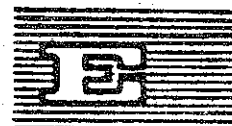


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THE BRICK INDUSTRY

M66-1083

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THE BRICK INDUSTRY

I. Introduction

In West Africa bricks are the traditional building material. It has long been the practice in African countries to use sun-dried bricks made by handicraftsmen, the bricks being perhaps improved by the addition of straw, and known as swish. Less frequent use is made of burnt bricks produced by handicraftsmen, or bricks manufactured in brickworks.

The fuel in general use is local wood or industrial and agriculture waste - coconut and groundnut husks - but it is intended to make use of fuel oil in the new brickworks now under construction. Because of the very low population density in this sub-region and the relatively high cost of transport, brickworks will be found today only in places near towns and their capacity is almost invariably geared to the needs of the immediate surroundings.

The necessary raw materials for the manufacture of bricks can be found practically throughout the whole of West of Africa, and since bricks hold out many advantages from the building standpoint, they warrant consideration as a basic building material. Consequently, a great deal of attention should be paid to the development of the brick industry.

II. The evolutionary trend in consumption

(1) The cost of products from brickworks is approximately US\$18 per ton, and the cost of transport approximately 6 cents per ton/kilometer, which means that over a distance of 300 kilometers from the brickworks, bricks are double their price. Transport costs make bricks very expensive, and for this reason import-export does not play an essential role. In the custom statistics, products from brickworks fall into two categories:

- 662.4 (1) building bricks - building bricks of ceramic materials
- 662.4 (2) roofing tiles, chimney pots and liners and other constructional ceramic ware - tiles and architectural ornamental material.

In 1961-1964, these commodities were imported into West Africa. Imports of bricks are available for Dahomey, Ghana, the Ivory Coast, Mali, Niger, Nigeria, Senegal, Togo and the Upper Volta. The estimates for the West African sub-region are as follows:

TABLE 1

Imports of bricks in to West Africa

	<u>Total 9 countries</u>		<u>Estimates sub-region</u>		<u>Average price</u> per unit \$/Tons	<u>Consumption</u> per head of population gr/ cap
	1,000\$/year	Tons/year	1,000\$/year	Tons/year		
662.4 (1)	27.9	253.4	31	277	112	3
662.4 (2)	453.7	2,125.4	496	2,325	213	25

Classification 662.4 (1) is a completely negligible quantity so far as imports are concerned. In classification 662.4 (2) are included Ghana, Nigeria, and Senegal with imports valuing 453,000 dollars a year and weighing 2,119 tons a year. The other countries in West Africa do not import these commodities.

(2). There is practically no export of bricks and tiles, and the small quantities exported are negligible. Since tiles alone are imported, and only in small quantities, it is unnecessary to go into the question of imports. Consideration of the internal market alone would suffice.

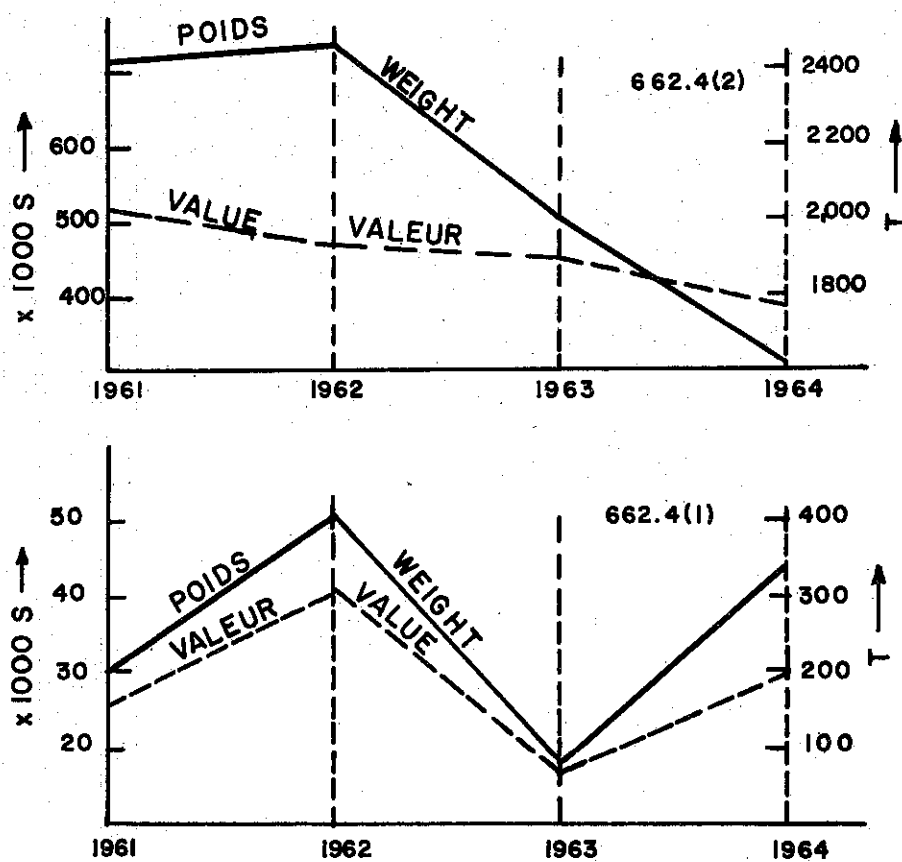
(3) Statistical data of the evolutionary trend in imports is available only for the years 1961 to 1964. The import market for these commodities can be clearly seen in Figure I. During the four years when imports of 662.4 (1) were made, the maximum was 400 tons a year in 1962, and the annual average only 277 tons a year, the development of the import market being somewhat unsteady. The only deduction to be made is that owing to the fact that most of the West African countries attained independence

in 1960, the market became brisk in 1961 to 1962, but there was a falling off in 1963 which was more evident in the case of tiles than bricks. Brick imports represent only one-tenth of the production of a small brickworks for the whole of the sub-region. The imports of tiles are most substantial, being equivalent to the production of a small brickworks, namely 2,430 tons a year maximum, and 2,325 tons a year on the average for the period 1961 to 1964.

Figure 1

West African imports of bricks (1) and tile (2)

Les importations de brique (1) et de tuile (2) en l'Afrique de l'ouest



III. Domestic Production

The following brickworks are at present in production in West Africa:

TABLE 2

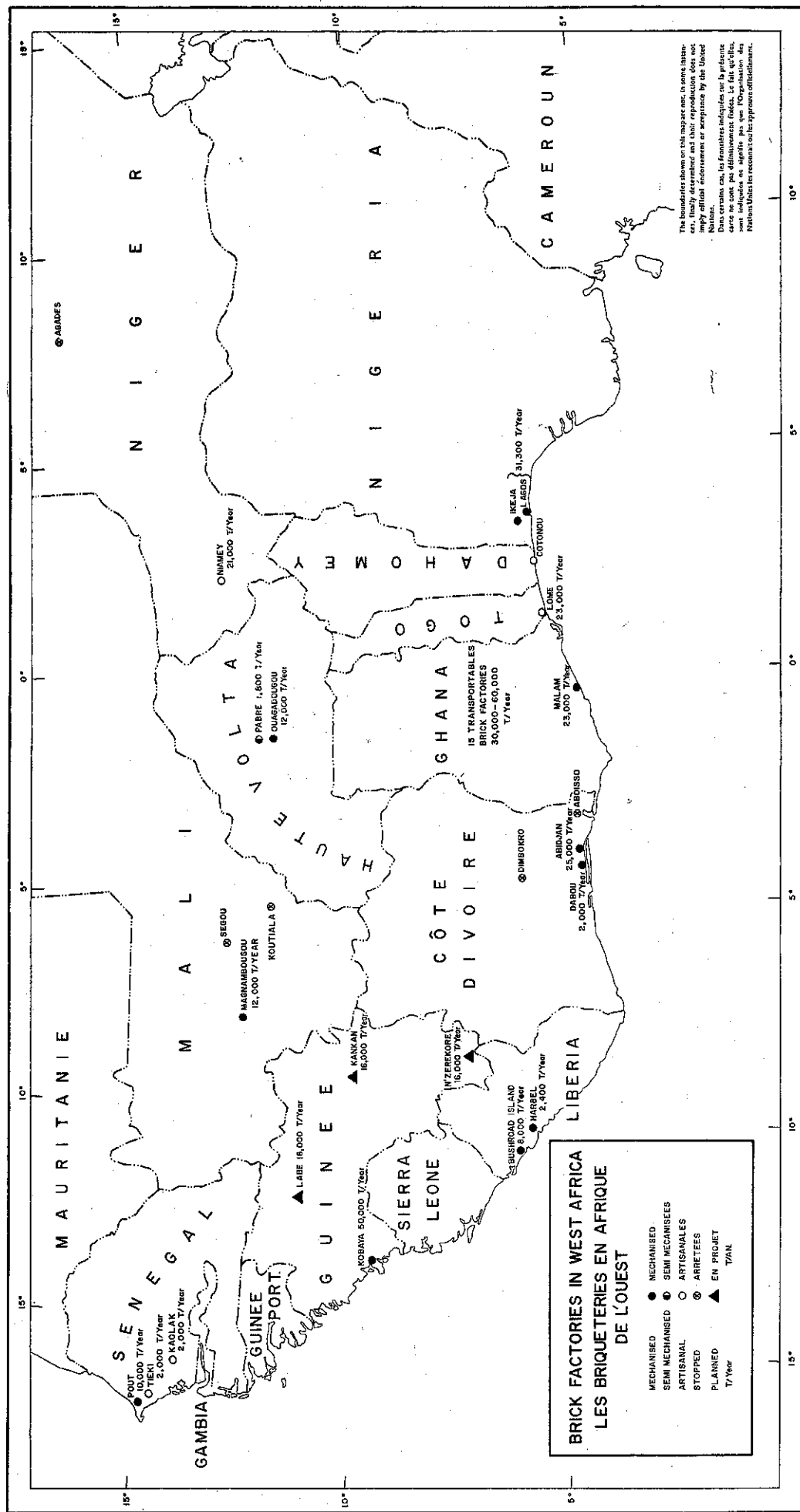
Brickworks in West Africa

Countries	Location	Capacity	Notes
Ivory Coast	Dabou	2,000 tons/annum	Hollow bricks and solid bricks
	Abidjan (SOBRICI)	25,000 tons/annum	Under construction hollow and solid bricks, hollow ceiling pots, tiles.
Dahomey	-	-	Handicraft production, unevenly distributed and fragmentary
Gambia	-	-	There are no brickworks in the Gambia
Ghana	Malam	23,000 tons/year	Hollow bricks and solid bricks, tiles, piping and setts.
	15 mobile brick-works	30-60,000 tons/year	Production under way.
Guinea	Kobaya	50,000 tons/year	Hollow bricks and solid bricks, tiles
	Kankan Lebé N'Zérékoré	16,000 tons/year	The project is now being studied
Upper Volta	Pabre	1,800 tons/year	Hollow bricks and solid bricks
(VOLBRICERAM)	Ouagadougou	12,000 tons/year	Hollow bricks, solid bricks and hollow ceiling tiles
	Bushroad Island	8,000 tons/year	Hollow bricks and solid bricks
Liberia	Harbel	2,400 tons/year	-
Mali	Magnambougou	12,000 tons/year	Hollow bricks, solid bricks, hollow ceiling pots tiles, and piping

TABLE 2 (Cont'd.)
Brickworks in West Africa

Countries	Location	Capacity	Notes
Mauritania	-	-	There are no brickworks.
Niger	Niamey	21,000 tons/year	Under construction, hollow bricks, solid bricks, hollow ceiling tiles and tiles.
Nigeria	Lagos (Construction industries) Ikoji (Clay Industries)	31,300 tons/year	Hollow bricks, solid bricks hollow ceiling tiles and tiles
Senegal	Pout	10,000 tons/year	Hollow bricks, and solid bricks
	Tiécky	2,000 tons/year	Handicraft bricks
	Kaolack	2,000 tons/year	Handicraft bricks
Sierra Leone	-	-	There are no brickworks
Togo	-	18,000 tons/year	Handicraft production widely distributed and fragmentary
	Total	317,500 tons/year	maximum, plus handicraft production

The location of the various brickworks is shown in Map 1. To sum up, from existing capacities and brickworks soon to come into production (Ouagadougou, Niamey, Kankan, Labé, N'Zérékoré and Ghana), a total production capacity of about 3,000 tons a year may be anticipated, so far as burnt bricks are concerned; add to this the production of solid burnt bricks made by Togolese handicraftsmen, which can be estimated at 12-20 million solid bricks, approximately a capacity of 18,000 tons of burnt bricks a year. The total for West Africa would therefore be roughly 320,000 tons a year burnt bricks in 1967 to 1968.



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IV. Observations arising from a study of the local industry

(1) In Africa bricks are the traditional building material, and practically everywhere in Africa raw materials for brickmaking can be found. Bricks combine all the useful and necessary properties required in building materials: price, mechanical and thermal features, they are easy to manufacture, durable and weather resisting. Their only drawback is transport, which is very costly.

(2) In the brick industry, various products can be manufactured in several dimensions. In the six West African countries production is mainly concerned with solid bricks, hollow bricks, hollow ceiling tiles, drains, girders, setts, tiles, ornamental bricks, etc. Solid bricks are made in three dimensions: 5.5 x 11 x 22 cm.; 2" x 5" x 10", and in Lomé 5 x 9 x 20 cm; hollow bricks are produced in more than 30 dimensions. It may perhaps be mentioned here that standardization in the building industry would be very useful, since it would simplify the brickworks programme and contribute to an improvement in production economy.

(3) The production programme and unit prices of bricks are given in a somewhat simplified form in Table 3, which also contains a few comparable dimensions. In that table will be found, in addition the prices and dimensions of concrete parpens, which are given by way of comparison with bricks^{1/}.

(4) It will be seen from Table 3 that there is competition between certain countries in bricks and parpens. This competition does exist, and should to be taken into account. In Table 4 the prices of 20 cm or 9" walls are given in dollars per square metre.

^{1/} Parpens or cement blocks are solid or hollow concrete bricks.

TABLE 3.
Dimensions and cost of bricks in West Africa

[illegible]

The unit price of export:

562.4	{ 2 } Building bricks
562.4	{ 3 } Tiles, etc.

- 1/ The figures should be increased by a 14 per cent production charge
- 2/ The selling price is calculated on the sale of 75 per cent of the total production
- 3/ Prices (excluding charges on turnover)
- 4/ The price is inclusive of charges, but exclusive of transport costs.

4/ The price is inclusive of charges, but exclusive of transport costs.

TABLE 4

The prices of bricks and parpens for 1 sq.m. of a
20 cm. or 9" wall, without coating or mortar, in
US dollars

	Ghana	Ivory- Coast	Niger	Nigeria	Mali	Togo	Upper Volta
Solid cement blocks	3.1-4.5	3.0	8.5-14.2				8.5-14.2
Hollow cement blocks	2.1-3.6	2.2-2.7	7.8-10.8		2.6-3.6		7.8-10.8
Solid bricks	-	5.7		9.8	5.8	0.7	6.2
Hollow bricks	3.2-4.0	1.9-4.0	2.4-2.6	2.3-3.0	2.2-2.3		2.8-3.9

These prices are calculated only for bricks, and the brick requirements per sq.metre are calculated with an allowance of 1 cm. for mortar. The price of mortar is not included.

