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THE ROLE OF THE CEMENT-BASED INDUSTRIES IN ECONOMIES OF CONSTRUCTION AND THE PROSPECTS OF THEIR DEVELOPMENT IN WEST AFRICA

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CHAPTER I

INTRODUCTION

1. One of the obstacles to a low-cost housing programme in the West African sub-region is the limited supply of building materials locally produced. The present report will deal with some of the more general features of techincal and economic problems that the cement-based building materials industries need to face in order to contribute to the economic and social progress of the countries in general and in particular, to the improvement of their housing conditions.

2. Great importance is given to the maximum use of local natural resources and the replacement of imports by building materials domestically produced. This action is highly desirable in order to encourage the establishment of additional building materials enterprises and increase the productivity of existing concerns.

3. It is well known that the resources available for the construction of low-cost houses are very limited compared to the vast social needs derived from the high rate of population growth, the pace of urbanization and the unhealthy conditions of the majority of dwellings both in urban and in rural areas.

4. The main cause of this problem is the large gap between the cost of building materials and components and the low-paying capacity of the majority of the population. Consequently, it becomes essential to reduce the cost of materials by increasing the productivity of the equipment and of the labour force. This cannot be achieved without the establishment of new industrial concerns and the expansion of those which already exist. But in order for further industries to be developed, a sufficient demand for their products must be provided.

5. The cement-based products are frequently and rightly associated with economies in construction costs. The development of the cement-based industries is an essential step to be taken in order to achieve the objective of narrowing the gap between building costs and the income of the overwhelming mass of the population in need of housing.

CHAPTER II

ROLE AND IMPORTANCE OF CEMENT-BASED MATERIALS

A. Materials in use in housing in West Africa

6. The use of cement-based building materials in housing construction in the West African countries is growing at a relatively high rate and constitutes a large sector in the utilization of cement. In recent years, cement products have gradually replaced other traditional building materials in use in urban housing such as timber and mid-bricks. This trend is reflected in the continuous growth of cement consumption and the corresponding expansion of the cement-based industries.

7. Factories producing one kind or another of cement-based products are found in almost all of the countries of the West African sub-region. At one end there are prefabricated panel factories using mechanized techniques and, at the other, small installations not requiring substantial investment and equipment for the production of materials near the building site such as blocks, pipes and light precast elements. The asbestos-cement industry is beginning to have an important domestic market also. The asbestos sheet is one basic material in roof construction for low-income group families. Currently, however, the corrugated iron sheet is still the main roofing material, especially in urban housing.

8. The following table gives a rough picture of the building materials used today in rural and urban areas, as well as an indication of the natural resources and materials available in the West African countries.

TABLE 1

Materials Used in Housing in the Countries of West Africa

Country	Rural Housing			Urban Housing			Natural resources and building materials available from local production
	Floor	Wall	Roof	Floor	Wall	Roof	
Dahomey	earth	mud-bricks	timber poles palm leaves	cement	cement blocks	C.I. sheets clay tiles	sand and gravel limestone clay
Ghana	earth	mud-blocks soil-cement blocks	thatch roofs	concrete	cement blocks bricks hollow blocks	C.I. sheets aluminium sheets asbestos cement sheets clay tiles	planned sanitary ware&tile factories timber, kaolin, feldspath plywood, clay deposits reinforcement bags plant concrete panel prefabrication plant proposed asbestos-cement plant brick factory aluminium sheets plant
Guinea	earth	mud-bricks	thatch roofs	concrete	bricks cement blocks		brick factory plywood concrete panel prefabrication plant clay
Ivory Coast	earth	mud-bricks	thatch roofs G.I. sheets	cement tile	bricks hollow bricks cement blocks	C.I. sheets	Kaolin Clay timber corrugating iron sheet plant brick factory
Liberia	earth	mud-bricks		concrete	bricks hollow bricks cement blocks Terrazo tiles	C.I. sheets	Timber Proposed asbestos-cement plant cement plant under study clay brick production

