REPORT
ON
THE SMALL AND MEDIUM SCALE INDUSTRIES PROJECT IN GHANA

MARCH 1964

OVERSEAS TECHNICAL COOPERATION AGENCY OF JAPAN

PREFACE

At the request of the Government of Republic of Ghana, it was undertaken by the Government of Japan to conduct the basic field survey necessary for the development project of the Ghanaian small and medium scale enterprises, giving the executing commission to the Overseas Technical Cooperation Agency in Tokyo.

The Overseas Technical Cooperation Agency (OTCA) realized that the Ghanaian project for the minor enterprises would assume considerable industrial importance in utilizing the domestic producing material into the products for itself, and organized a survey team which consisted of the members with exerpt knowledge in such respective fields as plywood, porcelain and earthenwares, paper and pulp, vegetable fiber (rush) utilization, nail and wire, and toy. Mr. Kentaro Kon, director of the Toyoo Plywood Co., was appointed leader of the team.

The team started from Tokyo on the 14th of November, 1963 to Ghana, where it stayed for about one month. During the period, the survey team members carried out the diligent specialized studies, discussed the project to chase the feasibility, made the field investigations as best as possible, and gathered the available data necessary for the development of the projects.

The Government of Ghana rendered much valuable assistance and cooperation to the survey team so that the survey could result in a considerable success and its results be represented in this survey report.

The OTCA was established in July 1962 by the Government of Japan as the executing organization for the overseas technical cooperation on governmental basis. Since then, it has been exerting the best efforts to live up with the purpose of its establishment, receiving the trainees from abroad, and despatching its technical experts or conducting preliminary survey for development projects.

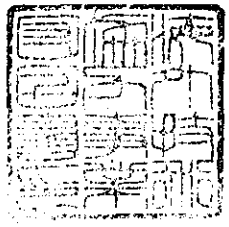
Now that the survey has been successfully carried out, it should be more than appreciated if this survey report should make contributions to facilitating the progress of the Ghanaian development projects for minor industries, so that the friendly relationship as well as technical ties might be more fastened between Ghana and Japan.

Lastly, our hearfelt thanks hereby should be expressed to the officials and personnels of the Government of Ghana who gave their ungrudging kindness and assistance to the survey team.

Shinichi Shibusawa

Director General

Overseas Technical Cooperation Agency



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A. INTRODUCTION

A-1. Circumustantial Background Let to Despatch of Survey Team.

In March, 1964, on the occasion when the Ghanaian Economic Commission Group led by the Minister of Agriculture paid a visit to Japan, it officially requested that a survey team should be despatched to Ghana by the Government of Japan for conducting the field survey on the Ghanaian project for the minor enterprises. The nation's project aims at the development of its small and medium scale industries which should cover the whole process to yield certain products out of its rich forestal and other resources or materials, ranging 18 categories of industry.

The preliminary study was made on the proposed 18 items of industry, among which were (1) paper and cardboard paper, (2) footware (made of rubber, plastic material and leather), (3) sugar, (4) glassware, (5) plywood and chip-board, (6) porcelain and earthenware, (7) electrical appliances (assembly work of TV-set, heater, refrigerator, etc.), (8) nail and wire, (9) plastic material (forming process). Further studies selected several items for the Government of Japan to finally acquire a possible outlook for sending its field survey team.

Consequently, the notice to the effect was sent to the Government of Ghana at the beginning of July, inquiring for the desirable items to which heavy priority should be preferrably given in its project among the listed categories of industry.

The Ghanaian government gave the reply through Japanese embassy in Accra on the 23rd of September, and requested the Japanese survey team to be despatched for those 6 categories of industries such as (1) paper and pulp, (2) plywood, (3) porcelain and earthenware, (4) vegetable fiber utilization, (5) nail and wire, and (6) toys.

A-2. Composition of Survey Team.

Assigned subject	Name
Plywood	Kentaro Kon
Vegetable fiber	Hiroshi Ito
Toy	Kinichiro Shimizu
Porcelain and earthenware	Ryozo Naito
Nail and Wire	Masumi Sato
Pulp and Paper	Shigeru Ohashi

A-3. Scope of Survey.

Entering into the details of the scopes of the 6-industries, the survey was carried out to investigate the following target subjects:-

(1) Survey for the possible utilization of the existing materials resources in Ghana.

Qualification of available materials, their distribution status, economical utilization from a transportation standpoint included, etc... Further, the test pieces of materials shall be brought to Japan for the closer testing and experiments, if necessary.

(2) Availability of the necessary intermediate materials.

(3) Preestimate of the future demand.

(4) Investigation for the present status of the relative industries.

(5) Investigation for the labour market.

(6) Equipment planning.

According to the above subjects, the survey should be conducted to make out the flow charts of required process, the outline equipment planning and finally the estimate of the costs for individual categories of industry.

At this moment of compiling the report, however, it must be admitted that some parts of the inital purpose could have not been achieved due to the circumstantial difficulties, and that there are many investigation subjects to be still pursued for completion.

A-4. Outline of the survey results.

The survey results for the individual categories of industry are outlined as follows:-

(1) Paper and pulp.

In Ghana there is not a paper mill that can give the processing treatment on the material pulp. An existing paper factory, located in Takoradi city famous for the wood shipping port, is only making the corrugated cardboard box, packing bag, and toilet paper roll out of the imported material finished paper. The factory's output is called 5,000 tons for a year, and nothing of its products but the toilet paper is the direct consumable goods for the everyday life.

The demand for paper in Ghana chiefly consists of the use for newspaper, printing and writing paper, packing paper, board paper.

Among them, the printing and writing paper are mostly used in the governmental publication, textbook, office forms and writing paper, and notebook. Therefore, the greater part of the consumption comes from the governmental and industrial used under the present circumustances.

On the other hand, the higher the peoples' living standard arises, the more demand would be expected to be increasing sharply. The rapid modernization of the country, now under way, would no doubt bring about the drastic increase of the paper consumption and demand accordingly.

The southwest part of Ghana is covered by the forestal zone, which is equivalent to approximately one-third of the whole area of Ghanaian territory. Therefore, it is naturally induced that a pulp paper factory should be considered to be constructed near the district utilizing the rich resources at hand, and the blueprint of the Planning Commission of the Ghanaian government disclosed that the pulp paper factory was planned and that the construction site is prearranged to be at Asankrangwa (by the Tano river). However, its early materialization of the construction should be difficult. For it turned out that the construction at least at the interior of the district would not possibly be carried out because of the reasons pointed out in the report. Meanwhile, the utilization office of Agricultural Ministry at Takoradi has a mind to designate Bepose as a construction site nearby Tokoradi along the Pula river, a distribution center of material woods.

Another construction project of a paper mill is separately under consideration, which is to utilize the bagasse as the material for paper. Favoured by its location and available at the cheaper cost prices than the wood pulp, the project is very prospective to be materialized.

The cheap availability of the bagasse material will slide into the fuel cost estimate at the same time. Besides being free from the material transportation charges, the neighbourhood of Akuse seems to satisfy the conditions suitable for factory site. Presently the sugar refinery is in operation so that the existing services for electricity and water supply may be easily extended for the use of the new paper factory. Furthermore, being near Accra, the transportation of the products for marketing is very convenient as well

as the auxiliary materials purchases.

The subjects items inquired for in the investigation are shown as follows:-

I. Supply and Consumption of paper in Ghana.
   (1) Import of paper and cardboard.
   (2) Domestic production and domestic consumption.

II. Observations on the Pulp and Paper Manufacturing plan formed by Ghanaian Government.
   (1) Production capacity
   (2) Raw Material
      a) Bagasse
      b) Wood pulp
   (3) Mill site

III. Our Recommendable plan for the Manufacture of Pulp and Paper from Bagasse
   (1) Outline
   (2) Flow sheet.
   (3) Recommendable layout for the factory.

IV. The Cost of the Bagasse Pulp and Paper Mill.
   (1) Initial Cost.
      a) Plant Cost
      b) Building cost
   (2) Operation Cost.
      a) Raw material cost
      b) Labours cost
      c) Overhead cost

V. Profit estimated and Saving amount of Foreign Currency.
   (1) Annual profit estimated
   (2) Saving amount of Roreign Currency .

The study in this regard has revealed that the proposed paper mill should have the capacity of 50 tons per day as the optimum size of production, and that the required investment should amount to £2,109,960-0-0 in total. According to the project when worked as intended originally, the annual profit is 15% against the invested mOney, achieving a saving of 70% in the outflow of the foreign currency.

(2) Porcelain and earthenware.

In Ghana there is not a modernized factory of ceramic manufacture. The native people make the pottery and a few earthenware products in the ancient traditional manner, so the imported goods have to be used for most of daily use ceramic necessities or construction earthen materials.

Therefore, the establishment of the ceramic industry should be of a great improvement to the peoples' living standard and to the development of the country at the same time. The industry would not probably bring in a substantial economic effect unless the main materials such as clay, feldpar and quartz could be available as the natural products of Ghana. Accordingly, the initial target investigation subject was to set to locate the material distribution condition in Ghana. The field survey was carried out for an area ranging 2,500 miles over the land where included Accra, Kumasi, Tamale, Bolgatanga, Navrongo, Dunkwa, Takoradi, Nauli, Cape Coast, Mouri, Saltpond, Akosombo and Atianvi, etc., while the necessary test pieces of materials were gathered for further examinations. As the result, it was discovered that there existed good quantities of superior kaoline deposits in the district neighbouring the Saltpond by-pass.

The feldspar material are rich in the pegmatite dykes scattered almost all over the land of Ghana, and the quartz are also available in many places. Especially, it was recognized that the superior quartz had been left unused in quantities at the gold producing center at Dunkwa. As for the main materials, the survey results were very satisfactory for the development of the ceramic industry.

For the ceramic industry to be established, important is to secure the water supply resources and electricity service. According to the Geological Survey of Ghana, there is a rich underground currency available in the south coastal area. As regards the electricity, it is scheduled that a magnificient scale of hydro-power plant, now under construction at Akosombo, should be expectedly completed in 1967.

Furthermore, the fundamental industries would be soon under way to the rapid development so as to upbring and enhance the country's industrial level. In keeping up with the exploitation to

chase the development, the minor industries including the ceramics should make a progress, resulting in the direct profit given to the peoples' live.

Those listed below are the investigation subjects probed in the survey:-

I. Market conditions of porcelain and earthenwares.

II. Distribution conditionsoof ceramic materials.

III. Production plan of porcelain and other ceramic wares.

IV. Manufacturing process, equipments and their prices.

V. Slection of the suitable factory site.

VI. Estimates of various costs and charges.

(1) Construction cost.
(2) Material cost.
(3) Labour cost.
(4) Indirect cost.
(5) Total cost.

VII. Annual profit.

VIII. Conclusion.

The survey came to a general conclusion that: (1) the main materials could be available with the home-producing ones, (2) the production scale would be set to £180,000-0-0 output for a year, suitable for the anticipatory demand, and (3) the factory construction location would be selected in the west coastal area. The required amount of investment is estimated approximately £125,835-0-0. The profit ratio for a year is about 13% over the invested amount, enabling a saving of so much as £54,165-0-0 in the outflow of the foreign currency for a year.

(3) Plywood:

Ghana which has long been known as a timber exporting country, emerged into the world's timber market after World War II when her rich forest resources which are available in many different species came to be recognized by European countries. Export of Ghana's round and sawn timbers to Europe has ever since been on the steady uptrend, contributing in a large measure to the country's foreign

currency acquisition.

It goes without saying, however, that from the viewpoint of upholding balanced economy which is of utter importance to every developing nation like Ghana, it is preferable if the wood materials are exported not in round or sawn timbers but in processed wooden articles since they would sell at higher prices and earn more export income. Measures to this end are therefore urged to be taken in order that the present inflow of foreign made plywoods be prevented and the outflow of Ghana's foreign currency reserve may be checked.

The present plan for the construction of a plywood factory has been drawn up with the objective of materializing the above suggestion.

Plywood boards required for the construction of schools, hospitals, hotels and apartment houses in Ghana are all imported from abroad at present. It may be worth mentioning here that the investigations of this time have revealed that the proposed plywood factory will turn out sufficient veneer products to meet with such increasing domestic demand. The investigations also lead to the conviction that the factory will be capable of producing sufficient quantities of plywood boards that would serve as an important export item of the country.

The following are the major items dealt with in this report.

I. Demand and Supply Situation.

II. Kinds, quality and colouration of veneer plywood boards available on the market.

III. Quality Test.

IV. Project for Establishing a New Plywood Factory.

- IV-1 Construction Site.
- IV-2 Factory Layout and Flow Sheet.
- IV-3 Cost of Factory Facilities, and Workers.
- IV-4 Monthly Production Cost.
- IV-5 Estimated Annual Profit.
- IV-6 Conclusion

Brief description of the proposed factory is as follows.

Monthly production of 237,000 sheets (4' x 8' x 4 mm) has been drawn up on the basis of the low cost and abundance of the wood materials as well as of the expected expansion of the domestic

demand and the increase in foreign currency acquision by export. The factory is suggested to be constructed either in Takoradi or Tema. The total investment required for the construction is estimated at £177,120 which may appear an exceedingly large amount. However, since the annual profit rate against the total investment amount is expected to reach as high as 46% and the yearly foreign currency saving as much as £1,148,000, the proposed project would not only be commercially practicable but would also positively contribute to Ghana's economy.

(4) Wire and Nail

There are two nail-making factories in Ghana and the present self-supply rate of nail is a little exceeding 50% for the demand. On the other hand, with the increase of the expansion of the investment on the building and other construction, the demand is sharply rising, and it has come up to the stage that a third factory of the same scale as those existing should be needed not so far in the future. It is why the project should be expected to expedite in materializing itself.

No material wire for nail has not yet produced in Ghana, but all imported. Besides being the materials for nail manufacture, the demand for the wire would come out from the used such as binding, construction and fence materials.

Consequently, if all these demand were satisfied by the home products, it should make an unlimitted contribution to the Ghanaian industrialization and the saving of the outflow of foreign currency as well.

The steel rod required as material for wire could not be produced by the steel works now under construction in Tema. Therefore, it should be a drawbackmto this project that the material steel rod must be still imported form abroad.

The investigation subject which have done in the survey are given:-

I. Market situation of iron wire.

II. Production Programme.

III. Factory layout

IV. Flow sheet and manufacturing process

V. Specifications of equipment recommended.

VI. Construction site.

VII. Construction cost.

VIII. Production cost

IX. Profit calculation.

X. Conclusion.

According to the survey results, the most desirous is the production scheme for 9,600 tons of annual wire output. The necessary investment for both galvanized steel wire and nail factories would reach at £121,310-0-0. The expected profit ratio would be 130.6% over the investment for a year, achieving a saving of 32.8% in the foreign currency. From the profitability and foreign currency saving standpoints, the project should be of a profound economical significance to be materialized as early as possible.

(5) Toy

At present the Ghanaian children for the most part are not so favoured with the toy. Even the children dwelling in the city districts could not afford to enjoy the toy. The department stores in large cities are merchandizing the imported toys indeed, but they only deal with the children of foreign residents or those of a very small upper class. The spread of the toy is thus confined to a narrow circle, and it is chiefly because the prices of toys are too expensive for the people, compared to their income standard.

Toys are made of wood, fiber and tin plate, among which the home-producing wood and fiber are quite available for the toy-manufacture. Consequently, if a rich labour and low-priced material were given, it would be surely possible for the Ghanaian for themselves to produce the toys by far cheaper than the imported ones.

In developing the project, the educational toys should be taken into consideration to be included in the production scheme. Recently scientific education has been emphasized in the preliminary and middle school education. Side by side with theoretical teaching, the scientific models are being used to produce a good practical effect. No such method is employed in the Ghanaian schools presently, but not so far in the future the demand for this purpose should arise in

quantities. The scientific education would play an important role in driving the industrialization in Ghana.

The survey covered the following investigation subjects:-

I. Consumption status of toy in Ghana.

II. Production Programme of toy.

III. Draft plan by Japan for toy factory construction.

IV. Estimate for toy factory.

V. Profit

VI. Conclusion.

According to the survey results, it is possible to realize the toy production equivalent to £126,000-0-0 for a year against the invested £94,530-0-0. Namely, the profit ration over the investment is 32%, and, meanwhile, a saving of £74,264-0-0 in the foreign currency outflow will be estimated to be effected.

The skillful technicians for press working and metal printing should become needed in the course of the development of the project. In this regard, Japan is willing to extend its assistance in fostering the required technicians.

(6) Utilization of natural rush in Ghana.

Generally in Ghana, the mattress made of vegetable fibers is in a wide use for the daily life, besides the ordinary bed. These mattress are at present imported from Hong Kong, or Japan, or other countries. On the other hand, Ghana is rich in the natural rush which is very akin to that cultivated rush in Japan. The survey was therefore focused on probing the possiblities to utilize the wild rush.

As a result of the testing of the Ghanaian rush on the weaving machine in Japan, the product was proved to be enough marketable in many respects.

Furthermore, it is quite feasible for the Japanese cultivated rush to be transplanted into Ghana where the favourite climate will make the rapid growth of rush. There is a very bright prospect over the possiblity that Ghana could make itself as one of the main rush export countries. At the present, the wild rush grows in plenty along the understreams of the Volta river, and the available quantity should amount to £240,000-0-0 through £250,000-0-0, as converted into finished products. The growing period is about

three or four months, bringing on three crops a year. The fact only assure that the abundant material rush should be available for the utilization project.

The survey in Ghana covered the following investigation subjects:-

I. Recent supply-demand status of mattress in Ghana.
II. Study on the production project of mattress.
III. Draft Plan by Japan for mattress factory consutrction.
IV. Estimate for mattress factory construction.
V. Conclusion.

According to the survey results, it is most proper to start with the production scale of 18,000 sheets (45" x 90") for a month. The production can be ensured, backed by the presently available wild rush growth.

The required capital amounts to £169,150-0-0, producing a profit ratio of 28% against the investment. The outflow of the foreign currency could be saved about £70,180-0-0. The development of the rush utilization project should made a great contribution to the Ghanaian national economy as a whole.

B. PROJECT OF PULP & PAPER MANUFACTURE

The content of our Report is as follows;

I. Supply and Consumption of Paper in Ghana
   (1) Import of paper and paperboard
   (2) Domestic production and domestic consumption

II. Observations on the Pulp & Paper Manufacturing Plan formed by Ghana Government
   (1) Production capacity
   (2) Raw materials
      a. Bagasse
      b. Wood
   (3) Mill site

III. Our Recommendable Plan for the Manufacture of Pulp & Paper from Bagasse
   (1) Outline
   (2) Flow Sheet
   (3) Layout

IV. The Cost of the Bagasse Pulp & Paper Mill
   (1) Initial cost
      a. Plant cost
      b. Building cost
   (2) Operating cost
      a. Raw materials cost
      b. Labours cost
      c. Overhead cost

V. Profit estimated and Saving amout of Foreign Currency
   (1) Annual profit estimated
   (2) Saving amount of Foreign Currency

I. Supply and Consumption of Paper in Ghana

(1) Import of Paper and Paperboard

Commodity	QUANTITY cwt				VALUE £G			
	1960	1961	1962	1963(Jan.-Jun.)	1960	1961	1962	1963(Jan.-Jun.)
News-print paper	80,906	65,316	83,979	33,828	215,490	188,094	233,442	118,029
Printing & Writing paper	28,689	43,873	31,532	45,888	177,302	225,675	277,222	222,664
Common Packing and Wrapping paper	5,301	12,386	8,323	11,050	37,968	55,236	53,753	61,855
Paperboard	17,245	19,716	12,386	18,605	63,450	131,863	83,529	90,143
Fiberboard and Building Board	11,809	60,805	35,723	18,987	26,826	112,006	95,092	54,275
Other Paper and Paperboard	12,688	8,885	4,681	8,801	123,187	57,242	39,162	77,787
TOTAL	156,638	210,981	176,450	137,159	644,223	770,116	782,200	624,753

20 cwt = 1 ton

1 £G = 1,008 yen

(2) Domestic Production and domestic Consumption

There is no paper mill in Ghana except a small toilet paper manufacturing factory; and Ghana does not re-export paper and paperboard.

Therefore, domestic consumption of paper is almost equal to the import quantity of that.

The import statistics of Paper and Paperboard above refered shows that Ghana has a great demand for Newsprint paper and Printing & Writing paper. The demand will be greater year by year because Ghana has put the great emphasis on education.

II. Observations on the Pulp & Paper Manufacturing Plan formed by Ghana Government

(1) Production Capacity

Proposed production capacity is 50 tons per day/24 hrs. -yearly 15,000 tons. The quantity of 15,000 tons per year is much more than the consumption of Newsprint paper (4,200 tons) and Printing & Writing paper (1,600 tons) in 1962. It is about three times as larger as the consumption. But the paper consumption in Ghana has been very speedily increased as shown in Table I.

Table I. Increasing rate of the paper consumption in Ghana (1957 - '62)

year	1957/'58	'58/'59	'59/'60	'60/'61	'61/'62	average
Newsprint paper	60%	8%	59%	-20%	24%	26%
Printing & Writing paper	23%	5%	71%	90%	-28%	32%
Total of Paper & Paper board	40%	15%	62%	35%	-16%	23%

It seems to be very difficult task to estimate the paper consumption in Ghana in 1968 when the proposed paer mill shall be start.

Under unfavourable circumstances in the future, the paper consumption in 1968 might be under 10,000 tons. (Table II.). On the contrary, under favourable circumstances, it might be over 15,000 tons. (Table III)

Table II. Anticipater consumption of Newsprint paper and and Printing & Writing paper (unfavourable)

year	1963	1964	1965	1966	1967	1968
		(Newsprint Paper)				
increasing rate	10%	9%	8%	7%	6%	5%
consumption (tons)	4,620	5,035	5,437	5,817	6,166	6,474
		(Printing & Writing Paper)				
increasing rate	15%	14%	13%	12%	11%	10%
consumption (tons)	1,805	2,057	2,324	2,602	2,888	3,176

Table III. Anticipated consumption of Newsprint paper and Printing & Writing Paper (favourable)

year	1963	1964	1965	1966	1967	1968	
Newsprint paper consumption (tons)	5,040	6,048	7,257	8,708	10,449	12,538	increasing rate 20% each year
Printing & Writing paper consumption	1962	2,452	3,065	3,831	4,788	5,985	increasing rate 25% each year

In every point of view, we regard the production capacity of 15,000 tons per year as appropriate if the initial production is 9,000 tons of Newsprint paper and 6,000 tons of Printing & Writing paper.

Table IV, is our recommendable plan for the initial production capacity of the proposed pulp & paper mill. At the same time, the plant has to be prepared for the expansion of production because a rapid industrial growth is expected in Ghana.

Table IV. Production capacity

	tons/day(24hrs.)	tons/month(25days)	tons/year(300days)
Newsprint paper	30	750	9,000
Printing & Writing paper	20	500	6,000
Total	50	1,250	15,000

Note: The mill is to be operated in three shifts of eight hours.
(3) (8)

(2) Raw Material

a) Bagasse

Sugar Cane Bagasse is to be used as the main raw material for the proposed pulp & paper manufacture, though Sugar Cane has been not yet produced in Ghana. According to the Ghana plan, the Bagasse required for the pulp & paper mill is supplied from the Sugar Plant that is to be constructed at Akuse in 1964-66 and fully operated in 1968. For the purpose of supplying the necesssary quantity of Sugar Cane to the Sugar Plant, Ghana Government is going to plant sugar cane in the area of 8,000 acres near-by Akuse.

The official schedule of Sugar Cane supply, Sugar production and the quantity of Bagasse available for the pulp & paper mill are below given.

Production schedule of the Sugar Plant

(tons/year)

YEAR	SUGAR	SUGAR CANE to be supplied	BAGASSE (dry) to be come from
1966	8,000	80,000	16,000
1967	16,000	160,000	32,000
1968	24,000 (full operation)	240,000	48,000

The proposed pulp & paper mill of 50 tons per day capacity required the under given quantity of raw material Bagasse.

	tons/day	tons/month	tons/year
Paper Production	50	1,250	15,000
Bagasse requisition (yield: 34%)	150	3,750	45,000
Bagasse requisition (yield: 60%)	85	2,125	25,500

Remark: Pulp yield of Bagasse is 33-35% under the general process here to fore in use in the pulp & paper industry.
The yield is increased to 40-60% by means of our patented process.

We can not coduct the pulp & paper making test of Bagassed grown in Ghana because it is not yet available. But Bagasse pulp has been approved the quality all over the world.
Table ans Sample Paper under given are that we have performed the pulp & paper making test using the Bagasse grown in Cuba.

With making good quality paper from Bagasse, there is not trouble, we believe, in case of Ghana also. In the result, the problem of raw material for the proposed pulp & paper mill would be completely resolved in 1967-68, if the project of the Sugar Plant worked well.

Quality Table of Bagasse Bleached Paper

Freeness	oSR	50
Density		0.713
Bursting factor		4.15
Breaking length	km	5.89
Elongation	%	1.68
Tear factor		68.3
Folding endurance	time	170

Sample: Bagasse Bleached Paper

b) Wood

In our stay in Ghana, we have made several times a short tour of inspection in the wooded regions because we had been informed that Ghana Government was planning the use of woods for the raw material of paper pulp. By the way, it was at near the end of our survey schedule when Ghana Government decleared to us the use of Bagasse as the main raw material of paper pulp.

The wooded land in Ghana covers an area of 31,800 squares miles, of which 2900 squares miles is a Rain Forest Zone; 3250

squares miles is Transition Zone; 25,600 squares miles is a Moist Semi-Decidous Forest Zone. In the Moist Semi-Deciduous Forest zone, about 300 squares miles is being lost every year owing to cultivation, lumbering, fire and especially cutting for Cocoa plantation. At present the forest region of 16,000 squares miles is available for resources of wood, of which 5,800 squares miles is the Reversed Forest now where man keeps off.

The most remarkable feature of the resources of wood in Ghana is a wide variety of the species of trees growing ia a forest region. Over 300 species of trees have been reported in Ghana.
The representatives of them are Red Wood=Gaboon(26.8%) and WaWa(42.5%).

We selected 51 species of woods in Ghana and brought them into Japan. A pulp & paper making test has been already performed on WAWA in our laboratory. (Refer to attached "TEST REPORT") "TEST REPORT" approves WAWA available for the raw material of paper pulp.

But there are not a few difficulties in using these woods for the proposed pulp & paper mill.
Some important difficulties of them are in the following points;

1) to select and collect some proper wood among many other woods.
2) to transport the wood to the mill from the forest region.
3) to get proper woods at economical price and to employ workers in the forest region.
4) to supply enough industrial power- electric, mill water and etc.- to the pulp & paper mill.

If any plan of pulp & paper mill using raw material wood should be realized in Ghana under such a unfavourable condition as above-mentioned, we would suggest that Beposo City might be fit for the site of the mill. The city is near Takoradi where a harber has opened, and along the Pra River. They can transport woods by rail and can manufacture Wood Pulp from two or three similar kind of woods.

In conclusion, more carefull study and consideration have to be done on the plan of a pulp and paper mill using wood as the main raw material.