(5) It is necessary to mention the fact that prices for cement blocks are calculated correctly in the table shown above, but some entrepreneurs do not put sufficient cement into the cement blocks, and this may produce cheaper but definitely poor cement blocks which will compete with bricks.

(6) In normal circumstances, it is always possible to arrange for the conditions under which cement and bricks are to be manufactured, and regulate the production rates accordingly. Regulating production rate means regulating the price of cement and bricks, so as to produce conditions in which the price of bricks will be better than the price of parpens, in the case of walls where bricks are preferable, because of their technical features. It is also worth mentioning that well wrought bricks can be used architecturally as walls can be made entirely of red bricks, thus economizing on coating which is also a saving in economic terms. This is the normal procedure in countries where climatic conditions are rigorous, for example, in Scandinavia, England, the USSR and in spite of these climatic conditions which are more rigorous than in West Africa, the life span of buildings is reckoned in terms of centuries.

(7) West Africa is poor in raw materials for the manufacture of cement, and the countries with the most abundant supplies of limestone have a reserve that will last only for a few scores of years, whereas raw materials for bricks are to be found everywhere. It is worth mentioning here that West Africa will never be self-sufficient in cement, and it is therefore worthwhile recommending the development of the brick industry as quickly as possible after this report has been examined.

(8) The bricks produced in West Africa are not perfect, and much can be done to improve them. One notable feature is that the conditions necessary for the preparation of clay are not observed in West Africa, and the observance of such conditions is a sine qua non if very high quality bricks are to be produced, capable of competing on easy terms with other building materials.

In some brickworks, clay is extracted and used after being moistened directly in the process of treatment, without any homogenization or period of repose. In factories where handicraft methods are used, a worker extracts clay, prepares a paste and moulds the bricks. The moulding is done during the first part of the day with the prepared paste, and at the close of day the workman prepares the earth for the next days' work.

This method of treatment is insufficient, to obtain good quality bricks it is necessary to take great care over the preparation of clay, in other words homogenization, preparation with water or vapour, and a period of repose.

It is also necessary to consider establishing an educational centre for workers. In order to improve the manufacture of bricks, raw materials must be looked for, discovered and assessed, and proper methods of treatment and manufacture determined. This implies assessing a large quantity of samples. For a long time this type of work has been carried out in European or American institutes, but this is a rather inconvenient method. Proposals should be made for setting up an institute of this kind in certain West African countries. Such an institute would also serve to educate workers at the top.

In this connexion, the Kumasi Institute in Ghana bids fair to supply such an institute.

V. Development projects up to 1980

(1) To determine the requirements in bricks and the development of brick production up to 1980, we must first establish the amount of building activity that goes on, evaluate the present production of bricks, and use this as a basis to make proposals for the future. The following production methods may be used:

- (a) The evaluation of the requirements in bricks for West Africa in relation to building activity;
- (b) The figures obtained under (a), should be compared with those for development in the European or American countries where statistics abound. It should be noted that in Europe and America industrial production practically holds sway, whereas in West Africa handicraft production is the order of the day. Unfortunately, there are no statistics for this type of production, and the first prerequisite will be to arrive at some estimate of it.

(2) In annex II is to be found an estimate of development in building activities.

An estimate of industrial production will be found in Table 2 and Annex III. According to that table production will reach a total of 320,000 tons a year when the new brickworks are completed and come into production. Their production may be assessed as follows: (in thousands of tons a year)

	<u>1965</u>	<u>1968</u>
<u>Solid bricks, hollow bricks and</u> <u>ornamental bricks</u>	120	270
<u>Tiles and other materials</u>	<u>6.0</u>	<u>42</u>
Total	126	312

(3) As regards the estimated handicraft production, in Annex I will be found a few statistics for the Ivory Coast and the Upper Volta.

(4) New dwellings in the West Africa residential areas are built of industrial and handicraft burnt bricks, parpens, wood, stone and other materials. The handicraft production of bricks is very highly developed in Africa and represents a substantial proportion of the over-all production. Along the littoral, as in Togo, Dahomey and Nigeria, only burnt bricks made by handicraftsmen are produced, whereas in the hinterland particularly in the Niger, the Upper Volta and Mali, swish bricks are common.

In Nigeria, which represents 60 per cent of the production of the sub-region, it is estimated that the production of bricks whether from clay or not, is 20 per cent as regards burnt bricks, and 80 per cent as regards sub-dried bricks. This estimate is valid for the whole of the sub-region.

From Annex I the percentage of industrial and handicraft burnt bricks can be established as follows: 2.5 per cent industrial, and 17.5 per cent handicraft bricks. For the year 1965, this estimate in figures was as follows:

- Industrial burnt bricks.	2.5 per cent	80,000 m ³	1.5 kg/l	120,000 T
- Handicraft burnt bricks.	17.5 per cent	560,000 m ³	1.6 kg/l	900,000 T
- Swish bricks	80 per cent	2,560,000 m ³	1.8 kg/l	4,000,000 T
Burnt bricks	20 per cent	640,000 m ³		1,020,000 T
Swish bricks	80 per cent	2,560,000 m ³		4,000,000 T

(5) Building activity is estimated as follows:

(in thousands of sq.metres)

The total area of walls and partitions

	<u>1965</u>	<u>1980</u>
Cheap dwelling houses	6.20	30.70
Medium-range dwelling houses	0.46	2.24
Good quality dwelling houses	<u>0.10</u>	<u>0.45</u>
Total dwelling houses	6.76	33.39

(in thousands of sq. metres)

The total area of walls and partitions

	<u>1965</u>	<u>1980</u>
Industrial buildings	2.43	12.00
Educational buildings	1.91	9.38
Miscellaneous	<u>0.52</u>	<u>2.62</u>
Total	11.62	57.39
Floors	4.92	24.32
Roofs	5.09	26.32

Percentage of walls in industrial burnt bricks. 4.45 per cent

Percentage of walls in handicraft burnt bricks. 30.9 per cent

Unitary production: 3 kg. bricks:

- Industrial bricks : 40 million pcs. = 0.41 bricks/per capita
- Handicraft burnt bricks 300 million pcs. = 3.07 bricks per capita
- Burnt bricks 340 million pcs. = 3.48 bricks per capita

The ratio of industrial bricks to handicraft bricks in volume: 1:7

The ratio of industrial bricks to handicraft bricks in weight: 1:7.5

From the assessed value of the prospects of building activity in 1980, we may assume a 20 per cent requirement of brick walls, and a contribution from the brick industry of 40-50 per cent of the total brick production.

	<u>Alternatives</u>		
	I	II	III
The volume of walls for dwelling houses		9.47 millions of dam ³	
The volume of walls in burnt bricks		1.89 millions of dam ³	
The total volume of walls in burnt bricks		1,935,000 m ³	
The requirements of bricks in weight		2,776,000 Tons	
Percentage of these requirements in industrial bricks.	40 %	50 %	

Alternatives

	I	II
The weight of these requirements in industrial bricks	1,110,000 T	1,388,000 T
The percentage of these requirements in handicraft bricks	60 %	50 %
The weight of these requirements in handicraft bricks	1,666,000 T	1,388,000 T

Increase in production:

(a) Industrial : handicraft in 1965-1980:

$$120:1,110 = 1:9.25 \quad 120:1,388 = 1:11.6$$

(b) Industrial : handicraft in 1967/1968-1980 :

$$270:1,110 = 1:4.12 \quad 270:1,388 = 1:5.15$$

(6) The production of solid and hollow bricks in relation to the total production of the brickworks is 85-90 per cent. The total production according to this estimate would then be:

Alternative I : $1,110,000 \times (1.18-1.11) = 1,310,000 - 1,230,000 \text{ T}$

Alternative II : $1,388,000 \times (1.18-1.11) = 1,640,000 - 1,540,000 \text{ T}$

On the basis of this estimate, the production from brickworks in West Africa in 1980 should be:

- Solid and hollow bricks	1.14 - 1.39 million tons
- Other products (tiles, hollow ceiling pots, drains)	0.12 - 0.15 million tons
- Total production	1.23 - 1.54 million tons

An alternative method would be to assess the production of various countries in the world, the evolutionary changes in production, and compare the results with those of cement, which is regarded as the most important building material.

(7) Brick production in the following countries:

TABLE 5

Brick production in various countries (in millions of single bricks per year)

Countries	1950	1953	1955	1956	1957	1958	1959	1960
Belgium	2,004	2,212	2,433	2,241	2,412	2,210	2,151	2,259
France	3,143	3,130	4,097	4,104	4,334	4,277	4,088	4,088
Italy	1,458	2,008	2,801	2,842 ^{5/}	3,134	3,344	3,579	
Canada	375	426	489	510	474	541	551	470
Germany (FR)	4,123	5,082	5,812	5,729	5,498	5,409	6,114	6,222
Holland ^{1/}	1,192	1,336	1,439	1,486	1,583	1,517	1,542	1,626
Norway	98	101	109	102	79	85	94	
Austria	568	471	799	848	865	804	873	940
Sweden ^{2/}	357	375	377	337	313	293	330	326
United States	6,333	5,874	7,902	8,085	6,658	6,489	7,300	6,952
Britain ^{3/}	5,921	7,195	7,163	7,131	6,914	6,440	6,967	7,279
Yugoslavia	977	664	799	813	897	1,066	1,076	1,234
Albania	14	46	58	61	68	76	125	
Bulgaria	237	427	444	553	489	575	758	
North Korea	11	17	618	694	736			
Hungary	796	1,321	1,198	1,203	1,385	1,416	1,659	1,776
Germany (DR) ^{2/}	1,356	1,920	1,963	1,954	2,148	2,187	2,345	2,272
Poland	1,235	2,233	2,590	2,624	2,748	2,794	3,214	3,100
Rumania	371	800	668	750	719	822	918	572
USSR ^{6/}	10,204	16,788	20,825	21,566	24,671	28,689	33,048	35,100
Czechoslovakia	865	1,212	1,475	1,592	1,711	1,748	1,908	1,910

^{1/} Ornamental bricks not included

^{2/} Sand and limestone bricks included

^{3/} Northern Ireland not included

^{4/} Only burnt bricks

^{5/} Tiles included as from 1956

^{6/} Kolkoz handicraft production included.

(8) The unit of production of bricks in the following countries :

TABLE 6

The unit of production of bricks in various countries (per unit per capita)

Countries	1950	1953	1955	1956	1957	1958	1959	1960
Belgium	232	252	274	251	268	244	236	247
France (in kg.)	75	73	95	94	98	96	91	90
Italy	31	42	58	59	65	69	73	
Canada	27	29	31	32	29	32	32	26
Germany (FR)	88	105	118	115	109	106	118	117
Holland	118	127	134	136	144	136	136	142
Norway	30	30	32	29	23	24	26	
Austria	82	68	115	121	124	115	124	133
Sweden	51	52	52	46	42	40	44	44
United States	42	37	48	48	39	37	41	39
England	121	146	147	143	134	125	138	143
Yugoslavia	60	40	45	46	50	59	58	66
Albania	11	35	42	43	47	50	80	
Bulgaria	33	58	59	73	64	74	97	
North Korea	1	2	66	73	77			
Hungary	85	138	122	122	141	143	167	178
Germany (DR)	74	106	109	110	123	126	136	131
Poland	50	85	95	94	97	97	110	104
Rumania	23	47	39	43	40	46	50	31
USSR	57	88	106	108	121	139	157	164
Czechoslovakia	70	94	113	120	128	130	141	140

(9) The production of tiles

TABLE 7

The production of tiles in various countries (in millions of single tiles per year)

Countries	1950	1953	1955	1956	1957	1958	1959	1960
Belgium ^{2/}	191	179	291	187	196			
France ^{2/}	802	915	999	1,008	1,077	1,220		
Italy	161	219	273	1/				
Germany (FR)	922	929	1,033	1,093	1,022	905	1,000	
Holland	106	106	111	115	118	98	103	
Austria ^{3/}	96	69	72	73	68	58	56	
Sweden ^{3/}	71	69	63	61	61	47		
United States ^{4/}	339	294	475	439	409	450		
England ^{4/}	15	25	24	24	23	22		
Yugoslavia	228	186	177	186	191	198	219	
Albania	4	11	18	20	20			
Bulgaria	139	146	157	158	169	204	232	
North Korea	-	1	34	59	56			
Hungary	102	109	149	135	130	162	203	
Germany (DR)	263		308	321	345	358	370	359
Poland	73	85	127	115	123	118	110	99
Rumania	134	122	140	146	197	233	261	275
USSR	222	377	472	498	557	671	761	
Czechoslovakia	152	127	172	183	191	204	201	180
Total	4,620	3,969	5,050	4,825	4,953			

1/ Bricks are included as from 1956

2/ In thousands of tons

3/ Only in the case of burnt bricks

4/ In millions of sq.m., England excluding Northern Ireland.

Brick production in the countries mentioned above as compared with their production of tiles:

	1950	1953	1955	1956 ^{1/}	1957 ^{1/}
- Bricks (per single pos.) in millions	41,165	52,111	63,461	64,613	64,149
- Tiles (per single pos.) in millions	4,020	3,969	5,057	4,825	4,953
- Percentage of tiles as compared with bricks	9.7 %	7.6 %	7.95%	7.5 %	7.7 %

^{1/} Including Italy only for the years 1950, 1953, 1955.

(10) Building activity in the following countries:

TABLE 8

Building activity in various countries
(in thousands of units, a unit = a dwelling)

Countries		1950	1953	1955	1956	1957	1958	1959	1960
Belgium	(a)	45	39	45	44	45	47	47	
	(i)	71	116	210	237	274	292	320	314
France	(ii)	41	80	175	205				
	(i)	74	150	216	232	274	276	295	268
Italy	(ii)	52	121	129	202				
Germany (FR)		360	525	538	561	528	488	555	551
Holland		55	63	62	69	89	90	84	85
Sweden	(i)	2 45	53	58	58	65	63	69	68
United States	(iii)	1,396	1,104	1,329	1,118	1,042	1,209	1,379	1,180
England	(i)	215	330	329	310	310	281	284	307
	(ii)	205	327	324					
Yugoslavia	(i)		38	30	37	45	61	61	
Canada	(ii)	89	97	128	136	117	147	146	
Hungary		25	17	32	26	51	42	47	
Germany (DR)		31	32	33	33	61	63	80	80
Poland		68	79	94	95	122	129	133	
Rumania			46	56	78	78			
USSR		1,170	1,245	1,512	1,613	2,197	2,692	3,050	2,912
Czechoslovakia		38	39	51	64	64	54	68	78
Norway	(i)	22	35	32	27	27	26	27	27

(i) All dwellings including those rebuilt

(ii) New dwellings only

(iii) Only new dwellings in town.