TABLE 1 (cont'd)

Mali	earth	mud-bricks soil-cement lime blocks		concrete	bricks cement blocks	C.I. sheets	brick factory future sanitary ware factory Kaolin deposits marble cement plant under construction
Niger	earth			cement tile concrete floor	cement blocks bricks hollow bricks	C.I. sheets	Kaolin, feldspath deposits cement timber brick factory proposed precast concrete products and cement tile factories
Nigeria	earth and concrete	mud-bricks	timber poles	cement floor tiles wood	bricks cement blocks	C.I. sheets aluminium sheets asbestos- cement sheets	cement timber clay plywood iron sheets factory for galvanizing and corrugating aluminium sheets limestone coal asbestos-cement plants prestressed concrete
Senegal	earth and concrete	cement blocks mud-bricks	thatch roof	cement tiles	cement blocks	C.I. sheets aluminium sheets asbestos- ccement sheets	cement clay, meph timber asbestos-cement plant limestone brick factory
Sierra Leone	earth	stone mud bricks	thatch roof	concrete wood	cement blocks bricks stone	C.I. sheets	stone quarrying timber clay study for corrugated G.I. sheets study for small reinforcing bars plant

TABLE 1 (cont'd)

Togo	earth	mud-bricks	thatch palm leaves	clay tiles	cement blocks bricks	C.I. sheets asbestos-cement sheets	clinker grinding plant project stone quarrying sand and gravel some limestone cement blocks and pipes proposed clay roofing tile - marble
Upper Volta	earth	mud-bricks			bricks cement blocks		some limestone brick factory

Source: Document HOU/WP/4, ECA, 1964.
Economic Commission for Africa Expert Mission Reports 1964.

9. In order to improve the quality of construction, there is a wide scope for expansion in the uses of cement-based building materials, but ways to reduce costs by increasing productivity in their manufacture as well as in the construction methods must always be kept in mind.

B. Cement utilization in the cement-based materials

10. Cement enters extensively into construction activities. Associated with other materials it can be used in any type of construction. Amongst its many uses, its function as the basic material for concrete is perhaps the most important. The technical versatility of cement in conjunction with a range of aggregates, and reinforcing where appropriate has promoted its widespread use. Equally significant are the economies associated with the use of concrete as a building material. These are many and varied and include first cost, site costs and cost economies arising out of the extension of modern factory methods in the concrete products industry and the building trades. Precast concrete has become increasingly popular, since the quality of the ingredients, their proportions, mixing, placing and curing can be more easily controlled. This advantage is being rapidly realized in fresh concrete mixes as well by the manufacture of ready mixed concrete.

11. Materials handling costs are frequently reduced by the extensive use of concrete as a building material, owing to the multiplicity of its possible applications on any one building site. It can be used for access roads, for flooring, for foundations, for reinforced structural members, and for walls and surfaces. Moreover, it can be cast in a great variety of forms, either in situ or precast at the building site. The following examples demonstrate the extent to which low-cost housing in particular depend on cement-based materials.

12. To produce one cubic metre of concrete, an average of 300 kgs. of cement, one-half cubic metre of sand, and one cubic metre of coarse aggregate are required, and the weight is approximately 2,300 kgs. These figures are close enough for the estimates of cement utilization for the purpose of the present study. If the weight of a non-reinforced concrete element is known, approximately one-seventh or 14 per cent of this weight

is the quantity of cement required to produce it, and 28 per cent is the quantity of sand and 56 per cent the quantity of aggregate. For example, a 50 square metre site prefabricated house with concrete floor, walls and flat slab roof requires 6 tons of cement, 10 m^3 of sand, 20 m^3 coarse aggregate and 1 ton of reinforcement bars.

