21,700	-
- Marble, worked for building and monument	11,000	-	13,440	2,880	12,900	-	28,500	166	78,000	-
- Pipe, of asbestos-cement, cellulose fibre cement, and the like	161,000	3,420	72,700	4,550	285,500	-	318,500	14,310	662,000	-
- Asbestos boards, for building	120,500	73,800	306,500	302,500	262,000	-	396,000	202,100	541,000	-
- Refractory bricks, blocks, tiles and similar refractory construction material	167,000	-	151,300	-	184,300	-	635,000	1,082	234,000	-
- Asbestos, crude washed or ground	1,010,000	-	1,380,000	-	1,353,000	-	1,478,000	-	2,550,000	-
- Paper, kraft	1,310,000	-	1,442,000	-	1,286,000	-	1,524,000	-	2,090,000	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Concrete reinforcement rounds including tube, round and square, iron or steel	7,460,000	-	8,770,000	-	8,590,000	-	14,230,000	-	14,200,000	-
- Joists, girders, bars, and rods, of iron or steel, hot rolled, forged, extruded, cold-formed, or cold finished including precision made	2,750,000	-	2,055,000	-	2,620,000	-	2,550,000	-	3,548,000	25
- Nail, wire	1,270,000	-	1,510,000	-	1,974,000	-	2,720,000	-	2,705,000	-
- Gypsum, calcined	2,810	-	7,000	-	5,360	-	14,480	-	12,900	-
- Angles and section, of iron or steel, hot-rolled, forged, extruded, cold-formed, or cold-finished	863,000	-	1,031,000	-	1,190,000	-	1,741,000	-	2,035,000	-
- Tubes and pipes, of iron or steel, other than cast iron	3,585,000	-	5,260,000	-	4,890,000	-	3,595,000	-	3,220,000	-
- Aluminium foil, backed with paper or other reinforcing material	493,000	-	511,000	-	570,000	-	840,000	-	854,000	-
- Structures, complete or incomplete, whether or not assembled of iron or steel	820,000	-	1,331,000	-	1,514,000	-	2,740,000	-	4,700,000	-
- Parts of structures, other, of iron or steel	137,500	-	880,000	-	345,000	-	2,700,000	-	1,388,000	-
- Belts and nuts, including bolt ends and screw studs, whether or not threaded or tapped, of iron or steel	1,040,000	931	1,090,000	105	825,000	-	1,255,000	-	1,386,000	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Air-conditioning machines, self-contained, comprising a motor-driven fan and elements for changing the temperature and humidity of air.	795,000	-	1,160,000	-	1,563,000	-	2,048,000	-	3,062,000	-
- Insulated cables for electricity, including co-axial cables	3,025,000	-	3,165,000	-	1,168,000	-	2,452,000	-	2,042,000	-
- Insulated wire for electricity, including enamelled or anodised	1,688,000	30	1,360,000	-	1,190,000	-	1,225,000	-	1,099,000	-
- Refrigerators and freezers, domestic types, electric, gas or other types, self-contained unit	984,000	-	1,438,000	-	1,631,000	-	1,950,000	-	2,825,000	-
- Sand, including ground quartz	27,850	-	15,730	-	16,610	-	298,200	-	18,300	-
- Gravel, crushed stone	15,140	-	13,280	-	12,270	-	14,310	-	9,950	-
- Clay and kaolin	77,200	-	186,000	-	94,000	-	174,600	-	143,500	-
- Marbles, blocks, slabs whether sawn or not, unpolished	29,550	796	19,500	-	70,300	-	54,400	-	10,840	-
- Building and monumental stones, not worked, n.e.s.	2,630	-	2,900	-	2,025	-	18,420	-	17,850	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Floor coverings, prepared on a base of paper or paper-board, whether or not cut to size, with or without coating of linoleum compounds	133,000	-	119,800	-	145,800	-	340,000	-	532,000	-