(11) Number of new dwellings (per million inhabitants)

TABLE 9

Number of new dwellings per million inhabitants

Countries		1950	1953	1955	1956	1957	1958	1959	1960
Belgium	(i)	5,209	4,443	5,074	4,931	5,006	5,192	5,163	
France	(i)	1,701	2,720	4,853	5,430	6,214	6,549	7,096	6,895
	(ii)	982	1,876	4,040	4,702				
Italy	(i)	1,588	3,153	4,494	4,805	5,652	5,664	6,014	5,429
	(ii)	1,116	2,544	3,728	4,189				
Germany (FR)	(i)	7,675	10,689	10,940	11,271	10,467	9,547	10,726	10,324
Holland	(i)	5,438	6,004	5,767	6,337	8,075	8,046	7,403	7,404
Sweden	(i)	6,413	7,391	7,987	7,928	8,823	8,496	9,257	9,091
England	(i)	4,272	6,520	6,455	6,054	6,025	5,437	5,463	5,861
	(ii)	4,074	6,461	6,357					
Yugoslavia	(i)		2,229	1,706	2,080	2,499	3,354	3,307	
Canada	(ii)	6,491	6,534	8,154	8,457	7,053	8,623	8,371	
Hungary		2,678	1,770	3,253	2,631	5,175	4,243	4,722	
Germany (DR)		1,686	1,900	1,953	1,977	3,482	3,630	4,625	4,625
Poland		2,739	3,009	3,446	3,415	4,311	4,482	4,546	
Rumania			2,730	3,232	4,436	4,375			
USSR		6,134	6,555	7,694	8,065	10,800	13,009	14,489	13,582
Czechoslovakia		3,067	3,042	3,895	4,838	4,791	4,008	5,015	5,715

(i) New dwellings as well as dwellings that have been rebuilt

(ii) Only new dwellings.

Table 5 and 9 reveal the consumption of bricks and tiles per dwelling, and this is shown in Table 10.

(12) Consumption of bricks and tiles per dwelling

B = bricks

T = tiles

TABLE 10

(in millions of units)

Countries	1950		1953		1955		1956		1957		1958		1959		1960	
	B		B		B		B		B		B		B		B	
	T		T		T		T		T		T		T		T	
Belgium	44.5	4.2	56.7	4.6	54.1	6.5	50.9	4.3	53.6	4.4	47.0		45.8			
France	44.3	11.3	27.0	7.9	19.5	4.8	17.3	4.3	15.8	3.3	14.6	4.2	12.8		13.0	
Germany (FR)	43.7	8.5	60.0		59.5	9.3	59.2	9.7	35.2	4.7	34.7	5.7	29.3	4.6	28.4	
Hungary	31.8	4.1	77.7	6.4	37.4	4.7	46.3	4.2	27.2	2.6	33.7	3.9	35.3	4.3		
Czechoslovakia	22.8	4.0	31.1	3.3	28.9	3.4	24.9	2.9	26.7	3.0	32.4	3.8	28.1	3.0	24.5	
England	27.5	-	21.8	-	21.8	-	23.0	-	22.3	-	22.9	-	24.5	-	23.7	
Poland	18.2	1.1	28.3	1.0	27.6	1.4	27.6	1.2	22.5	1.0	21.7	0.9	24.2	0.8		
Holland	21.7	1.9	21.2	1.7	23.2	1.8	21.5	1.7	17.8	1.3	16.9	1.1	18.4	1.2	19.1	
Italy	19.7	2.2	13.4	1.5	13.0	1.3	12.3		11.4		12.1		12.1			
Rumania			17.4		11.9		9.6		9.2							
			2.7		2.5		1.6		2.5							
Germany (DR)	11.5	12.5	9.9	6.2	10.8	4.8	10.2	4.7	10.4	3.7	11.1	3.3	11.0	3.4	11.3	
USSR	8.7	0.2	13.5	0.3	13.8	0.3	13.4	0.3	11.2	0.3	10.7	0.2	10.8	0.2	12.0	
Yugoslavia			17.5	4.9	26.6	5.9	22.0	5.0	19.9	4.2	17.5	3.2	17.6	3.6		
Sweden	7.9	1.6	7.1	1.3	6.5	1.1	5.8	1.1	4.8	0.9	4.7	0.7	4.8		4.8	

B = bricks
T = tiles

TABLE 10 (Cont'd)

(in millions of units)

Countries	1950	1953	1955	1956	1957	1958	1959	1960
	B	B	B	B	B	B	B	B
	T	T	T	T	T	T	T	T
Canda	4.2	4.4	3.8	3.8	4.1	3.7	3.8	
United States	4.5	5.3	6.0	7.2	6.4	5.4	5.3	5.9
	0.2	0.3	0.3	0.4	0.4	0.4		
Norway	4.5	2.9	3.4	3.8	2.9	3.3	3.5	

(13) Evaluation of the growth rates of brick production in the following countries:

Countries	Period	Production of bricks per capita during this period		Growth rate %	Requirements of bricks per dwelling period 1,000 bricks/ dwelling	
France	1950-59	75 -	91	2.2	1950-59	44.3 - 12.8
Germany (FR)	1950-50	88 -	118	3.3	1950-59	11.5 - 11.0
Austria	1950-60	82 -	133	5.0	1950-59	
Germany (DR)	1950-59	74 -	136	7.0	1950-59	43.7 - 29.3
Czechoslovakia	1950-60	70 -	140	7.2	1950-59	22.8 - 28.1
Hungary	1950-60	85 -	178	7.7	1950-59	31.8 - 35.3
Rumania	1950-59	23 -	50	9.0	1953-57	17.4 - 9.2
Poland	1950-59	50 -	110	9.2	1950-59	18.2 - 24.2
Italy	1950-59	31 -	73	10.0	1950-59	19.7 - 12.1
USSR	1950-60	57 -	164	11.2	1950-60	8.7 - 12.0
Bulgaria	1950-59	53 -	97	12.8		
Albania	1950-59	11 -	80	24.7		
North Korea	1950-57	1 -	77	86		

No direct conclusion can be drawn from this assessment as regards the development of the brick industry in West Africa. The only observations possible are that given special conditions, a 25 to 80 per cent growth in brick production may be obtained, and secondly in the developed countries it is easier to improve the production of bricks than any other building material. The deduction may also be made that the percentage of growth for the countries with a good GDP per head of population, is the lowest and vice-versa. Finally, it may be established that as far as West Africa is concerned, a growth rate of 11 to 25 per cent in weight may be obtained:

	1965	1980
Rate 11 per cent	120,000	574,000 ^{11 per}
Rate 25 per cent	120,000	3,410,000 ^{25 per}
Average rate 18 per cent	120,000	1,198,000 ^{18 per}

The results of this method of evaluation are bound to be doubtful.

TABLE 11

(14) Index of brick production in various countries in 1953-1959,
as compared with West Africa for the years 1965-68-80

Countries	Brick Production per capita		New buildings per million inhabitants		Number of bricks per dwelling (in thousands of bricks)		Population (per million inhabitants)		Brick production (in millions of bricks a year)		Dwellings (in thousands of units)	
	1953	1959	1953	1959	1953	1959	1953	1959	1953	1959	1953	1959
Belgium	255	236	4,443	5,163	56.7	45.8	8.78	9.10	2,212	2,151	39	47
Czechoslovakia	94	141	3,042	5,015	31.1	28.1	12.82	13.56	1,212	1,908	39	68
England	146	138	6,520	5,463	21.8	24.5	50.61	51.99	7,195	6,967	330	284
France	27	30	2,720	7,096	27.0	12.8	42.65	45.10	3,130	4,088	116	320
Germany (FR)	106	136	1,900	4,625	60.0	29.3	18.18	17.30	1,920	2,345	32	80
Germany (DR)	105	118	10,689	10,726	9.9	11.0	50.41	53.95	5,082	6,114	515	555
Hungary	138	167	1,770	4,722	77.7	35.3	9.59	9.95	1,321	1,659	17	47
Italy	42	73	3,153	6,014	13.4	12.1	47.53	49.05	2,008	3,579	150	295
Poland	85	110	3,009	4,546	28.3	24.2	26.26	29.26	2,233	3,214	79	133
Romania	47	50	2,730	-	17.4	-	16.85	18.26	800	918	46	-
The United States	146	138	-	-	5.3	-	159.79	17.70	5,874	7,300	1,104	1,379
USSR	88	157	6,555	14,489	13.5	10.8	189.93	210.50	16,788	33,048	1,245	3,050
West Africa ^{1/}	1965 - 1980	1965	1965	1980	1965	1980	1965	1980	1965	1980	1965	1980
(a) Industrial bricks	0.41 - 2.51	-	-	-	762	1,423	-	-	40	370	-	-
(b) Artistic bricks	3.06 - 3.77	536	-	1,760	5,708	2,142	97.96	147.73	300	557	53	260
(c) Burnt bricks	3.47 - 6.28	-	-	-	6,470	3,565	-	-	340	927	-	-

1/ Estimates from maximum figures given in paragraph (6) (production of bricks 1.11 million tons) for the period 1965 to 1980 with a production 120 - 270 - 1,110 thousand tons or 40-90-370 million units.

Note: In all cases the calculation of the number of bricks per dwelling excludes non-residential building activity.

15) In Table 11, it will be seen that the projects (pages 10-13) for the manufacture of bricks, depend upon the conditions governing possible development. The number of new dwellings in the other countries for the period 1963-1969 is about 1,800 to 10,000 per million inhabitants. In the sub-region the number of new dwellings is about 536 - 1,760 per million inhabitants. The number of bricks per dwelling in other countries of the world is anything from 5,000 to 70,000. In the sub-region in 1980, there will be approximately 3,565 bricks per dwelling. The increase in brick production in the sub-region in 1980 will be as follows, in percentage and weight:

	<u>1965</u>	<u>1967-68</u>
- Industrial bricks	925 %	412 %
- Handicraft burnt bricks	186 %	176 %
- Burnt bricks	272 %	228 %

This assumption squares with the possibilities of the sub-region.

(16) The analysis made is epitomized in Table 12.

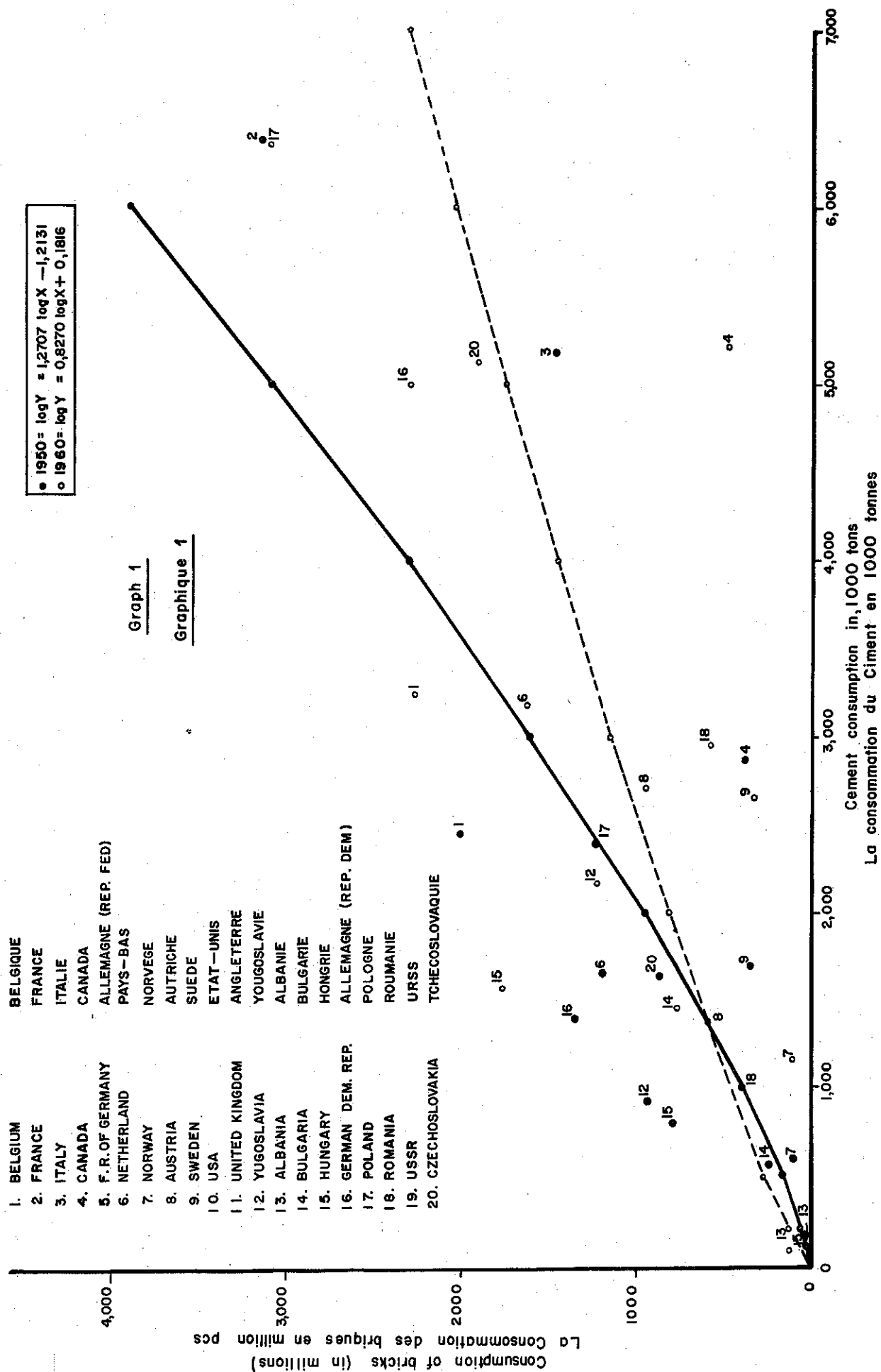
TABLE 12
Index of brick production projects for residential needs

			1965	1980
(1)	Production	million	97.96	147.73
(2)	gross capital formation	million US\$	1,231	5,408
(3)	Building investments	million US\$	492	2,434
(4)	Building investments less than 30 per cent for services and (amenities)	million US\$	3,444	1,704
(5)	Houses (45 per cent of 4)	million US\$	155	767
(i)	cheap 80 %	million US\$	124	614
(ii)	medium-range 15 %	million US\$	23	115
(iii)	good quality 5 %	million US\$	8	38
(6)	Non-residential buildings	million US\$	189	937
(i)	industrial buildings	million US\$	76	375
(ii)	educational "	million US\$	76	375
(iii)	other types of "	million US\$	37	187
(7)	Surface area: cheap at 50\$/m ²	millions m ²	2.48	12.28
	Surface area: middle range quality at 90\$/m ²	millions m ²	0.26	1.28
	Surface area: good quality at 120/m ²	millions m ²	0.07	0.32
	Industrial surface area at 50\$/m ²	millions m ²	1.52	7.50
	Educational surface area at 70\$/m ²	millions m ²	1.09	5.36
	Other types of surface area at 100\$/m ²	millions m ²	0.37	1.87
	Total		5.79	28.61
(8)	Cheap houses at 50 m ²	unit	49,600	245,600
	Medium-range houses 100m ²	unit	2,600	12,800
	Good quality houses 200 m ²	unit	350	1,600

TABLE 12 (cont'd)

Index of brick production projects for residential needs

		1965	1980
(9) Total surface area of walls		52,550	260,000
(i) Houses	millions m ²	6.76	33.39
(ii) Industrial buildings	millions m ²	2.43	12.00
(iii) Educational buildings	millions m ²	1.91	9.38
(iv) Other types of buildings	millions m ²	0.52	2.62
Total	millions m ²	11.62	57.39
(10) Total volume of walls	millions m ³		
(i) Houses	millions m ³	1.11	5.51
(ii) Industrial buildings	millions m ³	0.41	1.98
(iii) Educational buildings	millions m ³	0.32	1.55
(iv) Other types of buildings	millions m ³	0.09	0.43
Total	millions m ³	1.92	9.47
Unitary number of dwellings	un./million inhabitants	536	1,760
Burnt brick production	1000 T/year	1,020	2,780
Industrial brick production	1000 T/year	120	1,110
Handicraft brick production	1000 T/year	900	1,670
Burnt brick production	1000 m ³ /year	680	1,935
Industrial brick production	1000 m ³ /year	86	822
Handicraft brick production	1000 m ³ /year	594	1,113
Percentage of walls in burnt bricks	%	35.4	20.4
Percentage of walls in industrial bricks	%	4.5	8.7
Percentage of walls in handicraft bricks	%	30.9	11.7



(17) The previous estimates will have to be revised. In order to verify them, cement and brick consumption in different countries may be compared, because the need for these materials is dependent one upon the other. To assess the connexion between these two building materials, one can proceed logarithmically. Table 13 gives the consumption of cement and brick in a number of countries.