13. The following is a detailed breakdown of the cement requirement for three types of construction methods for a low-cost house :

TABLE 2

Site prefabricated concrete panel house, concrete floors, walls and roof

	Material	Area (m^2)	Thickness (cm)	Total Volume (m^3)	Cement (kg.) a/	Sand (m^3)	Coarse Aggregate (m^3)	Reinforcement (kg)
Floor	concrete	50	6	3	900	1.5	3.0	0
Walls	concrete (3.2 kg. reinforcement per m^2)	100	8	8	2,400	4.0	8.0	320
Roof	concrete (7 kg. reinforcement per m^2)	60	10	6	1,800	3.0	6.0	630
Foundation	concrete	45 ML	40	1.8	540	0.9	1.8	0
Total					5,640	9.4	18.8	950
Total including waste					6,000	10.0	20.0	1,000
Amount required for one square metre of enclosed area					120	0.2 (300 kg.)	0.4 (600kg.)	20

Total weight of the materials: 6 tons cement
15 tons sand (10 m^3)
30 tons aggregate (20 m^3)
1 ton reinforcement
52 or 1,040 kg. per square metre

a/ Concrete mix : 1.2.4. or 300 kg. per m^3

14. When using concrete blocks for the walls, concrete floor, and asbestos-cement corrugated sheets for roofing for the same type of house, the cement consumption will be as follows:

TABLE 3

Conventionally constructed houses

	Material	Area (m^2)	Thickness	Total Volume (m^3)	Cement (kg.) a/	Sand (m^3)	Coarse Aggregate	Asbestos (kg.)
Floor	concrete	50	6 cm	3	900	1.5	3.0	-
Walls	cement blocks (115 cm)	100	15 cm	15 (including hollows)	2,400	4.6	4.6	-
Roof	asbestos-cement sheets	60	6 mm 2/ (13 Kg./m^2 b/)	total weight 780 kg.	(85%) 660	-	-	120
Foundation	concrete	45 ML	60 cm c/	2.70	710	1.4	2.7	-
Total					4,670	7.5	10.3	120
Total including waste					5,000	8.0	11.0	130
Amount required for one sq. metre of enclosed area					1000	0.16 (240 Kg.)	0.22 (330 Kg.)	2.6

a/ 10 x 20 x 40 cement block (10 cm) weights each 8.5 kg. - 125 blocks = 1 m^3
15 x 20 x 40 cement block (15 cm) weights each 14 kg. - 84 = 1 m^3
20 x 20 x 40 cement block (20 cm) weights each 24 kg. - 62.5 = 1 m^3

To produce a 10 cm block = kg. cement = 1.2 kg. or for one m^2 of wall requires 14 kg. cement

To produce a 15 cm block = kg. cement = 2.1 kg. or for one m^2 of wall requires 24 kg. cement

To produce a 20 cm block = kg. cement = 3.4 kg. or for one m^2 of wall requires 39 kg. cement

b/ Information from Nigerite Asbestos Cement Products.

c/ 1.3.3 mix

Total weight of the materials - cement = 5.0 tons
sand = 12.0 tons
aggregate = 16.0 tons
asbestos = 1.30 kg.
33.5 tons or 670 kg.

15. To manufacture 1,000 m^2 of concrete blocks (with a mix 1 cement, 3 of sand and 3 of gravel), the following material consumption is required:

TABLE 4

Cement blocks for ten houses of 100 M^2 of wall area each

Type of block	Thickness of wall cm	No. of blocks m^2	No. of blocks m^3	For 1,000 m^2 of wall: Cement tons	Sand m^3	Gravel m^3	Weight tons blocks
10 x 20 x 40 cm	10	12.5	125	15.1	30 (45.3 tons	30	106.2
15 x 20 x 40	15	12.5	84	25.0	50 (75tons)	50	175.0
20 x 20 x 40	20	12.5	62.5	43.0	86.0 (129 tons)	86.0	300.0

16. To build concrete walls for ten houses (1,000 m^2 wall area) approximately 15 tons of cement for a 10 cm thick wall, 25 tons for a 15 cm thick wall and 43 tons for a 20 cm thick wall are required. Also required are 60 m^3 of aggregates for the first thin wall, 100 m^3 for the medium thick wall, and 172 m^3 for the 20 cm thick wall.