- Cement fondu	540	-	748	-	906	-	1,834	-	1,880	-
- Cement, n.e.s.	373,000	-	29,000	-	1,913	-	414,000	-	1,640,000	-
- Building materials, of asphalt or similar materials	20,950	-	15,250	-	32,700	-	17,500	-	18,400	-
- Building materials, of vegetable fibre straw, wood shavings or wood waste, agglomerated with cement, plaster or with other mineral binding substances	26,400	-	20,600	115	61,000	-	76,500	-	85,500	-
- Building materials of asbestos cement cellulose, fibre cement or the like.	397,000	6,890	215,500	528	106,300	-	85,900	-	64,000	-
- Building materials, of asbestos, of mixtures with a basis of asbestos and mixtures with a basis of asbestos and magnesium carbonate	21,400	-	23,300	231	-	-	1,148	-	9,350	-
- Building bricks, including flooring blocks, support or filler tiles and the like, of brisk earth or of ordinary baked clay	121	2,360	3,085	395	813	-	1,351	-	4,550	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Glazed setts, flags and paving, hearth and wall tiles, of brick earth or of ordinary baked clay	338,000	-	325,000	-	568,000	-	704,000	-	955,000	-
- Unglazed setts, flags and paving, hearth and wall tiles, other than brick earth or ordinary baked clay	45,600	10	49,800	48	153,200	-	105,000	-	-	-
- Glazed setts, flags and paving, hearth and wall tiles, other than brick earth or ordinary baked clay	175,500	-	327,000	-	465,000	-	268,800	-	390,500	-
- Heat-insulating bricks, blocks, tiles, and other insulating construction materials of infusorial earth, kieselguhr, siliceous fossil meal, or similar siliceous earth	4,260	-	554	-	2,440	40	14,470	-	7,340	-
- Veneer sheets and sheets for plywood	1,500	46,000	403	18,700	-	12,160	-	-	2,142	-
- Plywood, blockboard, laminated board, battenboard and veneered panels	86,000	46,700	43,500	28,400	547	5,430	-	-	53,200	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Hard boards	15,820	433	64,300	-	50,700	-	57,500	-	187,000	-
- Soft board or insulating board	63,000	-	111,100	-	69,800	-	116,700	-	266,200	-
- Building material of plastering material	2,290	-	-	-	-	-	-	-	-	-
- Brick, tile, slabs, paving blocks, squares and other construction material of pressed or mould glass	24,650	517	63,500	2,310	35,100	-	40,500	-	35,600	-
- Aluminium foil, ether, whether or not embossed, cut to shape, perforated, coated, printed	200,500	-	116,800	-	121,400	-	135,800	-	211,200	-
- Cement mixers	-	-	-	-	-	-	-	-	187,000	-
- Concrete mixers	-	-	-	-	-	-	-	-	754,000	-
- Parts of concrete mixer	-	-	-	-	-	-	-	-	35,420	-
- Parts of cement mixer	-	-	-	-	-	-	-	-	1,792	-
- Gypsum crude	-	-	1,635	-	3,550	-	-	-	-	-
- Articles of concrete, n.e.s.	-	-	-	-	-	65,600	-	-	-	-
- Articles of cement, including slag cement, n.e.s.	-	-	-	-	-	28	6,090	-	50	-
- Piping conduits and guttering, including angles, bends, and similar fittings of brick earth or of ordinary baked clay. Unglased setts, flags and paving hearth and wall tiles, of brick earth or of ordinary baked clay	-	-	-		147,300	-	-	-	317,000	-