TABLE 13

Cement and brick consumption in a number of countries

	Cement (1,000 T)			Bricks (million of pcs)		
	1950	1959	1960	1950	1959	1960
Belgium	2,460		3,234	2,004		2,259
France	6,376		13,173	3,143		4,088
Italy	5,185	14,294		1,458	3,579	
Canada	2,874		5,195	375		470
West Germany	9,557		24,012	4,123		6,222
Holland	1,663		3,172	1,192		1,626
Norway	586	1,105		98	94	
Austria	1,310		2,707	568		940
Sweden	1,689		2,641	357		326
United States	38,032		54,084	6,333		6,952
England	112		12,672	5,921		7,279
Yugoslavia	921		2,169	977		1,234
Albania	15	79		14	125	
Bulgaria	547	1,432		237	758	
Hungary	787		1,571	796		1,776
East Germany	1,389		4,984	1,356		2,272
Poland	2,364		6,339	1,235		3,100
Rumania	978		2,955	371		572
USSR	10,164		45,270	10,204		35,100
Czechoslovakia	1,630		5,127	865		1,910

From these calculations we will arrive at two formulae, one for 1950 and the other for the year 1960:

I. 1950: $\log Y = 1.2707 \log X - 1.2131$

II. 1960: $\log Y_1 = 0.8270 \log X_1 + 0.1816$

These two formulae represent two curves which are indicated in Graph 1. From the formulae it will be seen that during the period 1950 to 1960 the requirements in bricks changed from a concave curve to a convex one. The question now arises which of the two curves approximates more closely to conditions obtaining in Africa. It may be assumed that modern methods of construction have been responsible for the meagre requirements of bricks, as compared with the more substantial requirements of cement. This phenomenon can also be observed in the African countries. Therefore formula II may be taken as representing West Africa.

(18) In Table 14 the two assumptions are based on formulae I and II, so far as West Africa is concerned. In this table the unit weight of bricks is put at 3.5 kg because the formulae are based on that weight, and up to now we have adopted the weight of 3.0 kg for West Africa, reckoning on thinner walls in Africa.

According to figures given in Table 14, it will be observed that assumption II seems more probable than assumption I. According to this method the requirements in bricks are 1,465 tons for the sub-region, having regard to the previous estimates, and assuming the requirements to be 1,100 tons a year from the new brickworks, plus 320 thousand tons a year from the existing brick works, making a total of 1,420 tons in the sub-region. This figure we shall regard as the minimum requirement.

TABLE 14
Evaluation of Brick Consumption in West Africa

Sub-region	Cement consumption- 1,000 T/year 1980	Cement consumption kg/per capita 1980	Population million 1980	Brick consumption- in 1,000 tons	1965	1967/8	Brick consumption							
							million bricks	Assumption I		Assumption II				
								1,000 T	% consumption per country 1/1,000 T.	1,000 T.	% consumption per country			
Dahomey	257	77.0	3.35	2.0	2.0	70	20.0	1.1	12	149.5	43	2.9	32	
Gambia	39	79.5	0.49	-	-	6	1.7	0.1	1	31.4	9	0.6	7	
Ghana	2,173	180.0	12.13	3.5	70.0	1,065	304.3	17.3	190	874.2	250	17.1	188	
Guinea	456	90.5	5.03	22.2	65.0	146	41.7	2.4	26	240.2	69	4.7	52	
Ivory Coast	1,890	353.0	5.38	3.0	21.0	820	234.3	13.3	146	778.6	222	15.1	166	
Liberia	190	153.0	1.24	10.4	10.4	48	13.7	0.8	9	116.5	33	2.3	25	
Mali	133	20.6	6.48	12.0	12.0	31	8.9	0.5	6	86.7	25	1.7	19	
Mauritania	33	37.0	0.89	-	-	5	1.4	0.1	1	27.4	8	0.5	6	
Niger	85	18.2	4.67	3.6	18.0	17	4.9	0.3	3	59.9	17	1.2	13	
Nigeria	5,262	57.8	91.00	25.0	30.0	3,277	936.2	53.3	586	1,816.0	519	35.4	389	
Senegal	1,047	228.0	4.63	14.0	14.0	421	120.2	6.9	76	477.7	137	9.4	103	
Sierra Leone	470	128.0	3.66	-	-	152	43.4	2.5	28	246.3	70	4.8	53	
Togo	156	65.8	2.37	18.0	18.0	38	10.9	0.6	7	98.9	28	1.9	21	
Upper Volta	202	31.5	6.41	6.3	9.6	52	14.9	0.8	9	122.5	35	2.4	26	
Sub-region	12,394	83.9	147.73	120.0	270.0	6,148	1,756.7	100.0%	1,100	5,125.8	1,465	100.0	1,100	

1/ Reduction for consumption of 1,100 tons of bricks.

(19) It should be noted that the evaluation made from the facts contained in paragraph 17 et seq., is given indiscriminately for the whole of brick production, but according to paragraph 16 and the preceding paragraphs, brick production is divided up into industrial production and handicraft production (1,100 tons industrial) and (1,670 tons handicraft) the total production being 2,780 tons of burnt bricks. Assumption II, with the figure of 1,465 thousand tons is a very poor result.

However, bearing in mind the fact that the official statistics do not give the handicraft production figures, particularly in the case of swish, such reserves are to be met with only very occasionally, for instance in Czechoslovakia where the ratio for the year 1961 was as follows:

Percentage of houses built in:

(a) swish	10.5 %
(b) wood	4.1 %
(c) stone	14.6 %
(d) burnt bricks and other types of brick	67.2 %

In the other countries mentioned in Table 13, the percentage of burnt brick and other brick dwellings is still smaller than in Czechoslovakia. The percentage of swish brick houses is higher in the other countries of the world, and it will be observed that this is true of countries with a very large GDP.

Bearing in mind the fact that statistics are available only for industrial production, we have restricted ourselves to these figures to provide an estimate of future industrial production in West Africa.

VI. The production of tiles and other products

(1) The production of tiles, hollow ceiling pots, setts, drains and other articles in West Africa in 1965 was 6,000 tons, and should increase to 42,000 tons a year in 1968. Tiles constitute practically 30 to 50 per cent of that figure, that is from 1,800 to 3,000 tons in 1965, let us say 2,000 tons, and from 13,000 to 21,000 tons in 1968, let us say 17,000. If we

take the dimension of a tile as 40/20 cm, weight 2.5 kg per tile, and the requirements per sq.metre of roofing as approximately 15 tiles, the estimated production in 1965 was 800,000 tiles for 53,300 sq.metres of roofing.

In 1968 the estimate is 17,000 tons, that is, 6.8 million tiles or 543,300 sq.metres of roofing.

In 1961 to 1964 imports under classification were 662.4(2) on the average 2,125 tons, tiles in this group representing approximately 80 per cent that is 1,700 tons, giving a total consumption in 1965 of 3,700 tons or 1,480,000 tiles for 98,700 sq.metres of roofing.

(2) The estimate of roofing requirements is as follows in accordance with Annex II:

total roofing	million m ³	<u>1965</u> 5.09
tile production	million m ³	0.099
total percentage of roofing in bricks	percentage	1.94
percentage of residential roofing in bricks	percentage	4.00

Tile production in the countries mentioned in Table 8 was as follows in percentages of bricks produced:

1950	9.7 %
1953	7.6 %
1955	7.95 %
1956	7.5 %
1957	<u>7.7 %</u>

7.95 % for the period 1950-1957, affecting houses only leaving out of account non-residential building activity.

(3) Tile productions in West Africa in 1980 can cover 2.5 to 4.2 per cent roofing that is to say, an area of 28.61 million sq.metres and 26.32 million sq.metres for roofing.

The requirements in tiles are 2.5 to 4.2 per cent of the needs in roofing, that is, 660 - 1,100 thousand sq.metres namely 9.9 - 16.5 million tiles or 24,750 - 41,250 tons a year, that is, 35,000 tons a year.

(4) The complete breakdown of the needs in bricks, tiles and other materials is as follows, for products manufactured in brick works:

	<u>1965</u>	<u>1980</u>
Requirements in bricks 1,000 tons	120	1,100
Requirements in tiles 1,000 tons	4	35
Requirements in other materials 1,000 tons	2	155
Total requirements:	126	1,290

The upshot of this procedure where projects are concerned is that the production of burnt bricks should rise to 1,300,000 tons in 1980 if the estimated future building programme is to be ensured.

VII. Raw materials and other materials for industrial production

(1) In order to manufacture bricks it is necessary to discuss questions of raw material, fuel, energy and employees. As regards raw materials, it may be observed that deposits can be found in all the countries concerned. A brief description of these deposits is given in Annex IV.

(2) Fuel: At present various materials are used as fuel. In Lomé for instance use is made of coconut husks, in Niger of local wood, groundnut husks and palm trees, and in the modern brick works of fuel oil.

In 1980 it ought to be possible to reckon on a 70 per cent production with fuel oil, and a 30 per cent production with other fuels. The fuel breakdown would then be as follows:

- calorific value of fuel oil	9,500 kcal/kg
- calorific value of other types of fuel	3,500 kcal/kg
- consumption for heating purposes	550,000 kcal/T

60 kg of fuel oil per ton or

157 kg of other types of oil per ton

- quantity heated with fuel oil	910,000 T
- quantity heated with other types of fuel	390,000 T
- requirements in fuel oil	52,000 T
- requirements in other fuels	61,000 T

(3) Energy. As far as energy is concerned, we must reckon upon at least the following requirements:

preparation-manufacture	18 kWh/T firing
drying	6 kWh/T firing
burning, miscellaneous	6 kWh/T firing
Total	<hr/> 30 kWh/T firing

This gives a total need in energy a year of 39 million kWh. This figure is valuable statistically, because for one thing the needs are met by diesel aggregates or other means of energy.

(4) If projects are to be drawn up for each country, certain prerequisites are necessary:

(a) It is not at present possible to plan a precise and detailed project, because all the clay deposits are not yet known. It is therefore only possible to give an idea of the capacity necessary for the countries concerned, without examining the possibilities of locating the brickworks;

(b) The level of salaries and investment costs change from one African country to another. In this report use has been made of an average for each country, without taking account of differences in salaries or investment costs in the various countries;

(c) The conditions for financing vary also with different countries. Consequently the various amounts for amortization, interest, and financial costs will also differ. In this report an average has been struck to meet these diverse conditions;

(d) Assumption II indicates that per country we have obtained the necessary capacity, but this estimate is subject to correction in the case of a few countries where account must be taken of the special conditions prevailing.

(e) In any case whenever a calculation has been made with fuel oil as the technological fuel, we must say that in actual fact

about 30 per cent of the calories will be produced by wood and 70 per cent by fuel oil. The price of fuel oil in the coastal countries is assumed to be US\$ 22 per ton, with the possibility of an increase up to US\$ 47 per ton for the inland countries.

(f) The price of electricity has been calculated as follows:

Dahomey	12.50	F.CFA/kWh	50.6\$/1,000 kWh
Gambia	12.-	"	48.6 "
Ghana	6.- (9.-)		24.3-36.5 "
Guinea	9.40	"	38.1
Ivory Coast	7.-	"	28.4 "
Liberia	7.50	"	30.4 "
Mali	24.0	"	97.2 "
Mauritania	27.-	"	109.4 "
Niger	22.36	"	90.6 "
Nigeria	12.-	"	48.6 "
Senegal	10.39	"	42.1 "
Sierra Leone	5.40	"	21.9 "
Togo	14.50	"	58.8 "
Upper Volta	18.83	"	76.3 "

(5) On the basis of the foregoing conditions, a capacity range for brickworks has been chosen as follows: 6-8-10-15-17-20-30-40 thousand tons a year as indicated in Table 15 - which analyses production costs.

In graphs 2, 3, 4, 5, 6, (Annex VI) will be found productivity, level of salaries, unit of consumption of electric energy, percentage of gross profits and the percentage of investments (buildings, equipment and other factors).

(6) On this basis Table 16 has been drawn up. It will be found in annex V, and the results in Table 17. Investment costs are analyzed in annex IV.