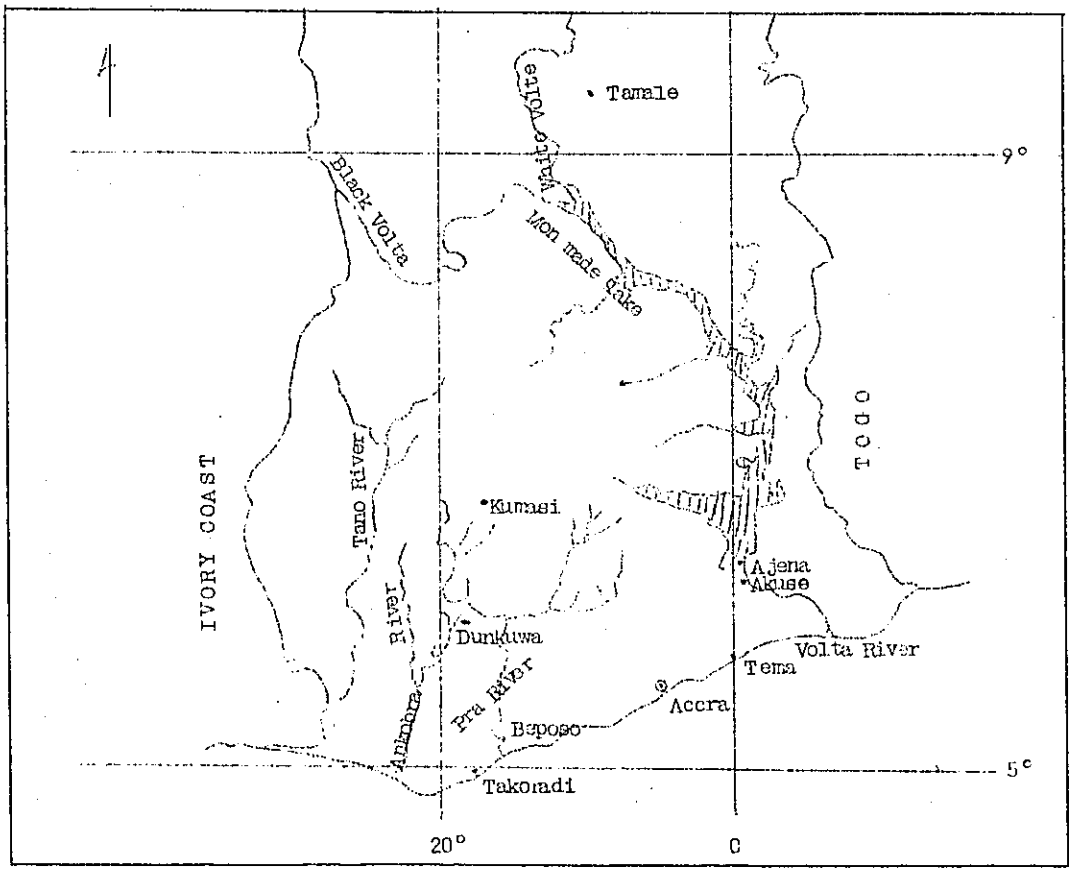
(3) Mill Site

The proposed mill site is near the above-mentioned Sugar Plant in Akuse. It lies in 35 miles to the biggest harber Tema and 45 miles to Capital City Accra. About the site, there is no obstacle to supply electric power and mill water, because Akuse is along the Volta River and the Volta Power Plant (in Ajena) is 18 miles up the river.

In near the future, a central industrial area is to be laid out here by Ghana Government.

Recently the combinate of sugar plant with paper plant has been planed by many countries and the good results have been expected. We can find such a example in South America, East Asia, Middle East and Arab.

On this point of view, the proposed mill site is the fittest for the Bagasse Pulp & Paper Mill.



III. Our Recommendable Plan for the Manufacture of Pulp & Paper from Bagasse

(1) Outline

Name of the Plant: A complete Pulp & Paper Manufacturing Plant from Bagasse without recovery system

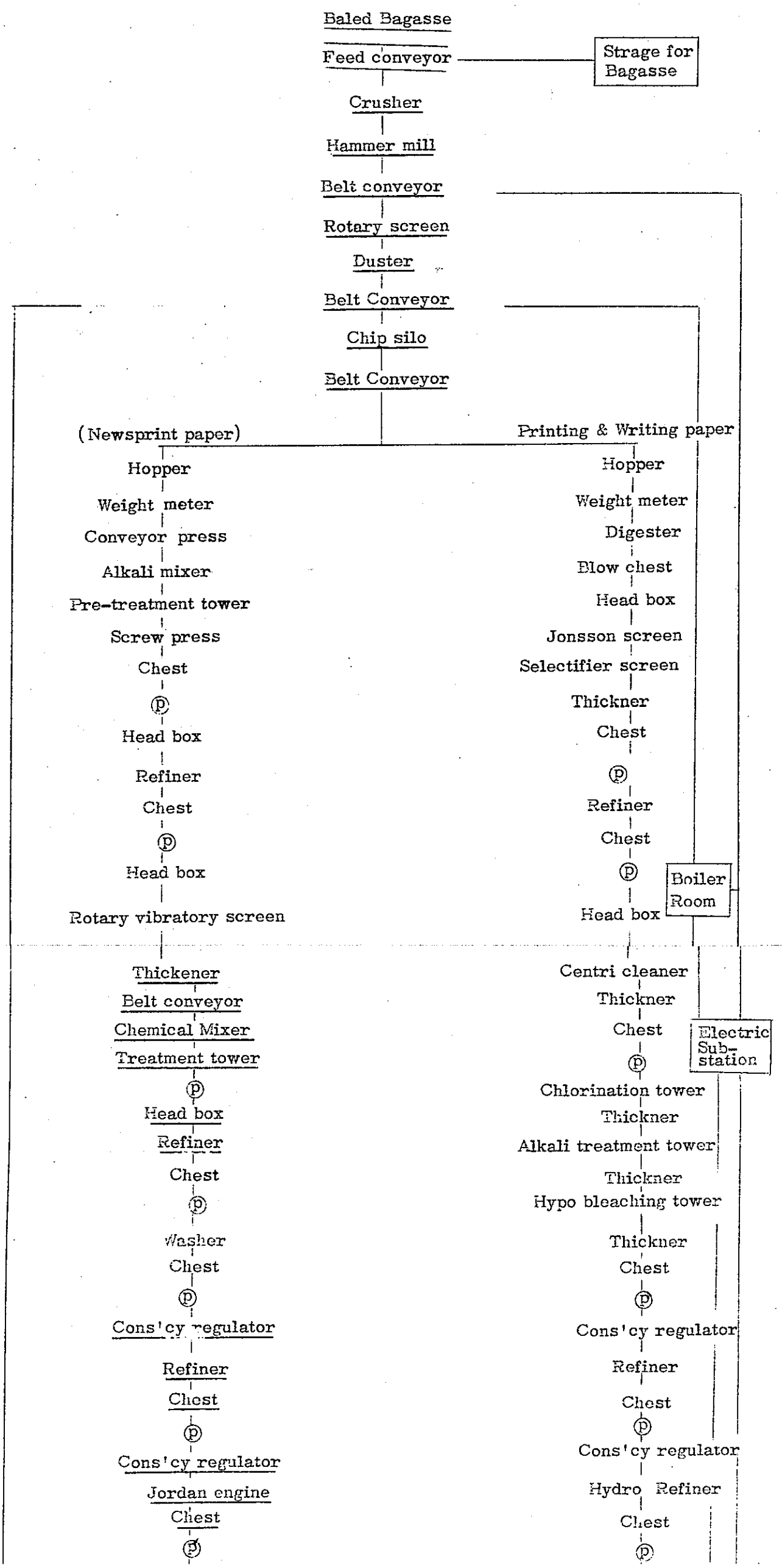
Finish Products	Raw Material	Process	Capacity for pulping	Capacity for Paper making	Yield
Newsprint Paper	Bagasse	Patented Okuno Process	50 tons/day	50 tons/day/24hrs. 1,250 tons/month/25days 15,000 tons/year/300days	40% 60%
Printing & Writing Paper	Bagasse	Soda Process	50 tons/day		33% 35%

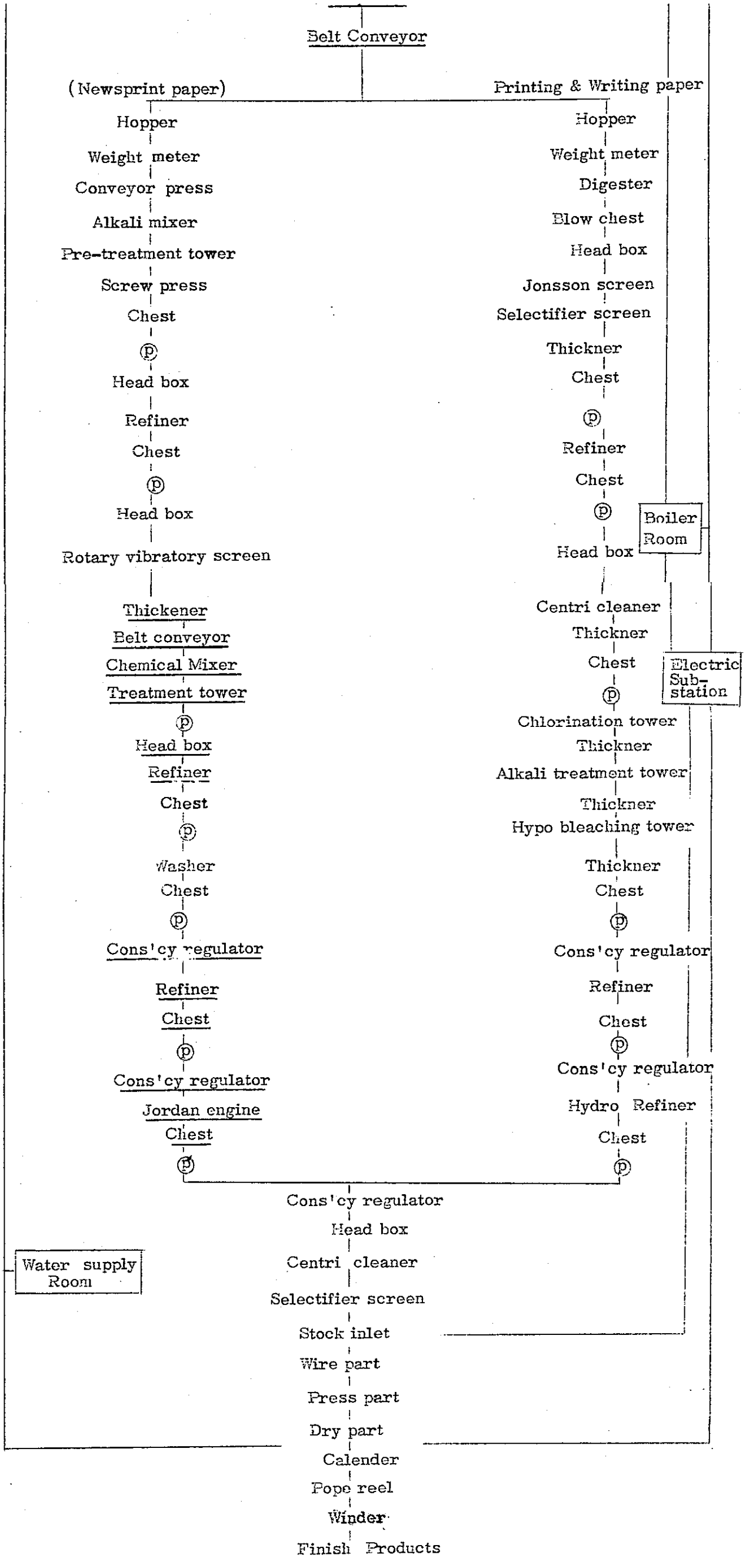
Remark:

1) Specifications of the plant shall be given as ordered by customer..
2) The production rate of Newsprint paper to Printing & Writing paper is at customer's will on demand for each paper every month.
   At present, the rate of Newsprint 3 : 2 Printing & Writing is appropriate.
3) The plant is prepared the production capacity to increase up to 100 tons/day - Newsprint 50 tons and Printing & Writing 50 tons - by one more set of fourdrinear paper machine and small expansion of Raw Material Preparation Room.

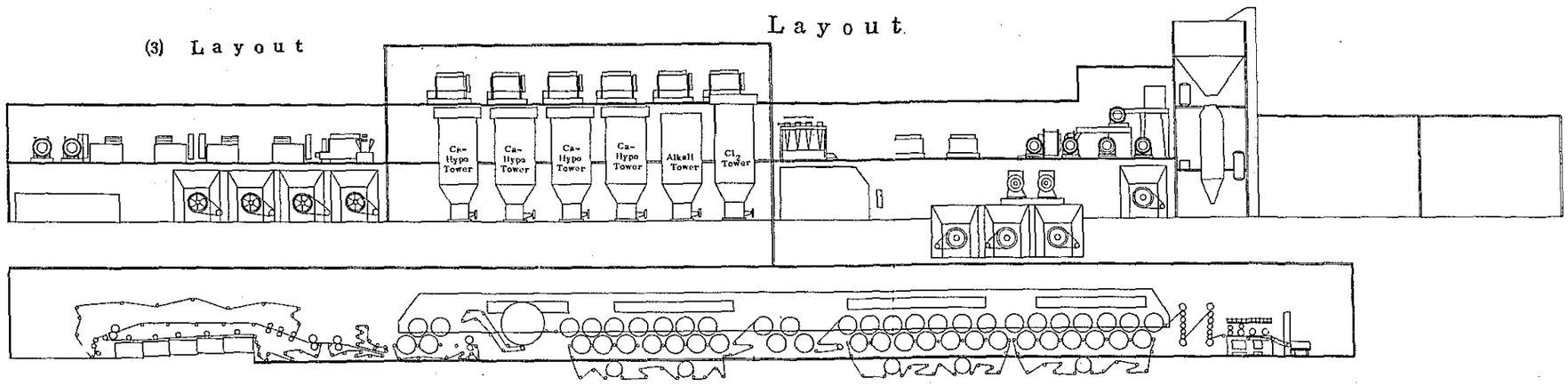
(2) Flow Sheet

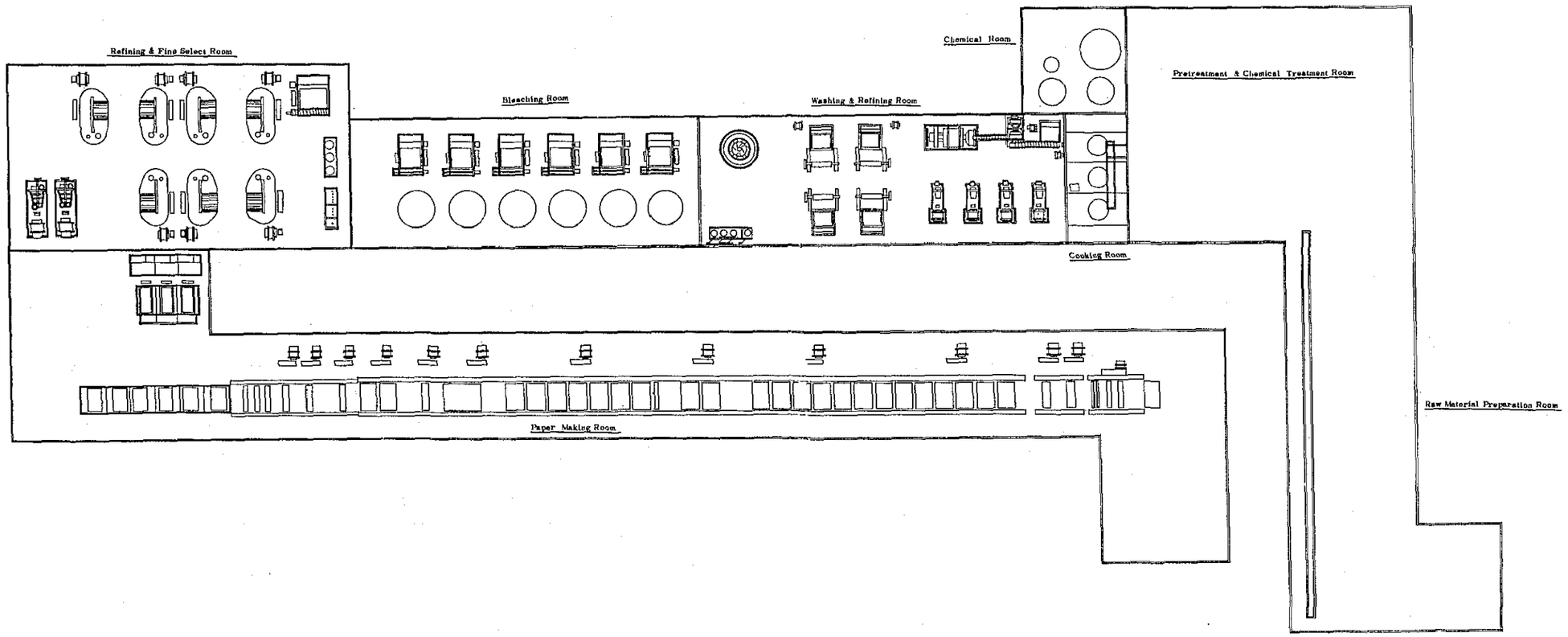
FLOW SHEET




Belt Conveyor
(Newsprint paper)
Printing & Writing paper
Hopper
Weight meter
Conveyor press
Alkali mixer
Pre-treatment tower
Screw press
Chest
Head box
Refiner
Chest
Head box
Rotary vibratory screen
Thickener
Belt conveyor
Chemical Mixer
Treatment tower
Head box
Refiner
Chest
Washer
Chest
Cons'cy regulator
Refiner
Chest
Cons'cy regulator
Jordan engine
Chest
Hopper
Weight meter
Digester
Blow chest
Head box
Jonsson screen
Selectifier screen
Thickner
Chest
Refiner
Chest
Boiler Room
Head box
Centri cleaner
Thickner
Chest
Electric Sub-station
Chlorination tower
Thickner
Alkali treatment tower
Thickner
Hypo bleaching tower
Thickner
Chest
Cons'cy regulator
Refiner
Chest
Cons'cy regulator
Hydro Refiner
Chest
Cons'cy regulator
Head box
Centri cleaner
Selectifier screen
Stock inlet
Wire part
Press part
Dry part
Calender
Pope reel
Winder
Finish Products
Water supply Room

(3) Layout


Layout
Ca-Hypo Tower
Ca-Hypo Tower
Ca-Hypo Tower
Ca-Hypo Tower
Alkali Tower
Cl_2 Tower


Refining & Fine Select Room
Bleaching Room
Washing & Refining Room
Chemical Room
Pretreatment & Chemical Treatment Room
Cooking Room
Paper Making Room
Raw Material Preparation Room

IV. The Cost of the Bagasse Pulp & Paper Mill

(1) Initial Cost

a) Plant cost

	(£)
A. Raw Material Preparation Room	37,000
B. Pretreatment Room	116,000
C. Chemical Treatment Room	95,000
D. Cooking Room	61,000
E. Washing & Refining Room	147,000
F. Bleaching & Fine Select Room	145,000
G. Refining Room (for Newsprint Dept.)	84,000
G'. Refining Room (for P. & W. Dept.)	100,000
H. Paper Making Room	441,000
I. Boiler Room	126,000
J. Electric Sub-station	47,000
K. Water Supply Room	51,000
L. Electric Wiring	40,000
M. Piping	63,000
Sub-total	1,553,000
N. Freight & Shipping Charge	310,000
GRAND TOTAL	£ 1,863,600

b) Building Cost

	Building Area (Acre)	Unt Cost/Acre (£)	Cost (£)
A. Factory	2.650	120,000.-	318,000.-
B. Storage	0.330	40,000.-	13,200.-
C. Office	0.033	120,000.-	3,960.-
TOTAL			£335,160.-

* Initial Cost = a)Plant Cost + b)Building Cost = £2,198,760.-

Remark:

(1) This estimate is rough one, and the full particulars and the final estimate shall be given as ordered by customer.

(2) Laboratory, Electrolysis, Repair shop and Finishing equipment are excluded from this estimated cost. The rough estimate of these equipments are as follows;

	(£)
Laboratory equipment	10,500
Electrolysis equipment	210,000
Finishing equipment	74,000
Repair shop	52,000

(3) Freight and shipping charges of the building materials are excluded in this estimated cost because some of them will be in home supplied.

(2) Operating Cost

a) Raw Material Cost

Name of Material Cost	Q'ty/year (ton)	Unit price/ton	Total Amount
Bagasse:	36,000	-	-
Chemicals:		(Jap. Yen)	(Jap. Yen)
Liquid chlorine	360.0	30,000	10,800,000
Sodium Hydroxide	2,100.0	31,000	65,100,000
Bleaching powder	240.0	25,000	6,000,000
Sodium Silicate	531.6	12,000	6,379,200
Hydrogen Peroxide	240.0	95,000	22,800,000
Sulphur dioxide	102.0	80,000	8,160,000
China clay	1,320.0	15,000	19,800,000
Rosin Size	213.0	90,000	19,170,000
Alum cake	426.0	15,000	6,390,000
Sub-total Chemicals:			¥164,599,200 (£163,300.-/-.)
Mill Water:	7,500,000.0	-	-
Fuel expense: (Heavy Oil)	13,500.0	£31,3/3	£420,680,-/-
Electricity expense:	7,500,000 KWH	£-/3.5	£109,375,-/-
GRAND TOTAL			£693,355-/-

Remark:

(1) The price of Chemicals is of Japanese market price Ghana has not imported such a good.

(2) The price of Fuel oil and Electricity is of market price in Ghana at present.

(3) The mill water is not city water but by self-supply waterworks.

b) Labour Cost

Title	Number of Person	Wages & Salary(month) (£/person)	1 month requirement (£)	Amount (year) (£)
Head Engineer	1	300	300	3,600
Chief Engineer	3	35	105	1,260
Foreman	27	25	675	8,100
Workers	180	15	2,700	32,400
Chief Officer	3	125	375	4,500
Officers	12	12	144	1,728
TOTAL	226	512	4,299	£51,588.-

Remark:

Salary and expense of despatched Japanese consultant and engineers are excluded from this estimated cost.

c) Overhead Cost

1) Depreciation	(yearly)
Plant & Equipment (Plant Cost x 12%)	£223,632
Building (Building Cost x 4.5%)	£ 15,082
Sub-total	£238,714
2) Maintenance & Repair (Plant Cost x 1%)	£18,636
3) Miscellaneous Cost & Expense (Annual Sales income x 80% x 3%)	£ 32,256
TOTAL	£289,606

* Operating Cost = a) Raw Material Cost + b) Labour Cost + c) Overhead Cost = £1,034,549

V. Profit Estimated and Saving Amount of Foreign Currency

(1) Annual Profit Estimated

a. Sales Income

Article	Annual Production (Ton)	Unit Price (£/ton)	Total Amount (£)
Newsprint Paper	9,000	56	504,000
Printing & Writing Paper	6,000	140	840,000
TOTAL	15,000		£1,344,000

b. Annual Profit

Annual Profit = Annual Sales Amount - Total Operating Cost
= 1,344,000 - 1,034,549
= £309,451

c. Percentage of Profit

Percentage of Profit = Annual Profit /Annual Sales Proceed
= 310,000/1,344,000
= 23.0%

d. Unit Cost and Unit Profit

Profit per ton = 310,000/15,000 = £20.6
Production Cost per ton = 1,034,549/15,000 = £69.0

(2) Saving Amount of Foreign Currency

$$\text{Saving Percentage} = \left(1 - \frac{A}{B}\right) \times 100 = (1 - 0.299) \times 100$$
$$= 70.1\%$$

A: Depreciation of Plant + Cost of Raw Material imported
B: Import Price of Finish Products x Annual Production

TEST REPORT

of

Pulp & Paper Making from Broad Leafed Tree grown in

Ghana

Outline of the Test:

WAWA (Triplochiton scleroxylon) was selected among broad leafed trees grown in Ghana for the subject of our test. Of the wood, wood analysing test, pulp making test, paper making test and quality test of the sample paper sheet were conducted. In consideration of the test result, suitability and adaptability of the wood for a raw material of paper pulp was discussed.

I. Characteristics of WAWA wood

Density		0.39
Fiber length	mm	0.91
Fiber width		11.6
Fiber ratio length:width		78.5
Total cellulose	%	52.3
Lingnin	%	33.2
Pentosan	%	12.9
Extracts by Ether	%	0.1
Extracts by Hot water	%	7.9
Extracts by 1% NaOH	%	15.1

Test method; TAPPI Standard and JIS (Japan Industrial Standard)

II. Pulp Making Test:

(1) Cooking Process

Two cooking process were adapted for the WAWA pulp making test.

a. Kraft Process	Pulp for middle or high grade printing & writing paper (bleached) and wrapping paper (unbleached)
b. Semi Chemical Process	Pulp for middle grade printing & writing paper (bleached), envelop paper (unbleached), corrugate medium and liner board (unbleached).

(2) Treatment

Chipping and Cooking:-

WAWA wood was chipped in 1/2 - 2"/3 long chips with laboratory type small chipper.

The chips were cooked under two comperative cooking conditions to each process; that is to say, quantity of chemical additives was varied under a definite temperature (Max. 170°C), time (total time 4hrs. at Kraft, 3.5hrs. at S C P) and pressure (Max. 8.0 kg/cm^2 at Kraft, 9.0 kg/cm^2 at S C P). Chemical liquor was heated up to 60 - 70°C and sent to digester. The liquor quantity in the digester was 5.5 - 5.7 times more than the weight of the chips.

Washing and Cleaning:-

After blowing off, the pulping materials were washed by 100 mesh wire and screened with 8"/1,000 Flat Screen. (Kraft process) Then, pulp yield was measured. In case of S C P process; the pulping materials were, after blowing off, treated by Disc-refiner and screened by the same Flat Screen. Then the pulp yield was measured also.

Quality Test:-

Based on the value of chlorine absorbency, Freeness of each pulp was measured. In sheet, brightness of each pulp was measured.

(3) Test Table of WAWA Pulp Making Test

*

Cooking Process		KRAFT		SCP	
Test No.		1842	1847	1852	1857
Chip weight (B.D.)	g	700	700	700	700
Moisture of chip	%	12.6	12.6	12.6	12.6
Added NaOH INa_2O)	%	6.30(15.0)	5.35(12.75)		
Added Na_2S (Na_2O)	%	19.45(5.0)	16.5(4.25)		
Sulphidity	%	25.0	25.0		
Added Na_2SO_3	%			19.8	16.0
Added Na_2CO_3	%			4.5	4.0
Liquor ratio		5.5	5.5	5.6	5.7
Maximum temperature	^oC	170	170	170	170
Time to Max. temp.	min.	90	90	90	90
Time at Max. temp.	min.	150	150	120	120
Total time	hrs.	4.0	4.0	3.5	3.5
Pulp weight	g	274	298	457	473
Yield of pulp	%	40.6	44.0	65.1	67.7
Cl_2 Absorbency at ^oC	%	3.5	3.9	14.2	15.5
Brightness of pulp (hunter)	%	25.6	24.5	31.6	27.5

III. Pulp Bleaching Test

Three stages bleaching test (Chlorine - Alkali - Calcium Hypo) was performed to the fore-going # 1842 Kraft Pulp.

Test Table:

Stage	Treatment agent	Added chemicals % (to pulp quantity)	Temp. (°C)	Time (min.)	Stuff consistency(%)
1st	Chlorine	Cl_2 equivalent to $0^{\circ}C$ Cl_2 absorbency X 120%	10	60	5.0
2nd	Alkali	Na OH 2.0%	60	60	7.0
3rd	Hypochlorite	Ca-Hypo 2.0% (as available chlorine) NaOH 1.0% (for pH control)	37	180	7.0
Finish	Acid	Solution Bath keeping pH 4 by SO_2 addition	10	60	3.0
Brightness of the bleach pulp: 77.6%					
Yield of the pulp for bleaching: 84.2%					

IV. Paper Quality Test

After cooking and bleaching test, each of WAWA pulps was beated up to 50°SR by laboratory type beater under the same beating condition, and sample paper sheets were made. Of the sample papers, quality test was conducted.

Test Table

Test No.		1842	1847	1852	1857
Freeness	°SR	48	47	51	50
Substance	g/m^2	63.5	63.2	64.5	63.5
Thickness	mm	0.085	0.090	0.105	0.116
Density	g/cm^3	0.74	0.70	0.61	0.54
Bursting factor		5.55	7.48	4.10	3.03
Breaking length	km	7.59	8.34	6.71	5.56
Elongation	%	3.0	2.8	2.5	1.9
Tear factor		73.4	118.7	63.5	57.9
Folding endurance (MIT 1.0 kg)	times	227	637	64	28
Stiffness (Gurley)	mg	10.9	13.3	13.3	15.3

Remark: #1842 is of the sample paper made from Bleached pulp.

V. Conclusion

(1) Kraft Process

Unbleached WAWA pulp(#1847) made by this process is available for the manufacture of Bag Paper, and Bleached WAWA pulp (#1842) is good for Writing and Printing Paper.

(2) Semi Chemical Process

#1852 WAWA pulp made by this process is available for the manufacture of Wrapping and Envelope Paper, and #1857 pulp is good for Corrugate medium and Liner board.

C. PROJECT FOR THE ESTABLISHMENT OF PORCELAIN AND EARTHENWARE FACTORY

I. MARKET CONDITIONS OF PORCELAIN AND EARTHENWARES

Ghana covers an area of 237,875 km^2 that is almost two-thirds of that of Japan. The southern half part of the country is bristled with the tropic woods; and the northern half is an extremely dry plain when comes the dry season. Geologically, it forms a comparatively flat land with hills of easy grades for the most parts. The highest mountain in it is even about 900 m high above the sea level. As a whole, Ghana maintains the teritory of highly effective area. Backed by such a favourable land, she is concentrating her efforts to exploit the nation's strength. The special emphasis is given to her industrialization projects. Under the remarkable progress are the electrical power resources development plan of akosombo, the industrial site marking-up plan of Tema, and the city planning and road constructions at various parts of the country. With the progress of the land developments as abovementioned, the national living standard is being elevated all the time. However, as far as the ceramic manufactures are concerned, there is no factory even to meet the local demand for porcelain and earthenwares. Only one government management factory is established for the red bricks, with the capacity of 750,000 pieces a month. Under the present circumstances, the rest of the demands has to be fulfilled by the imported goods. The importing status of these porcelain and other ceramic materials as of the first half-year of 1963 (January to June) is shown in the following table.