Commodities	1962		1963		1964		1965		1966	
	Import	Export	Import	Export	Import	Export	Import	Export	Import	Export
- Piping conduits and guttering, including angles, bends and similar fittings other than brick earth or of ordinary baked clay. Unglazed setts, flags and paving, hearth and wall tiles, other than brick earth or of ordinary baked clay.	-	-	-	-	-	-	-	-	137,000	-
- Sinks, wash-basins, bidets, water closet pan, urinal baths and the like, sanitary fitting, of iron or steel	77,600	-	163,500	-	227,200	-	327,500	-	487,000	-
- Sinks, wash-basins, bidets, water closet pans, urinals, baths & the like, sanitary fittings of ceramic	481,000	-	694,000	-	742,000	-	1,030,000	-	1,300,000	-
- Sinks, wash-basins, bidets, water closet pans, urinals, baths and the like, sanitary fittings of other material except metal	18,320	-	34,600	-	46,500	-	22,200	-	41,400	-

ANNEX 4

RAW MATERIALS FOR BUILDING MATERIALS MANUFACTURE

Legend:
- ○ Indications exist
- ◒ Indications proven
- ● Exploited or produced
- △ Exploited occasionally
- ▲ Exported
- ⬇ Research conducted, exploitation projected
- ⊞ Available
- □ Unknown
- ⊠ Not produced

METALLIC MINERALS	1	Alumina	□
	2	Antimony	▲
	3	Chromite	◒
	4	Copper	■
	5	Iron	▲
	6	Lead	●
	7	Magnesite	□
	8	Manganese	●
	9	Molybdenum	□
	10	Nickel	□
	11	Tin	▲
	12	Titanium	●
	13	Wolfram	●
	14	Zinc	◒
CLAY AND NON-METALLIC MATERIALS	15	Asbestos	○
	16	Bloated clay	○
	17	Clay	●
	18	Diatomites	○
	19	Fluorite	●
	20	Fly ash	◒
	21	Glass (silica)	●
	22	Granite	◒
	23	Gravel	▲
	24	Gypsum	▲
	25	Laterite	●
	26	Lignite	◒
	27	Lime	●
	28	Limestone	◒
	29	Marl	◒
	30	Metallurgical slag	◒
	31	Mica	○
	32	Oil shale	⬇
	33	Pozzolana	○
	34	Sand (quarry)	□
	35	Sand (river)	◒
	36	Sand (sea)	◒
	37	Silicates (porcel.)	◒
	38	Slate	□
	39	Soapstone	●
	40	Vermiculite	□
ANIMAL PRODUCTS	41	Bones	▲
	42	Feathers	▲
	43	Hides and skins	▲
	44	Hoofs	●
	45	Horns	▲
	46	Scales, fish	▲
PLANT PRODUCTS — Fibres	47	Pagasse	●
	48	Cane	●
	49	Cotton	●
	50	Jute	▲
	51	Kapok	▲
	52	Kenaf	▲
	53	Ramie	▲
	54	Coconut	▲
	55	Water hyacinth	△
	56	Bamboo	●
Wood	57	Daeng	●
	58	Kh'am	●
	59	Mangrove	●
	60	Phluang	●
	61	Pradu	●
	62	Takhian	●
	63	Teak	▲
	64	Tong/Rang	●
	65	Yang	▲
MISCELLANEOUS MATERIALS — Oil	66	Castor	△
	67	Coconut	●
	68	Corn	⊠
	69	Cotton	⬇
	70	Pearut	●
	71	Rice bran	●
	72	Rubber seed	⊠
	73	Sesame seed	⬇
	74	Soya bean	⬇
	75	Tung	●
	76	Yang	●
Starch	77	Cassava	▲
	78	Corn	⊠
	79	Mung bean	△
	80	Peanut	⊠
	81	Soya bean	⊠
Resin-Tar	82	Creosote	⊠
	83	Gamboge	▲
	84	Gum benzoin	▲
	85	Gum dammer	▲
	86	Lac and shellac	▲
Vegetable waste	87	Coconut husk	●
	88	Rice husk	●
	89	Tamarind seed	⊞
	90	Tea waste	⊞
	91	Rice straw	⬇
	92	Rubber	△