(7) The development of these brick industries will require the following establishment:

Manager	46
Office	175
Maintenance	148
Skilled workers	447
Unskilled workers	2,481
Total	3,297

(8) The proposed development index for an average brickworks is as follows:

- productivity per worker	359 T/per year
- productivity per employee	335 T/per year
- unit of electricity consumption	29,2 kWh/T firing
- unit of total electricity consumption.	32.07 millions kWh/ per year
- unit price of product	15,8 \$/T firing
- average capacity of brickworks	24,000 T/per year
- average investments of brickworks	770 millions \$/ per brickworks
- gross yield of brickworks	380 millions\$/per brickworks
- value added of brickworks	258 millions \$/per brickworks
- average number of employees	72/per brickworks
- average consumption of fuel oil	1,430 T/per year

TABLE 15

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Page 39Analysis of Production Costs

	1,000 t/annum		6	8		10	15		17	20		30	40
	US\$/t	1,000 \$		24	23		25	21		26	30		
Capacity Investments			144	184		210	375		440	600	1,050	1,400	
Employees: Manager			1	1		1	1		1	10	1	1	1
Office			2	2		3	3		3	4	4	5	5
Maintenance			2	2		2	3		3	3	4	4	4
Skilled workers			6	6		7	8		9	10	11	12	12
Unskilled workers			16	22		28	39		43	43	66	87	87
Unitary salaries: Manager	US\$/year		9,000	10,500		11,200	13,000		13,500	14,000	15,000	15,500	
Office			1,400	1,400		1,450	1,450		1,500	1,500	1,600	1,600	
Maintenance			700	700		730	730		750	750	780	780	
Skilled workers			640	650		650	660		660	670	680	690	
Unskilled workers			480	480		485	490		500	510	515	520	
Average salary:	US\$/employee month		915	883		854	813		807	808	767	735	
Total salaries	US\$/t		24,720	29,160		35,140	43,930		47,630	49,320	65,990	80,140	
			4.12	3.65		3.51	2.93		2.80	2.47	2.20	2.00	
Productivity of workers:	t/annum		270	280		290	320		330	380	390	405	
Investments: Buildings	%		43	44		44	40		40	35	37	38	
Equipment	%		44	44		44	49		49	54	53	52	
Miscellaneous	%		13	12		12	11		11	11	10	10	
Buildings	\$		62	81		93	150		176	210	390	530	
Equipment			64	81		92	184		216	324	560	730	
Miscellaneous equipment	\$		18	22		25	41		48	66	100	140	
Equipment	\$		64	81		92	184		216	324	560	730	
Non-equipment	\$		80	103		118	191		224	276	490	670	
Amortization: Equipment	\$		10,300	12,500		15,590	25,000		29,400	35,000	65,000	88,000	
Non-equipment	\$		4,000	5,060		5,900	9,550		11,200	13,800	24,500	44,000	
Total	\$		14,300	18,560		21,490	34,550		40,600	48,800	89,500	132,000	
Maintenance: Equipment	\$		3,200	4,050		4,650	7,500		8,800	10,500	19,500	26,500	
Buildings	\$		1,600	2,060		2,360	3,820		4,480	5,520	9,800	13,400	
Total	\$		4,800	6,110		7,010	11,280		13,280	16,020	29,300	39,900	

TABLE 15 (Cont'd)

Analysis of Production Costs

Interest	\$	5,040	6,440	7,350	13,125	15,400	21,000	36,750	49,000
Insurance, miscellaneous	\$	1,008	1,288	1,470	2,625	3,080	4,200	7,350	9,800
Fuel at US \$22/t	\$	7,920	10,560	13,200	19,800	22,440	26,400	39,600	52,800
	T	360	480	600	900	1,200	1,200	1,800	2,400
Electricity	kWh/T	22	23	24	25	26	27	30	32
	1000 kWh/year	132	184	240	375	442	540	900	1,280
Gross profit	%	11.0	11.7	12.2	13.4	13.8	14.4	16	17
	\$	15,840	21,530	25,620	50,250	60,720	86,400	168,000	238,000
Salaries	\$	24,720	29,160	35,140	43,930	47,630	49,320	65,990	80,140
Charges and holidays	\$	4,940	5,830	7,030	8,790	9,530	9,860	13,200	16,030
Amortization	\$	14,300	18,560	21,400	34,550	40,600	48,800	89,500	132,000
Maintenance	\$	4,800	6,140	7,010	11,320	13,280	16,020	29,300	39,900
Interest	\$	5,040	6,440	7,350	13,125	15,400	21,000	36,750	49,000
Insurance, miscellaneous	\$	1,008	1,288	1,470	2,625	3,080	4,200	7,350	9,800
Fuel	\$	7,920	10,560	13,200	19,800	22,440	26,400	39,600	52,800
Profits	\$	15,840	21,530	25,620	50,250	60,720	86,400	168,000	238,000
Total	\$	78,570	99,480	118,220	184,390	212,680	262,000	449,690	617,670

TABLE 17

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Proposed brickworks in West Africa per country

	Existing capacity in 1968 in 1,000 t	Proposed new capacity in (1,000t)	Total capa- city in 1980 1,000 t	No. & capa- city of new brickworks in 1,000 t	No. of employ- ees	Invest- ments in US\$1,000	Gross turn- over US\$1,000	Value added in US\$ 1,000
Dahomey	2	32	34	1 x 15 1 x 17	113	815	438.4	296.1
Gambia	-	8		1 x 8	33	184	108.4	75.1
Ghana	74	160	234	2 x 40 2 x 30 1 x 20	451	5,500	2,540.4	1,800.1
Guinea	82	-	82	-	-	-	-	-
Ivory Coast	25	190	215	3 x 40 2 x 30 1 x 10	540	6,510	3,055.6	2,159.0
Liberia	10	20	30	1 x 20	61	600	278.4	194.4
Mali	12	14	26	1 x 6 1 x 8	55	328	225.7	135.0
Mauritania	-	8	8	1 x 8	33	184	119.6	75.1
Niger	26	17	43	1 x 17	59	440	278.2	158.4
Nigeria	36	440	476	5 x 40 4 x 30 4 x 20 4 x 10	1,297	14,440	7,189.6	4,811.9
Senegal	16	115	131	1 x 40 2 x 30 1 x 15	335	3,875	1,857.5	1,277.2

TABLE 17 (continued)

Proposed brickworks in West Africa per country

	Existing capacity in 1968 in 1,000 t	Proposed new capacity in (1,000t)	Total capa- city in 1980 1,000 t	No. & capa- city of new brick works in 1,000 t	No. of employ- ees	Invest- ments in US\$1,000	Gross turn- over US\$1,000	Value added in US\$ 1,000
Sierra Leone	—	60	60	3 x 20	183	1,800	821.6	583.2
Togo	18	10	28	1 x 10	41	210	132.3	89.1
Upper Volta	11	25	36	1 x 10 1 x 15 1 x 6	96	585	364.3	226.8
Sub-region	312	1,099	1,411	3 x 8 7 x 10 3 x 15 2 x 17 9 x 20 10 x 30 11 x 40	3,297	35,471	17,410.0	11,883.4

Total 46 new brickworks

VIII. Recommendations

The following are a few recommendations for the implementation of the proposed development programme:

1. Geological exploration must be organized in the sub-region to ascertain deposits of raw materials not as yet discovered, this work to be carried out on the basis of sub-regional co-operation. Three to four such exploratory missions should be organized for groups of countries, and a maximum of two to three laboratories established to evaluate any samples found.
2. Typical projects should be drawn up for future brickworks based on the recommendations of this report. This will ensure economy in the cost of projects (about 4 - 8 per cent of investments) while at the same time guaranteeing that entrepreneurs devote their time to high quality projects.
3. In conjunction with (2), it must be stated that it would be a very great advantage to have a building centre set up, as this might ensure the most economical building programme for the whole of the sub-region.
4. In any case, an educational centre must be set up for the new cadres, and for the training of specialists.
5. Some attention must also be paid to handicraft production, and measures taken to improve it. There are also very interesting plans for the mobile equipment of brickworks as in Ghana. When these come into production, it will be necessary to study their technical and economic results in order to implement them in other African countries.

ANNEX I

Statistics of building activity in the Ivory Coast
and the Upper Volta

Building activity in the Ivory Coast was as follows for the years indicated below:

		<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>
one storey	nb.	223	288	693	1,143	766	562
buildings	m2	28,425	44,220	124,714	176,166	134,127	105,213
multi-storey	nb.	33	61	118	308	216	227
buildings	m2	5,115	25,028	76,610	149,298	151,040	113,191
industrial	nb.	3	3	13	19	15	18
buildings	m2	1,272	2,117	8,994	20,259	14,208	30,590
commercial	nb.	25	19	54	45	30	12
buildings	m2	5,920	5,018	7,911	9,691	5,544	8,675
warehouses and	nb.	13	17	14	23	19	25
hangars	m2	5,700	7,383	5,104	10,900	7,648	10,662
miscellaneous	nb.	22	9	19	36	34	54
	m2	4,307	2,978	15,918	10,892	27,751	8,825
		<hr/>					
Total		nb. 319	397	911	1,574	1,080	898
		m2 50,739	86,744	239,251	377,206	340,318	276,556
		\$		16,000,000	19,460,000	21,396,000	

From 1955 to 1958 the following brickworks were in production:

Moosou 2,000 tons per annum; Dabou 1,600 tons per annum; Akoure 800 tons per annum; Bamoro 1,200 tons per annum; Moncourt 600 tons per annum; Luquet 800 tons per annum; maximum total capacity 7,000 tons per annum.

	<u>1958</u>	<u>1959</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1963</u>
Area of dwellings in sq. metres	33,540	69,248	201,324	325,464	285,167	218,404
Area of other buildings in sq. metres	17,199	17,496	37,927	51,742	55,151	58,152
In bricks and parpens:						
Dwellings	33,540	69,248	201,324	325,464	285,167	218,404
10 per cent of others	1,720	1,750	3,800	5,170	5,515	5,815
	35,260	70,998	205,124	330,624	290,682	224,219

It may be asserted that maximum production capacity was not attained except in 1961. If we take 75 per cent of the production capacity as having been attained we shall have 5,250 thousand tons of bricks a year, the weight of a unit of bricks per cubic metre being 1.5 tons, which makes 3,500 cubic metres a year. If we assume that the volume of the walls for dwellings is 0.4 cubic metres/sq.metres and 0.15 cubic metres/sq.metres for other buildings, the total requirements for walls in cubic metres will be:

325,464 sq.metres x 0.4	=	130,185 cubic metres
5,170 sq.metres x 0.15	=	775 cubic metres
Total		130,960 cubic metres of wall

Since the volume of bricks produced industrially is 3,500 cubic metres per year (for a 75 per cent usage of the total production capacity), we should thus have a 2.67 per cent usage of industrial bricks out of the total volume of walls used.

In the Upper Volta, building activity was as follows:

	Public market area of walls in sq.metres	Private market area of walls in sq.metres	Total area of walls in sq.metres	cubic capacity of walls 48 cm thick
1958	46,500	2,530	49,030	8,825
1959	4,900	8,130	13,030	2,345
1960	17,500	5,440	22,940	4,129
1961	24,200	5,670	29,870	5,376
1962	44,500	12,660	57,160	10,288

In the Upper Volta there are two brickworks with a capacity of 3,600 tons a year, which gives 4,200 cubic metres a year. In 1959/1960 production was 5,960 tons a year, that is 94.5 per cent of the total capacity, and the volume of bricks produced was 4,000 cubic metres a year.

The percentages are as follows:

- 1958 - 45.3 per cent of the volume of walls
- 1960 - 97.5 per cent of the volume of walls
- 1962 - 41.0 per cent of the volume of walls

At Ouagadougou, according to an estimate made by the Bureau Central d'Etudes d'outre-mer with headquarters in Paris, 2 - 3 million swish bricks are produced for the needs of Ouagadougou. These bricks are of the following dimensions: 35 x 15 x 8 centimetres, volume 4.25 cubic centimetres, production being 8,500 - 12,750 cubic metres a year. This gives a production percentage of burnt bricks of 25 to 33 per cent of the over-all production, for a building centre where the country's two brickworks are situated.

Since there are no statistics for handicraft brick production we can arrive at a deduction only on the basis of the following figures:

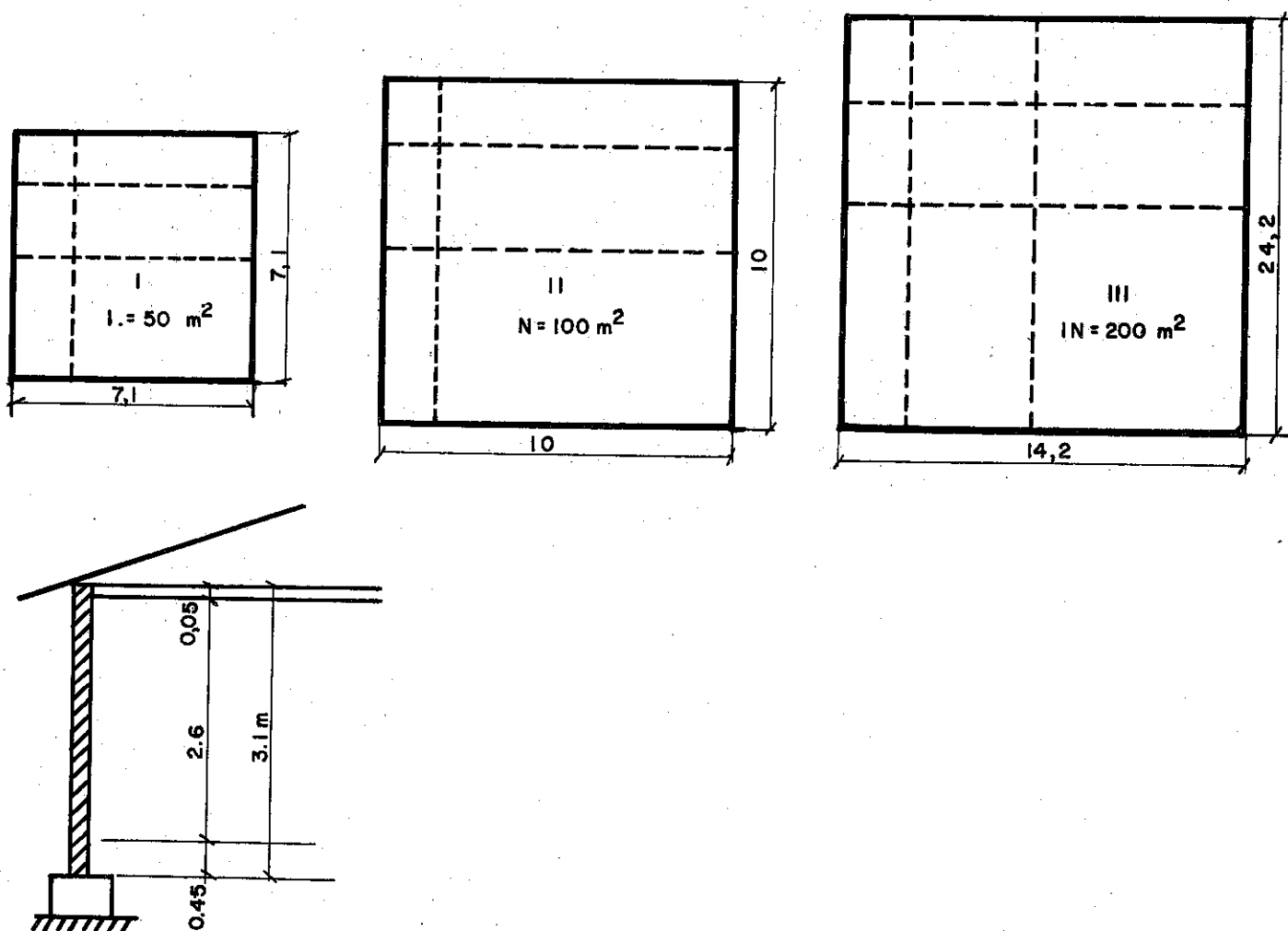
- The Upper Volta has a population of approximately 4.3 million inhabitants
- Ouagadougou 50,000 inhabitants
- Ouagadougou has approximately 45,000 swish dwellings
- to put up a house you need 5-6,000 swish bricks
- 80 per cent of the houses are in swish, that is 3.44 million inhabitants
- the average number of persons per dwelling is 3.5 inhabitants
- number of swish houses in the Upper Volta: 1 million
- ordinary repairs 50 bricks per house per year
- increase in population 96,000 inhabitants per year
- number of new houses 27,000 per year
- number of bricks for new houses 160 million bricks
- total requirements in bricks 210 million bricks
- 890,000 tons/per year.

According to these figures, the over-all percentage of burnt brick production is 0.5 per cent. In any case it cannot be in excess of 1 - 2 per cent.