17. For the construction of 1,000 panel prefabricated concrete houses for low-income groups, 6,000 tons of cement, 10,000 m^3 of sand, 20,000 m^3 of coarse aggregate and 1,000 tons of reinforcement bars are required.

18. When the concrete roof is replaced by asbestos-cement sheets, the concrete walls by cement blocks and a floor construction similar to the example above, the materials required for 1,000 houses will be :

5,000 tons cement, 8,000 m^3 sand 11,000 m^3 coarse aggregate 130 tons asbestos

If the concrete floor slab could be replaced, in some areas, by the use of cement floor tiles, it might be possible to reduce the amount of cement required but probably not possible to reduce the price of the individual

house. The production of mosaic and terrazo floors could be encouraged since the equipment does not require large capital and may be locally constructed without any serious difficulty.

19. The utilization of cement in other cement-based building materials industries such as pipes and other precast elements is difficult to estimate due to the diversity of products, and its importance is relatively smaller when compared with the volume of materials required for walls, floor, roof and foundations, as already discussed earlier in this report. Cement-based building materials will thus have an increasing importance in the construction of low-income housing.

20. In a study prepared for the Central American region on the construction of 20,000 low-cost housing units, it was found that the cement-based building materials represent 35 per cent of the cost of all materials and equipment necessary to produce a house costing US $1,700[1/]. Concrete or cement tile was used for the floor, concrete blocks for the walls, and asbestos-cement or reinforced concrete slab for the roof. Only one country out of six used clay tiles as roofing material and brick for the construction of the walls.

21. It is expected that the use of cement products in floor construction in the West African sub-region will increase at a fast rate, since it is economical and suitable for the climatic conditions of the area. Cement block in wall construction will continue to be used, and the use of clay bricks will continue in many countries as well as local methods of wall construction using adobe, mud bricks and stabilized soil with other binding agents differing from cement.

22. As far as roof construction is concerned, asbestos-cement will play an important role in the market but corrugated iron and aluminium sheets might continue to be popular, particularly in countries which produce them. In rural areas, if large reductions in prices of roof materials are not realized the thatch roof might continue to be the main material.

1/ E/CN.12/CCE/SC4/17, ECLA.

CHAPTER III

AN APPRAISAL OF THE PRESENT STATUS OF THE CEMENT-BASED INDUSTRIES

A. Concrete Products

23. The domestic availability and utilization of concrete products vary greatly among the countries of the sub-region. In countries such as Nigeria and Ghana and to a somewhat lesser extent in Senegal and Ivory Coast, the domestic industry is well developed and offers a wide range of diverse concrete products. In Abeokuta, Nigeria, the Nigerian Prestressed Concrete Company fabricates light to heavy structural components for floor and bridge constructions as well as precast electric transmission poles, fence grills, etc. The Anglo-Canadian Cement Comapny in Lagos likewise produces a range of cement-products, including concrete blocks, floor slabs and other concrete precast items. A number of smaller enterprises manufacture concrete and terrazo tiles, concreto pipes, hollow blocks and so on. Such enterprises are furthermore widely distributed throughout the country and are fairly efficiently operated. In addition, productions especially of concrete blocks based on modest equipment are extensively undertaken. According to the 1962 industrial census the gross output of some 20 establishments was valued at over £1.3 million with a value added of nearly £0.8 million, the employment being of the order of 2,000 persons.

24. According to the Ghana Industrial Census of 1962, the number of concrete products establishments was reported to be 118 with an employment figure of over 1,200 persons. Furthermore, in subsequent years a notable expansion of the industry was noted to have taken place in response to inceased construction activities. Besides new and well-equipped installations, a panel prefabrication plant was put up from which production is expected to begin in the near future. This and the factory in Guinea are the only modern panel prefabrication operations in the sub-region.