TABLE 1. Importing Status of Porcelain and Other Ceramic Materials, January to June 1963.

Item	Q'ty (ton)	Amount (£G)
Household ware of porcelain china or other ceramic materials	207.5	29,385
Ornament of porcelain china or other ceramic material	27.5	1,571
Unglazed setts flags tiles	1,350.0	13,594
Glazed setts flags tiles	403.2	61,542
Laboratory and Industrial Ceramic wares	6.3	7,695
Roofing tiles, chimney pots, etc.	192.8	23,171
Piping condits guttering	40.9	3,076
Water filters	21.8	3,526

According to the analytic study on the results of the market survey for the qualities, designs and selling prices, these imported porcelain and other ceramic wares can be divided into two kinds: porcelain ware and ironstone ware. Entering into detail, the porcelain wares are mostly meant for the tablewares or utensils to be used by a small number of expensive hotels and restaurants. Among the small balance of the imported porcelain wares are the flower-vases, the ornamental miniatures of animals and toys. The everday table wares and utensils are mostly of the ironstone wares. Their qualities would for the most part belong to the middle class or the inferior. Their decorations are chiefly made of simple patterns and line drawings. Few high-quality goods are on the market. On the other hand, the selling prices of the ceramic manufactures are considered to be rather high, as shown in the Table 2.

TABLE 2. Exaples of Selling Prices of Porcelain Wares and Other Ceramic materials Appearing on the Market in Ghana

Kind	Tea Set (6 persons)	Ornaments	Salad Bowl	Dinner Set (31 pieces)
Porcelain ware	£2 - 5	20 - 30 S.	15 - 18 S.	£22 - 40
Ironstone ware	18 - 20 S.	2 - 15 S.	5 - 7 S.	£20 - 28

As the national living standard is enhanced and the industrialization plan is developed, the demands for the ceramic products would have to be on the steady increase. For example, the more demands will rise for the tablewares and ornaments of everyday life, the sanitary wares and tiles for city housing and plant construction plans, the ceramic materials for the electric-power development and other industrial purposes. The national projects are well under way to substantiate the original aims of the development. In addition, as conclusive from the past data of the import ceramics (Table 3), it can be on the safe assumption that the demand should still largely increase in the future.

Judging from the fact that the development plan is making headway without a hitch, and from the prospect over the future Ghana's political situation, it would be advantageous to take up the ceramic industry for the purpose of satisfying not only domestic demand but that from the west Africa or even all Africa. In the light of this view, the prospect over ceramic industry in Ghana will be very bright and promising.

TABLE 3. Transional Status of Quantity of Imported Porcelain and Other Ceramic Materials

ITEM	1958		1959		1960	
	Q'ty (ton)	Amount (£G)	Q'ty (ton)	Amount (£G)	Q'ty (ton)	Amount (£G)
Table ware	-----	89,698	-----	103,781	-----	119,067
Bricks, tiles, pipes etc.	2,025.2	95,521	2,246.4	147,355	2,294.4	214,647

II. DISTRIBUTION CONDITIONS OF CERAMIC MATERIALS

As evident in the history, Ghana is rich in the mineral resources. However, the survey has been conducted to make clear the distribution conditions of the ceramic materials, being started from Accra to Navrongo, a city nearby the northern border, through the coastline. The investigation has revealed that the country is favoured with the materials necessary for the ceramic manufactures such as kaoline or china clay, feldspar, Quartz, limestone and dolomite, etc.

To be specific, the Saltpond district in the central region is proved rich in the extremely excellent kaoline. According to the Geological Survey of Ghana; Bulletin No.29, the estimated amount of the kaoline deposits is about 560,000 ton at the present productive locations. Furthermore, the four more deposits with almost same potential output as in Saltpond had been recognized to be available in the neighbouring areas. The feldspar material can be available from the existing pegmatite dykes interspersed throughout the country. Especially, the feldspar produced in the pegmatite mines at the Mouri district of the central region will belong to the orthoclase which is characteristic of the superior quality. The test results of these kaoline and feldspar are partly shown as in the following Table 4.

TABLE4 : CHEMICAL COMPOSITION (%)
OF KAOLINE AND FELDSPAR

Kine	Prodtcing place	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2	Na_2O	K_2O	Igloss	Total	Remarks
Kaoline (raw)	Saltpond	63.91	23.50	0.38	0.05	0.11	Tr	0.08	0.29	9.25	97.57	Fire-resistance SK32+
Kaoline (washed)	Saltpond	51.12	33.43	0.58	0.05	0.09	Tr	0.11	0.29	13.03	98.70	Fire-resistance SK36+
Feldspar	Mouri	64.98	17.44	0.25	0.07	0.17	Tr	3.71	9.85	0.85	97.32	

Quartz is found here and there in the country, and especially is known that the extremely superior quality quartz can be available as a by-product of the gold-extraction along the river-basin of the Ofin in the Dunkwa district. However, nothing of the quartz has been utilized at present, left stacking up for the length of several kilometers. The estimated amount of the stacked-up quartz is reportedly reaching 600,000 tons. If this quartz is made use of, no excavation is needed, so that a great deal of economy should be brought about in manufacturing the porcelain and ceramic wares.

As for the lime-stone, there would probably be almost unlimited resources available in the country, as described in the Geological Survey of Ghana; Bulletin No. 23. The survey conducted this time has only made sure the fact. No investigation could be made for the dolomite resources, but the Geological Survey reported that a good amount of dolomite should be output in the Buipe district by the Black Volta River in the northern region.

After all, it would be quite possible that the almost all the materials necessary for the ceramic manufacturing should be prepared from the domestic resources. However, the kaoline only appears to be a little qualified. Attributable to its origin, the kaoline would belong to the primary and residual clay and is short in its plasticity. To supplement the plasticity, it is considered necessary that ball clay should be imported from any other country.

III. PRODUCTION PLAN OF PORCELAIN AND OTHER CERAMIC WARES

According to the materials used, the ceramic wares are divided into three categories, that is, porcelain, earthenware and stoneware. Further, changing with the use, there can be many kinds set up: (1) Everyday items or tablewares such as plate, cup, saucer, pot, etc., (2) construction materials such as sanitary ware, tile, pipe, etc., and (3) industrial materials such as insulator, chemical porcelain, etc.. Besides being different in materials and used, there is a wide range of difference in their manufacturing process, easy or difficult, or complicate or simple. Therefore, it can hardly be expected that line of facilities provided should accomodate all the manufacturing processes for any required product.

In a country like Ghana where no ceramic factory exists, it is not so proctical to plan any highly technical manufacture at the beginning. No matter how large demand is expected locally, it would be even uneconomical chiefly because it would take a long time to acquire the technical skillfullness, and no immediate effect would be brought about in the development. From this point of view, the market conditions are taken into consideration to work out the feasible construction plan of the suitable ceramic factory in Ghana. The manufacturing item is selected to be the tableware of stoneware, the manufacturing technic of which will be comperatively easy to acquire. The recommended production plan is outlined as follows:

DECISION OF ANNUAL OUTPUT

The recommendable annual output should be dependent upon the quantitative demand. Moreover, the effective output of the ceramic manufacturing is closely related with the size of the firing kiln used.

Concerning the demand, the fact should be taken into account that the ceramic products have been imported amounting to 700 through 900 tons annually. A future growth of demand may be anticipated to add the figures, so that a proper amount of annual output may be set around more than 1,000 tons.

With the cinsiderations paid to the productivity inclusive of thermal efficiency and working efficiency and etc., it should be pointed out that the tunnel kiln with effective capacity of 60m x 0.7m x 1.2m would be most suitable for the proposed production size. The firing is desirously to be completed within 35 or 40 hours. On the other hand, the size of the kiln used can direct the width of the platform car which transfer the products for firing. The width of platform car is 0.65m, and the length is accordingly about 1 meter. The effective area per car is 1.0m x 0.65m. Consequently, the tunnel kiln can accomodate 60 platform cars at all time, provided the length of the car is determined to be 1m. In order to complete the firing for the products on one platform car in 35 through 40 hours, each car should be sent into the tunnel kiln at the regular interval of 40 minutes, sending out one each at the same time. In this way, the finished products will be obtained at the rate of 36-car amount per hours.

Each platform car can load approximately 400 or 450 pieces of tablewares. The 36-car amount will mean 14,400 or 16,200 peices of them. And, the annual output can be given as 5,256,000 or 5,913,000 pieces. Of the tablewares,there are many kinds such as plate, cup, saucer, soup dish and so forth, but the average weight per piece would be somewhere around 200 g. The annual output weight can be given about 1,051 or 1,182 tons accordingly. In addition to the anticipatory demand already calculated, this would lead to a conclusion that the best suitable annual production wuantity should be 1,100 tons or 540 million pieces for one year.

With this target figures of production, to be attained in 5 years, the production plan has been worked out as shown in the Table 5.

In the first year, the production amount is made out to be lowered, as this period is designated for the technical training. The technical training will be given by the Japanese engineers who consist of a chief engineer, a raw material and preparation engineer, a forming engineer, a firing engineer, and a decorating engineer, making a total of 5 technical personnels. During the year, the manufacture of saggers will be carried out in preparation for the full operation of the facilities. From the second year, the yield will be gradually increased so as to achieve the target production amount in the fifth year.

TABLE 5: PRODUCTION PLAN OF TABLEWARES OF STONEWARE

Item	MONTHLY PRODUCTION AMOUNT (PCS.)				
	1st year	2nd year	3rd year	4th year	5th year
Plate (7", 8", 9" dia. 3 kinds)	180,000 x 40% = 72,000	180,000 x 70% = 126,000	180,000 x 80% = 144,000	180,000 x 90% = 162,000	180,000 x 100% = 180,000
Cup	70,000 x 40% = 28,000	70,000 x 70% = 49,000	70,000 x 80% = 56,000	70,000 x 90% = 63,000	70,000 x 100% = 70,000
Saucer	70,000 x 40% = 28,000	70,000 x 70% = 49,000	70,000 x 80% = 56,000	70,000 x 90% = 63,000	70,000 x 100% = 70,000
Salad Bowl	20,000 x 40% = 8,000	20,000 x 70% = 14,000	20,000 x 80% = 16,000	20,000 x 90% = 18,000	20,000 x 100% = 20.000
Soup Dish	60,000 x 40% = 24,000	60,000 x 70% = 42,000	60,000 x 80% = 48,000	60,000 x 90% = 54,000	60,000 x 100% = 60,000
Suger Bowl	30,000 x 40% = 12,000	30,000 x 70% = 21,000	30,000 x 80% = 24,000	30,000 x 90% = 27,000	30,000 x 100% = 30,000
Pot	20,000 x 40% = 8,000	20,000 x 70% = 14,000	20,000 x 80% = 16,000	20,000 x 90% = 18,000	20,000 x 100% = 20,000
Total:	180,000	315,000	360,000	405,000	450,000

IV. MANUFACTURING PROCESS, EQUIPMENTS AND THEIR PRICES

The ironstone wares beling to the fine earthenware of feldspar quality in the larger classification. Compared to the other kinds of earthenware, it contains the more quantities of feldspar and kaoline in the body, and accordingly more white and tightened. It could be said to be a well qualified earthenware. An example of the preparation for the body and glaze of the ironstone wares is given as follows:-

Body: Firing temperature at SK7 of

Kaoline	42%
Quartz	32
Feldspar	11
Ball clay	14
Lime stone	1

Glaze: Firing temperature at SK3a

Firt	46%
Quartz	19
Feldspar	9
Lime stone	7
Kaoline	6
Zircon	8
Zinc oxide	5

Seger formula:

$$\left.\begin{matrix}0.03K_2O\\0.18Na_2O\\0.43CaO\\0.36ZnO\end{matrix}\right\} 0.22Al_2O_3 \left\{\begin{matrix}2.80SiO_2\\0.32B_2O_3\\0.23ZrO_2\end{matrix}\right.$$

Of the materials which are tansported from the various producing centers, the clayey one like kaoline should be treated in the washing process. The stony materials should be washed away from the sticking dirts and dust, and placed to the crusher. Then, the roughly broken stones should be applied in the edge runner, reduced to powders.

After the exact measurements of each component material according to the specific proportion of the desired preparation, the measured materials should be processed together with spherulite and water in the ball mill for certain time. The ball

mill will effect fine pulverization and through mixing, giving what is called slip. The slip is conveyed to the agitation tank in which the slip should be incessantly stirred all through the treatment, and while agitated, the processed slip is piped out to the filter press where the contained water is extracted to produce the body with the moisture content of about 24 or 26%.

The forming of the body is carried out by means of a jigger or a slip casting. The formed articles, after adequate drying, should be buiscuit-fired at SK6a - SK8 (1,200 - 1,250°C).

Next, the glaze is applied on the surface, and the glost firing is carried out at the temperature of SK1a -SK3a (1,100 - 1,140°C). In case a decoration is needed, the decoration firing is further conducted at the temperature of about 800°C.

The required manufacturing process and the arrangement of the equipments are illustrated in the flow chart (Fig. 1) and the outlined layout (Fig. 2) respectively.

The specification and prices of the necessary equipments are as follows.

A. MATERIAL PREPARATORY SECTION

	Kind of Machinery Equipment	Q'ty	Price
1,	Jaw crusher with motor and one spare of jaw	1 set	£670

Capacity : abt. 500 kgs.- 1,000 kgs./hr
Feed opening : 10" x 5"
Material of Jaw : Manganese steel
Fixed Jaw Plate : Approx.300 x 275 x 32 m/m
Moving Jaw plate : " 340 x 240 x 32 m/m
Fly wheel : " 860 x 72 m/m
R.P.M. : 27.5
Motor : 3.7KW - 4P
G.W. 1250 kgs. Meas't 96 cft.

2,	Edge Runner with motor and accessories	1 set	1,160

Roller size : 150 mm x 100 mm
Capacity : abt.1,000 kgs./hr. (18 R.P.M.)
Motor : 7.5KW - 6P
G/W : 6,000 kgs.
H.P : 350 cft.

3,	Bucket conveyor with motor and accessories	1 set	250

Bucket size : 150 mm x 100 mm
Bucket Nox. : 26
Motor : 0.75KW - 4P
G/W : 330 kgs.
M/T : 60 cft.

4,	Portable Platform scale with drop lever	1 set	70

Capacity : 500 kgs.
Draduation : 25 kgs. x 200 grs.

5,	Elevator and Guided Rail	1 set	500

Capacity : 600 kgs.
Motor : 2.2KW - 4P
G/W : 1,000 kgs.
M/T : 216 cft.

6,	Three drum type Ball mill with lining stone, grinding stone and motor	3 sets (3 drums)	7,440

Capacity : 1,000 kgs. x 9
Motor : 11KW - 6P
G/W : 6,000 kgs. x 9 (54,000 kgs.)
M/T : 400 cft. x 9 (3,600 cft.)

7, Agitator (Round type) for slip mixing with motor and accessories — 3 sets — 615

Size of Tank	: 4,500 mm. dia. x 4,500 mm.
R.P.M.	: 14 - 20
Motor	: 2.2 KW - 4P x 3
G/W	: 550 kgs. x 3 (1,650 kgs.)
M/T	: 100 cft. x 3 (300 cft.)

8, Rotary Sieve (Double type) with absorbing pump and motor and accessories — 2 sets — 340

Motor	: 0.75KW - 4P x 2
G/W	: 120 kgs. x 2 (240 kgs.)
M/T	: 30 cft. x 2 (60 cft.)

9, Magnet Separator with rectifier and stainless steel filter plate and current failure alarm to transform A.C. to D. C. — 2 sets — 420

Capacity	: 600W x 2
Size of filter plate	: 17.3/4" x 25.5/8" x 21.5/8"
G/W	: 240 kgs. Meas't. 60 cft.

10, Diaphragm pump with motor — 2 sets — 680

Capacity	: abt. 1,800 l./hr. (in case of water)
Type	: Single action
Bore of Plunger	: 3"ϕ
Stroke of plunger	: 6"
Size of exhaust pipe	: 2"
Working pressure	: 100 - 150 lbs./in.^{2}
R.P.M.	: abt. 45
Motor	: 2.2 KW - 4P x 2

G/W 2,000 kgs. Meas't 170 cft.

11, Filter Press with nylon sheet and accessories — 2 sets — 4,830

Capacity	: abt. 3000 kgs./one charge
Type	: Type Screw type, Hand driven
Materials of Filter Plate	: Cast iron
Size of Plate	: abt. 28"ϕ x 1.1/2"
Nos. of room	: 85 pcs. x 2
Working pressure	: 100 to 150 lbs./inch^2
Required time per charge	: abt. 2-2.5 hr.
Accessories	: 2 sets of screen plate cock etc.

G/W. 17,600 kgs. Meas't. 800 cft.

12, De-Airing auger machine with motor, starter, switch vaccum pump and cutting equipment — 1 set — 960

Capacity	: 2,000 kgs./hr.
Inside dia.	: 10"
Max. Section area of the extruded clay	: 4.1/2"
Material of bland, roller and screen	: Bronze
R.P.M.	: 16 - 18
Motor	: 7.1/2HP-6P

G/W 1,500 kgs. Meas't. 130 cft.

13, Pipes and fitting — 1 set — 392

G/W : 1,500 kgs.
M/T : 120 cft.

B. FORMING SECTION

1, Semi Automatic Jigger — 6 sets — £3,540

Composition : 2 arms
Motor : 0.75KW
M/T : abt. 40 cft. x 6 (240 cft.)

2, Hand Operative type Machine Jigger with motor and accessories — 16 sets — 2,640

Composition : 4 arms in one set
Forming Jigger : 1
Tatara Jigger : 1
Motor : 1 (0.4 KW - 4P) x 16
G/W : 350 kgs. x 16 (5,600 kgs.)
M/T : 60 cft. x 16 (960 cft.)

3, Automatic Dryer with motor 3 rooms 1 unit — 1 unit — 3,400

Size of each one room : W6' x L19' x H16'
Nos. of Shelf " : 60 pcs. x 3
Chain length : 100' x 3
Shelf Size : 6' x 1.1/2'
Motor : 0.375KW
Drying hour : 4 hrs.
G/W 11,000 kgs. M/T 1,000 cft.

4. Finishing Jigger with motor and accessories (Four arms in one — 6 sets — 1,080

Motor : 0.4KW-4P
G/W : 500 kgs. x 6 (3,000 kgs.)
M/T : 100 cft. x 6 (600 cft.)

5, Shelf Transfer Car — 5 sets — 460

G/W : 110 kgs. x 5 (550 kgs.)
M/T : 30 cft. x 5 (150 cft.)

6, Press for casting slip — 2 sets — 366

G/W : 500 kgs. x 2 (1,000 kgs.)
M/T : 200 cft. x 2 (400 cft.)

7, Agitator for casting slip (Two-in-one) — 1 set — 120

Motor : 0.75KW - 4P
G/W : 250 kgs.
M/T : 50 cft.

8, Duct for Drying Furnace		3 sets	759
	Dia. of Duct : 380 mm Length of Duct : 20 m x 3 G/W : 600 kgs. x 3 (1800 kgs.) M/ T : 100 cft. x 3 (300 cft.)		
9, Blower for Drying Furnace		3 sets	426
	Motor : 3.7KW - 4P x 3 G/W : 300 kgs. x 3 (900 kgs.) M/T : 45 cft. x (135 cft.)		
10, Sagger Pin Forming Machine with motor and accessories		1 set	105
	Motor : 0.4KW - 4P G/W : 200 kgs. M/T : 20 cft.		

C. BISCUIT FIRING SECTION

Buiscuit Firing Tunnel Kiln		1 unit
All length	: 60 m	
Capacity	: abt. 450,000 pcs. per month	
Effective Area	: 700mm x 1,200 mm (width) (height)	
1, Fuel Transfer Equipment		
	Dia. 25m/m pump	2 sets
	Dia. 25m/m Oil Strainer	2 sets
	Relief Pressure meter	2 sets
	Motor : 0.75KW - 4P	
2, Oil Control meter, Dia. 25m/m with strainer and By-pass		1 unit
3, 40 mm, dia. Oil Burner with strainer Micro-cock, seamless tube and burner-foot		10 units
	Capacity : 4 - 20 l./hr.	
4, 100 mm. Dia. Turbo Blower with motor and accessories		2 sets
	Capacity : 750 m/m Hg. 13m^3/minute Motor : 3.7KW - 4P	
5, 260 m/m Dia. Blowing Fan		2 sets
	Capacity : 54 m^3/minute Motor : 3.7KW - 4P	
6, 260 m/m Dia. Exhaust Fan		2 sets
	Motor : 5.5KW - 4P	

7, Pipes for Exhaust Fan, Blowing Fand and Oil transfer — 1 unit

8, Kiln Rails, (inner line, Outer line and traverse pointed with Bolts, Nuts, Joint and sleepers — 1 unit

9, Sand Seales iron plate — 1 unit

All length : 110m

10, Kiln Transfer-Car — 3 units

11, Kiln Cars — 75 units

12, Oil Pusher with motor and accessories — 1 set

Motor : 0.4KW -4P x 2

13, Under Kiln Car, Duct and Dumper — 1 set

14, Steel Fitting and other Steel accessories — 1 set

15, Kiln Reinforced Materials — 1 set

16, Kiln Door — 2 sets

17, Meters — 1 unit

(1)	5 point system Pyrometer	4 sets
(2)	Pt.-Rh. Pyrometer	10 sets
(3)	Al.-Cr. Pyrometer	10 sets
(4)	Wires	60 m.
(5)	12 points Record Meter with record panel	1 set
(6)	Draft gauge	2 sets
(7)	Alarm Bell	3 sets

G/W : abt. 4,500 kgs. (C1-C16)
M/T : abt. 2,500 cft. (C1-C16)

18, Kiln Materials

(1) Fire Brick (Usual shape)
SK34 : 4,000 pcs.
SK32 : 6,000 pcs.
Sk30 : 29,000 pcs.

(2) Fire Brick (Special shape)
SK34 : 20 tons
SK32 : 7.2 tons
SK30 : 25 tons

(3) Insolating Brick
B-1 : 15,000 pcs.

(4) Kiln Car-Brick
SK30 : 52 tons

(5) Fire Mortar
SK35 : 2,000 kgs.
SK34 : 3,500 kgs.
SK30 : 27,000 kgs.
B-1 : 4 tons
G/W : 290 tons
M/T : 4,870 cft.

Total: £20,210

D. GLOST FIRING SECTION

Glost firing tunnel kiln complete with the necessary equipments

Glost Firing Tunnel Kiln — 1 unit

All length : 40 m.
Effective Area : 700 mm. x 1,200 mm.

1, Oil Control Meter with strainer & By-pass — 1 set

Dia. : 25 m/m

2, 40 m/m Dia. Oil Burner w/strainer micro cock, Seamless tube and Burner foot — 8 sets

3, 100 mm. Dia. Turbo Blower with motor — 2 sets

Capacity : 750 m/m Hg.13m.3/minute
Motor : 3.7KW 4P x 2

4, Blowing Fan with motor — 2 sets

Dia. : 260 m/m
Capacity : 54 m/minute
Motor : 3.7KW - 4P x 2

5, Exhaust Fan with motor — 2 sets

Dia. : 260 m/m
Motor : 5.5KW - 4P x 2

6, Kiln Rail (Inner Rail, Outer Rail and traverse) — 1 set

with bolt, nut, joint and sleeper
: 250 m. length

7, Sand seal Iron Plate with Joint — 1 set

8, Trans-Car — 2 sets

9, Kiln Car — 60 sets

10, Oil Pusher with motor — 1 set

Motor : 0,4KW x 2

11, Under Kiln Car Duct with Dumper — 1 set

12, Steel Fittings and other accessories — 1 set

13, Kiln Reinforced Iron Materials — 1 set

14, Pipes for Oil Transfer and Blowing and Exhaust Fan — 1 set

15, Kiln Door — 2 sets

16, Meters — 1 unit

(1)	5 point system Pyrometer	4 pcs.
(2)	Pt-RH Pyrometer	10 pcs.
(3)	Al-Cr Pyrometer	10 pcs.
(4)	Wire	60 m.
(5)	12 point system Pyrometer	1 set
(6)	Draft gauge	2 sets
(7)	Alarm Bell	3 sets

G/W : abt. 40 tons (E1-E16)
M/T : abt. 2,400 cft. (E1-E16)

17, Kiln Materials

(1) Fire Brick (Usual shape)
SK34 : 4,000 pcs.
SK32 : 5,000 pcs.
SK30 : 2,700 pcs.

(2) Fire Brick (Special shape)
SK34 : 20 tons
SK32 : 7.5 tons
SK30 : 17 tons

(3) Kiln Car Brick
abt. 46 tons

(4) Fire motor
SK35 : 2,000 kgs.
SK34 : 3,500 kgs.
SK32 : 2,500 kgs.
SK30 : 20,000 kgs.

(5) Adiabatic Bricks
B-1 : 15,000 pcs.

(6) Adiabatic Mortar
B-1 : 13 tons
G/W : 260 tons
M/T : 4,680 cft.

Total: £18,112

E. DECORATING SECTION

1, Electric Decoration Kiln, Squ, type — 4 sets £3,600

Capacity : 1,800 pcs./one charge (in case of 9" plate W.2'x L.10' x D2'8")
G/W : 13,200 kgs.
M/T : 960 cft.

F. GLAZE MAKING SECTION

1,	Three drum type Ball Mill with lining stone, grinding stone and motor	1 set	£2,480
	Capacity : 1,000 kgs. x 3 Motor : 11KW06P x 1 G/W : 6,000 kgs. x 3 (18,000 kgs.) M/T : 400 cft. x 3 (1,200 cft.)		
2,	Rotary Sieve (single type) with Pump	1 set	130
	Motor : 0.4KW-4P G/W : 150 kgs. M/T : 20 cft.		
3,	Magnet Separator with rectifier and stainless steel filter plate and current failure alarm to transform A.C. to D.C.	1 set	240
	Capacity : 600W Size of magnetic separator : 17.3/4" x 25.5/8" x 21.5/8" G/W : 120 kgs. Meas't : 30 cft.		
4,	Glaze Agitator with motor & accessories	1 set	200
	Size of tank : 3,000 mm. dia. 3,000 mm. depth R.P.M. : 14-20 Motor : 2.2KW-4P G/W : 350 kgs. M/T : 75 cft.		

G. SAGGER MAKING SECTION

1,	Edge Runner with Motor	1 set	£820
	Roller dia. : 1,200 mm x 300 mm R.P.M. : 20 Capacity : 550 kgs./per hr. Motor : 3.7KW-4P G/W : 4,000 kgs. M/T : 300 cft.		
2,	Bucket Conveyor with motor	1 set	235
	Bucket dia/ : 150 mm x 100 mm Nos. of Bucket : 26 Motor : 0.75KW-4P G/W : 330 kgs. M/T : 60 cft.		

3,	Pug Machine with motor	1 set	760
	Capacity : 2,000 kgs./per hour Motor : 3.7 KW-4P G/W : 3,000 kgs. M/T : 200 cft.		
4,	Friction Press with motor	1 set	760
	Capacity : 1,000 kgs./per hour Motor : 3.7KW-4P G/W : 3,000 kgs. M/T : 250 cft.		
5,	Steel mould for Friction Press (Cups & Bowls, Plates and Pots)	10 sets	1,120
	G/W : 10 kgs. x 10 (100 kgs.) M/T : 170 cft. x 10 (1,700 cft.)		

H. MOULD MAKING SECTION

1,	Vacuum type Bubble-Eliminater with Motor and Pump	1 set	£177
	Motor : 0.4 KW-4P G/W : 200 kgs. M/T : 35 cft.		
2,	Table-jigger	1 unit	81
	18" dia. : 2 pcs. 10" : 4"		

I. LABORATORY SECTION

1,	Pot Mill with motor	1 set	£220
	Nos. of Pot Mills 250mm dia. : 3 pcs. 125mm dia. : 5 pcs. R.P.M. : 50 Motor : 1.5KW-4P G/W : 350 kgs. M/T : 50 cft.		
2,	Auto-Grave	1 set	173
	G/W : 150 kgs. M/T : 30 cft.		
3,	Electric Firing Furnace for testing with voltage	1 set	502
	Capacity : 20KW G/W : 500 kgs. M/T : 100 cft.		

4, Agitating Machine for raw material with mortar and motor — 1 set — 88

Nos. of Mortars	: 10" dia. 2 pcs.
Motor	: 0.4KW-4P
G/W	: 50 kgs.
M/T	: 20 cft.