ESTIMATION DU DEVELOPPEMENT DE L'ACTIVITE EN CONSTRUCTION EN
AFRIQUE DE L'OUEST

ESTIMATED GROWTH OF CONSTRUCTION WORK IN WEST AFRICA

La ventilation du be besoin de murs et cloisons est la suivante:
The breakdown of wall and partition requirements is as follows:



(<u>I</u>	<u>N</u>	<u>IN</u>
(1) circumference walls	28.4 m	40.0 m	56.8 m
(2) partitions	21.3 m	30.0 m	56.8 m
(3) the area of circumference walls	88.0 m2	124 m2	176.1 m2
the area of partitions	63.9 m2	90.0 m2	170.4 m2
the area of circumference walls without windows or doors (minus 22 per cent)	68.6 m2	96.7 m2	137.4 m2
the area of partitions without doors (minus 10-14-18 per cent)	57.5 m2	77.4 m2	139.7 m2
(4) the volume of circumference walls (22 cm)	15.1 m3	21.3 m3	30.2 m3
the volume of partitions	5.8 m3	7.7 m3	14.0 m3
(5) the total area of walls in 1965, million sq.meters	3.40	0.25	0.048
the total area of partitions	2.85	0.20	0.049
the total area of walls in 1980	16.85	1.24	0.220
the total area of partitions "	14.12	0.99	0.224
the total area of walls in 1965, million sq.meters.		3.70	
the total area of partitions in 1965		3.10	
the total area of walls in 1980		18.31	
the total area of partitions in 1980		15.34	
(6) The volume of walls and par- titions in cubic metres	20.9	29.0	44.2
the total volume in 1965 in million of cubic metres	1.036	0.075	0.015
the total volume in 1980 in million of cubic metres	5,133	0.371	0.071
the total volume in 1965 in million of cubic metres		1.128	
the total volume in 1980 in million of cubic metres		5.575	

	Unit	1965	1980
(7) the number of houses	per unit	52,550	260,000
(8) total area of houses	million m2	2,810	13,880
the unit area of houses	m2/hab.		53.3
the unit area of walls per sq.metre of floor space	m2/m2		1.32
the unit area of partitions per sq.metre of floor space	m2/m2		1.10
the unit area of walls and partitions per sq.metre of floor space	m2/m2		2.42
(9) the unit volume of walls per sq.metre of floor space	m3/m2		0.29
the unit volume of partitions per sq.metre of floor space	m3/m2		0.11
the unit volume of walls and partitions per sq.metre of floor space.	m3/m2		0.40
(10) The average thickness of the walls and partitions	cm		16.57

The element of construction	Total area of houses in million sq.metres		Total quantity of constructional elements in million of sq.metres		
	Type of construction	1965	1980	1965	1980
Walls and partitions	cheap house	2.48	12.28	6.20	30.70
	middle-range house	0.26	1.28	0.46	2.24
	good quality house	0.07	0.32	0.10	0.45
	industrial house	1.52	7.50	2.43	12.00
	for educational purposes	1.09	5.36	1.91	9.38
	other types of houses	0.37	1.87	0.52	2.62
	Total	5.79	28.61	11.62	57.39
Floors		5.79	28.61	4.92	24.32
Roof		5.79	28.61	5.09	26.32
The volume of walls and partitions with a general thickness of 16.5 cm for all types of houses	million cubic meters			1.92	9.47

ANNEX III

Estimate of brick and tile production in thousands of tons a year
(industrial production)

	Bricks		Tiles and other materials		Total	
	1965	1966/68	1965	1966/68	1965	1966/68
Ivory Coast	3.0	21.0	--	4.0	3.0	25.0
Dahomey	2.0	2.0	-	-	2.0	2.0
Gambia	-	-	-	-	-	-
Ghana	3.5	70.0	0.5	4.0	4.0	74.0
Guinea	22.2	65.0	-	17.0	22.2	82.0
Upper Volta	6.3	9.6	0.5	0.8	6.8	10.4
Liberia	10.4	10.4	-	-	10.4	10.4
Mali	12.0	12.0	-	-	12.0	12.0
Mauritania	-	-	-	-	-	-
Niger	3.6	18.0	-	8.0	3.6	26.0
Nigeria	25.0	30.0	3.0	6.0	28.0	36.0
Senegal	14.0	14.0	2.0	2.0	16.0	16.0
Sierra Leone	-	-	-	-	-	-
Togo (Lomé)	18.0	18.0	-	-	18.0	18.0
Total	120.0	270.0	6.0	41.8	126.0	311.8

ANNEX IV

A brief description of the brickworks and clay deposits in West Africa

GHANA

Malam Brickworks

This brickworks which is known as "Ghana State Brick and Tile Corporation" is situated 12 kms from Accra and was completed in 1953. The manufacturing programme for this brickworks is as follows:

	Dimensions	Cost in cedis per 1,000 bricks	Weight per brick kgs.
Hollow bricks	6" x 9" x 12"	140	12.7
	6" x 9" x 9"	120	10.9
	6" x 9" x 6"	90	5.9
	6" x 9" x 3"	70	2.7
	4" x 9" x 12"	120	9.1
	4" x 9" x 9"	90	5.9
	4" x 9" x 6"	70	4.1
	3" x 9" x 12"	90	5.4
	3" x 9" x 9"	70	4.1
	3" x 9" x 6"	60	2.7
Facing bricks	3" x 4" x 8 $\frac{1}{2}$ " solid	60	3.2
	3" x 4" x 8 $\frac{1}{2}$ " hollow	60	2.3
Marseilles roofing tiles	17 $\frac{1}{2}$ " x 11"	90	3.6
	17 $\frac{1}{2}$ " x 5 $\frac{1}{2}$ "	70	1.8
Roman roofing tiles			
half-round tiles :			
Underside bricks (under)		80	
Upperside bricks (cover)		80	
(eaves)		80	
the roofage (ridge)		240	

	Dimensions	Cost in cedis per 1,000 bricks	Weight per brick kgs.
Lintel tiles	9" x 12"	90	2.3
	9" x 9"	70	2.3
Ridge tiles (16")		240	4.5
Cable-covers		90	5.4
Drain pipes 1/1		90	3.6
1/2		60	1.8

Note: Hollow bricks: 6" x 9" x 12", 4" x 9" x 12", 3" x 9" x 12" are the basic sizes, any other sizes being fractional. The factory capacity (the oven capacity) is solid bricks 9,500 per day, hollow bricks - basic sizes - 1,600 a day, tiles 3,000 a day, hollow bricks - fractional sizes - 19,000 bricks a day.

The production of bricks from this brickworks in the coming years will be as follows:

	1963	1964	1965
6" Hollow bricks	269,986	273,942	165,847
4" Hollow bricks	60,110	122,642	74,728
3" Hollow bricks	25,882	34,294	20,016
Ornamental bricks (solid)	43,865	188,228	341,464
Tiles	33,529	29,738	17,876
Total revenue in pounds sterling	27,970	28,941	29,287

As regards the brick industry in Ghana, the Government intends to use mobile brickworks. The Government has bought 15 of these, 11 of which have already been delivered, and are expected to come into production this year.

Hollow bricks: 6" x 9" x 12", 4" x 9" x 12", 3" x 9" x 12" are the basic sizes, any other sizes being fractional. The factory capacity (the oven capacity) is solid bricks 9,500 per day, hollow bricks - basic sizes - 1,600 a day, tiles 3,000 a day, hollow bricks - fractional sizes - 19,000 bricks a day.

The production of bricks from this brickworks in the coming years will be as follows:

	1963	1964	1965
6" Hollow brick	269,986	273,942	165,847
4" Hollow brick	60,110	122,642	74,728

Ghana State and Tile Corporation also manufactures parpens. The prices and dimensions of the conglomerates are as follows:

	<u>Dimensions</u>	<u>Free price</u>	<u>when delivered</u> ^{1/}
Compact cement blocks	6" x 9" x 18"	20 pence	22 pence
	4" x 9" x 18"	18 pence	20 pence
Hollow cement blocks	9" x 9" x 18"	20 pence	22 pence
	6" x 9" x 18"	18 pence	20 pence
	4" x 9" x 18"	16 pence	18 pence

THE REPUBLIC OF GUINEA

Kobaya

The brickworks at Kobaya situated 20 km from Conakry, came into production in 1964. The basic equipment is: 6 presses 4 of which are tile presses with a production capacity of a thousand pieces an hour whereas the brick presses have a capacity of 4,000 units each an hour. There are two production chains which manufacture either bricks or tiles. The capacity of the 60 chamber driers is 2,000 tiles or 1,800 bricks. The circular oven of 110 metres can hold 150,000 bricks or 200,000 tiles, and is heated by gas oil.

The production programme is as follows:

"Marseilles" type tiles, dimensions	2 x 20 x 40 cm.
Solid bricks	6.5 x 12 x 25 cm.
	13 x 12 x 25 cm.
Hollow bricks	14 x 25 x 25 cm.
Hollow ceiling pots	

The annual production is 16 million units - 9 million bricks and 7,000,000 tiles, with an allowance of 5 per cent for breakages. The cost of solid bricks is 12 frs. gross a piece. The brickworks employs 200 workers and technicians, 10 being foreigners, 25 women and 13 Guineans trained abroad, holding managerial posts.

The Government hopes to build - three handicraft brickworks at Kankan, Labé and N'Zérékoré, each of them having a capacity of a third of the one at Kobaya. The investments proposed for each brickworks are frs. Guinea 200,000.

^{1/} This price includes the cost of transport within a radius of 16 miles.

THE IVORY COAST

Brickworks at Dabou

At Dabou, there is a brickworks belonging to the SACIA "Société Agricole Commerciale et Industrielle de l'Agreby" with a capacity of 2,000 tons per year. The bricks are not of good quality. The selling price of a solid brick measuring 6 x 11 x 22 cm. and weighing 2.3 kg. is 28 frs. CFA; a hollow brick measuring 15 x 20 x 40 cm. is 30.60 frs. CFA.

The brickworks at Bouaké is no longer in production.

The brickworks at Abidjan

The Société de briquetterie de Côte-d'Ivoire, SOBRICI, was set up this year at Abidjan as a limited liability company. The proposed production is 30,000 tons per year. This brickworks has been the subject of a study conducted by the Development and Resources Corporation, New York in conjunction with the SODEMI company, and the results of the study have been set out in a report dated September 1964. This project in so far as its balance of payments position is concerned rests on the production and sale of 25,000 tons a year of all the various products, in accordance with the following breakdown:

Hollow bricks	7 x 20 x 40 cm.	3 holes)	
	6 x 11 x 22 cm.	10 holes)	<u>F.CFA</u>
	10 x 20 x 40 cm.	4 holes)	16,000 t. at 4,400 f/t =
	(12-14-16-20) x 25 x 40)		70,400,000
	15 x 20 x 40 cm.	6 holes)	
Ornamental bricks				3,000 t. at 6,522 f/t = 19,566,000
Ordinary bricks	6 x 11 x 22 cm.			2,000 t. at 4,783 f/t = 9,566,000
Setts, tiles, drains				4,000 t. at 15,000 f/t = 60,000,000
Total:				<hr/> 25,000 tons 159,532,000

The weakness of this balance of payments position is the assumption that 4,000 tons per year of setts, tiles and drains can be valorized at the price of 15,000 frs. CFA per ton, that is to say, 16 per cent of the weight and 37.6 per cent of the value of the annual production.

At Abidjan the prices of the parpens compared with Dabou bricks are on the average calculated at the following rates, for pieces of 15 x 20 x 40 cm.

- SABM parpens - value on delivery:	31 F.)	total 36 F.
transport and breakages	5 F.)	
- Hollow bricks from Dabou - value on delivery	30.6)	total 39.60 F.
transport and breakages	9 F.)	

The prices per piece measuring 10 x 20 x 40 cm. and 7 x 20 x 40 cm. are as follows:

	<u>15x20x40</u>	<u>10x20x40</u>	<u>7x20x40</u>
SABM parpens	36	30.25	24.50
Hollow bricks from Dabou	39.60	28.60	23.10

The selling price of a unit of 15x20x40 cm. incorporated in the building is as follows:

	<u>Cost price</u> on the building site	<u>Selling price</u>
Parpens made by the entrepreneur	26	36.00
Parpens bought from SABM	36	49.86
Dabou bricks	39.60	54.85

If we calculate only the price of the bricks and mortar, and do not take into account manual labour for putting them in place, that is to say, masons and their assistants, the comparative costs are as follows, as between the various brick walls or parpens for a square metre of wall:

Units of 15x20x40:

Bricks	12.4 pcs. at 39.60 = 491 F.	Parpens	11.3 pcs @ 25 = 4 406 F.
Mortar	19 litres @ 4.30 = 82 F.	Mortar	30 litres @ 4.30 = 129 F.
Total	= 573 F.	Total	= 535 F.

Units of 10x20x40:

Bricks	12.4 pos @ 28.60 = 355 F.	Parpens	11.3 pos @ 30.25 = 342 F.
Mortar	23 litres @ 4.30 = 99 F.	Mortar	20 litres @ 4.30 = 86 F.
Total = 411 F.		Total = 428 F.	

Units of 7x20x40:

Bricks	12.4 pos @ 23.10 = 287 F.	Parpens	11.3 pos @ 24.50 = 276 F.
Mortar	9 litres @ 4.30 = 39 F.	Mortar	14 litres @ 4.30 = 60 F.
Total = 326 F.		Total = 336 F.	

If we take the same calculations for parpens made on the building sites, the prices will be as follows:

Units 15 cm. = 422 F.; 10 cm. = 333 F.; 7 cm. 269 F.

which will mean that the price for building 7 to 15 cm. walls per sq. metre will be:

Thickness	Dabou bricks	Parpens bought from SABM	Parpens made by the entrepreneur
7 cm.	326 F.	336 F.	269 F.
10 cm.	411 F.	428 F.	333 F.
15 cm.	573 F.	535 F.	422 F.

LIBERIA

In Liberia there are two brickworks, one at "Bushroad Island" in Monrovia, and the other at Firestone. These two brickworks employ a total of 48 workers, 4 of whom are foreigners. The production includes solid and hollow bricks of the following dimensions: 2" x 4.5" x 9.5" upto 6" x 4" x 11.5". The price per unit is 4.10 cents.

The production of the brickworks at Monrovia is 5,000 to 6,000 bricks per day, the annual production being 1.8 to 2 million bricks worth US \$90,000.

The production of the brickworks at Firestone is 600,000 bricks per day to the value of US \$30,000.

In Liberia solid and hollow parpens measuring 4" x 6" x 8" are produced. The total capacity of this production is estimated at 10 million per year, to the value of US \$1 million.

Parpens

<u>Dimensions</u>	<u>Unit price</u>	<u>Weight in pounds</u>
8"x16"x8"	18 ¢	39
8"x16"x8"	16 ¢	31-36
4"x16"x8"	14 ¢	23-26

THE REPUBLIC OF MALI

Brickworks at Magambougou

The brickworks at Magambougou is situated 12 km from Bamako and has been in existence for a long time. In 1960 it had two kilns with a capacity of 12,000 cu.m of bricks a year. In 1962 new kilns were installed and the whole outfit modernized. The capacity of this brickworks is 10,000 to 12,000 tons of burnt bricks a year. The production programme is as follows:

- Hollow bricks of all dimensions
- Solid bricks and tiles in baked earth
- Hollow ceiling pots for floors and terraces
- Piping and drains
- "Roman" tiles or flat tiles

The Markala brickworks

This factory went out of production in 1952 and its equipment was installed at Tonkoto. The daily capacity of the factory was:

- 6,000 solid bricks
- 7,000 hollow bricks

The supplies of clay came from the village of Sarakala, situated 2 km. from the factory; the clay was fairly greasy and had to be mixed with local sand.