25. In Senegal and the Ivory Coast, production of concrete components is mainly undertaken by building contractors. Even so, there are a

few establishments which operate on industrial basis. Ten such establishments were reported to be operating in Senegal in 1962. In the Ivory Coast, the turnover of the industry was CFA francs 250 million in 1960 and the estimate for 1965 is expected to reach some CFA francs 400 million. The concrete products enterprise SABM, which operates in Abidjan and Bouaké as well as in Dakar and Conakry is a typical set-up of its kind in West Africa. Its products include blocks, pipes, fencing grilles, claustras, road kerbs, wash basins, septic tanks, prestressed precast units etc. Production is based on simple but effective manufacturing units which are essentially labour-intensive in operation. Neither the mixing of concrete nor the handling, stacking and curing of its products claims the sophisticated mechanized processes now being used extensively in the industrialized countries.

26. In the majority of the other countries of the sub-region, the concrete products industry has not made much progress. Generally, the major activities in this area are undertaken either by the large construction firms for their own needs or artisan productions based on simple hand-operated presses. Sandwiched between these two operations, well-established and somewhat efficiently operated enterprises are, nevertheless, occasionally encountered. It can in general be observed that each country has at least one concrete products installation producing one or more types of products. Such enterprises as CEBVITO (Entreprises des Bétons Vibrés Togolais) in Lomé, Acier et Bélon in Cotonou, Muneriz & Company in Monrovia, and others in Mali, Upper Volta, etc., differ from each other only in the extent of their activities. Government public works departments also undertake productions of concrete items. Notable examples are those of Ghana and, at a less intensive degree, those of Gambia and Sierra Leone.

27. The main features and characteristics of the concrete-based industries in the West African countries can best be visualized at their particualr levels of operations. At the bottom of the scale are the widely diffused artisanal and semi-artisanal operations. These activities are almost

wholly limited to the production of concrete, sandcrete or soil-cement blocks. Production is often intermittent depending on demand for the products, and the operation is normally carried out in simple hand-operated presses under an improvised shed. The monthly cement input does not at the most exceed 10 tons. Such activities are generally undertaken in urban and semi-urban areas by African entrepreneurs as a sideline to other occupations. Evidently investments in equipment and tools are low and so also are overheads. The quality of the products is generally poor but prices are low.

28. The next higher level of activity in this industry could embrace the individual entrepreneur as well as building contractors and government departments producing their own building materials including cement-products. Automatic presses are normally used and generally the operation is well organized. Workshops built in more durable materials are erected but investments are still modest. The activities of the enterprises could be defined by the monthly cement input which could be anywhere between 10 - 50 tons. The quality of the products is much superior to the artisan-produced ones and prices are also higher, Generally, however, the activity in this group is limited in its range of products. The individual entrepreneur is limited to the production of one or two products by mechanized or semi-mechanized means sometimes extending his activity to other products by improvising with moulds and shutters by manual means. The same is true of building contractors and government direct labour operations for another reason, namely their legitimate desire not to extend their activities beyond their immediate and normal requirements of basic concrete products.

29. The lack of a sufficiently large market is the main reason for limiting the level of activity of this group, but it is also true that limitations in the local availability of a range of concrete products hampers the growth of the market in that architects and engineers are not in a position to specify these products. It is not easy to say which side should break this vicious circle. Nevertheless, experience

in other countries has shown that the key to the dynamic growth of the cement products industries lies in the initiative, drive, technical know-how, and salesmanship of individual entrepreneurs besides the indisputable qualities of cement products. Obviously, the absence of an assured market would not attract foreign investors. That the cement products industries are limited to such modest activities in the majority of countries of the sub-region might therefore be attributed to the absence of local entrepreneurs with the qualities enumerated above.

30. At the top of the scale are found the well-equipped and highly organized establishments geared for large productions of a wide range of cement products. The monthly cement input could be considerably over 100 tons. In these cases, investments are of a much higher order than for the group mentioned earlier. Larger and more mechanized productive units are employed and, in addition, mechanical handling and batching of materials is likely to be the rule rather than the exception. These enterprises enjoy relatively larger markets but they also create demand in that they can offer a wide range of products and promote their marketing. They require highly trained technicians and labourers in order to ensure a high quality for their products and to cope with the complex technical problems involved in fabricating such materials as prestressed precast components, fabricated panels, etc.