J. OTHER TOODS — 1 unit

1, Mould Case

Full Plate	10" dia.	10 sets
	9"	10 "
	7"	10 "
Bowl	10"	5 "
	9"	5 "
Soup Plate	10"	10 "
	9"	10 "
	7"	10 "
Curry cup	4.1/2"	10 "
	5"	10 "
	5.1/2"	10 "
	6"	5 "
	6.1/2"	5 "
	7"	5 "
	8"	5 "
Tea Cup	A type	10 "
	B "	10 "
	C "	10 "
Saucer	A "	10 "
	B "	10 "
	C "	10 "
Tea Pot	5"	3 "
	4"	3 "
	3"	3 "
Milk Pot	Medium	3 "
	Small	3 "
Sugar Pot	Medium	3 "
	Small	3 "

Total: £536

2, Drying conveyor with motor — 1 set — £1,052

All length	: 30 m.
Belt width	: 600 mm.
Motor	: 0.75KW-4P
G/W	: 3,000 kgs.
M/T	: 300 cft.

V. SELECTION OF THE SUITABLE FACTORY SITE

All the ceramic wares are made of the earth and quarrying materials which weigh a good heavy weight. It is therefore desirous for the factory to be constructed at the place of traffic convenience for the material transportation. The most favourable construction site should be pointed out to be in the neighbouring area of the material producing centers. From this standpoint, the area situated between Cape Coast and Saltpond in the central region should be recommended as the most suitable construction site for the reason why the area is rich in kaoline and feldspar produces, both of which are indispensable for the ceramic manufacturing.

Besides the conveniences for the material transportation, the ceramic manufacturing should require the other important condition that the firing kilns should stay free from the humidity caused by the ground moisture. In order to prevent the vapour emitted in the kilns, and ensure the good firing condition, the enough precaution should be made to avoid the moisture coming from under the foundation ground. From the technical point of view, the proposed construction site should be located on an elevated land where the underground water level is low.

Common with the requisite for the site of any kind of factory, the traffic conveniences are also required for the deliveries of the subsidiary materials and the finished products. Taking into account the supply of the industrial electric power and water, and the available working population, the site will be confined to the neighbourhood of a city.

As the result of the considerations given to the abovementioned, the proposed construction site would be designated as the best suitable to be somewhere along the Saltpond by-pass.

VI. ESTIMATES OF VARIOUS COSTS AND CHARGES

(1) Construction Cost

The chief construction in this plan will be made for the factory, material warehouse, product warehouse and office building. The unit price of each construction was estimated made reference to the survey of the G.N.C.C. (Ghana National Costruction

Corporation) and to the instances prevailing in Japan. The estimated construction costs are shown as follows:

Construction	Unit (£)	Amount (£)
Factory	25	104,400
Material Warehouse	6	360
Product Warehouse	8	960
Office Building	30	5,400
	Total:	£111,120

The blueprint of the factory is as shown as in Fig. 2, and the arrangement of the four main buildings is as in Fig. 3.

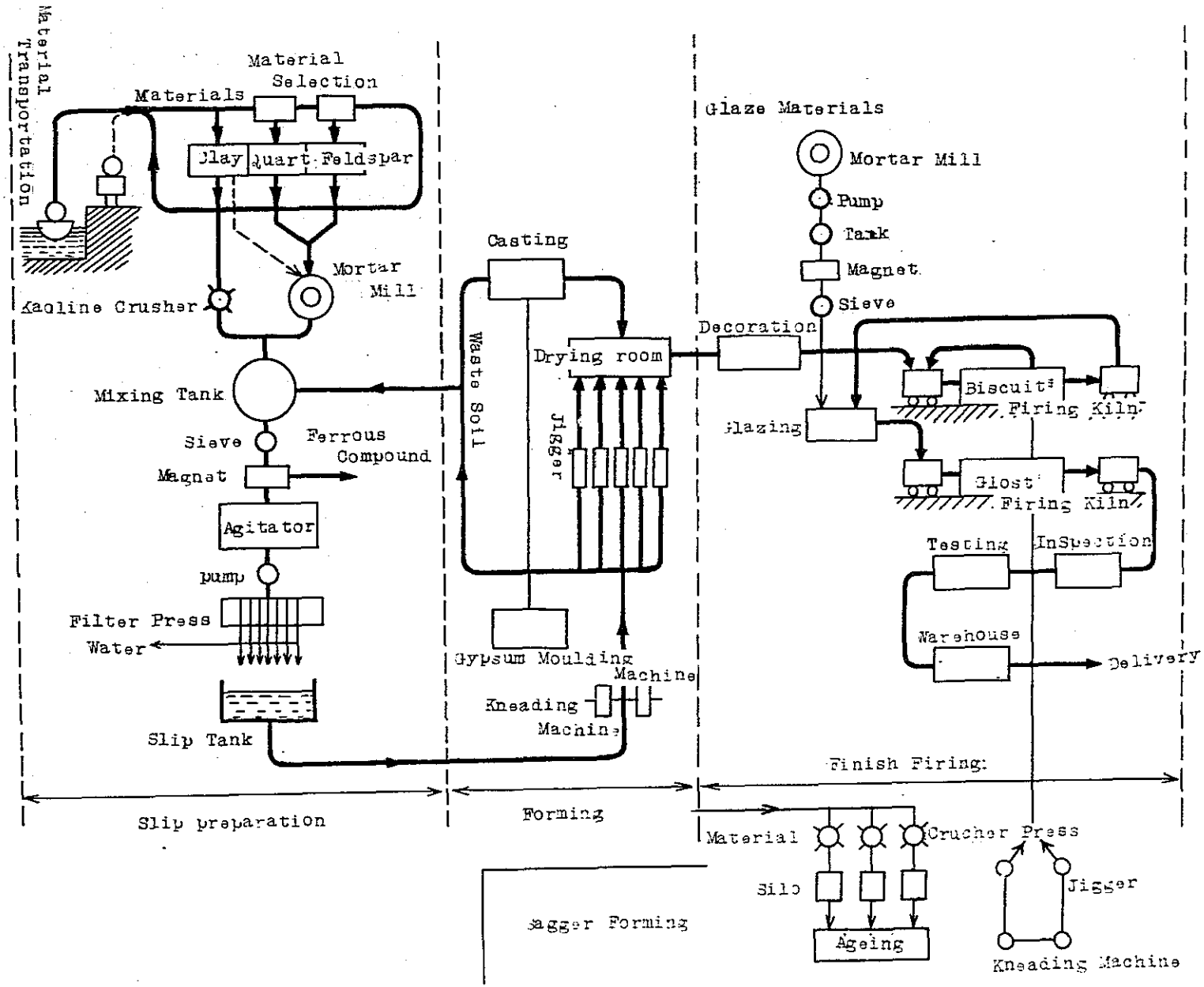
(2) Material Cost

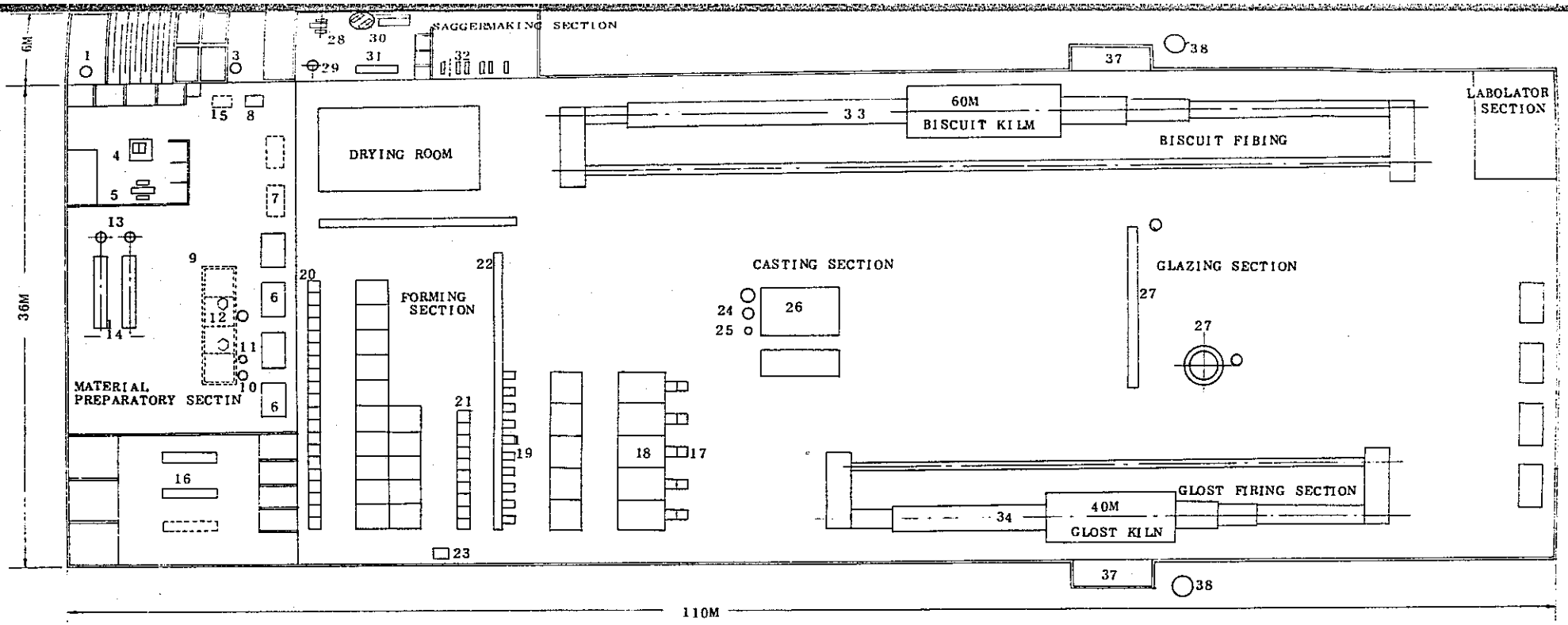
This plan is to achieve the production amount per year of 1,100 tons as concluded in the 3rd chapter, and the necessary amount of raw materials should be about 1,200 tons, which are increased by 10% on the intended production amount. In the meantime, as the preparations of the body and glaze are shown in the 4th chapter of this report, the necessary amount of their materials can be easily calculated.

The following coefficient figures are to be used to calculate the estimated costs:

1. Wage is 10^{s} for an 8-hour day.
2. Hire of 10-ton for truck is 120^{s} for a day.
3. Hire of vehicle for collecting materials is 120^{s} for a day.
4. Hire of a rock drill for digging materials is 60^{s} for a day.
5. According to the test, the effective componet of the kaoline is measured 44%. With a transportation truck, a collecting vehicle and two man-powers, the transportation of the kaoline needs 23 days.
6. In quarrying the feldspar, three rock drills and three man-powers being used, 8-days are required in total. With a transportation truck, a collecting vehicle and three man-powers, the transportation of the feldspar needs 4 days in total.

Fig 1


Material Transportation
Material Selection
Materials
Clay
Quart
Feldspar
Mortar Mill
Kaoline Crusher
Mixing Tank
Sieve
Ferrous Compound
Magnet
Agitator
pump
Filter Press
Water
Slip Tank
Slip preparation
Casting
Waste Soil
Drying room
Jigger
Gypsum Moulding Machine
Kneading Machine
Forming
Glaze Materials
Mortar Mill
Pump
Tank
Magnet
Sieve
Decoration
Biscuit Firing Kiln
Glazing
Glost Firing Kiln
Testing
InSpection
Warehouse
Delivery
Finish Firing
Material
Crucher Press
Silo
Jigger
Ageing
Kneading Machine
Sagger Forming



NO.	DISCRIPTION	QTY	NO.	DISCRIPTION	QTY
1	DISINTEGLATER	1	21	MACHINE JIGGER	0
2	TURBIN PUMP	1	22	BELT CONVEYER	2
3	DIAPHRAGM PUMP	1	23	EXHUST FAN	1
4	ROLL CRUSHER	1	24	MIXING AGITATER	2
5	JAW CRUSHER	1	25	DIAPHRAGM PUMP	1
6	BALL MILL 2000K	4	26	SLIP CASTING MACHINE	1
7	" 1000K	1	27	GLAZE CONVEYER	2
8	" 100K	1	28	JAW CRUSHER	1
9	MIXING AGITATER	4	29	VERTICAL PUG MILL	1
10	DIAPHRAGM PUMP	2	30	EDGE RUNNER	1
11	MAGNETIC SEPARATER	1	31	HORIZONTAL PUG MILL	1
12	SIEVE	2	32	FRICTION PRESS	3
13	DIAPHRAGM PUMP	2	33	BISCUIT KILN	1
14	FILTER PRESS	2	34	GLOST KILN	1
15	ELEVATER	1	35	DECORATION KILN	4
16	DE-AIRING AUGER MACHINE	2	36	LABORATORY EQUIPMENT	1
17	AUTOMATIC JIGGER	10	37	FIRING EQUIPMENT	2
18	AUTOMATIC DRYER	10	38	MAIN OIL TANK	2
19	MACHINE JIGGER	18			
20	MACHINE JIGGER	20			

INCREASE PLAN

IM MNH

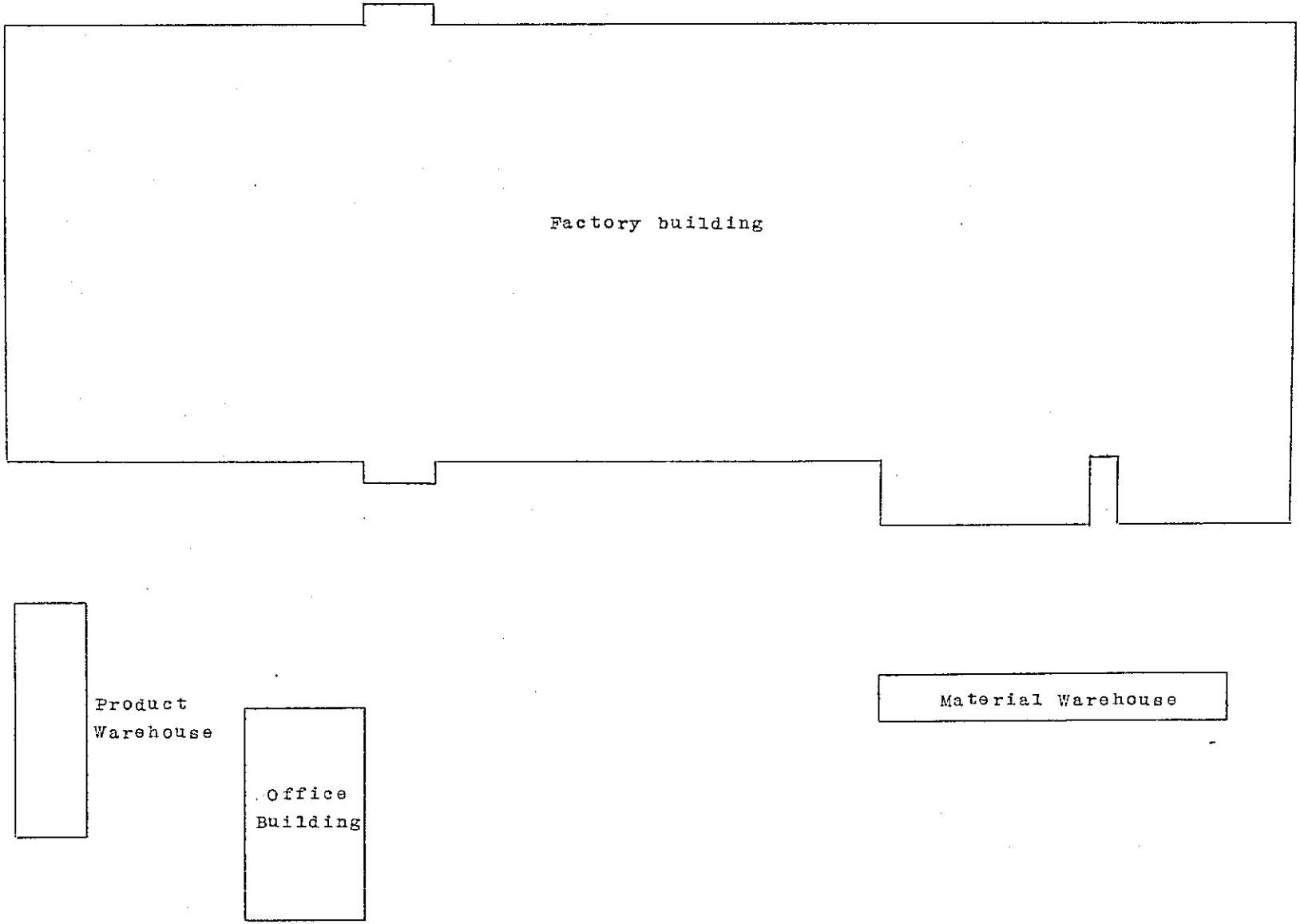
FIG. 2 IRONSTONE WARE MFG. PLANT

SCALE 1/300

UNIT METER

Fig. 3 Arrangement of four main buildings

Unit: meter
Scale: 1/500



7. The stacked-up quartz described in the 2nd chapter will be used, and no quarrying is required. With four transportation trucks, collecting vahicle and two man-powers, the transportation of the quartz needs 10 days.
8. In quarrying the lime-stone, three rock drills and four man-powers being used, one day is required. Two transporation trucks and 10 man-powers being used, one day is required to transport this material.
9. Concerning the raw materials and subsidary materials which are planed to be imported, the current import/export market prices in Japan are refrenced to as the standards.
10. The prices of water and electric power are those which are currently prevailed in Ghana.

Based on the abovementioned coefficient figures, the individual unit prices were set up to give the material costs as follows:-

	Item	Annual Consumption (ton)	Unit Price (s) Mining Q'ty	Transportation Cost	Import Price	Amount (£)	Remarks
Body	Kaoline	504	0	12	---	303	
	Feldspar	132	13	8	---	73	
	Quartz	384	0	16	---	307	
	Ball Clay	168	---	18	400	2,671	Imported
	Lime-stone	12	19	28	---	28	
Glaze	Frit	90	---	18	700	3,222	Imported
	Quartz	34	0	16	---	27	
	Feldspar	17	13	8	---	18	
	Lime-stone	13	19	28	---	31	
	Kaoline	11	0	12	---	7	
	Zircon	15	---	18	2000	1,513	Imported
	Zinc White	9	---	18	3,200	1,448	Imported
Sagger	Kaoline (lower grade	26	0	12	---	16	
	Ball Clay (lower grade)	22	---	18	300	350	Imported
	Shamotto	52	---	18	160	463	Imported
Subsidary Materials	Fuel (Crude Oil	gallon 364,000	---	108/1,000 gallon	630/1,000 gallon	13,431	Imported
	Gypsum	50	---	18	120	345	Imported
	Water	gallon 1,200,000		4		240	
	Electricity	420,000KWH 200KVA		2.5[1]/KWH + £12/KVA		6,775	

Total: 31,268

(3) Labour Cost

The production size planned in this report will require about 280 personnels including the manager. The making-up of the members will be given as follows:

Manager	No. of Personnel
Plant Superientendent	1
Manager of Manufacturing Technics	1
Office Member	
Office Superintendent	1
General Affairs	5
Personnel	1
Accounting	1
Commodity	1
Procurement	1
Sales Promotion	5
Technical Member	
Material Preparatory	2
Forming	3
Moulding	1
Firing	2
Decoration	1
Packing & Inspection	1
Testing	2
Labour	1
Factory Worker	
Material Preparatory	22
Forming	44
Moulding	17
Glazing	23
Drying	5
Firing	25
Decoration	40
Packing & Inspection	36
Sagger	12
Testing	15
Labour	12

The survey on the labour market in Ghana let out that the avarage wage (per month) should be reasonable for the indivifual mambers of this making-up:-

Manager:	£300
Office Superintendeng:	125
Office Worker:	10
Technical Personnel:	35
Factory Worker:	15

Based on the abovementioned avarage wages, the total labour cost is calculated as follows:-

Manager:	£300 x 2 x 12 months = £7,200
Office Worker:	(£125 x 1 x 12 m/s) + (£10 x 16 x 12 m/s) = £3,420
Technical Personnel:	£35 x 13 x 12 m/s = £5,460
Factory Worker:	£15 x 251 x 12 m/s = £45,180
	Total: £61,260

(4) Indirect Cost

Depreciation cost:

Equipments:	£82,930 x 12% = £9,942
Building:	£111,120 x 4.5% = £5,000
Vehicle:	£3,200 x 53.6% = £1,715

4 vehicles should be maintained to handle the delivery of the products. Unit Price per vehicle: £800.

Repairing Cost:	£4,500
Administrative Charges:	12,150
Total:	£33,307

(5) Total Cost

Raw Material Cost:	£31,268
Pay and Wage:	61,260
Indirect Cost:	33,307
Total	£125,835

VII. ANNUAL PROFIT

As references are made to the ruling rates of wage in Ghana, the nation's living standard and further to the market prices of the imported goods shown in Table 2, the cost price of the product on ex-factory basis might be moderate to set at 8^{s} per dozen pieces on the avarage. This unit price will give the total amount of the expected annual profit as follows:-

Annual output:	450,000 doz.
Annual Sales Value:	£180,000
Total Cost:	£125,835
Annual Profit:	(Annual Sales Value) - (Total Cost) = £54,165
Profit per piece:	Annual Profit/Annual Output = 0.12^{s}
Cost per piece:	Annual Cost/Annual Output = 0.56^{s}
Profit Rate:	Annual Profit/Annual Sales Value x 100 = 30%

VIII. CONCLUSION

In consequence of the thorough study made to the respective results of the site investigation for the ceramic industry in Ghana, the survey team came to the conclusion that, inasmuch as both required material availability and the prospective future demand are concerned, the planned production should be quite feasible to start in Ghana under the present conditions.

Among the porcelain and earthenwares, there are many kinds of article, but in this plan taken up are the only ordinary table-wares to be used in the everyday life. However, it will be also possible to manufacture the other kinds of porcelain and earthen-wares, sanitary wares, tile or earthen pipes on an almost same production scale as regards the investment amount and the available materials, provided a little modifications should be made in relation to the equipments and the processing technics.

Peculiar to the ceramic industry, it will be rather difficult that the full automation should be achieved. There are still many points of processing left for the manual skillfullness. Keeping up with the development of the planned project on the ceramic manufacture, it is suggested, or recommended that the education and training of the Ghanaian technical personnels should be carried out by the Japanese engineers so that the firm establishment of ceramic industry could be attained in Ghana.

D. PROJECT FOR THE ESTABLISHMENT OF A PLYWOOD FACTORY IN GHANA

I. Demand and Supply Situation.

Demand and supply situation of veneer products in Ghana during the past few years is given below together with the relevant data tabulated.

Production of Veneer Plywood Boards & Veneer Sheets

Quantity: in 1,000 CFT
Value : in £1,000

(Veneer Sheets)

	(1959)		(1960)		(1961)		(1962)	
	Q'ty	Value	Q'ty	Value	Q'ty	Value	Q'ty	Value
Export	18.13	38.05	19.06	39.20	34.56	30.51	30.88	41.99
Processing at home	2.94	5.91	8.37	15.94	12.39	23.60	12.10	23.50
Stock	2.18	4.40	1.33	2.52	0.81	1.52	0.25	0.48
TOTAL:	23.25	48.36	28.76	57.67	47.76	55.64	43.23	65.97

(Veneer Plywood Boards)

	(1959)		(1960)		(1961)		(1962)	
	Q'ty	Value	Q'ty	Value	Q'ty	Value	Q'ty	Value
Export	148.29	278.24	151.13	311.34	145.41	291.99	435.06	769.54
Domestic demand	57.75	120.21	99.10	207.46	129.35	270.79	108.99	288.12
Processing at home	2.13	8.36	7.44	14.80	7.19	14.30	10.34	20.58
Stock	0.76	2.98	1.89	3.76	12.27	24.27	43.35	82.76
TOTAL:	207.41	409.79	255.78	529.84	294.22	601.35	597.74	1,161.00

As is clear from the above table, export of both veneer sheets and veneer ply wood boards has been on the steady upward tendency. Comparison of export volume of veneer plywood boards in 1962 with that in 1960 indicates a remarkable and rapid increase achieved during two

short years.

On the other hand, however, it was revealed that veneer plywood boards are still being imported. But the importation of plywood boards is expected to be gradually confined to specific items and eventually be eliminated. Given below are import statistics by country of veneer plywood boards, veneer sheets, and plywood and veneer panels during 1962.

(Veneer plywood boards and veneer sheets)

Country	Q'ty (CFT)	Value (£)
UK	21	383
Canada	102	129
Norway	1,344	957
TOTAL:	1,467	1,474

(Plywood and veneer panels)

Country	Q'ty (CFT)	Value (£)
UK	2,039	265
Nigeria	5,013	2,650
French Equatorial Africa	23,119	29,568
Israel	47,550	46,200
Japan	2,192	833
USA	334	127
TOTAL:	80,247	79,643

Import of these items is noticed to be declining recently with Israel remaining as the only major exporting country.

Production data tabulated above also indicate that there has been a sharp increase in the domestic demand both for veneer plywood boards and veneer sheets, which jumped by about 4 - 5 times during 1959 - 1962 period. Since the consumption of veneer products is anticipated to further increase as the country's extensive construction plan is put into practice in the future, it is desired that efforts be directed to enhancing the domestic production.

II. Kinds, quality and colouration of veneer plywood boards available on the market.

Plywood boards available on the market are predominantly those

of the size 4' x 8', glued with the completely waterproof adhesives. Thickness of this kind of boards ranges from 1/4 mm to 4 mm for ordinary uses. For specific purposes, however, boards of 4 mm, 5 mm, 6 mm, 9 mm, 12 mm and 15 mm are also offered. Selling price of the 3 ply board, size 4' x 8' x 4 mm, made from the Mahogany material, is Sh. 16 per sheet. Most of these boards are of fine quality with no overlaps and comparatively little knots, pitch pocket or cracks.

With regard to the polishing finish, it was noted that sanders are utilized in Ghana. It appeared that the use of scrapers for this purpose is practised only in Japan. It was reported during the investigation that sanders are sufficient to perform the polishing finish since the sanded boards have to be painted before using.

It is suggested that more care be exercised for the colour scheme in assorting veneer sheets by means of the slicer. If studies are made for selecting colours or combination of colours which are more appealing to the customers, the finished products would not only present better appearance but also sell at higher prices. Further, if plywood boards are produced in more diversified kinds by improved surface processing, export to Europe will undoubtedly increase to a large extent.

About 40 different kinds of woods are generally known as materials for veneer plywood boards. Of these 40 kinds, the following are most well known as export timbers.

Walnut, Mahogany, Obeche, Agba, Niangon, Iroko, Iople, Opepe, Makore, Edinam, and Idigbo.

It may as well be recommended to utilize the above materials for different purposes in manufacturing plywood boards, e.g., Mahogany for core veneer and Abeche or Wawa or surface veneer.

III. Quality Test

Although the quality of the veneer plywood boards depends considerably on its materials, the most decisive factor that determines the quality is the glue. Adhesion test conducted on the glues used for the Ghanaian plywood boards, given below in detal, proved that they are of satisfactory quality.

The test was performed in strict compliance with so called JAS Method (Japan Agricultural and Forestry Standard Method) which

in substance is identical with the CS Method of the United States. The main chemical component of the glue was found to be urea or phenol both of which provide perfect water-proof property.

(Photo #1 at the end of this report:
A test piece cut on one side before testing)

The test, called "Repetitive Boiling Test," is the latest and most effective method to determine the interrelation between the glue and the veneer. The test is conducted in the following order:

Test piece is cut on one side as shown in Photo #1. If the test piece consits of five or more veneers, the required number of 3 ply test pieces is prepared by peeling off the unnecessary veneers in such a way as each glued surface in the original test piece is contained in one of the 3 ply test pieces. Test pieces thus prepared are cut on one side and soaked in the boiling water. After 4 hours of soaking, they are taken out and dried at $60^{\circ}C \pm 3^{\circ}C$ for 20 hours, soaked again for 4 hours in the boiling water, left soaked in the water until the water temperature drops to the ambinet temperature. Adhesion test is then conducted on the wet test pieces that are taken out of the water. Adhesive power is determined by measuring the tensile load imposed upon the test piece at the moment of its breaking which is caused by the tension excercised at the load speed of 1,320 lbs. or less per minute in two opposite directions, i.e., in the direction of both ends of the test piece.

As a result of the above boiling and adhesion test, it was revealed that the Ghanaian plywood boards possess the adhesive power exceeding the specified standard of 110 $lbs/inch^2$.