The Brickworks at Ségou

The brickworks at Dialabougou situated 12 km from Ségou, was founded by the French Catholic Mission in 1895. Up to 1956, the date when the factory came to a standstill, this brickworks supplied the needs of the area in red earth products. The solid bricks were of good quality and there is a plan now under consideration for bringing this factory back into production.

The Brickworks at Koutiala

This factory was abandoned in 1952. It was situated 125 km. from Ségou. The price of bricks and hollow ceiling pots in 1962 was as follows:

Hollow bricks	9 holes	11x11x22 cm.	15 Mali Frs.
Hollow bricks	3 "	8x15x30 cm.	20 " "
Hollow bricks	9 "	16x16x30 cm.	25 " "
Hollow bricks	12 "	13x20x40 cm.	35 " "
Hollow bricks	8 "	11x11x22 cm.	25 " "
Solid bricks		5.5x11x22 cm.	30 " "
Hollow ceiling pots		12x24x28 cm.	35 " "

In 1962 the prices of cement blocks were as follows:

Cement blocks	20x20x40 cm.	55 FM
Cement blocks	15x20x40 cm.	45 FM
Cement blocks	10x20x40 cm.	40 FM.

NIGER

There were three brickworks in the Niger, one at Niamey, another at Yantala and the third at Agadés. At present the new brickworks at Niamey has almost been completed and ready to come into production whereas the other two have gone out of production. The brickworks at Yantala had a production of 2,600 tons a year and the one at Agadés approximately 1,000 tons a year.

Niamey

The proposed capacity for the new brickworks is 18,000 tons a year, the maximum capacity being 70 tons a day for 300 days, a total of 21,000 tons a year. It is estimated that this factory will be able to supply a radius of 500 kms. approximately, and the transport costs will be 15 frs. CFA per kilometer.

Investments are as follows:

- Equipment	20,000,000 F.CFA
- Construction	50,000,000 F.CFA
- Terracing	2,000,000 F.CFA
- Rolling stock, miscellaneous	12,500,000 F.CFA
Total	84,500,000 F.CFA

The production programme is as follows:

- Hollow bricks	20x20x33	10 kgs (unit weight, approx.)
- Hollow bricks	15x20x33	7.5
- Hollow bricks	10x20x33	5
- Hollow bricks	7.5x20x33	4
- Hollow bricks	5x20x33	3
- Solid bricks and repressed or facing bricks	5.5x11x22	
- Round Tiles	floor, girders and hollow ceiling pots	
	floor with 160 millimeter storeys	
	floor with a 100 millimeter ceiling	
	solid bricks 5.5x11x22 cm.	

The price per ton is estimated at 4,500 F.CFA. The requirements in bricks for Niamey are put at approximately 18,000 tons a year.

If we reckon on the sale of 75 per cent of the total annual production, the selling price for an annual production of 14,250 tons should fetch 5,600 F.CFA, and the unit prices should be as follows:

15x20x33 cm.	7.5 kg	43 F.CFA
10x20x33 cm.	5 kg.	28.5 "
7.5x20x33 cm.	4 kg.	22.5 "
5x20x33 cm.	3 kg.	17 "
Ornamental bricks	2 kg.	11.5 "
Hollow ceiling pots		
17x17x30 cm.	5 kg.	28.5 "
Ridgings, length 33 cm.	3.2 kg.	18 "
Ground setts		
10x10x3	0.25	4 to 5 "

There is a proposal to construct driers and kilns in several towns in the Niger, the other types of equipment being mobile and made to operate according to possibilities offered by each market namely:

- Maradi	40 %	3,200 to 4,000 tons/year
- Zinder	30 %	2,400 to 3,000 "
- Tanout	15 %	1,200 to 1,500 "
- Agadès	10 %	800 to 1,000 "
- N'Gnimi	5 %	400 to 500 "

Total 8,000 to 10,000 tons/year

This proposal also comprises a limited market for moulded and dried bricks, but not for burnt bricks, since baking can be carried out by the buyers themselves in small kilns of their own making. The finished products will obviously be of inferior quality, but the cost of the bricks on the other hand will be lower, being approximately 40 per cent less.

The prices of parpens in the Niger are as follows:

Hollow conglomerates	10x20x40 cm.	@ 120 F.CFA	weight 11 kg
Solid cement blocks	15x20x40 cm.	@ 135 "	weight 15 kg
	20x20x40 cm.	@ 165 "	weight 25 kg
	7x20x40 cm.	@ 115 "	weight 11 kg
	10x20x40 cm.	@ 125 "	weight 16 kg
	15x20x40 cm.	@ 140 "	weight 25 kg
	20x20x40 cm.	@ 180 "	weight 32 kg

NIGERIA

Nigeria has a very developed brick industry. Two modern brickworks factories are situated at Lagos, namely "Construction Industries Co. Ltd." and "Clay Industries Ltd." Ikeja.

The production programme is as follows:

	<u>Dimensions</u>	<u>Price per brick</u> sh/p	<u>Price of transport</u> 32 km-sh/p
Solid bricks	2"x5"x10"	-/7	-/1
Hollow bricks	3"x9"x12"	-/7	-/1
	4"x9"x12"	-/8	-/1
	6"x9"x12"	-/10	-/1½
	8"x9"x12"	1/3	-/2
	9"x9"x12"	1/3	-/2
"Velox" hollow ceiling pots	6½" - length 9"	1/10	-/2
	8" - length 9"	2/4	-/2½
	girder - length 9"	-/10	-/1
"Classic"	6½" - length 9"	1/10	-/2
	8½" - length 9"	2/4	-/2½
Hollow roofing bricks	8"x6"x12"	1/8	-/2
Hollow bricks sunbreakers			
"Rectangular" type bricks		1/8	-/2
"Double-octagonal" type bricks		1/9	-/2

The Ikeja brickworks has a capacity of 200,000 to 300,000 bricks per month.

SIERRA LEONE

In Sierra Leone there is no brick or tile production, no developments taking place in the brick industry, nor any proposal to that effect.

Twelve years ago, an attempt was made to produce bricks in the Freetown area, but it met with little success.

There are clay deposits at Yema, Koya Chiefdom and Bullom, and successful attempts have been made to produce bricks with the clay found there.

TOGO

At Lomé, bricks are not only the ordinary material used for building, they are also the traditional building material. Bricks are manufactured by a large number of small entrepreneurs dotted all along the lagoon, from the Ghana frontier to the Lomé airport. It is estimated that approximately 40 entrepreneurs work 7 months in the year and employ about 1,000 persons. The annual production is estimated at 12,000,000 bricks. That is a further production estimate of 15 to 20 million units, that is to say, approximately 23,000 tons a year. It is difficult to verify these production figures.

After extraction, the clay is humidified, beaten up and run into wooden moulds. When dried in the sun, the bricks vary considerably in dimension : (9x10) x (3.5-5.5) x (19-21) cm.. These are piled up in stacks of varying dimensions generally 10x3, 5x3, 5 m. As a rule, the ordinary type of kiln, normally a two chamber kiln, can accommodate from 50 to 70,000 bricks. But there are also smaller kilns with a single chamber accommodating approximately 30,000 bricks. When there is an increase in demand, large kilns with 3 to 4 chambers are built, capable of dealing with 100,000 bricks and over.

The outside is smeared over with mud. When this coating of mud has dried off, coconut husks are used as fuel. The heating or baking process lasts from 36 to 72 hours. The heating or baking conditions are not really ideal with the result that after baking only 50 per cent of the bricks and sometimes less are fit for use. Because the bricks are irregular, both in form and dimensions, and are fairly fragile with little resistance to compression, a project for improving their manufacture was drawn up by the

"United Nations Technical Assistance Programme".

The selling price of these bricks is very low: frs CFA 1.30 apiece.

UPPER VOLTA

Ouagadougou

The brickworks at Pabre

There are two brickworks at Ouagadougou, one belonging to the Catholic Mission at Pabre, 20 km. from Ouagadougou. This brickworks operates six months in the year, and produces on the average 300 tons a month, that is to say, 1,800 tons throughout the six month period. It employs 15 workers and 40 temporary manual labourers. The production is reserved entirely for the needs of the mission.

The "Dragages" brickworks

This brickworks is situated on the Yako road, on the outskirts of Ouagadougou. It has a production of the order of 4,500 tons a year, and operates with 55 employees throughout the year. The annual production for the period 1959 to 1960 was as follows:

				Price per Unit F.CFA	Unit Weight kg	Annual Production	
						Tons	F.CFA
Solid bricks	5.5x11x22cm			12			
Hollow bricks	5.5x11x22cm.	3 holes	12		2.3	81,963	427,632
Hollow bricks	7.5x15x33cm.	8 holes	20		4.1	252,347	1,230,960
Hollow bricks	11x20x40 cm	8 holes	43		10.0	927,980	3,990,314
Hollow bricks	15x20x40 cm	12 holes	50		12.0	2,432,904	10,137,100
Hollow ceiling pots.	15		50		8.1	281,985	1,392,520
Hollow ceiling pots.	20		44		10.4	109,564	463,540
Drains			30		4.25	72,369	510,840
						4,159,112	18,152,906

Ordinary solid bricks measuring 5.5 x 11.22 cm. are also produced. They cost frs. CFA. 12 apiece, and solid compact repressed bricks of similar dimensions 14 F.CFA. Since these prices are ex-factory, a 14 per cent production charge should be added.

These two brickworks were antiquated and used similar techniques drying in the open air, and baking in kilns on a wood fire the flame heating the bricks direct. For this reason, it was decided in accordance with the interim (63/68) plan, to set up a new brickworks at Ouagadougou, and this is now almost completed. The maximum capacity of this factory is 12,000 tons a year and the production programme is as follows:

Hollow bricks	40x20x5	4 holes
	40x20x7	4 holes
	40x20x10	8 holes
	40x20x15	12 holes
	40x20x20	16 holes
solid bricks	22x11x5.5	
Hollow ceiling pots	33x25x15	
	33x25x20	
	50x25x15	
	50x25x20	
Setts	20x20x2.5	

The new company is known as the "Société Voltaïque de Briqueterie et de Céramique - VOLBRICERAM". It came into existence on 21 September 1964, with a working capital of frs CFA 30 million. The selling price (excluding charges) of 6 hole bricks measuring 15x20x35 cm. with a unit weight of 7 kg. is estimated at frs. CFA 5,200 F.CFA per ton, that is 140 bricks.

The following is the proposed production increase :

First year	5,500 tons/year
Second year	6,600 tons/year
Third year	7,700 tons/year

Fourth year	8,800 tons/year
Fifth year	10,000 tons/year
Maximum capacity	12,000 tons/year

Swish bricks at Ouagadougou

Around places where water settles and along the banks of the pools studding the town of Ouagadougou, there are handicraft works producing bricks directly from clay soils. In order to improve the resistance of these clay soils, the straw from cut millet is often mixed with it. The paste thus obtained is then put into wooden moulds, and quickly formed into a compact mass before being dried in the sun. The usual dimensions of the bricks when dried in the sun. The usual dimensions of the bricks when dried are 8x15x35 cm. There are no statistics for this type of production. It is estimated that there are about 45,000 dwellings at Ouagadougou, made of this kind of brick. The poor state of earthen walls, as the result of the rains, warrants the assumption that native huts should be renewed at the very maximum every ten years. Consequently, 4,000 to 5,000 native huts need to be built every year at Ouagadougou.

To put up a small house 5,000 to 6,000 bricks are required. Consequently, the production of sun-dried bricks at Ouagadougou would be in the neighbourhood of 2 to 3 million units a year.

Practically all the entrepreneurs in Ouagadougou make their own concrete parpens. The selling price of these parpens is fairly high:

Hollow cement blocks	10x20x40 cm.	120 F.CFA	11 kg
	15x20x40 cm.	135 F.CFA	15 kg
	20x20x40 cm.	165 F.CFA	25 kg
solid cement blocks	7x20x40 cm.	115 F.CFA	11 kg
	10x20x40 cm.	125 F.CFA	16 kg
	15x20x40 cm.	140 F.CFA	25 kg
	20x20x40 cm.	180 F.CFA	32 kg

According to statistics, the estimate of building activity in the Upper Volta is as follows:^{1/}

^{1/} From building materials used in the construction of the National Development Bank of the Upper Volta.

Administrative market				
Year	Number of markets known in Ouaga. F.CFA	Known surface areas sq.metres	Sum total of markets	Extrapolation walls - sq.metres
1958	49,822,177	3,343	691,198,968	46,500
1959	21,899,680	1,215	88,075,775	4,900
1960	73,253,728	6,232	205,065,639	17,500
1961	66,845,371	2,426	667,784,259	24,200
1962	30,749,884	3,247	421,892,419	44,500
(6 months)1963	159,019,293	11,404	293,110,070	19,100

Number of buildings

National Development Bank

(Entirely completed)

Year	Number of buildings	Surface area of walls - sq.metres	Cost
1958	13	2,524.85	15,499,000
1959	38	8,130.30	63,043,000
1960	28	5,437.22	51,652,000
1961	27	5,665.31	50,621,000
1962	49	12,662.76	104,469,000

Year	Administrative Market sq.metre	Private Market sq.metre	Total sq.metre	Number of bricks	Tonnage pro- duced baked - tons
1958	46,500	2,530	49,030	686,420	8,240
1959	4,900	8,130	13,030	182,420	2,190
1960	17,500	5,440	22,940	321,160	3,860
1961	24,200	5,670	29,870	418,180	5,020
1962	44,500	12,660	57,160	800,240	9,600
1963	38,000	8,000	46,000	644,000	7,730
(extrapolation)					

Cost of Investment

The estimate of investment costs may be based on the cost of brickworks which are at present under construction in Ouagadougou, Niamey and Abidjan. The list of investments is as follows:

<u>Niamey</u>	\$
Plot	4,000
Civil engineering	150,000
Manufacturing material	61,000
Auxiliary material	68,500
Miscellaneous	20,200
Constitution	1,820
First establishment	<u>45,000</u>
Total	\$350,720

<u>Ouagadougou</u>	
Buildings	44,200
Drying rooms	18,400
Kiln	151,000
Production chain	64,000
Drying department	27,000
Stocking and fuel department	23,500
Rolling stock	11,800
Electricity	28,400
Miscellaneous, contingencies	<u>16,600</u>
Total	\$ 384,000

<u>Abidjan</u>	
Imported Equipment	740,000
Mobile equipment	153,000
Buildings	433,000
Plot	151,000
Rolling stock	<u>122,000</u>
Total	\$1,599,000

The indices of these factories are as follows:

		<u>Niamey</u>	<u>Ouagadougou</u>	<u>Abidjan</u>
Proposed production	T/year	14,250	12,000	25,000
Total Investments	\$	350,720	384,000	1,599,000
Buildings - Construction	\$	150,000	216,600	433,000
Equipment and electricity	\$	180,000	154,800	893,000
Other expenditure	\$	20,720	16,600	273,000
Investments for metric ton				
capacity	\$/T	24.5	32.0	
Equipment " " " "		12.5	12.9	35.8
Building " " " "		10.5	17.7	18.3
Miscellaneous " " " "		1.4	1.4	10.9