31. Such enterprises are almost wholly owned and operated by expatriates, who were in the first place attracted by the prospects of a large local demand. That is why operations of these magnitudes are today limited to only a few countries of the sub-region, notably Nigeria and Ghana. But the prospects for increased cement-products utilization in preference to substitute materials are good. No doubt, if entrepreneurs were to overlook the initial riskiness of launching larger scale activities of cement-products manufacture, that the undertaking would soon be profitable can be forecast with some certainty. In Guinea, for example, a state panel prefabrication plant was established in spite of a demand for cement-products, which is not far

different from many of the other countries of the sub-region. Given a policy of building material utilization and allocation which favours the domestic industry, there is no reason why the enterprise should not prove profitable. In Togo, at least one large installation operates successfully.

32. It is sometimes pointed out that artisanally produced cement-products are priced so low that this acts as a disincentive to entrepreneurs intending to start industrial productions. It should, however, be remembered that artisan and semi-artisan productions are limited to a few products only, mainly concrete blocks. Numerous other products remain to interest investors. Besides, the need for products conforming to standard specifications of quality, shape and size, reserves to industrial production the whole range of cement-products. Furthermore, the fact that construction investments largely take place in the public sector ensures the major share of the market to industrially produced cement products.

33. The ex-factory prices of the products do not vary significantly among countries in spite of differing scales of operations and input supply conditions. Table 5 below demonstrates this situation for four selected countries in the sub-region. It will be noted that the smaller installations in Dahomey and Sierra Leone are highly competitive to the larger ones of Nigeria. The examples given are evidently not representative or exhaustive enough to permit the drawing of any firm conclusions as to economies of scale in the cement-products industry. But it could nevertheless be observed that highly efficient and economic productive units are available for any given level of operation in the industry. Thus, with a small automatic press, the cost of producing a concrete block is not likely to be different from one produced from a larger press.

34. This does not mean that there are no advantages to be gained from economies of scale in the indsutry. Far from it. The larger operations have advantages of minimizing overhead costs through larger and more varied productions and through lower employment levels than the smaller

operations. Moreover, the larger operations are better placed to negotiate better purchase prices of inputs (cement, sand, aggregates, etc.) Given a certain price level for the productions, the large operations stand to secure considerably higher profit margins than the smaller operations anyway.

TABLE 5

Ex-Factory Prices of Concrete Products in Selected West African Countries

Country	Size of Operation in monthly cement requirement (tons)	Concrete Blocks		Pipes		Other Products	
		Size	Price US$ per pc.	Size	Price US$ per pc.	Remarks	Price US$
Dahomey	10	10 x 20 x 40	0.10	–	–	Precast, foot-paths kerbs grilles, etc.	24 per ton
		15 x 20 x 40	0.14	–	–		
		20 x 20 x 40	0.18	–	–		
						precast slab	6 per m^2
Guinea		10 x 20 x 40	0.1[illegible]	–	–	–	–
		15 x 20 x 40	0.26	–	–	–	–
		20 x 20 x 40	0.31	–	–	–	–
Nigeria	100	10 x 22.5x45	0.17	10 cm. dia.	0.70	Precast kerbs foot-paths etc.	28 per ton
		15 x 22.5x45	0.25	45 cm. dia.	4.48		
		22.5x22.5x45	0.28	60 cm. dia.	6.10		
Sierra Leone	50	10 x 22.5x45	0.18	30 cm. dia.	2.20	Paving slabs,	
		15 x 22.5x45	0.25	45 cm. dia.	3.10		
		22.5x22.5x45	0.32	60 cm. dia.	4.20	Kerbs, etc.	22 per ton
						Precast slabs	30 per ton

Source: ECA Mission Reports (various).