(Photo #2 at the end of this report:
Test piece broken after sustaining the tensile load imposed by the adhesion test)

The adhesive power of the test piece is computed by the formula given below. However, in the event where the ratio of the thickness of the surface veneer against that of core veneer exceeds 1.5,

the adhesive power computed by the said formula must be multiplied by the index appearing in the list below in accordance with the thickness ratio.

$$\text{Adhesive power (lbs/inch}^2) = \frac{P}{b \times h}$$

p - maximum tensile load imposed by the adhesion test.
b - Width of the glued surface (inch)
h - Length of the glued surface (inch)

Thickness Ratio	Index
More than 1.5 & below 2.0	1.1
" 2.0 " 2.5	1.2
" 2.5 " 3.0	1.3
" 3.0 " 3.5	1.4
" 3.5 " 4.0	1.5
" 4.0 " 4.5	1.7
" 4.5 / /	2.0

The following figures of adhesive power of the Ghanaian veneer plywood boards have been computed on the basis of the above-mentioned method.

Test piece	Adhesive Power (lbs/inch^2)	Breakage (%)
4 mm	206	80
(3 ply)	199	10
	249	80
	177	90
18 mm	156	80
(5 ply)	184	5
	191	80
	170	5
	113	70

The fact that the maximum tensile load exercised on each of the above test pieces registered more than 110 lbs. shows explicitly that the adhesive power of the glue used for the Ghanaian plywood boards amply meets the specified standard. This fact also serves to evidence that the materials are of excellent quality.

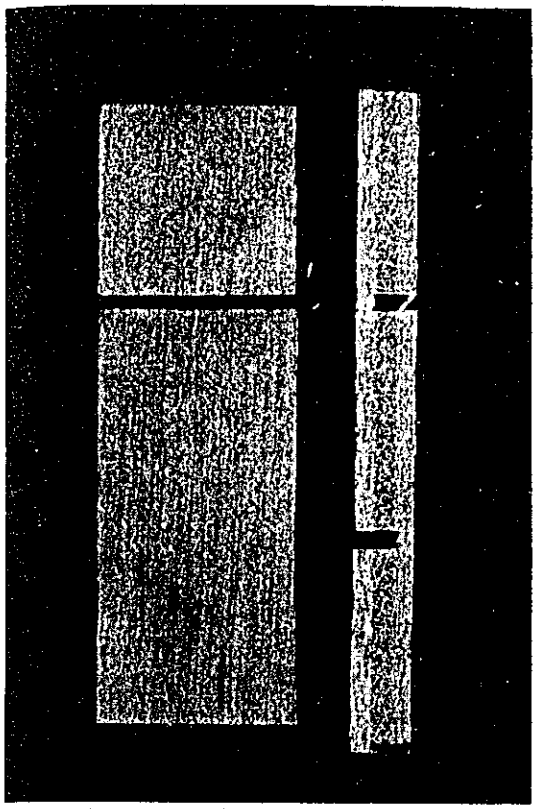


Photo #1

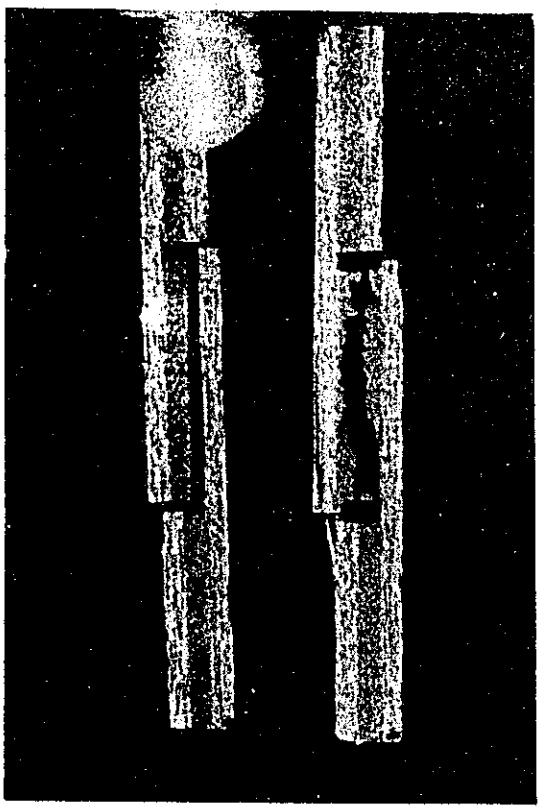


Photo #2

IV. Project for Establishing a New Plywood Factory.

Plans for establishing a new plywood factory, given in detail in the following sections, have been drawn up in due consideration of the present demand & supply situation relative to the domestic production, export and import, as well as of the outlook for the future production pattern of veneer products. It is considered most appropriate for the proposed factory to have the monthly productive capacity of 100,000 ft^3, i.e., 237,000 sheets in terms of size 4' x 8' x 4 mm.

IV- 1 Construction Site.

The proposed factory is recommended to be constructed either in Takoradi or Tema. The former has the advantage of being an old established timber distributing centre where no difficulties will be encountered in the recruitment of workers as it is located within the labour market area. The city is further locationally favoured for both export and domestic sales. The latter, Tema city, is a new developing industrial city with a vast power supply source of Volta Dam available in its proximity. The area required for the construction of the factory can be easily secured in Tema. Further, being located close to Accra, inland transportation routes can readily be availed of by the city. Considering the future export of plywood boards, Tema may be recommended as the construction site of second choice.

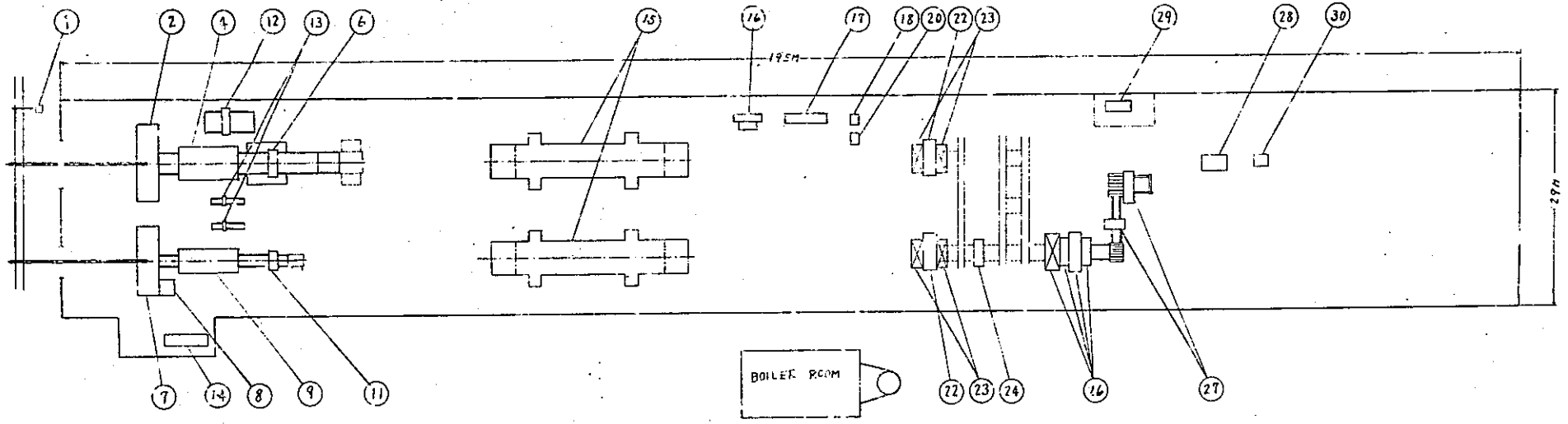
In so far as the communication facilities are concerned, Kumasi city, the supply centre of wood materials, is equally accessible to the above two cities. The distance between Kumasi and the two cities are also about the same. However, preference may be given to Takoradi if one considers the advantages that it offers by being a timber distributing centre where there are established government offices and organisations of timber dealers. Nevertheless, the first preference will have to be given to Tema if the plywood industry is ever to be developed to such an extent as would be capable of producing processed articles of plywood and commodities that require the techniques of the chemical industry.

IV - 2 Factory Layout and Flow Sheet

The factory layout and Flow Sheet are as follows.

NOTE:

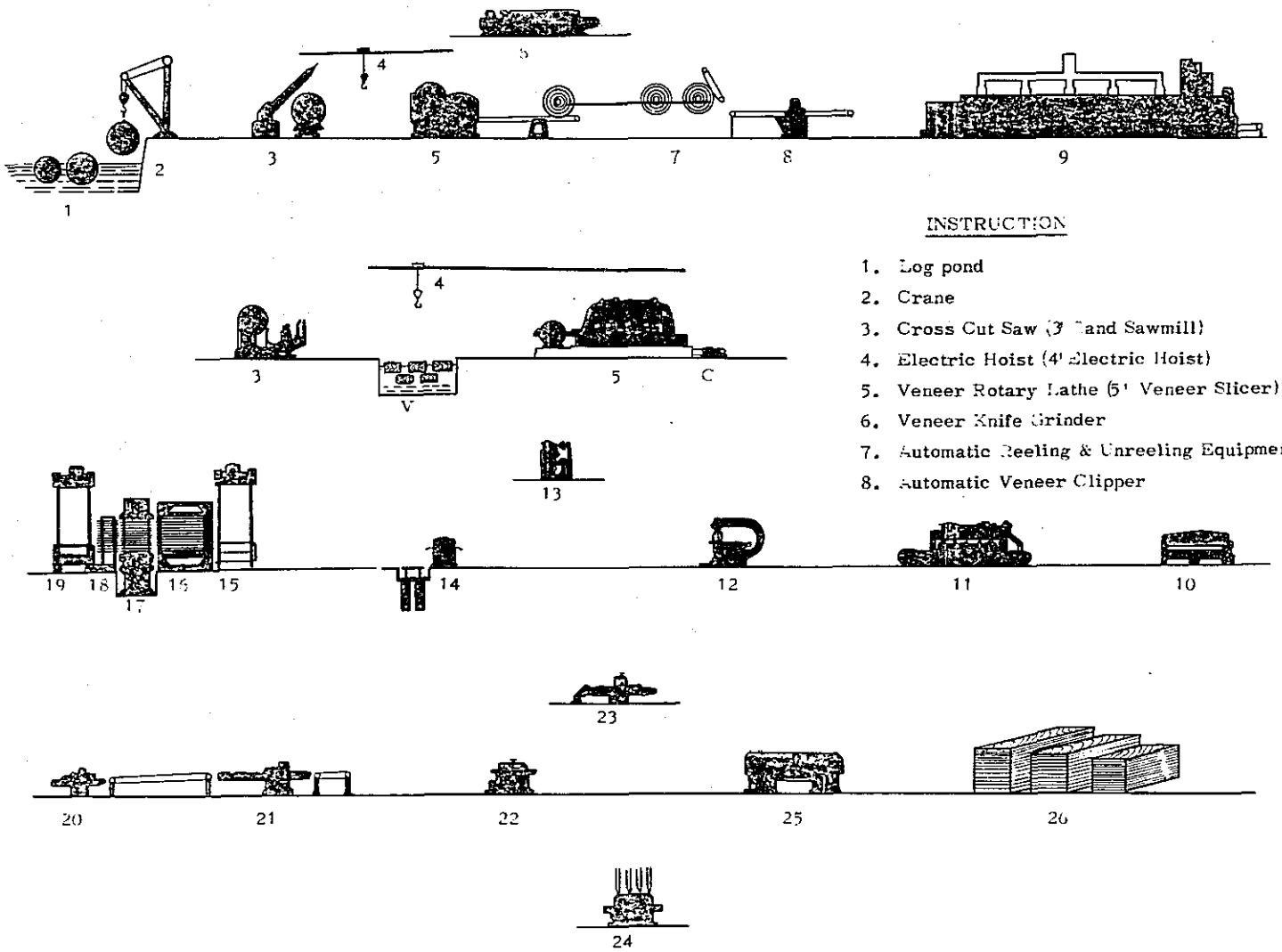
This LAYOUT shows the principal arrangement of Basic Main Machineries and Equipment not including Supplementary and Auxil. Equipment.



ITEM	NAME OF MACHINE	ITEM	NAME OF MACHINE
1	POND AND DECK SAW	16	DRY VENEER SIZING CLIPPER
2	VENEER ROTARY LATHE	17	VENEER JOINTER
3	WARD LEONAD CONTROL SYSTEM	18	TAPING MACHINE
4	VENEER REELING AND UNREELING	19	TAPELESS SPLICER
5	AUTOMATIC REELING SYNCHRONIZER	20	PATCHING MACHINE
6	VENEER AUTO CLIPPER	21	GLUE MIXER
7	VENEER ROTARY LATHE	22	GLUE SPREADER
8	POLE CHANGE MOTR	23	X LIFTS
9	VENEER REELING AND UNREELING	24	COLD PRESS
10	SEMI-AUTOMATIC REELING SYNCHRONIZER	25	TURN BUCKLES
11	VENEER AUTO CLIPPER	26	ELEVETER LOADER, HOTPRESS AND UNLOADER
12	MANUAL GREEN VENEER CLIPPER	27	DOUBLE JAWS
13	MANAL GREEN VENEER CLIPPER	28	SCRAPER
14	VENEER KNIFE GRINDER	29	SCRAPER KNIFE GRINDER
15	VENIEER ROLIER DRYER	30	WIDE BELT SANDER

LAYOUT OF VENEER PLANT

FLOW SHEET



INSTRUCTION

1. Log pond
2. Crane
3. Cross Cut Saw (3' Band Sawmill)
4. Electric Hoist (4' Electric Hoist)
5. Veneer Rotary Lathe (5' Veneer Slicer)
6. Veneer Knife Grinder
7. Automatic Reeling & Unreeling Equipment
8. Automatic Veneer Clipper
9. Veneer Dryer
10. Sizing Veneer Clipper
11. Automatic Veneer Jointer
12. Tapeless Splicer
13. Glue Mixer
14. Glue Spreader
15. Elevator for Hot Press
16. Automatic Loader
17. Hot Press
18. Automatic Unloader
19. Elevator for Hot Press
20. Double Sizer (for length wise cutting)
21. Double Sizer (for cross wise cutting)
22. Scraper
23. Scraper Knife Grinder
24. Drum Sander
25. Auto Sander
26. Products (Plywood)

V. Boiling Vat

C. Automatic Conveyor for Slicer

IV - 3 Cost of Factory Facilities, and Workers

Details of the factory facilities and workers required for the monthly output of 100,000 ft^3 of veneer plywood boards are tabulated at the end of this section.

Cost of machines and equipment for the proposed factory amounts to £350,000, and that of the factory building and other items £300,000, totalling £650,000.

Supposing that the depreciation of the above takes 10 years, the yearly and monthly depreciation amount would be as follows.

Item	Amount	Yearly Depreciation Amount	Monthly Depreciation Amount
Machines & equipment	£477,120	£47,712	
Factory bldg. & other items	£300,000	£30,000	
Total	£777,120	£77,712	£6,476
Interest (4% per annum)		£19,428	£1,619

Remarks: Details of factory building and other items

Factory building	@Sh.40/ft^2	2.5 acres	£210,000
Warehouse	@Sh.23/ft^2	500 acres	
Boiling tank for wood material with a Crane			£20,000
Indoor road construction for factory building			£20,000
Office			£12,000
Office fixtures including air conditioners			£13,000
Electric wiring works & water works			£25,000
		TOTAL:	£300,000

Machines & Equipment, and Workers Required for Veneer and Plywood Factory with the Monthly Productive Capacity of 100,000 CFT.

Section	Model	Nomenclature	No.	worker / machine	Total	Remarks
Wood material	(Log to be taken out of the log pond)				3	
		Chain saw	1	1	1	
Rotary lathing	V24-DH	High speed rotary lathe (9')	2	6	12	
	V24-DH	" (5')	1	3	3	
	V92-D	Veneer knife grinder	1	2	2	
Clipping	V43-D	Automatic clipper (9')	4	4	16	
		" (5')	1	4	4	
	V40-D	Manual clipper (9')	2	4	8	
	V40-D	Manual clipper (5')	4	4	16	
Drying	S40-B	Roller dryer	2	7	42	(3 shift system)
Preparation	V40-B	Dry veneer sizing clipper	1	2	2	
	W02-B	Veneer jointer	1	3	3	
	W-11	Taping machine	2	2	4	
	CC	Splicer	2	2	4	
		Patching machine	1	2	2	
		Small circular saw	6	1	6	
	(Selection of core veneer and preparation of veneers)				12	
	(Assortment of veneers)				6	
Gluing	X02	Glue mixer	3	1	3	
	W23	Glue spreader	2	5	10	
	P10	Cold press	2	2	4	
	(Separation of veneers)				4	
	(Mending of veneers)				6	
Hot press		Hot press	2	3	12	(2 shift system)
Finishing	W30-CD	Double sizer	1	5	5	
	W41	Scraper	2	2	4	
		Scraper knife grinder	1	1	1	

Section	Model	Nomenclature	No.	Worker machine	Total	Rmarks
		Chip saw	1	1	1	
	WS-D	Deluxe Sander	1	2	2	
Despatch-ing	(Inspection, despatching, & storage)				15	
Supplemen-tary		Tester	1	1	1	
		For lift	2	1	2	
		Shreader	4	2	8	
		Boiler (5 t.)	2	2	12	(3 shift system
		Waste veneer conveyor	1	1	1	
		Electric work			5	
TOTAL:					242	

Price list of machines and equipment, quoted at CIF Tema, is given at the end of this report.

Conversion into CFT from 1 ton of Ghanaian Wood Materials in Logs

Species	CFT
Avodire	35
Candolel (Omu)	31
Chenchen	34
Edinam	35
Emeri (Indigbo)	37
Danta	28
Guare	30
Kokrodua (Afroromosia)	25
Mahogany	40
Makore (Bake)	35
Mansonia	31
Nyakom (Niangon)	32

Species	CFT
Obeche (Wawa)	50
Opepe (Kusia)	25
Sapele	33
Utile	35

IV - 4 Monthly Production Cost.

Proceeds: Sh.10 x 237,000 (4' x 8' x 4 mm) = £118,500

Sales expenditure: £118,500 x 5% = £5,925

Cost of wood materials: (£2/10 ft^3) x 200,000 ft^3 = £40,000

Cost of glue: 0.6 pence x 7,580,000 ft^2 = £18,950

Miscellaneous (electric power, water, heavy oil, etc):
Sh.1.9 x 7,580,000 ft^2 = £6,822

Labour cost: £25 x 242 workers
£30 x 12 staff-members) = £6,410

Packing cost (wire cost inclusive):
7 pence x 7,580,000 ft^2 = £2,274

IV - 5 Estimated Annual Profit

Monthly production cost:	Wood material	£40,000
	Glue	£18,950
	Wages	£6,410
	Miscellaneous	£6,822
	Depreciation	£6,476
	Interest	£1,619
	(Sub-total)	(£80,277)
	Sales expenditure	£5,925
	Packing cost	£2,274
	Cost price for sale	£8,199
	TOTAL:	£88,476

Monthly proceeds and profit:

Proceeds	£118,500
Cost & expenses	- £88,476
Profit	£30,024

Accordingly, the annual profit against the total investment of £777,120 is estimated at: £30,024 x 12 months = £360,288 which constitutes about 46% of the investment amount.

In the above calculation of the production cost, it was assumed that the monthly consumption of the wood material would amount to 200,000 ft^3. If, however, wood materials of superior quality are utilized, the monthly consumption will be reduced to about 143,000 ft^3 which costs £28,600 provided that the cost per cubic foot is £2. A monthly margin of £11,400 will therefore be accrued from utilizing materials of superior quality.

IV - 6 Conclusion.

As described above, plywood factory with the monthly productive capacity of 100,000 ft^3 is expected to earn an annual profit of £360,288 which accounts for nearly 46% of the total investment amount of £777,120. This high profit rate is justifiably explained by the fact that a) while the cost of wood materials constitutes a large portion in the production cost of veneer products, an abundance of woods suitable for veneer products is available at cheap prices in Ghana, b) worker's wages are substantially low as compared with those in Japan, and c) the prevailing market prices of veneer products in Ghana upon which the above calculation is based, is relatively high.

Though it is foreseeable that the market price will drop in some measure as the veneer products turned out by the proposed factory are put on the market in the future, there will be no difficulties in maintaining the annual profit rate of 20%. The proposed productive capacity of 100,000 ft^3 will amply meet with the domestic demand which has been, and will be increasing for the housing construction in which huge amounts of money are being invested.

It is anticipated that the export of veneer products to adjacent countries will lead to the acquisition of substantial amounts of foreign currencies. The foreign currency saving rate by the proposed project is, as formulated below, as high as 81%, or £1,148,000 in value. There is no doubt that the establishment of the proposed plywood factory will contribute in a great measure to the balanced economic development of Ghana.

Annual foreign currency saving amount:

$$\text{Production cost} - \text{Depreciation of machines \& equipment} - \text{Cost of import materials} = £1,148,000$$

Annual foreign currency saving rate:

$$1 - \frac{\text{Depreciation (machines \& equipment)} + \text{Cost of import materials}}{\text{Production cost}} = 81\%$$

PRICE LIST OF MACHINES & EQUIPMENT

DELIVERY TIME Within eight(8) months after contracted.

DELIVERY PLACE CIF Tema

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		I. BASIC MACHINERIES AND EQUIPMENT:			
1		POND AND DECK SAW .... 1,900mm (neary 6'-3") Provided with a super chain cutter with max. cutting length available 1,900mm driven by motor 7.5KW 1 set and complete with standard accessories.	1 set		480-0-0
2	V24-DH	"HEAVY DUTY" VENEER ROTARY LATHE ..... (For 4'x8' face & back veneer) 2,740mmL. x 1,600mmD. (9'-0" x 5'-3") Heavy duty main frames are mounted on the rigidly constructed bed frame and both main spindles of 150mm in diameter ate efficiently controlled by HYDRAULIC MECHANISM. Provided with complete set of PENUMATIC CONTROL SYSTEM, wich fuctions for quick release of pressure bar, center spur knife, changing of thickness gear and for quick forwarding and backwarding of knife carriage. Length of knife : 2,740mm Max. log dia. to be peeled : 1,600mm Peeling performance is assurable from 0.05mm to 9.90mm in 149 kinds of thickness. The main spindles of 150mm in diameter are made of steel	2 sets	19,153-0-0	38,306-0-0
6					

Item	Machine Type	Description Q'ty	PRICE (Stg. £, CIF Tema) Uit price	Amount
		iron and are set with Taper Roller Bearings and Bushings which are helpful to prevent adjustably the frictional wear that may occur during the long time spindle's rovolution. Equipped with auxil. motors 7.5KW 2 sets, 3.7KW, 1.5KW and 200 W 1 set each.		
3		MAIN DRIVE FOR VENEER ROTARY LATHE ARRANGE WITH WARD LEONARD CONTROL SYSTEM ..... 2 sets	8,015-0-0	16,030-0-0
		Capable to be infinetely variable log speed from 20 to 160 r.p.m. by means of AC.DC. Control System powered by output 75KW(DC) generated by 110KW(AC). Complete with Compensator, Electric Controllers and standard accessories.		
4	V60	VENEER REELING AND UNREELING SYSTEM WITH REEL CIRCULATION SYSTEM ..... 2 sets (DOUBLE DECK SYSTEM) -2,740mm x 1,200mm x 8,000mm (9'-0" x 4'-0" x 26'-4")	6,098-0-0	12,196-0-0
		Capable to reel veneers up to 1,200mm in diameter and 2,740mm in width. Reeling speed can be synchronized with peeling speed of Veneer Lathe in stepless by means of DC motor 3KW 1 set, quoted as below. Veneer fully reeled up by reeling system is transfered to unreeling system which is equipped with tow(2) unreeling		

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		devices at the separate double positions where the veneers are cut to the required width by auto. veneer clippers, provided with the electric drives arranged with motors 5.5KW 1 set, 0.75KW 4 sets, 200W 3 sets and standard accessories.			
5		AUTOMATIC DEELING SYNCHRONIZER WITH VENEER SPEED COMING FROM LATHE	2 sets	2,122-0-0	4,244-0-0
		Arranged with the specially designed "DC" Motor System provided with D.C. Generator, Rotary Controller, Resister and Control Panel.			
6-a	V43-D	VENEER AUTO, CLIPPER, IDEALLY MECHANIZED FOR RUNNING-CUT SYSTEM ..... -2,740mm - (9'-0")	4 sets	3,772-0-0	7,544-0-0
		Capable to cut veneers automatically in regular size and also in optional size only by pushing a button switch, functioned by Pneumatic Control System. Specially equipped with Veneer Tipple (lift conveyor) with motor 200W 1 set. Complete with electric drives arranged with motors 7.5KW and 2.2KW 1 set each, control panels and standard accessories.			
b		INCLINED CONVEYOR FOR AUTO CLIPPER	2 sets	1,772-0-	7,544-0-0
7	V24-DH	"HEAVY DUTY" VENEER ROTARY LATHE ..... -1,500mmL. x 1,600mmD.- (5'-0" x 5'-3")	1 set		17,915-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		Heaby duty main frames are mounted on the rigidly constructed bed frame and both main spindles of 150mm in diameter are efficiently controlled by HYDRAULIC MECHANISM. Proveded with complete set of PNEUMATIC CONTROL SYSTEM, which functions for quick release of pressure bar, center spur knife, changing of thickness gear, and for quick forwarding and backwarding of knife carriage. Length of knife: 1,500mmL. Max, dia. of logs to be peeled : 1,600mmD. Peeling performance is assurable from 0.05mm to 9.90mm in 149 kinds of thickness. The main spindles of 150mm in diameter are made of steel iron and are set with Taper Roller Bearings and Bushings which are helpful to prevent adjustably the frictional wear that may occur during the long time spindle's revolution. Equipped with auxil. motors 7.5KW 2 sets, 3.7KW, 1.5KW, 0.75KE and 200W 1 set each.			
8		MAIN DRIVE FOR VENEER ROTARY LATHE ARRANGED WITH POLE CHANGE MOTOR ..... 1 set Provided with POLE CHANGE MOTOR 37KW 1 set with 4- stepped variable speed of 30-45-60-90 r.p.m. which is easily controlled by			2,117-0-0

Item	Machine Type	Description Q'ty	PRICE (Stg. £, CIF Tema)	
			Unit price	Amount
		POLE CHANGER. Complete with magnet switches and standard accessories.		
9	V60	VENEER REELING AND UNREELING SYSTEM WITH REEL CIRCULATION SYSTEM ..... 1 set -1,500mmW. x 1,000mmD. x 8,000mmL.- (5'-0" x 3'-4" x 26'-4")		3,712-0-0
		Capable to reel veneers up to 1,000mm in diameter and 1,500mm in width. Reeling speed is synchronized with peeling speed of Veneer Lathe in stepless variable speed, by means of Reeling Speed Synchronizing System as quoted in the below item. Provided with electric drives arranged with motors 3.7KW, 0.75KW, 200W 1 set each, 400W 2 sets and standard accessories.		
10		SEMI-AUTOMATIC REELING SYNCHRONIZER WITH VENNER SPEED COMING FROM LATHE ..... 1 set		578-0-0
		Arranged with the specially designed "V.S. Motor System" Provided with necessary electric wirings and parts.		
11	V43-D	VENEER AUTO CLIPPER, IDEALLY MECHANIZED FOR RUNNING-CUT SYSTEM ..... 1 set -1,500mm- (5'-0")		3,270-0-0
		Capable to cut veneers automatically in regular size and also in optinal size only by pushing a button switch, functioned by Pneumatic Control		

Item	Machine Type	Description Q'ty	PRICE (Stg. £, CIF Tema)	
			Unit price	Amount
		System. Complete with electric drives arranged with motors 7.5KW and 2.2KW 1 set each, control panels and standard accessories.		
12	V40-D	MANUAL UREEN VENEER CLIPPER ..... 2 sets -2,740mm- (9'-0")	1,285-0-0	2,570-0-0
		Capable to cut veneer to the desired size by manual operation according to the crank mechanism, driven by motor 1.5KW 1 set. Complete with standard accessories.		
		Length of knife : 2,740mm (9'-0")		
13	V40-D	MANUAL GREEN VENEER CLIPPER ..... 4 sets -1,500mm- (5'-0")	1,050-0-0	4,200-0-0
		Capable to cut veneer to the desired size by manual operation according to the crank mechanism, driven by motor 0.75KW 1 set. Complete with standard accessories.		
		Length of knife : 1,500mm		
14	V92-D	"WET SYSTEM" PRECISION VENEER KNIFE GRINDER 1 set -2,800mm- (9'-3")		3,077-0-0
		A compact grinding carriage is mounted on the rigid frame bed and driven by 1.5KW motor with speed reducer to make smooth traverse motion of the said carriage. Provided with a grinding wheel directly driven by motor 3.7KW 1 set and		