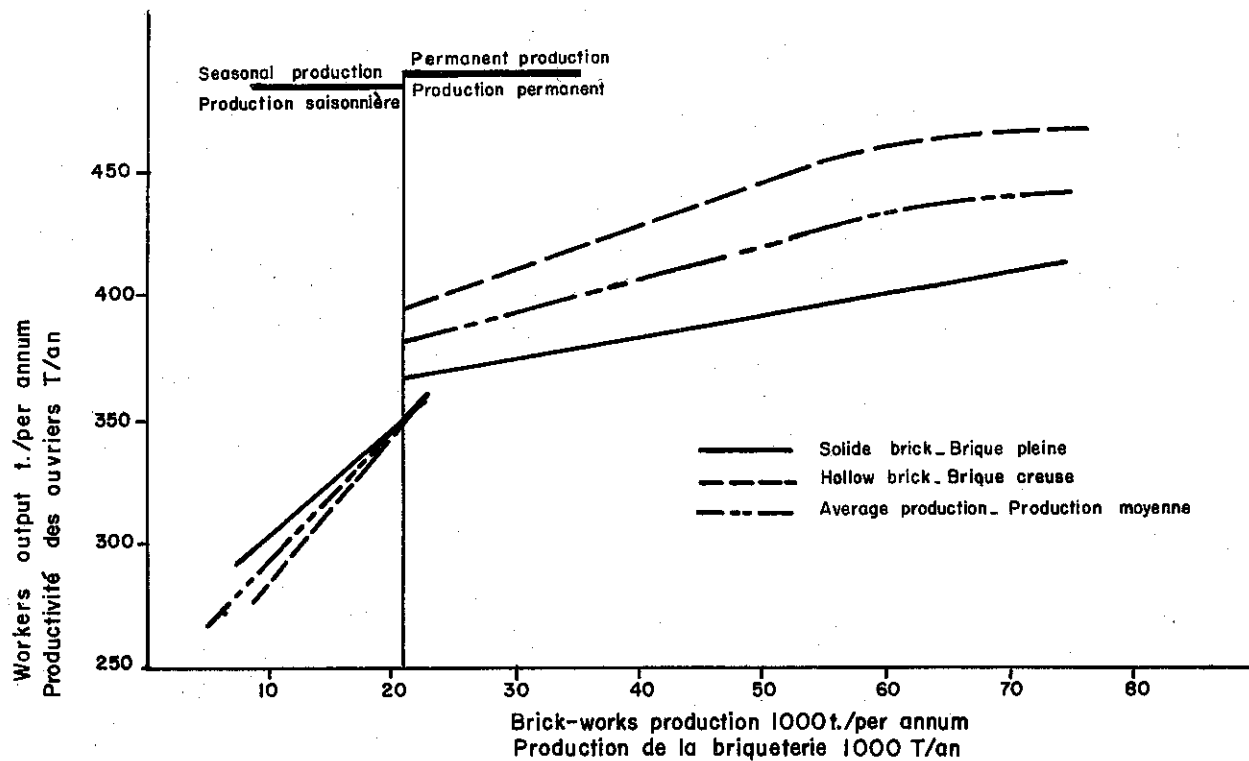
Since we must count upon an improvement in the mechanization of brickworks, we may take the following figures as providing an average for investments:

Equipment	20.0	\$/T
Building	16.0	"
<u>Miscellaneous</u>	<u>4.0</u>	<u>"</u>
Total	40.0	\$/T

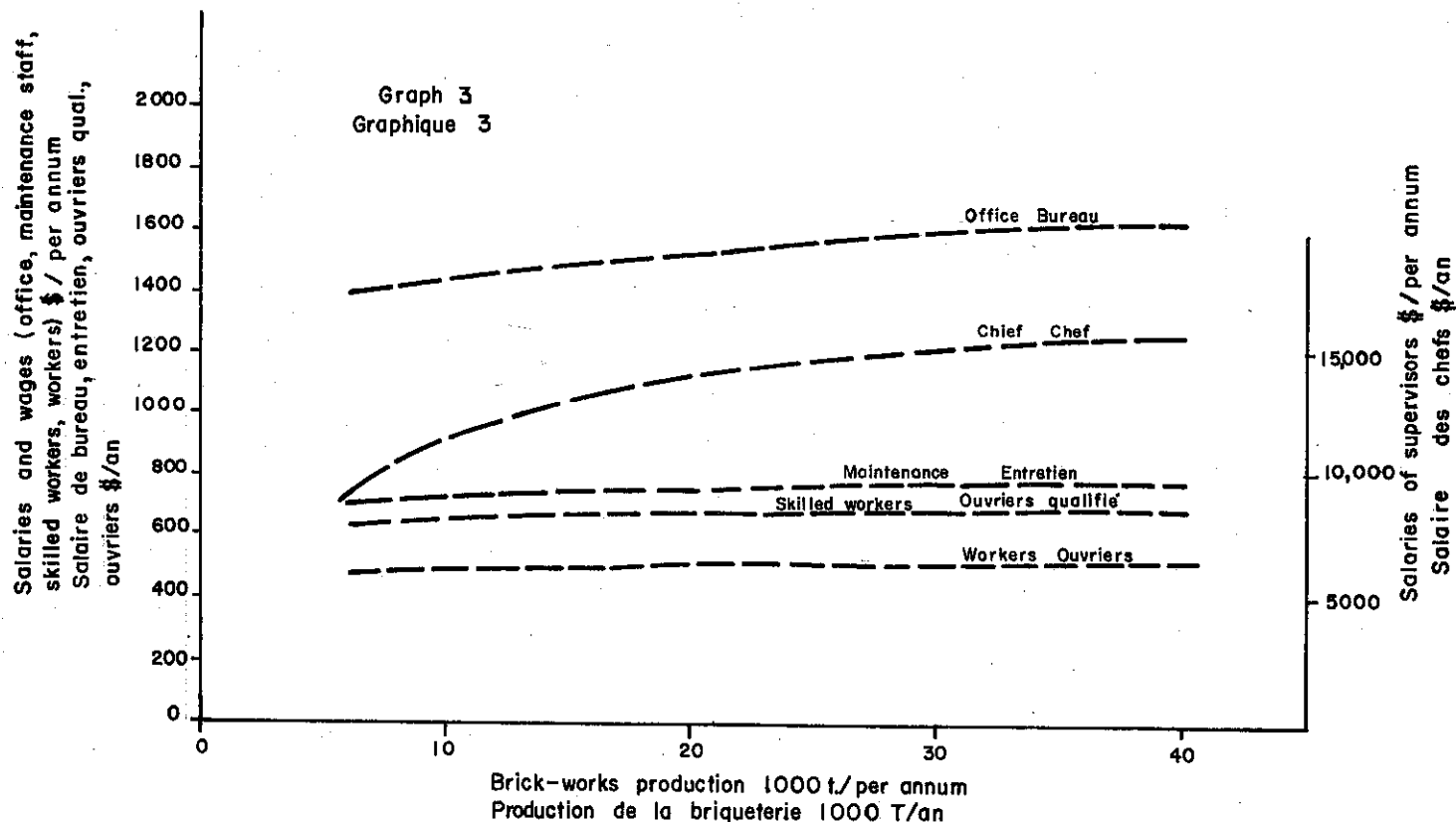
ANNEX V
Detailed calculation of brick reduction
in West Africa

	Capacity in 1968 1000 tons	Capacity according to assumption II - 1000 T	Entire capacity proposed 1000 T	New capacities 1000 tons	How operated in units of a 1000 T	Number of new brick- works	Manager	Office	Maintenance	Skilled workers	Unskilled workers	Total	Investments 1,000 \$	1,000 kWh/year	Fuel oil T/year	Salaries 1000 \$	Charges, holidays 1000 \$	Amortization 1000 \$	Maintenance 1000 \$	Financial costs 1000 \$	Insurance Miscellaneous 1000 \$	Fuel (ex - coast) 1000 \$	Transport of fuel to the interior 1000 \$	Efficiency 1000 \$	Gross Profit 1000 \$	Gross turnover 1000 \$	Value added in 1000 \$
Dahomey	2	32	34	32	1x15 + 1x17	2	2	6	6	17	82	113	815	817	1,920	91.6	18.3	75.2	24.6	28.5	5.7	42.2	41.3	111.0	438.4	296.1	
Gambia	-	7	8	8	1x8	1	1	2	2	6	22	33	184	184	480	29.2	5.8	18.6	6.1	6.4	1.3	10.6	8.9	21.5	108.4	75.1	
Ghana	74	188	234	160	2x40+2x30+1x20	5	5	22	29	56	349	451	5,500	4,900	9,600	341.6	68.3	491.8	154.4	132.5	38.5	211.2	18.0	125.7	898.4	2,540.4	1,800.1
Guinea	82	52	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ivory Coast	25	166	215	190	3x40+2x30+1x10	6	6	26	22	65	421	540	6,510	5,880	11,400	407.5	81.5	596.4	185.3	227.9	45.6	250.8	18.0	167.0	1,075.6	3,055.6	2,159.0
Liberia	10	25	30	20	1x20	1	1	4	3	10	43	61	600	540	1,200	49.3	9.9	48.8	16.0	21.0	4.2	26.4	16.4	86.4	278.4	194.4	
Mali	12	19	26	14	1x6 + 1x8	2	2	4	4	12	33	55	328	316	840	53.9	10.8	32.9	10.9	11.5	2.3	18.5	16.8	30.7	37.4	225.7	135.0
Mauritania	-	6	8	8	1x8	1	1	2	2	6	22	33	184	184	480	29.2	5.8	18.6	6.1	6.4	1.3	10.6	20.1	21.5	119.6	75.1	
Niger	26	13	43	17	1x17	1	1	3	3	9	43	59	440	442	1,020	47.6	9.5	40.6	13.3	15.4	3.1	22.4	25.5	40.1	60.7	278.2	158.4
Nigeria	36	389	476	440	5x40+4x30+4x20+4x10	17	17	69	56	172	983	1,297	14,440	13,120	26,400	1,002.5	200.5	1,298.8	408.8	505.4	101.1	680.8	144.0	637.6	2,310.1	7,189.6	4,811.9
Senegal	16	103	131	115	1x40+2x30+1x15	4	4	16	15	42	258	335	3,875	3,455	6,900	256.1	52.2	345.6	109.8	135.6	27.1	151.8	10.5	145.5	624.3	1,897.5	1,277.2
Sierra Leone	-	53	60	60	3x20	3	3	12	9	30	129	183	1,800	1,620	3,600	148.0	29.6	146.4	48.1	63.0	12.6	79.2	36.5	259.2	821.6	581.2	
Togo	18	21	28	10	1x10	1	1	3	2	7	28	41	210	240	600	35.1	7.0	21.4	7.0	7.4	1.5	13.2	14.1	25.6	132.3	89.1	
Upper Volta	11	26	36	25	1x10+1x15	2	2	6	5	15	68	96	585	1,500	375	79.1	15.8	56.0	18.3	20.5	4.1	33.0	28.6	75.9	364.3	226.8	
Sub-region	312	1,100	1,411	1,099	1x6+3x8+7x20+1x15+ 2x17+2x20+10x30+11x20	46	46	175	148	447	2,481	3,297	35,471	32,073	65,940	2,570.7	544.0	3,191.1	1,008.7	1,241.5	248.4	1,450.7	265.8	1,311.5	5,607.6	17,410.0	11,883.4

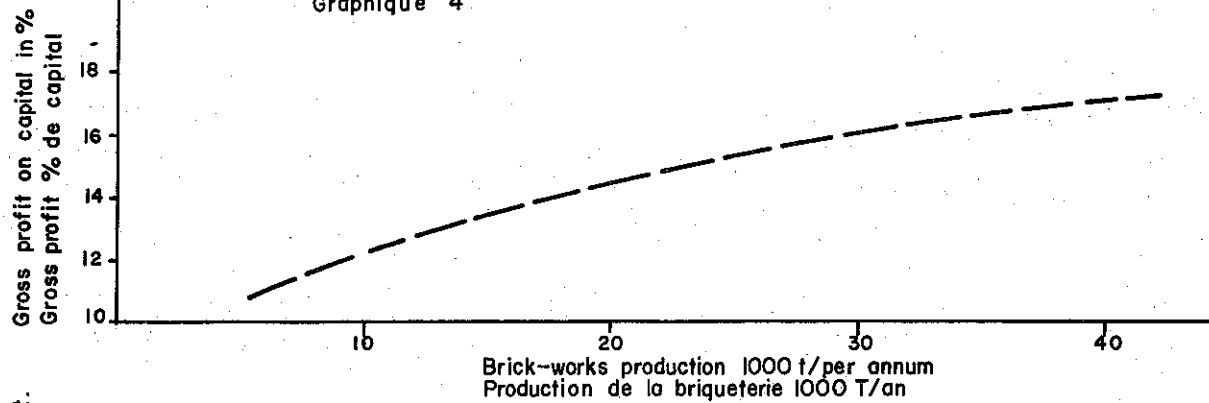
Graph 2
Graphique 2



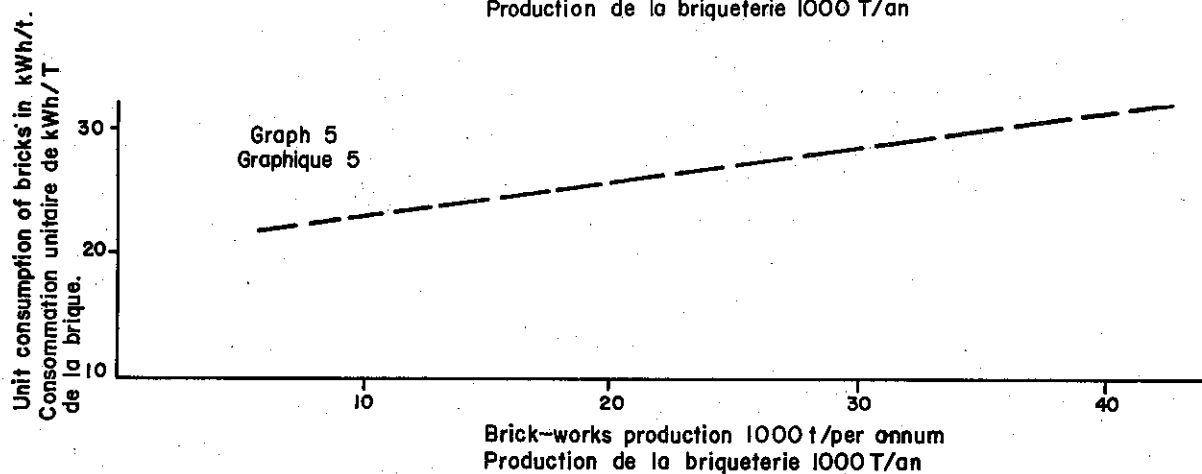
Graph 3
Graphique 3



Graph 4
Graphique 4



Graph 5
Graphique 5



Graph 6
Graphique 6