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
		a special Lapping attachment powered by motor 0.75KW 1 set. Complete with a gear pump for cooling driven by motor 400 W 1 set and standard accessories. Max. ginding dimension : 2,800mm Grinding speed : 9,750mm/min./60C. 7,920mm/min./50C.			
15	S40-B	"LONGITUDINAL CIRCULATION SYSTEM" VENEER ROLLER DRYER -4,570mmW. x 4D. x 12S.- (15'-0") Complete with "high efficient" Heating sections equipped with complete set of feeding rollers and steaming pipes, Feeding section, Cooling section with Forcedcooler and standard accessories. Nos. & Size of drying sections: Feeding section: 1(1,840mm) Heating section : 12(1,600mm per section) Cooling section : 1(2,489mm) Total length of dryer : 23,529mm Total width of dryer : 7,470mm Total height of dryer : 4,690mm Hourly drying capacity:- In condition of steam pressure 8 kgs/sq.cm., initial moisture conten 70-75%, final conten 7-8%, under normal stomospheric or equal wood species.	2 sets	33,273-0-0	66,546-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
		1,560 sheets of 4' x 8' x 0.85mm veneer or 434 sheets of 4' x 8' x 2.4mm veneer Stem consumption : 2,570 kgs/hr. Allowance : If higher stem pressure applied in drying, assurable more drying capacity accordingly. Provided with electric drives arranged with motors 22KW 2 sets, 11KW, 7.5KW and 1.5KW 1 set each.			
16	V42-B	DRY VENEER SIZING CLIPPER ..... -2,740mm- (9'-0") This machine is helpful to arrange regularly the narrow sized veneers for the better utilization. Complete with electric motor 1.5KW 1 set and standard accessories. Length of knife : 2,740mm (9'-0")	1 set		1,162-0-0
17	W02-B	"TRAVELLING CUTTER HEAD SYSTEM" VENEER JOINTER ..... -2740mm x 50mmTh.- (9'-0" x 0'-2") Provided with 2 sets of travelling cutter heads which are connected directly to the respective 2.2KW motors and are driven by means of rigid super chain powered by motor 1.5KW 1 set, clamping apparatus with special motor 1.5KW 1 set and all automatic controller 1 set.	1 set	3,	3,330-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
		Complete with the independent and portable attachment CUTTER GRINDER driven by motor 400W 1 set for grinding the cutter blades of cutter heads and standard accessories. Max. cutting size: 2,740mmL. x 50mmTh. Feeding speed of cutter heads: 9,140mm/min. (60C.) or 7,620mm/min. (50C.)			
18	W11	TAPING MACHINE .... -1,370mm- (4'-6") Complete with electric motor 1.5KW 1 set and stepless speed changer. Feeding speed is assurable from 4,600mm to 18,200mm per minute in stepless and depth of frame is 1,370mm. Attached with standard accessories.	2 sets	802-0-0	1,602-0-0
19	CC	TAPELESS SPLICER .. -1,040mm- (3'-5") Complete with driving motor 1.5KW 1 set and standard accessories. Splicing capacity in veneer thickness: 0.5mm - 6.0mm Frame opening : 1,040mm	2 sets	3,005-0-0	6,010-0-0
20		PATCHING MACHINE, MANUAL OPERATED Type : PP Consisting of four kinds of vessel type punches, in accordance with the size of defects. Supplied with 4 sets of cutter and foundation bolts.	1 set		385-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
21	XO2	GLUE MIXER	3 sets	390-0-0	1,170-0-0
		Capable to mix glue 210 Litre. Complete with motor 2.2KW 1 set and standard accessories.			
22	W23	"FOUR ROLL SYSTEM" PRECISION GLUE SPREADER ..... -2,740mm- (9'-0")	2 sets	3,960-0-0	7,920-0-0
		Furnised with "specially designed "Gluing Mechanism, capable to adjust quantity of glue to be spread on veneers according to the conditions, and to effect the delicate and uniform glue-spreading with faster speed. Mechanized in four roll system, two of rolls are rubber rolls and the others are finely finished with chromium plated steel. Equipped with motors 2.2KW, 0.75KW 1 set each and other standard accessories.			
		Length of rolls : 2,740mm Gluing speed : 60m or 80m/min. (2-stepped variable speed)			
23		X LIFTS FOR THE ABOVE	4 sets	707-0-0	2,828-0-0
		-Capacity : 2 tons-			
24	P10	"POWERFUL" COLD FRESS ..... -2,590mm x 1,380mm- (8'-6" x 4'-6")	2 sets	4,415-0-0	8,830-0-0
	7	Complete with "high efficient" and "powerful" Hyd. Pump driven by motor 7.5KW 1 set, Changing cock valve			

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		with operating lever for oil pressure 1 set and standard accessories. Size of table : 2,590mm x 1,380mm Max. opening between upper and middle tables : 1,220mm Ram & cylinder : 180mm dia. x 8 pc. Specific working pressure on plywood of 2,540mm x 1,300mm, in case of max. hyd. pressure 250 kgs/sq.cm. : 15.4 kgs/sq.cm. Total pressure: 508 tons			
25	a.	TURN BUCKLES FOR ABOVE COLD PRESS	400 pc.	5-9-0	2,180-0-0
	b.	I BEAMS FOR ABOVE COLD PRESS	400 pc.	3-19-0	1,900-0-0
26	a.13	"WIRE SYSTEM" ELEVATOR FOR SUTO. LOADDAR	2 sets	2,015-0-0	4,030-0-0
		Complete with driving motor 2.2KW 1 set and standard accessories. Size of table : for 8'x 4' plywood			
	b.L10	"STATIONARY TYPE" AUTOMATIC LOADER	2 sets	6,695-0-0	13,390-0-0
		Complete with driving motor 7.5KW and 5.5KW 1 set each and standard accessories. Nos. of deck: 20			
	c.P20	AUTOMATIC HOT PRESS	2 sets	17,065-0-0	34,130-0-0
		-2,700mm x 1,380mm x 20 openings- (8'-10" x 4'-6")			

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
		Provided with "swivel-jointed-pipes" for each hot platen, high efficient and powerful Hyd. Pumping System driven by motors 45KW 1 set and 7.5KW 1 set, all automatic Controller for pressing time, pressure and temperature, provided with temperature control valve 1 set and standard accessories. Size of hot platen : 2,700 x 1,380 x 38mm Nos. of hot platens : 21 pcs. (20 ops.) Daylight of each opening : 90mm Ram & cylinder : 390mm dia. x 2 pcs. Specific workingg pressure on hot platen in case of hyd. test pressure 250 kgs/sq.cm. : 16.2 kgs/sq.cm. Total pressure : 600 tons Closing time : 35 sec.			
	d.U10	ELEVATING UNLOADER ..... Practically designed to convey just pressed plywood out to next process automatically. Just pressed plywood is pushed out by each end of Loader's loading trays and unloated onto each deck of this Unloader, which is going down and then belt conveyor. Complete with electric motor 3.7KW 1 set and standard accessories.	2 sets	3,248-0-0	6,496-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
	e.	UNLOADING CONVEYOR Complete with driving motor 0.75KW 1 set and specially equipped with tipple device driven by electric motor 0.75KW and standard accessories.	2 sets	1,097-0-0	2,194-0-0
27	a. W30-DC	"HIGH SPEED" HEAVY DUTY DOUBLE SAWS Specially designed for high speed trimming of panels. Consisting of the length-wise cutting (First Saw) and the cross-wise cutting (Second Saw), with cutting speed 12 to 36 M/min., Equipped with electric motors 3.7KW x 4 sets, 2.2KW x 2 sets and 0.75KW x 2 sets and standard accessories.	1 pair		5,045-0-0
	b.	CHIP SAW FOR ABOVE 14" dia.	6 pcs.	41-0-0	246-0-0
	c.	CHIP SAW GRINDER Specification : Available dia. of saw to be ground : 100mm - 405mm Dia. of grinding wheel : 150mm Rev. of ginding wheel : 3,000 r.p.m./50C./S. 6,000 r.p.m./60C./S. Power req'd : for grinding wheel: 0.25KW for cooling pump : 40W for lightening device : 60W	1 set		857-0-0
	d.	GRINDING WHEEL (DIAMONG) FOR AVOVE	2 pc.	128-0-0	256-0-0

Item	Machine Type	Description Q'ty	PRICE (Stg. £, CIF Tema)	
			Unit price	Amount
28	W41	"HEAVY DUTY" PANEL SCRAPER WITH SUPER CHAIN DRIVE SYSTEM 2 sets -1,385mm- (4'-7") Furnished with the powerful frame construction and specially desig ned to make strong and accurate scrate scraping performance for plywood panels by means of super chain drive system powered by 11KW motor 1 set. Table lifting is controlled by motor 0.75KW 1 set and feeding speed is changed in 2-steps by gear change. Length of knife : 1,385mm Feeding speed : 27.4m - 36.8m/min. (2-stepped variable)	4,920-0-0	9,840-0-0
29	W91-B	"SUPER CHAIN FEED SYSTEM" PRECISION SCRAPER KNIFE GRINDER ..... 1 set -1,385mm- (4'-7") Provided with 2 pcs. of grinding wheels mounted on the grinding carriage, each of which is directly driven by motor 200W respectively. The travel of the carriage is effected by means of the super chain feed system driven by 0.75KW motor with reduction gear, functioned by electromagnetic system. Complete with standard accessories. Max. grinding dimension : 1,385mm Rev. of grinding wheels : 6,000 r.p.m.		1,402-0-0

Item	Machine Type	Description Q'ty	PRICE (Stg. £, CIF Tema)	
			Unit price	Amount
30	WS-D	"R.P.P" DELUXE SANDER (HEAVY DUTY TYPE) ..... 1 set Specification & accessories : Max. working width: 1,220mm/min. (4'-0") Range of working thickness: 2.7 - 25M/min. Feed speed : 25-92M/min. Abrasive belt speed : 1,300M/min. Abrasive belt size : 1,310mm x 2,500mm (4'-4" x 8'-3") Automatic control air pressure : 6-7 kg s/sq.cm. Electric motors : for 1st head belt driving : 37KW x 4P : 1 set for 2nd head belt driving : 30KW x 4P : 1 set for 3rd head belt driging : 22KW x 4P : 1 set for feeding : 3.7KW x 4P : 1 set for table : 0.75KW x 4P : 1 set Air compressor with 15KW motor 1 set : 1 set Electric control panel : 1 set Operating box : 1 set Dust collecting hoods : 1 set Standard tool box : 1 set Foundation bolt : 1 set Automatic feed conveyor : 1 set Contact platen : 1 set		13,830-0-0
31		Automatic Panel Conveying System for 4' x 8' line, as		

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		arranged between the folk cooling conveyor (included) and the position of discharging side on Deluxe Sander	One complete set		14,143-0-0
		Sub-Total (I)		CIF Tema Stg. £328,007-0-0	
		II. SUPPLEMENTARY EQUIPMENT			
1		Electric Hoist ..... 5 tons capacity Moterized lifting and travelling in single speed.	2 sets	1,187-0-0	2,374-0-0
2		MONO-RAIL FOR THE ABOVE HOIST ..... Complete with trolley wirings, supporters, insulators and stoppers for wirings. Overall length : 20m (10m/pc.)	2 sets	545-0-0	1,090-0-0
3		ELECTRIC HOIST ... 3 tons capacity Motorized lifting and tragelling in single speed.	1 set		565-0-0
4		MONO-RAIL FO THE ABOVE HOIST ..... Complete with trolley wirings, supporters, insulators and stoppers for worings. Overall length : 20m (10m/pc.)	1 set		545-0-0
5		FREE TRUCK ..... 3m x 1m	40 sets	68-0-0	2,720-0-0

Item	Machine Type	Description	Q't y	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
6		RACK ROLLER CONVEYOR	120 pcs.	68-0-0	2,720-0-0
		Width : 5" Pitch of roll : 6"			
7		Length of conveyor : 5'-0"/pc.			
7		"KETT" MOISTURE METER	3 sets	77-0-0	231-0-0
8		SHEAR TESTING MACHINE	1 set		638-0-0
		500 kgs capacity Complete with 400W motor 1 set and standard accessories.			
9		SHREDDER (300 cub.ft/hr. capacity)	4 sets	2,142-0-0	8,568-0-0
		With Electric Drive (22KW) and standard accessories.			
10		"CORE VENEER" CIRCULAR SAW	6 sets	428-0-0	2,568-0-0
11		FORK LIFT, 3 TONS	2 sets	2,828-0-0	5,656-0-0
12		VENEER WASTE CONVEYORS	1 lot		8,572-0-0
13		DUST COLLECTOR ..	1 lot		9,428-0-0
14		BOILER, with capacity 5 tons	2 sets	26,000-0-0	52,000-0-0
		Max. allowable working pressure : 12 kgs/sq.cm.			
		Actual evaporation : Normal 5,000 kgs/hr. Max. 6,000 kgs/hr.			
		Heating surface : 176m^2			
		Including :			
		1. Step grate with feeder	1 set		
		2. Brick setting materials	1 set		

Item	Machine Type	Escription	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
		3. Mechanical soot blower	1 set		
		4. Automatic feed water regulator	1 set		
		5. Feed water pumps driven by motor	1 set		
		driven by steam	1 set		
		6. Piping materials for boiler room	1 set		
		7. Steam header	1 set		
		8. Induced draft fan	1 set		
		9. Steel stack with guy wire	1 set		
		10. Brick materials for breaching	1 set		
		11. Flue gas duct with insulating matri-als	1 set		
		12. Feed water meter	1 set		
		13. Spare parts and tools	1 set		
		14. Control box & Electric wirings	1 set		
		15. Insulating materi-als and tools	1 set		
		Not including :			
		1. Pipings of outside Boiler room			
		2. Water saftener			
		3. Drain tank			
		4. Foundation and Building materials.			
		5. Ordinary red brick			
		6. Cement			
		7. Lime			
		8. River sand			
		9. Water supply tank			
15		Piping Materials from Boiler room to Hot Presses & Dryers	Complete 1 set		6,480-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema)	
				Unit price	Amount
16		Electric wirings of inside factory	Complete 1 set		12,960-0-0
		Sub-Total (II)		CIF Tema	Stg.£117,395-0-0
		III.- WORK SHIO MACHINERY & TOOLS			
1		Production High Speed Lathe -450mm x 1,250mm-	1 set		2,928-0-0
2		Shaper -600mm-	1 set		1,741-0-0
3		Milling Machine : Working surface : 1,350mm x 310mm Londitudinal travel : 710mm	1 set		5,854-0-0
4		Welder (Selearc D.C. welder)	1 set		330-0-0
5		Floor Type Grinder : Overall height : approx : 991mm Floor space : approx : 320mm x 380mm	1 set		102-0-0
6		Light Radial Drilling Machine Max. distance, column to spindle	1 set		2,587-0-0
7		Tools	1 set	2,132-0-0	
		Sub-Total (III)		CIF Tema	Stg.£15,674-0-0

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount
		IV. TOOLS FOR INSTALLATION OF PLYWOOD PLANT			
		Tools for installation of Veneer & Plywood Machinery	1 lot		700-0-0
		Tools for installation of Piping & Boiler	1 lot		2,060-0-0
		Sub-Total (IV)		CIF Tema Stg.	£2,760-0-0
		V. EXPENSES AND CHARGES FOR SENDING TECHNICIANS FOR MACHINERY AND BOILER INSTELLATION			
1		For : Basic Machineries and Equipment : 1. Nos. of technicians required : 4 mens 2. Period of Service : 6 months 3. Total salaries due technicians : Stg. £8,568-0-0 (@£357-0-0/man/month) 4. Total outfit allowance : Stg .£288-0-0 (@£72-0-0/man)			4,428-0-0
2		For : Boiler Equipment P 1. Nos. of technicians required : 2 men 2. Period of Service : 6 months 3. Total salaries due technicians : Stg. £4,284-0-0 (@£357-0-0/man/month) 4. Total out fit allowande : Stg. £144-0-0 (@£72-0-0/man)			

Item	Machine Type	Description	Q'ty	PRICE (Stg. £, CIF Tema) Unit price	Amount

PROVISION :

A) Hours of work : Employment of Technicians shall be on the basis of eight (8) hours a day, vorty-eight(48) hours a week.

B) Period of Employment : Employment of Technicians for machinery and boiler installation shall be for period of six(6) months after completion of the machinery foundation works which shall be made by the local arrangement.

C) Payment : Prior to departure, the Employer shall make available to the Technicians a credit for Starling Pounds Thirteen Thousands Two Hundreds Eight For Only (Stg.£13,284-0-0) to cover the above quoted expenses and charges.

D) The above mentioned expenses and charges do not include the flying charges (with return), boarding and lodging charges and other required expenses which shall be for account of the Employer.

E) Other provision shall be set in details upon the realization of this contract.

Sub-Total (V) CIF Tema Stg.£,13,284-0-0

Grand-Total Item (I), (II), (III), (IV), (V) ..... CIF Tema Stg.£477,120-0-0

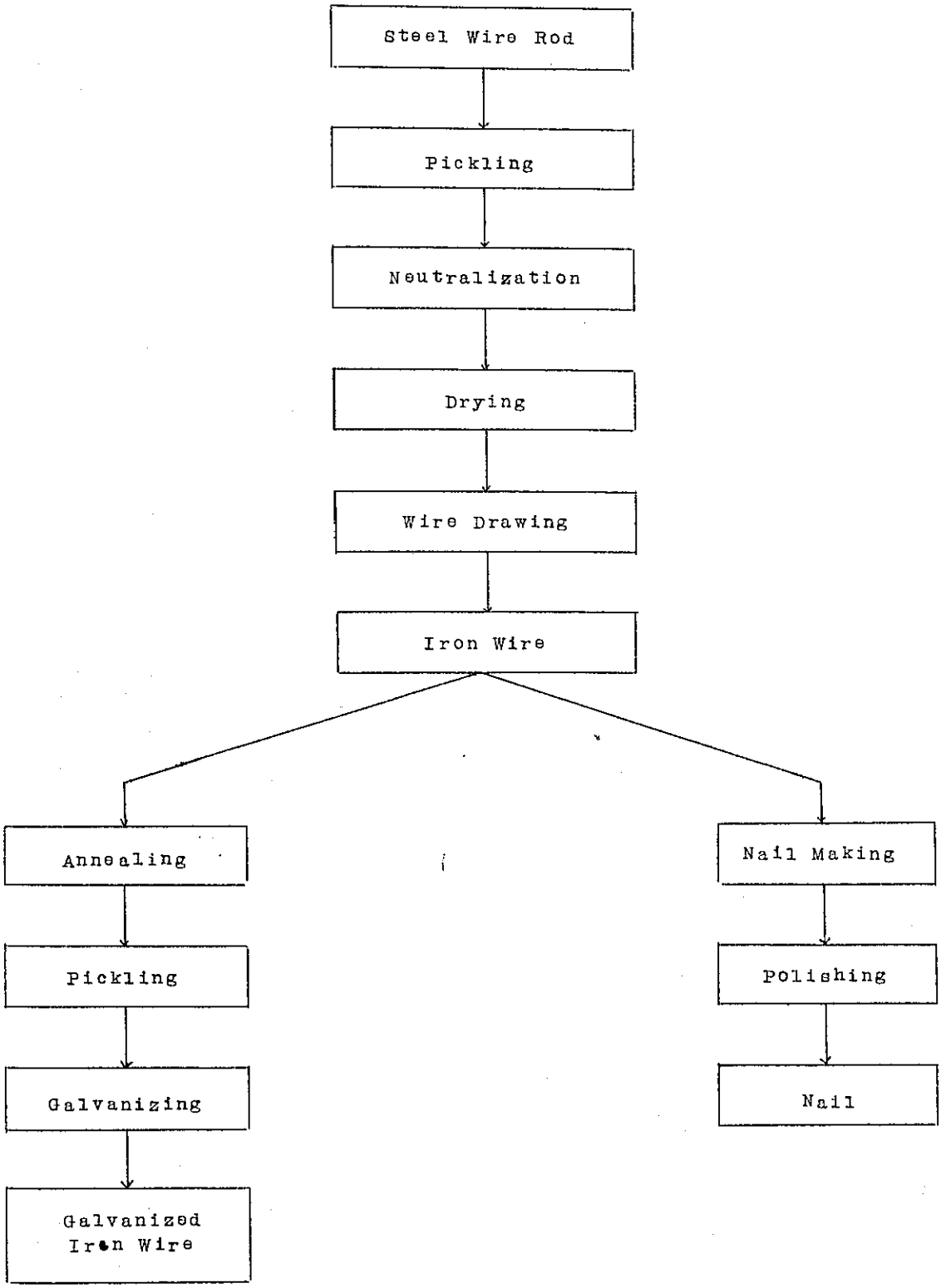
Remarks :

1) The above quoted machines and equipment are principally arranged with the electirc driven system based on 220V. and 60C.

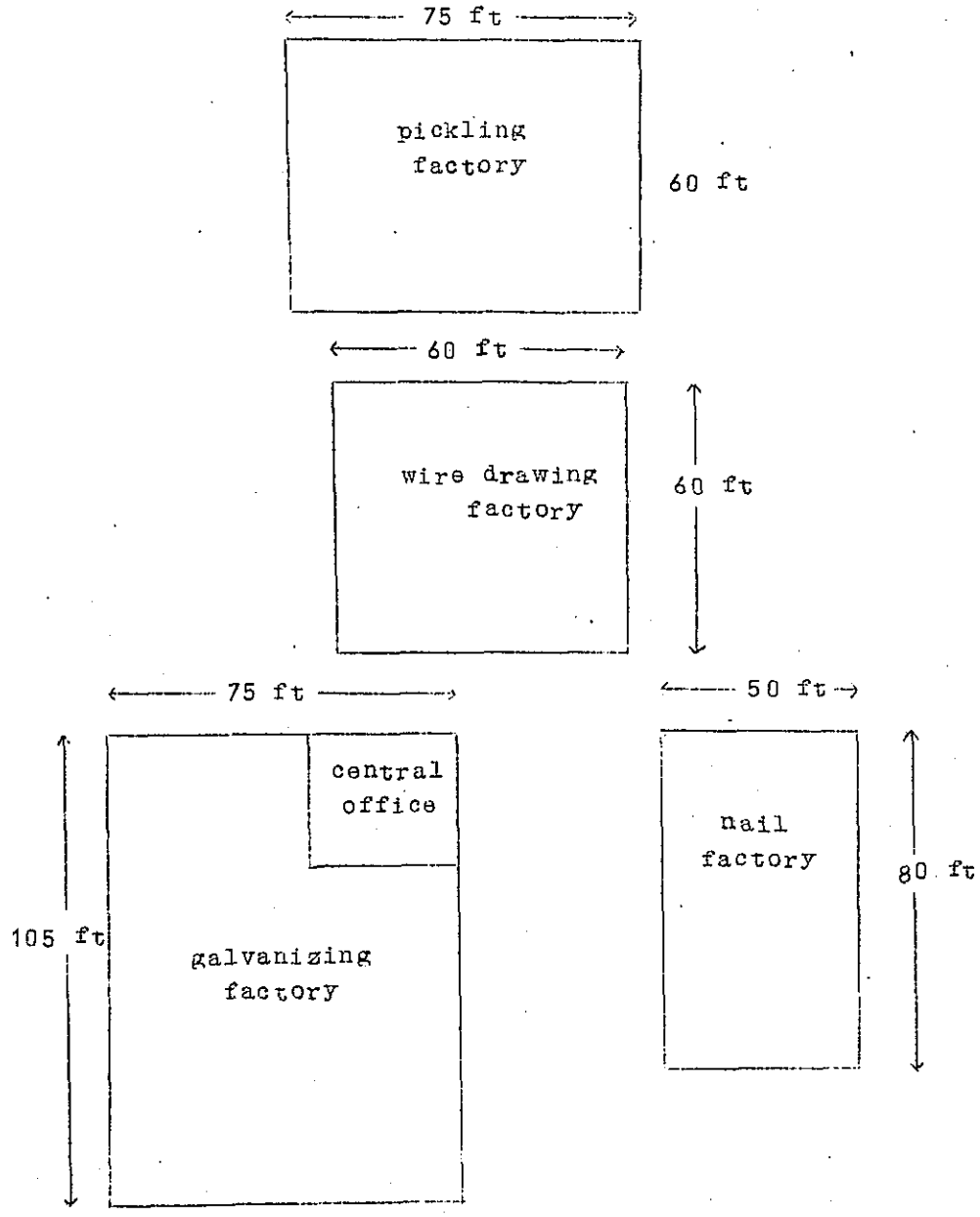
2) The quoted prices are based on the present price factors of the raw materials, and therefore, in case the present factors are changed, we shall request you to adjust the quotation prices accordingly.

3) The quoted machineries and equipment shall be final by the maker's inspection.

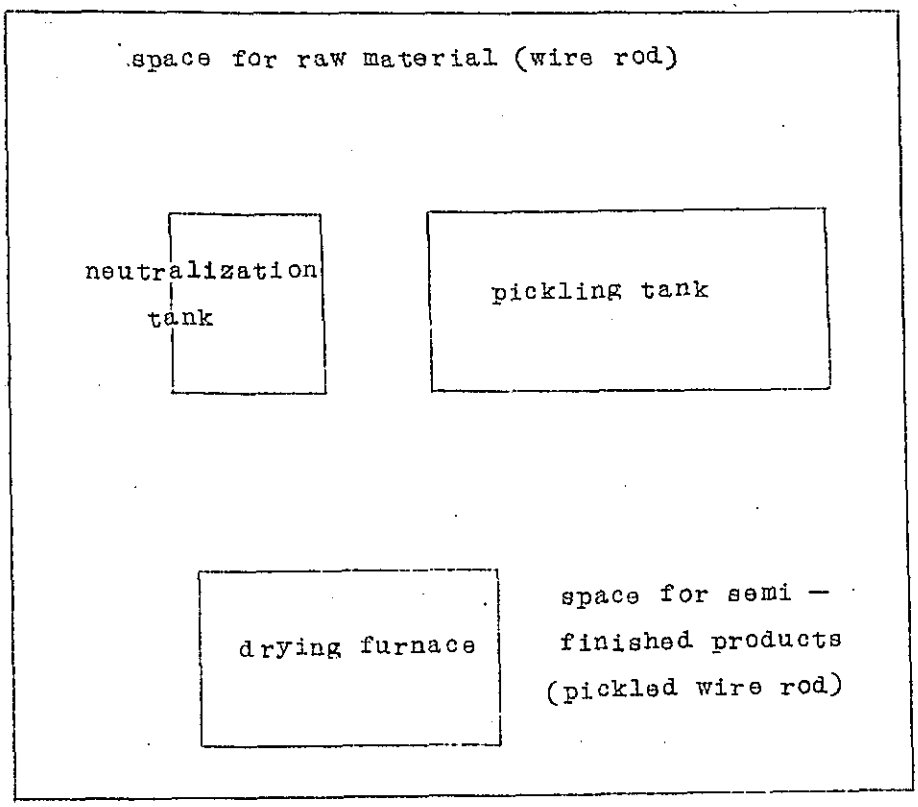
FLOW SHEET


Steel Wire Rod
Pickling
Neutralization
Drying
Wire Drawing
Iron Wire
Annealing
Pickling
Galvanizing
Galvanized Iron Wire
Nail Making
Polishing
Nail

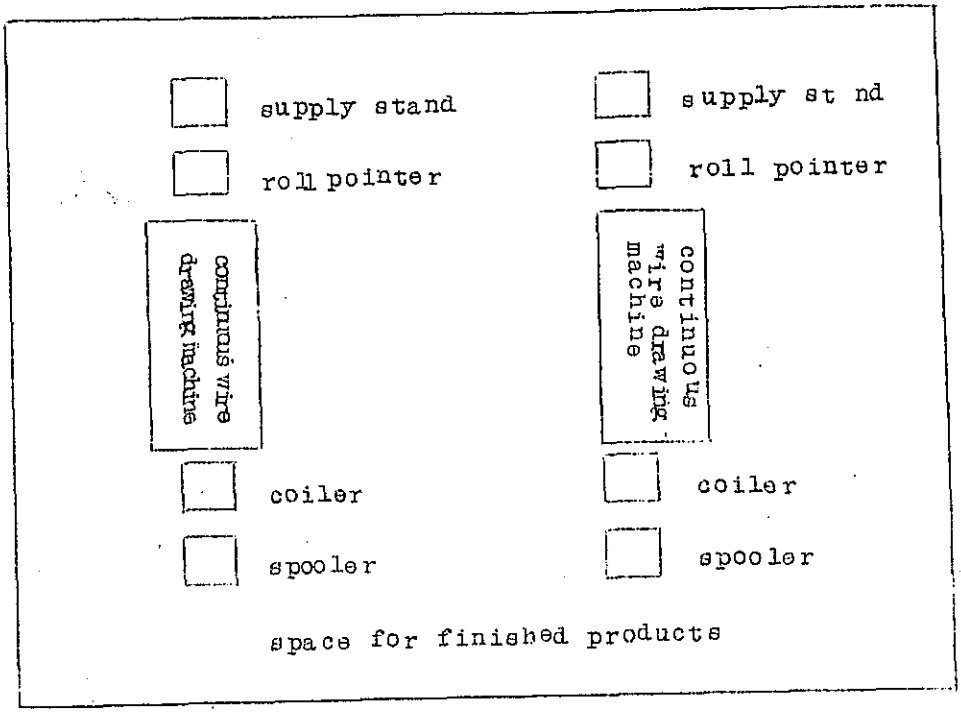
(1) Building Lay Out



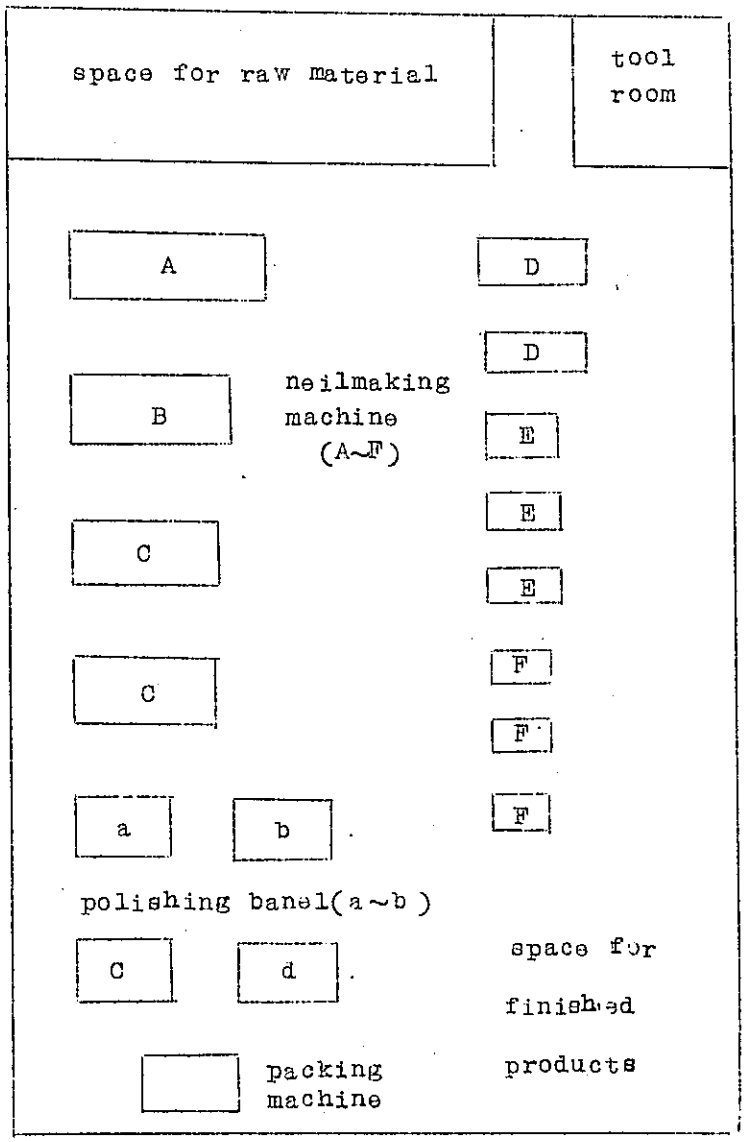
(2) Pickling Factory



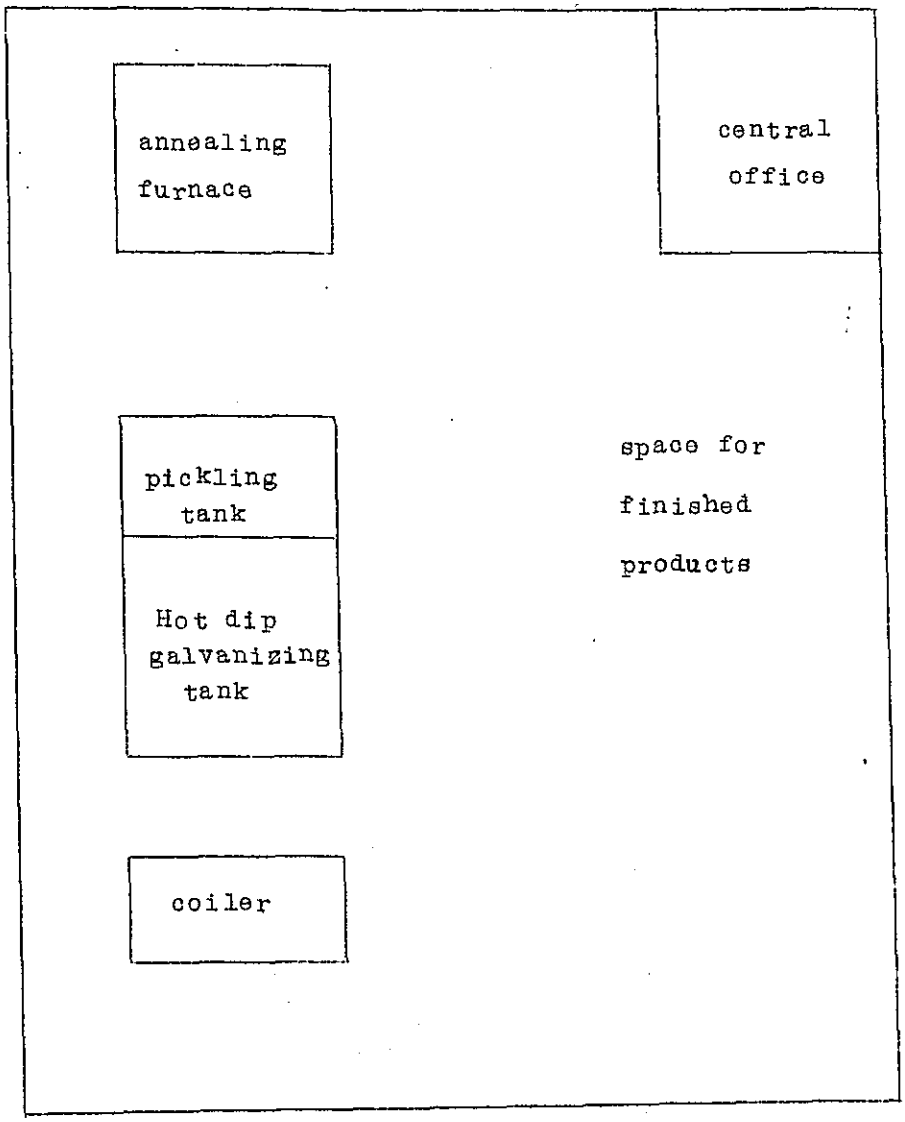
(3) Wire drawing Factory



(4) Nail Factory



(5) Galvanized Iron Wire Factory



E. PRODUCTION PROJECT FOR IRON WIRE, IRON NAIL AND GALVANIZED IRON WIRE.

I. MARKET SITUATION OF IRON WIRE

Demand for iron wires in Ghana can be broadly classified into two categories; one for consumption as the material for producing secondary products such as wire nets, wire ropes and barbed wires, the other for direct consumption for the purpose of banding and concrete piping. The following review of the present market situation is given with the stress placed on nails, wire ropes and wire nets which are in the largest demand in Ghana.

(1) Nails.

The productive capacity of the two nail factories now existing in Ghana (Metal Works Corporation and Wire Industries) is 6 - 7 tons and 2 - 3 tons per day respectively (two shift system), which indicates that Ghana's output of nails is approximately 3,000 tons assuming that the number of work-days is 300 days a year.

The annual demand for nails in Ghana exceeds this productive capacity, resulting in the import from abroad as given below:

Year	Q'ty (cwt)	Value (£G)
1961	31,252	120,311
1962	18,011	49,304

Consequently, the annual consumption of nails in Ghana is presumed to amount to about 4,500 tons.

The selling price of nails produced by the above two factories, which averages £4-10 per cwt, is detailed below by size.

Selling Price of Nails in Ghana

Inch x Gauge No.	S./cwt
1/2 x 18	142
3/4 x 17	102
1 x 16	112
1 x 15	108
1 x 14	106
1+1/2 x 14	98
1+1/2 x 13	92
2 x 12	88
2 x 11	88

Inch x Gauge No.	S./cwt
2+1/2 x 10	87
3 x 8	86
3 x 9	86
2+1/2 x 7	85
4 x 7	84
4 x 6	84
5 x 5	82
6 x 4	82

The production list given hereunder will, while providing information on the production by size of nails by Metal Works Corporation (daily output: 6 - 7 tons), make it clear that the consumption of nails in Ghana centers upon gauge #6 - 13 among which Gauge #10 - 12 are most greatly demanded. Nails of Gauge No. below 16 are produced in an extremely small quantity.

Production of Nails by Size (Apr. 1962 - Mar. 1963)

Inch x Gauge No.	Production (cwt)	Sales (cwt)
1/2 x 18	-	-
3/4 x 16 & 17	27	27
1 x 15	1,257	1,162
1 x 14	318	287
1/2 x 14	438	447
1+1/2 x 13	2,609	2,640
1/2 x 12	-	-
2 x 11	3,776	3,719
2 x 12	4,159	3,556
2+1/2 x 10	4,764	3,352
3 x 4	31	28
3 x 8	4,424	4,259
3 x 9	3,744	3,385
4 x 6	6,341	6,174
4 x 7	2,522	1,583
5 x 5	1,905	2,290
6 x 4	875	812
Total:	37,190	33,721

(2) Wire Nets and Wire Ropes.

Ghana has no factories capable of producing wire nets and wire ropes, and her demand for these products therefore depends solely upon import. Import statistics show that Ghana's annual consumption of wire nets amounts to an estimated figure of slightly less than 2,000 tons, and that of wire cables and ropes about 1,000 tons.

Import of Wire Nets and Wire Ropes

	(Wire Nets)		(Wire Ropes)	
Year	Q'ty (cwt)	Value (£G)	Q'ty (cwt)	Value (£G)
1957	21,844	92,305	13,018	130,118
1958	20,914	109,999	16,589	162,768
1959	26,818	155,829	18,930	189,976
1960	37,524	186,227	20,482	189,359
1961	37,168	197,323	-	-
1962	19,583	120,693	-	-
1963 (Jan-Jul)	22,906	134,669	-	-

From the data hitherto provided, it may be gathered that the annual consumption of iron wire products (nails, wire nets, wire cables and wire ropes) amounts to a total of about 7,500 tons.

An assumption that the consumption of iron wire products increases in future in proportion to the increase rate computed from the past trend of building and construction investment leads to the conclusion that the annual consumption would amount, after five years, to a total of 9,700 tons which equals 129% of the estimated present consumption of 7,500 tons. (See the list below)

Trend of Building and
Construction Investment (1955 - 1962)

(Value in £G Million)

	1955	1956	1957	1958	1959	1960	1961	1962
Building Investment	27	30	30	30	36	44	50	53
Construction Investment	12	11	11	12	16	17	20	21
Total	39	41	41	42	52	61	70	74
Increase Rate *	100	105	105	107	133	156	179	189

*Fluctuations in prices disregarded.

$It = 10.56t + 97.29$

I = Investment index (1955 = 100).

t = Years starting from 1955.

II. PRODUCTION PROGRAMME

Considering the present market situation and the estimated consumption increase in future, it would be reasonable to set the goal of the annual production of iron wires at 9,600 tons (800 tons per month).

Of the proposed total production of 9,600 tons, 3,000 tons is suggested to be supplied to the existing nail factories, and additional 2,100 tons to a new nail factory proposed to be established to cope with the expected future increase of consumption. The new factory is desired to be capable of outselling and eventually driving out imported nails.

The rest of 4,500 tons is recommended to be processed into galvanized iron wires to be subsequently provided as materials for producing wire nets and wire ropes.

With regard to the new factories suggested to be established for the production of steel wire products, it is suggested that both the nail factory and the galvanized iron wire factory be designed to be constructed within the iron wire factory, whereby more values will

be attached to the iron wire factory as an integrated factory and less expenses will be incurred by the transportation of its products.

Demand for wire nets, wire ropes and barbed wires is considered comparatively small with their markets scattered throughout the country. Since no full scale facilities are required to produce these three items, it would be advantageous to establish the manufacturing factories within the consuming areas.

A production programme is tabulated hereunder on the basis of the proposals and suggestions given above.

Production Programme

Primary Product	Secondary Product	Final Product	Remarks
		Iron wires for nails, 3,000 t./year (10 t./day)	To be supplied to existing nail factories
	Nails, 2,100 t./year (7 t./day)	Nails, 2,100 t./year (7 t./day)	To be put on domestic market.
Iron wires, 9,600 t./year (32 t./day)	Galvanized iron wires, 4,500 t./year (15 t./day)	Galvanized iron wires for wire nets, wire ropes & barbed wires, 4,500 t./year (15 t./day)	To be supplied to the proposed wire net & rope factories; may also be put on domestic market without processing.

Remarks: 1. Production based on 300 working days a year, 2 shift system for iron wires and nails, & 3 shift system for galvanized wires.

2. Loss of material caused when processing iron wires into nails (2-3%) and iron wires into galvanized iron wires (0.5%) disregarded.

III. FACTORY LAYOUT

See the attached drawings at the end of this report.

IV. FOW SHEET AND MANUFACTURING PROCESS

(1) Flow Sheet.

See the attached sheet at the end of this report.

(2) Manufacturing Process.

The iron wire rod B.W.G. No. 5 (5.6 mm dia.) is usually utilized for the production of iron wire products. The rod is at first dipped in the pickling tank containing dilute sulphuric acid which removes the scale by dissolution. After it is taken out of the pickling tank, the rod is dipped in the neutralization tank which contains calcium hydroxide to neutralize the dilute sulphuric acid remaining on it.

The calcium hydroxide serves as lubricant during the wire drawing process. Taken out of the neutralization tank, the rod is dried by the drying furnace. The hot blast from either side of the furnace dries the rod while it is hooked and moves in the furnace.

Then it is processed by the continuous wire drawing machine. The drawing frequency and the diameter of the dies are adjusted according to the desired wire diameter. The proposed drawing machine will have 5 blocks (5 dies), and will be capable of producing wires of B.W.G. #1 (7.6 mm dia.) ~ B.W.G. #16 (1.6 mm dia.). If wires of larger diameter than B.W.G. #5 are required, the rod will have to be accordingly larger in size.

Nails are made from the iron wires manufactured by the above process. Wires should have the same diameter as the nails to be produced. Iron wire is set in the nail manufacturing machine and processed continuously into nails which are then polished in the polishing barrel thereby cleaning the oily surface. Finishied nails are then packed and shipped out.

Galvanized iron wires are also manufactured from the iron wires of the same diameter as the finished galvanized wires. By passing through the annealing furnace, the iron wire is so annealed as to possess the specified tensile strength and elongation. As the annealing process causes the surface of the wire to be sulphurized, the scale will have to be removed by pickling process before being galvanized. The neutralized wire will then be galvanized by passing continuously through the hot dip galvanizing tank containing fused zinc. The proposed process is designed to have 5 supply stands and 15 coilers so that it may be adjusted for the simulataneous processing of 15 strands.

V. SPECIFICATIONS OF EQUIPMENT RECOMMENDED

(Price in £, CIF Ghana port)

(1) Iron Wire Factory.

Equipment	Spec. & Capacity	Q'ty	Price
Pickling Equipment	Pickling tank & neutralization tank, 2 t/h.	1 set	£7,000
Drying Furnace	With oil burner, blower, & coil suspension equipment, 2 t/h.	1 set	6,000
Continuous Wire Drawing Machine	5 blocks & 5 motors of 30 hr, Max. inlet dia. 0.315", Min. finishing dia. 0.063", 1 t/h.	2 sets	21,000
Coiler	10 hp	2 sets	3,400
Supply Stand	For coils of 350 lbs. & 660 lbs.	2 sets	240
Roll Painter	5 hr, Max. wire dia. 0.315"	2 sets	620
Finished Wire Bundling Stand	Dia. of 22", 16" & 12"	6 sets	1,200
Spooler	Take up capacity 2,200 lbs., 0.157", Torque motor: 55 lbs.-ft.	2 sets	3,000
Air Hoist	Capacity 500 kgs.	1 set	1,000
Crane	Capacity 2 tons	1 set	7,000
	Total:		£50,460

(2) Nail Factory.

Equipment	Spec. & Capacity	Q'ty	Price
Nail Making Machine	B.W.G. #22 - 15, 1 hp	2 sets	£1,500
"	B.W.G. #15 - 13, 2 hp	3 sets	6,000
"	B.W.G.# 15 - 10, 3 hp	3 sets	3,600
"	B.W.G. #14 - 8,5 hp	2 sets	3,400
"	B.W.G. #12 - 6,7.5 hp	1 set	2,300

Nail Making Machine	B.W.B. #11 - 4, 10 hp	1 set	3,000
Polishing Barrel	3 hp	1 set	260
"	5 hp	2 sets	600
"	7.5 hp	1 set	370
Nail Polishing Machine	1 hp, 10 casks/hr.	1 set	270
Cutter Grinder	0.5 hp	1 set	300
		Total:	£21,600

(3) Galvanized Iron Wire Factory.

Equipment	Spec. & Capacity	Q'ty	Price
Supply Stand	For 350 - 2,200 lbs.	5 sets	600
Annealing Furnace	0.7 t/hr.	1 set	4,200
Hot Dip Galvanizing Tank	15 strands, 0.7 t/hr., with Pickling tank.	1 set	6,500
Coiler	For 15 strands	1 set	2,500
		Total:	£13,300

VI. CONSTRUCTION SITE

Since the wire rod is not produced by the steel works at Tema, its supply is entirely dependent upon import. The proposed factory is therefore suggested to be set up near the port, i.e., either in Tema or Tacoradi, but with preference justifiably given to Tema from the viewpoint of the future distribution of consuming areas.

VII. CONSTRUCTION COST (Value in £)

(1) Iron Wire Gactory.

a) Building for pickling tank: 4,500 ft^2 x £1-0-0 = £4,500-0-0

b) Building for wire drawing: 3,600ft^2 x £2-0-0 = £7,200-0-0
machine

Total: £11.700-0-0

(2) Nail Factory.

Building: 4,000 ft^2 x £2-0-0 = £8,000-0-0

(3) Galvanized Wire Factory.

Building: 7,875 ft^2 x £2-0-0 = £15,750-0-0

VIII. PRODUCTION COST (Value in £)

(1) Iron Wire Factory.

Material	Unit Consumption	Unit Price	Cost per ton (B.W.G.#12)
Wire rod	1.020 t.	£41-19-0 (B.W.G.#5)	£42-15-10
Sulphuric acit	36 kgs.	0-0-2	0-6-0
Lime powder	2 kgs.	0-0-3	0-0-6
Soap	0.38 kgs.	0-3-0	0-1-2
Fuel	141/	0-0-7	0-8-2
Grease		0-1-3	0-1-3
Dies		0-1-5	0-1-5
Electricity	60 KWH	0-0-4.5	1-2-6
Water	1/0 t/	0-1-0	0-1-0
Labour *		1-9-0	1-9-0
Depreciation **		0-13-8	0-13-8
Indirect cost ***		0-12-0	0-12-0
		Total:	£46-12-6

*Labour Cost

Post	Monthly Pay	No.	Cost
Chief Engineer	£300	1	£300
Engineer	35	3	105
Foreman	25	4	100
Worker	15	30	450
Chief Officer	125	1	125
Officer	12	7	84
		Total:	£1,164

Remarks: 1. Labour cost/1 ton iron wire = £1,164 ÷ 800(t.) = £1-9-0

2. Officer will take char of the 3 factories, i.e., iron wire factory, nail factory & galvanized wire factory.

** Depreciation

Unit depreciation for plant & equipment : Plant & equipment value x 0.12 ÷ annual production

= £50,460 x 0.12 ÷ 9,600 (tons)

= £0-12-7

Unit depreciation for building : Building cost x 0.045 ÷ annual production

= £11,700 x 0.045 ÷ 9,600 tons

= £0-1-1

Total: £0-13-8

***Indirect cost includes cost of office work and repair cost.

(2) Nail Factory.

Material	Unit Consumption	Unit Price	Cost per ton (B.W.G. #12)
Iron wire	1,030 t.	£47-14-0	£49-2-7
Machine oil		0-2-0	0-2-0
Tool		0-0-6	0-0-6
Saw dust		0-2-0	0-2-0
Electricity	55 KWH	0-0-4.5	1-0-8
Packing material		3-10-0	3-10-0
Labour cost *		3-16-7	3-16-7
Depreciation **		1-5-15	1-5-15
Indirect cost ***		1-4-0	1-4-0
			Total: £60-4-7

*Labour cost

Post	Monthly pay	No.	Cost
Chief engineer	£ 300	1	£ 300
Engineer	35	2	70
Worker	15	20	300
			Total: £670-0-0

Remarks: Labor cost/1 ton nail = £670 ÷ 175 t. = £3-16-7

(3) Galvanized Iron Wire Factory.

Material	Unit Consumption	Unit Price	Cost per ton (B.W.G.#12)
Iron wire	1.005 t.	£47-14-0	£47-18-9
Zinc	10.2 kgs.	0-2-0	1-0-5
Lead	3.0 kgs.	0-2-1	0-6-3
Aluminium	0.5 kgs.	0-5-0	0-2-6
Fuel oil	70 l.	0-0-7	2-0-10
Chloric acid	16 kgs.	0-0-5	0-6-8
Flux	2 kgs.	0-1-3	0-2-6
Water	4 t.	0-1-0	0-4-0
Electricity	23 KWH	0-0-4.5	0-8-8
Labour cost *		2-10-10	2-10-10
Depreciation **		0-10-7	0-10-7
Indirect cost ***		0-18-0	0-18-0
			Total: £56-10-0

*Labour cost

Post	Monthly Pay	No.	Cost
Chief engineer	£300	1	£300
Engineer	35	3	105
Foreman	25	4	100
Worker	15	5	450
		Total:	£955

Remarks: Labour cost/1 ton gal. iron wire = £955 ÷ 375 t. = £2-20-10

**Depreciation

Unit depreciation for plant & equipment : £13,800 x 0.12 ÷ 4,500 t = £0-7-5

Unit depreciation for building : £15,750 x 0.045 ÷ 4,500 t. = £0-3-2

Total: £0-10-7

***Indirect cost includes cost of office work and repair cost.

IX. PROFIT CALCULATION (Value in £)

(1) Iron Wire Factory.

Annual profit = Annual sales - Annual cost
= £1-1-6 x 9,600 t. = £10,320

Annual sales = Unit price x Production quantity
= £47-14-0 x 9,600 t.

Annual cost = Unit cost x Production quantity
= £46-12-6 x 9,600 t.

Percentage of profit = Annual profit/Annual sales = 2.3%

Remarks: Unit price assumed to equal the import price.

(2) Nail Factory.

Annual profit = Annual sales - Annual cost
= £27-15-5 x 2,100 t. = £58,318-15-0

Annual sales = Unit price x Production quantity
= £88-0-0 x 2,100 t.

Annual cost = Unit cost x Production quantity
= £60-4-7 x 2,100 t.

Percentage of profit = Annual profit/Annual sales = 31.5%

Remarks: Unit price equals the present ex-factory price.

(3) Galvanized Iron Wire Factory.

Annual profit = Annual sales - Annual cost
= £19-17-0 x 4,500 t. = £89,325

Annual sales = Unit price x Production quantity
= £76-7-0 x 4,500 t.

Annual cost = Unit cost x Production quantity
= £56-10-0 x 4,500 t.

Percentage of profit = Annual profit/Annual sales = 26.0%

Remarks: Unit price assumed to equal import price.

X. CONCLUSION

As detailed in the profit calculation above, the percentage of profit expected to be accrued from the proposed iron wire factory, nail factory and galvanized iron wire factory is 2.3%, 31.5% and 26.0% respectively. The low percentage of profit of the iron wire

factory is attributable to the fact that while the selling prices of nails and galvanized iron wires are relatively high when compared with the cost of iron wire material, iron wires cost relatively low as compared with the cost of the steel wire rod.

Another cause of this low percentage is that the existing steel works are capable of producing only round bars of 9 mm. dia. but not the wire rod of 5.5 mm dia, making it imperative to utilize costly imported wire rods for the production of iron wires.

However, the total profit expected to be gained by the three factories combined is to be considered fairly high. Percentage of the annual profit against the total investment of £121,310 is 130.6% which equals £157,963, as calculated below:

$$\text{Annual profit/Total fixed investment} = \frac{£157,963}{£121,310}$$
$$= 130.6\%$$

If, therefore, the nail factory and the galvanized iron wire factory are established, as suggested, within the iron wire factory for the production of the three items, the proposed plan will be commercially quite practicable.

As expressed by the formula below, the proposed plan also ensures the saving of the country's foreign currency reserve.

$$\text{Saving rate} = \frac{\text{Cost of imported materials} + \text{Depreciation of imported machines}}{\text{Sales proceeds (calculated on the basis of import price)}}$$

Iron wire factory: 8.9%

Nail factory: 47.6%

Galvanized iron wire factory: 42.1%

The percentage of profit and the saving rate that could be expected from the three factories leads to the conclusion that the proposed project will contribute a great deal to the economy of Ghana.

F. CONSTRUCTION PROJECT FOR TOY FACTORY.

Introduction

The assigned investigation subject for the reporter was to study the feasibility to construct an all-out toy factory in Ghana, and at the same time to carry out the basic survey on the necessary pre-requisites for the development of the toy factory construction project. In order to attain this purpose, the best effort had been exerted to hear of the Ghanaian opinion and requirement. The reporter had had the fruitful discrussions with the concerning parties on the practical development methods several times. The inspection trips were made to Accra and other major cities to see the general industrial facilities available in the country. Further, a wide field survey was carried out to make clear the availability of such materials as wood and bamboo which will be needed for the production of wooden toys. The factory site was also studied in an attempt to select the most favorable location. The supply status of electric power and industrial water was among the survey items.

Concerning the spread or distribution status of toys in Ghana, almost nothing was given to the children or boys of even the town dwellers, while the toy amusements are very familiar with the children of the Western countries and Japan. It seemed that in Ghana the toy was monopolized by only a small number of privileged children. The toy shops could not be counted so many, though large department stores provided the toy quarters. This narrow circle of toy sales was probably caused by the fact that all the toys were imported from abroad and, accordingly, that the prices were too expensive to afford by the peoples' income level at the present.

On the other hand, the Ghanaian children have the stong desire for toy amusements, and the potential demand is extremely large. If the project materialized to enable Ghana to produce toys for itself, the products will be able to sell at half as much as cheap a price, resulting in the rapid spread of toys over the country. What is more prospective with the domestic production, is that Ghana could grow up to be a toy exporting country for the neighbouring states, all of which are now facing the same problem as Ghana.

The educational toy or scientific model should be taken up among the issues of the project. The survey team could not meet with an instance in which any school used the scientific models for the teaching stuff. However, as practised in many other countries, it is regarded as necessary that the education by using the models should be given to make children easily aquainted with science. The progress of the scientific level will be directly connected with the popularized science education.

The lower year boys of primary schools may be given the paper clay to form the shapes of animals or something. Or wooden plates and fine wire or thread may be given to them, out of which the boys can produce baby music instruments, learning by themselves the principle of basic acoustics or resonance. For the upper class boys, the miniatures or models of small electric motor, aeroplane, or radio set or transreceiver may be helpful for their understanding or the composition and working principles. All listed herein are only examples, but many other objects could be pointed out to be suitable for the teaching materials, provided that the illustration and explanation in detail have only to accompany the model set, and that the cheapest price is offered for the educational purpose.

The contents of the surveyed subject are shown as follows:

I. Consumption Status of Toy in Ghana.
   (1) Import record of toy.
   (2) Home production and consumption.

II. Production Programme.
   (1) Production capacity.
   (2) Material.
   (3) Production start and planned factory site.

III. Draft Plan by Japan for Toy Factory Construction.
   (1) General.
   (2) Flow sheet of manufacture.
      (a) Metal toy.
      (b) Wooden toy and Teaching stuff.
      (c) Fabric toy.
   (3) Layout of planned factory.

IV. Estimate for Toy Factory.

(1) Equipments cost.

(a) Machinery equipments cost.

(b) Building cost.

(2) Operation cost.

(a) Material cost.

(b) Pay and wage.

(c) Indirect cost.

(3) Total cost.

V. Profit.

(1) Expected Annual profit.

(2) Annual cost.

VI. Conclusion.

I. CONSUMPTION STATUS OF TOY IN GHANA.

(1) Import Record of Toy.

1958	£14,316
1959	£34,670
1960	£37,132

Import volume since 1961 is unknown, but the increase at a higher rate than before will be presumed.

(2) Home Production and Consumption.

There has not been any toy factory in Ghana. Consequently, the volume of toy consumption has always been almost the same with the imported volume.

The Ghanaian government shows a very enthusiastic support for education, and the scientific model or other educational toys will be needed in quantities. With the large potential demand, the future consumption of toys will be no doubt on the instant increase in Ghana.

II. PRODUCTION PROGRAMME.

(1) Production Capacity.

The demand for toy in Ghana has been sharply increasing year by year. Taking into account of the future increase, a planned production scale will have to be set to about £10,000 of monthly output, making £126,000 annually in total. The production will not only meet the domestic demand, but will cover the anticipatory volume of export to the Western African countries.

(2) Material.

The material stuff for metal toys such as tin plate, printing ink, rubber, plastic goods, etc., are not produced in Ghana, but all must be imported. The wooden material can be prepared in Ghana, for the onyina or some few other good quality woods are available at low prices. As for the fabric toy material, the imported texile will be used, but the Ghanaian wooden packing can serve for packing stuff.

(3) Production Start and Planned Factory Site.

It is possible to start production from one year after the contract made for construction.

Accra will be the best site for the construction, as given the various favourable conditions to provide such conveniences as electricity, water supply, labour, materials and transportation. Tema will be the next best.

III. DRAFT PLAN BY JAPAN FOR TOY FACTORY CONSTRUCTION.

(1) General:

Out of the total production valued in amount, 50%. will be for metal toys, 20% for wooden toys, 15% fabric toys, and 15% for school teaching stuff, which are considered as the most proportionate production. These percentages will be easily controlled to change with the individual requirement increase.

The equipments and facilities in the project are also planned to meet immediately with the change with required items. However, the estimates of the costs are made, based on the enumerated percentage of the production items.

(2) Flow Sheet of Manufacture.

(a) Metal Toy

Main Material

Tin plate; 0.3 - 0.5 - 0.7 mm in thickness (varying with use)

↓

Printing on Tin Plate

To print in 3 or 4 colours
Patterns and designs to be decided separately, suitably for items.

↓

Preservative Painting

Inside of tin plate to be coated by preservative paint.

↓

Hot Blast Drying

To dry the preservative-coated plate.

↓

Cutting.

To cut and prepare the plate in suitable size for the press.

↓

Press Working

To rap and emboss the printed plate according to the designed shapes.

↓

Gilding

Some parts are required gilding. Such parts should be left unpainted.

↓

Parts

Miniature motor, flywheel, rubber tire, plastic parts, spring, etc.

↓

Assembly

To assemble the parts into the pressed plate.

↓

Inspection

To inspect the finished items.

↓

Packing

To pack and package in cardboard box.

↓

Product

Product marketable.

(b) Wooden toys and school teaching stuff.

Material wood

To select suitable wood.

↓

Sawing

To cut the material by sawing machine into the required thickness.

↓

Planing.

To plane the wooden plate, finishing the surface.

↓

Wood working machine

To cut out in the designed patterns.

↓

Painting

To paint the cut patterns in colours.

↓

Assembly

To assemble the painted wood by the adhesive or nails.

↓

Inspection

To inspect the assembled item.

↓

Packing

To pack small items in cardboard box and wrap large ones in paper.

↓

Product

Product marketable.

(c) Fabric Toys.

Textile

Material textile.

↓

Cutting

To cut in signed shapes by tailor's cutter.

↓

Sewing machine

To sew up the cut material.

↓

Finish sewing

To fill the wad or packing and stitch up.

↓

Hair attached and drawing

Hair is attached and face is drawn on material doll. Animal same as as doll.

↓

Ornament attached

Ribbon or shoes etc. to be fitted.

↓

Inspection

End item inspection.

↓

Packing

To pack in cardboard box.

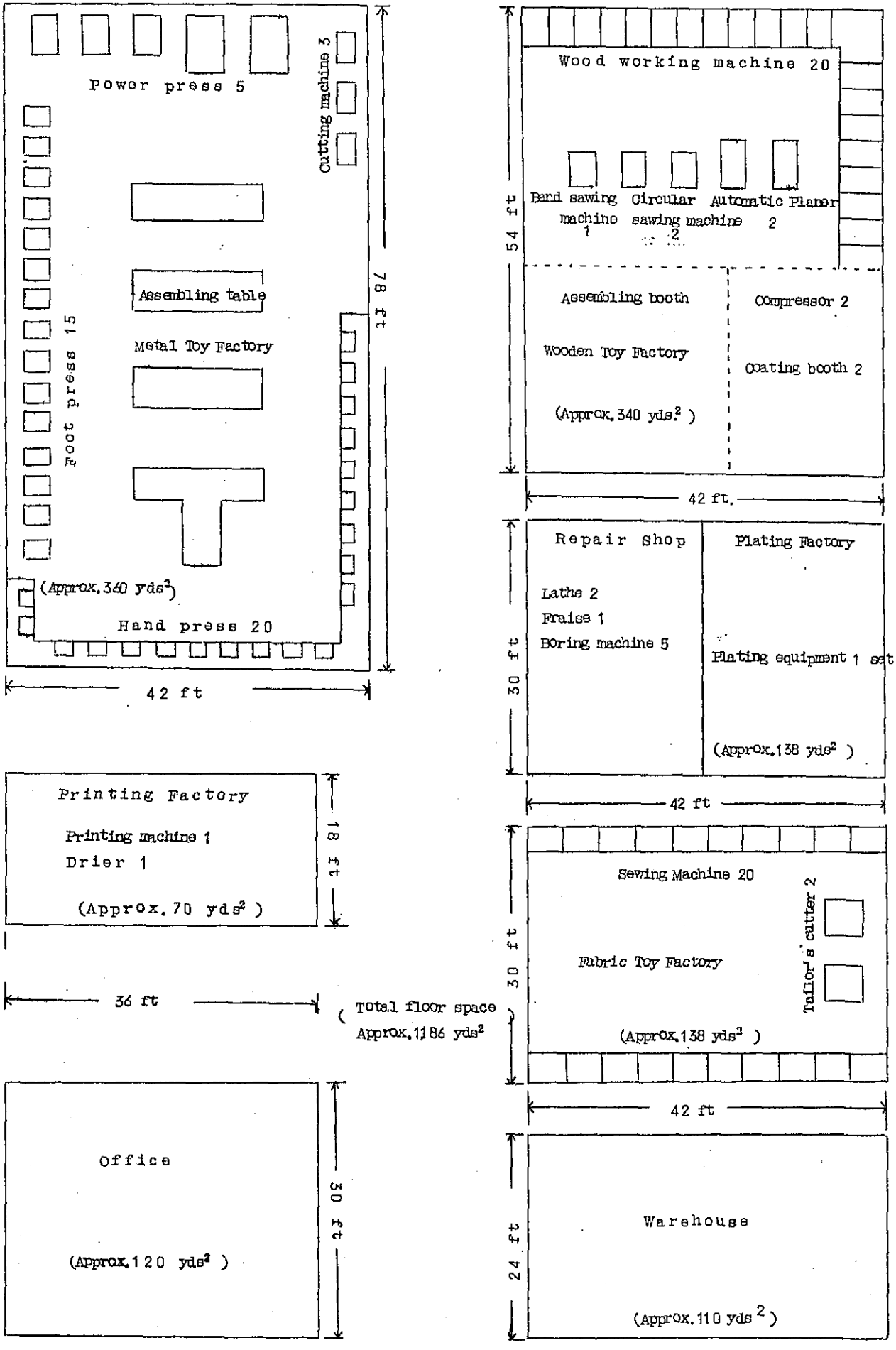
↓

Product

Product marketable.

↓

(3) Layout of planned factory



IV. ESTIMATE FOR TOY FACTORY

(1) Equipment cost.

(a) Machinery equipment cost.

Nomenclature	Unit (£)	Q'ty	HP	Amount
Power press #2	700	2	2	1,400
" #3	310	3	1	620
Foot press 2.5 t.	24	15		360
Hand press 0.6 t.	7.6	20		150
Cutting machine	120	3	½ - 1	360
Lathe 4 ft.	420	1	1	420
" 5 ft.	550	2	1	1,100
Fraise	450	1	1	450
Drilling machine	60	5	1/4 - ½	300
Tin plate printing machine	6,000	1	2	6,000
Hot blast dryer	2,800	1	1	2,800
Glinding equipment	3,400	1 set	1	3,400
Compressor	75	5	½	375
Wood working machine	48	20	1/4	960
Band sawing machine	110	1	1	110
Automatic planer	180	2	1	360
Circular sawing machine, 16	110	2	1	220
Sawing machine	65	20	1/4	1,300
Tailor's cutter	320	2	½	640
Jobber's table, shelf and carrying cart				
Coating booth & others	5,500			5,500
Tools	4,800			4,800
Fees for pattern & idea	25,000	5 or 6 kinds		25,000
Packing & Transportation charges of machines	6,000			6,000
Machinery fitting (by Japanese)	4,800	4 persons		4,800
Roll turning lathe	35	3		105
TOTAL:				£67,530

The prices includes the charges for machines installation.

(b) Building cost.

10,800 ft^2 x £2-11-10 = £27,000

(2) Operation cost.

(a) Material cost (for a year)

Tin plate 200 t.: £68 x 200 = £113,600

Wood 500t.: £20 x 500 = £10,000

Textile 400 yd: £30 x 400 = £12,000
Various kinds

@£30 per yd.

Plastic & rubber parts: approx. £4,000

Printing ink, paint & other chemicals: approx. £6,000

Total: £45,600

(b) Pay and wage (for a year)

Chief engineer 3 (each one for metal, wooden and fabric toy)	: £3,600 x 3 = £10,800
Engineer 6	: £420 x 6 = £2,520
Office worker 5	: £144 x 5 = £720
Factory worker 106	: £180 x 106 = £19,080
Total:	£33,120

(c) Indirect cost: £4,800

(d) Total operation cost.

Material + Pay and wage + indirect cost = £83,520

V. PROFIT

(1) Expected annual profit.

Annual profit: £30,670

Annual output £126,000
Annual cost £95,328 (-

Annual profit: £30,672

(2) Annual cost.

Material cost		£45,600
Pay and wage		33,120
Indirect cost		4,,800
Electric power 60,000 KWH (@4.5 pence/KWH)		450
Water	abt.	360
Depreciation of machinery equipment (7 year depreciation)		7,648
Depreciation of building (20 year depreciation)		11,350
	Total:	£95,328

Expected profit: £126,000 - £95,328 = £30,672

Remarks: The output varies with the production items. In the case of toys, the production item covers a wide range, so the exact output cannot be preestimated. However, judging from the actual examples prevailed in Japan, an average proportion is calculated from the material consumption volume and output, on which the anticipatory output of the project is estimated.

VI. CONCLUSION

When the project works well as intended initially, the investment for amount of £94,530 will bring about an estimated profit of £30,000, and the profit ratio reaches at approximately 32%. The saving of the foreign currency will be effected as the following formula give, and amount to £74,264 for a year. Consequently, it will be assured that the project will make an enormous contribution to the national economy as well as the educational progress.

Amount of saved foreign currency = Output - (Depreciation + imported material cost)
= £74,264

In developing the project, the most difficult would be the training of machinists for the press and metal printers. In this respect, Japan will make a positive cooperation with Ghana to expedite the development of the project.

APPENDIX: QUALITY TESTING AND COATING TESTING OF WOOD

Subject: Test Result of Analysis Test of Ghanaian Onyina.

1. Hardness:
   Medium hardness between the pine and the South-American Hard-barsa, best suitable for manufacturing wooden toys and /or education model materials.

2. Strength:
   Containing a proper greasiness, hard to break.

3. Processing:
   Not being a hard wood at all, very easy to be processed.

4. Painting:
   Due to the soft quality, the paint is absorbed more or less. When the undercoating is applied, no trouble occurs.

G. CONSTRUCTION PROJECT OF MATTRESS FACTORY TO USE RUSH AS MATERIAL.

General:

The assigned investigation subject in the survey team was to chase the possible utilization of the natural rush in Ghana. The survey was carried out in the respect of the quality, utilization method and demand status, and it was finally concluded that the construction of the factory should be practical under the present circumstances.

Based on the survey results, the plan of the factory construction is outlined as follows:

1.	Production Capacity:	Monthly 18,000 sheet (40" x 95")
2.	Material:	Ghanaian natural rush
3.	Production Item:	Home-use mattress, shade or sun-blind, luncheon-mattress

The survey report consists of the following contents:-

I. RECENT SUPPLY-DEMAND STATUS OF MATTRESS IN GHANA.
   (1) Import record of mattress
   (2) Domestic production and consumption

II. STUDY ON THE PRODUCTION PROJECT OF MATTRESS.
   (1) Production capacity
   (2) Material
   (3) Production start and planned factory site

III. DRAFT PLAN BY JAPAN FOR MATTRESS FACTORY CONSTRUCTION.
   (1) General
   (2) Flow sheet of manufacture
   (3) Building layout

IV. ESTIMATE FOR MATTRESS FACTORY CONSTRUCTION.
   (1) Cost for equipments
   (2) Cost for operation

V. CONCLUSION.

I. RECENT SUPPLY-DEMAND STATUS OF MATTRESS IN GHANA.

(1) Import record of mattress.

The record of the imported mattress for the past three year is given as follows:

1958	£35,717
1959	£67,813
1960	£112,431

(2) Domestic production and consumption.

There is no production factory of mattress in Ghana. Therefore, it will be safe to say that the domestic consumption should be almost equal to the volume of the imported mattress. The recent trend of increasing import, as shown for the past three years, will indicate that the more demand will rise rapidly for mattresses keeping up with the elevation of the people's living standard. The field investigation revealed that in the city districts each home was using 10 or 15 sheets of mattress at present. Judging from the average durability of mattress, it may be necessitated not so far in future that each home be in need for the purchase of two or three sheets of new mattress every year on an average.

II. STUDY ON THE PRODUCTION PROJECT OF MATTRESS.

(1) Production capacity.

Since there is no existing production facilities of mattress, the planned production should meet at least with the want Ghana is facing on the goods. Taking into consideration the present status of local demand, it was concluded upon deliberation together with the Ghanaian government officials that the proper amount of monthly production should be set to 18,000 sheets (rated in sheet of 40" x 95").

(2) Material.

The Ghanaian government has the mind to utilize the natural bulrush as the material for the project. The fact is, the wild bulrush is rich in the damp ground along the downstreams of the Volta river, and its quality is observed to be excellent for mattress manufacture. The distribution amount is estimated to reach £240,000 to 250,000 converted in the merchandise value. The growing period of the wild bulrush is about three or four months, bringing about the three crops a year. On the premises,

the annual output in the sum of £720,000 or 750,000 would be able to be realized in the project. This figure exceeds the consumption amount anticipated in the plan.

Due to the wild growth, the Ghanian bulrush is not so even in the thickness. This difference in stem diameter of individual bulrush will make a little difficult to do the weaving on machine.

The test pieces of the bulrush was brought back to Japan for quality analysis, which will be given separately in the attached, but the outlined characteristics are: (1) about four times as thick in diameter as the ordinary Japanese produce, and (2) slightly stronger in the tension strength test than the Japanese one.

The thick diameter will emerge in the different appearance and design of the finished product. The fine matting as the Japanese "tatami" mattress could not be produced, but the product would be more like a straw-mat with a little rough weaving. However, from a point of ventilative view, this kind of mattress would be more suitable for the natural climate of Ghana. The mattress made of the thick bulrush would give more comfort to the peoples' living customs and manner in Ghana than the fine woven of Japan.

On the other hand, when Ghana will be on the outlook for the export market of the produced mattress, the Ghanaian bulrush-material mattress might not command a good saleability because of its rough weaving as well as its hardness for dyeing finish. Both of them will badly affect the merchandise appearance or design. In this respect, the Japanese rush is recommended to be transplanted in Ghana. Concerning the feasibility to cultivate the Japanese rush in Ghana, the mass plantation would assuredly be reasoned. The Japanese rush for mattings is originated in the tropical areas with high temperature and much humidity. In fact, the cultivating area of such in Japan is generally limited to its southern part only where is favoured by the hot climate. This indicates that the transplantation of the Japanese rush should be successful, provided that the adequate amount of water and fertilizer be secured. In materializing the transplantation, Japan will extend its ungrudging cooperation of Ghana.

SUPPLEMENTARY:

REPORT ON TEST RESULT OF GHANAIAN BULRUSH

1. Tension test.

Ghanaian bulrush is on an average about three or four times as thick in diameter as the Japanese one. About five times as strong in the tension strength per one piece of rush in the dried conditions. However, the strength per sectional unit area is observed a little lower than the Japanese one. Consequently, the durability of the product will be not so long as the Japanese rush mattress, but it would be still strong enough for the mercantile goods.

2. Dyeing test.

The dyeing features are almost same as the Japanese rush, but not so clear in colour in the surface finish, a little dark. In the case of red tint dyeing, the appearance would not be so brilliant as the Japanese rush. No trouble will occur in the blue or black tint dyeing.

3. Weaving test.

Due to the tickness, many breakage takes place on the machine, resulting in lowering the yield. Further, the diameters of individual rush materials are uneven, influencing badly on the material selection time. These two factors will cause the lower productivity and larger cost charges than in Japan. Meanwhile, the material cost will be by far lower in Ghana, and no influence may be effected in the total production cost. The thickest rush material may be used, divided into two pieces. The halved material will not produce a fine weaving, and the method should not be employed.

(3) Production Start and Planned Factory Site.

The existing growth of the Ghanaian bulrush can be immediately cropped, so upon the completion of the planned factory, the material is available for the production start. The construction of factory and the equipments installation will be able to be completed within one year after the contract. the construction site is recommended to locate somwhere arount the Tema Port along the downstream of the Volta river. The place should stand near the abundant rush growth area as well as the consumption market.

III. DRAFT PLAN BY JAPAN FOR MATTRESS FACTORY CONSTRUCTION.

(1) General.

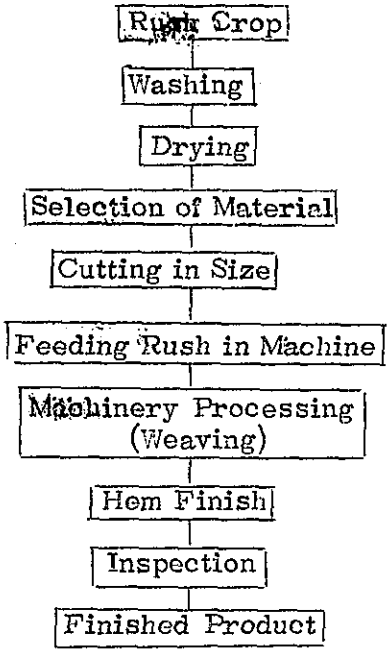
The monthly production will be 18,000 sheets (in 40" x 95" sheet) and the production items consist of the following:

1. Solid colour mattress 20%
2. Floral design mattress..... 40%
3. Scenery design mattress 20%
4. Natural-object design mattress ... 20%

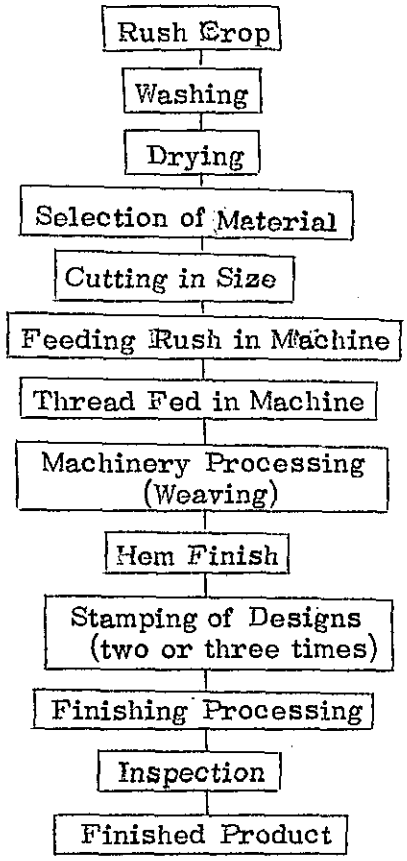
The planned percentage of production item could be easily controlled and rearranged, if needed.

(2) Flow Sheet of Manufacture

1. Solid colour mattress:



2. Floral design mattress



3. Scenery design mattress, same in manufacturing flow as the floral design mattress.

4. Natural-object design mattress, same in manufactring flow as the floral design mattress.

(3) Building Layout.

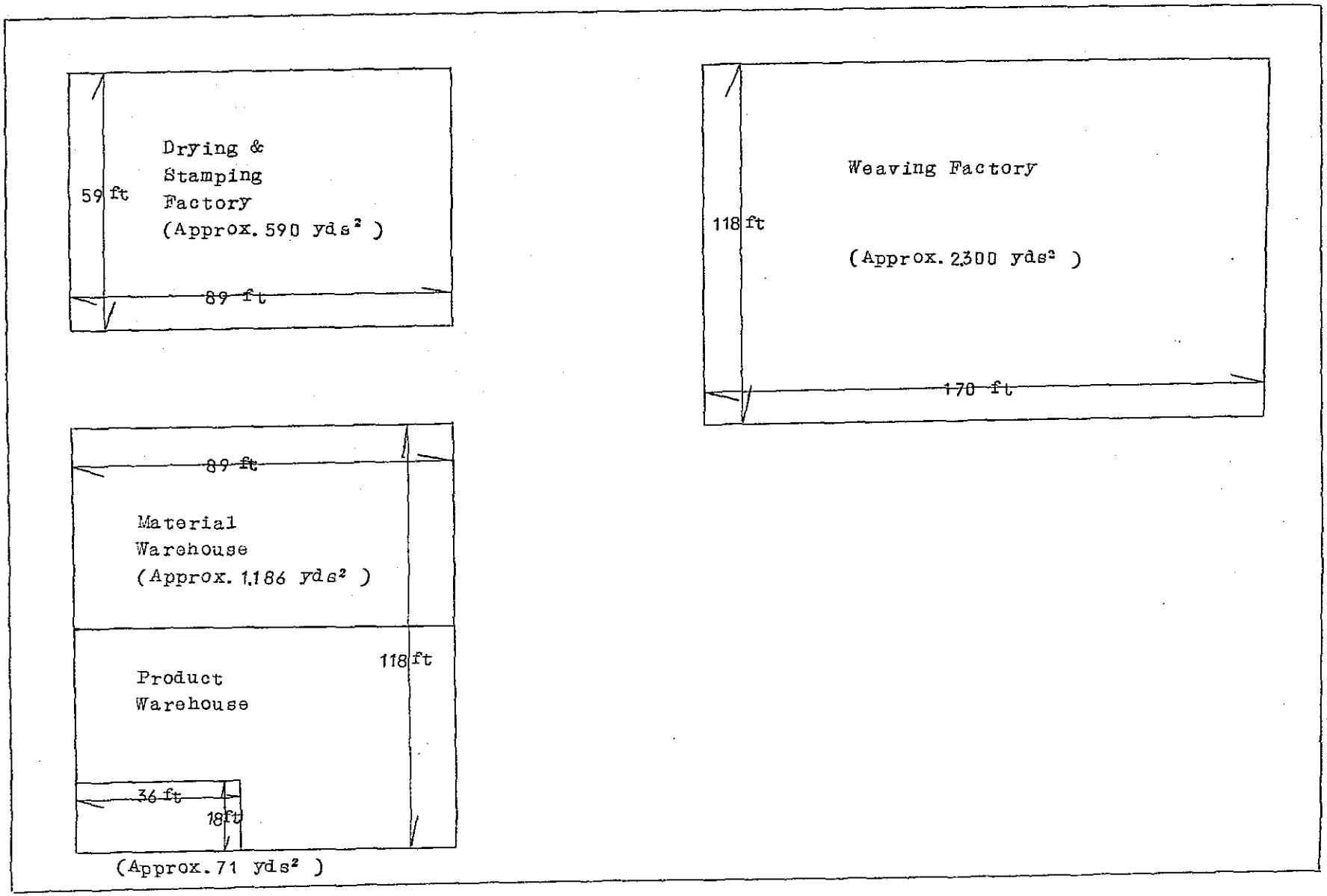
As per attached drawing.

IV. ESTIMATE FOR MATTRESS FACTORY CONSTRUCTION.

(1) Cost for Equipment.

The estimate for the equipments and building cost will be shown as per attached table. The annual depreciation amount is made out as follows:-

(3) Building Layout



Depreciation for machinery equipments: £92,650 ÷ 7 (years) = £13,235
Depreciation for building: £76,500 ÷ 20 (year) = £3,825

Total: annual depreciation amount: £17,060

TABLE: REQUIRED EQUIPMENTS AND ESTIMATE

Nomenclature	Q'ty	Unit	Amount
(Machinery)			
Weaving Machine for Thick Rush	15 units	£750	£11,250
Weaving Machine for Fine Rush	15 "	750	11,250
Finishing Machine (Large)	7 "	220	1,540
Finishing Machine (Small)	8 "	220	1,760
Sheath Removing Machine	6 "	130	780
Automatic Conveyor	15 m.	55	2,970
Boiler	1 unit	28,500	28,500
Blasting Machine (Large)	1 "	450	450
Forming Tools	1 set	13,800	13,800
Switch Board	1 unit	1,700	1,700
Wiring	1 set	1,300	1,300
Auxiliary jigs and tools	1 set	6,800	6,800
Kn itting Thread (6 months stock)			2,300
Knitting Thread (for Japanese rush; 6 months stock)			3,500
Pattern Impression Materials (with tools)	1 set		3,850
Working Table	30 sets	30	900
		Total:	£92,650

** Prices including freight and installation charges.

(Building)			
Factory, abt.5,250 ft^2	1 bldg.	£80	£12,000
Factory, abt.20,300 ft^2	1 "	75	43,500
Warehouse abt.10,500 ft^2	1 "	70	21,000
		Total:	£76,500

** Prices including charges for concrete working.

(2) Cost for Operation (for One Year)

(a) Material cost £3,960

Reeds: £250 x 12 (m/s) = ¥3,000

Thread: £50 x 12 (m/s) = £600

Dye stuff: £30 x 12 (m/s) =£360

(b) Pay and Wage £15,480

Chief engineer: £350 x 12 (m/s) x 1 (person) = £4,200

Engineer: £30 x 12 (m/s) x 3 (person) = £1,080

Clerk: £20 x 12 (m/s) x 5 (person) = £1,200

Worker: £15 x 12 (m/s) x 50 (person) = £9,000

(c) Electricity and Water £2,190

Electricity: 7,500 KWH x 12 m/s x 5 pence = £750

Water: 30,000 gallon x 12 m/s x 4/1,000 shilling = £1,440

(d) Other expenses: £200 x 12 m/s = £2,400

(e) Grand Total: £24,030

Remarks: The cost of material rush only covers the expense (chiefly charges wage) required for the transportation from the cropped place to the factory.

V. SALES PROFIT.

(1) Estimated Annual Cost Charges.

Operation cost:	£24,030
Depreciation:	17,060
Total:	£41,090

Remarks: The operation cost in the project appears very low, almost as low as one-third of that required in Japan. It is caused by the low-expensed material available from the feral growth.

(2) Expected annual profit.

(a) Annual Proceed.

18,000 sheets x 12 m/s x 12 shilling = £87,840

Remarks: The unit selling price is regarded same as the imported mattress from Japan (CIF price plus import duty).

(b) Annual Expenses: £41,090

(c) Expected Annual Profit: £87,840 - £41,090 = £46,750

VI. CONCLUSION

The construction project of mattress factory, when working as intended, will make a great contribution to the progress of Ghanaian national economy. Against the invested amount of £16,150, the annual profit is expected to be £46,750, producing 28% of profit ratio. The saving of foreign currency, as given by the following formula, will reach £70,180.

Saved amount of foreign currency = Annual output - (Depreciation + imported material cost)

The required materials are for the most part available from the domestic producing ones, providing the favourable condition with the project to be materialized. It is therefore trusted that the project should be in the interest of the elevation of people's living standard, while achieving a saving of large sum in foreign currency outflow.

An important requirement in developing the construction project is to carry up with the transplantation project of the Japanese rush into Ghana, so that Ghana can produce high quality mattresses to grow into a powerful exporting country itself of a full range of mattress goods.