35. It would appear reasonable to assume that the prices of cement products in the coastal countries of the sub-region on the average fall in the range of US$15 for concrete blocks, US$20 for concrete pipes, US$25 for cement tiles and US$30 for other precast elements. The most important component of the cost of production is the material inputs which are likely to account for 60-70 per cent, cement accounting for the largest share in this cost. The price of cement is the major determinant of cost. The above figures are therefore likely to be exceeded by substantial margins for the land-locked countries of the sub-region. Thus in Upper Volta, the price of concrete blocks is around US$20 per ton and in Mauritania and Guinea, where the price of cement is higher than in other coastal countries[1], prices of blocks are US$17 and US$19, respectively.

B. Asbestos Cement Products

36. The situation as regards the asbestos-cement-products industry is more precise and more easily identifiable than the cement products industries in the sub-region. There are only three factories in the whole sub-region, two of which, moreover, are located in one country - Nigeria. Furthermore, these three factories are a very recent development; the oldest claims five years of activity and the youngest one year.

37. In Nigeria the two factories are those of the Turner Asbestos-Cement Company Ltd. at Emene-Enugu and Asbestos-Cement Products Ltd. at Ikeja. The Turner Asbestos-Cement Company is a joint venture between the Government of the Eastern Region and Turner Asbestos Company (UK). The factory was put up at a cost of approximately US$4 million. In 1963, it started the production of corrugated and flat sheets as well as some moulded products. The installed productive capacity for the above-mentioned factory is 10,000 tons per year. In 1964, this Company also started the production of pressure pipes, roof and soil drainage pipes, fuel pipes, etc. The Turner Asbestos-Cement Company Ltd. employs 250 local workers and ten foreign employees requiring US$16,000 for generating one job.

1/ See Doc. E/CN.14/INR/117, August 1966

38. The Asbestos-Cement Products Co. Ltd., which started production in 1961 with a capital of US$2.8 million, is a subsidiary of the Eternit Group with the participation of the Western Nigeria Development Corporation and other private shareholders. The production capacity per year is 18,000 tons of sheet products and 12,500 tons of pipe products. Moulded pieces such as rain pipes and accessories, water tanks and septic tanks are also produced. The approximate cost of installed machinery is US$980,000 for producing asbestos-cement sheets and US$1,200,000 for producing pipe products, which means that US$54 is required to produce one ton of sheets and US$96 to produce one ton of asbestos-cement pipes. The factory employs between 175 and 200 local workers and five foreign workers. Some asbestos-cement products such as channel roof are beginning to be exported to Ghana, Liberia, Togo and Dahomey, and there is a clear possibility for increasing the export market to the coastal areas of West and Equatorial Africa.

39. The second country in West Africa that produces asbestos-cement building materials is Senegal whose plant started production in October 1965 with a capital of US$750,000 for manufacturing 12,000 tons of asbestos-cement products yearly. The factory employs 105 local workers and five foreign workers.

40. In addition, Ghana and the Ivory Coast have advanced projects for asbestos-cement production. In 1964, a German firm signed a contract with the Government of Ghana for financing an asbestos-cement factory at Tema. The agreement calls for an investment of US$3,600,000 for sheet production of 24,000 tons per year and the production of 18,000 tons of pipes, thus giving an investment of US$ 86 for the production of one metric ton of asbestos-cement building material. A project for an asbestos-cement plant for Abidjan with a capacity of 8,000 tons per year of sheet products and 4,000 tons of pipe products has been studied. The project is expected to be carried out between 1965 and 1970. The investment required is estimated at US$1,200,000.

41. The main reason that could be indicated to explain the lag in the development of this industry is perhaps the problem of marketing of the product in West Africa. While asbestos-cement products display excellent qualities as roofing, sheeting and drainage materials, they nevertheless have a high weight-to-cost ratio and furthermore they suffer from a high breakage incidence in handling and transport. Under the inadequate transport facilities prevailing in the sub-region, asbestos-cement products are generally not competitive to other substitute materials. Thus corrugated and aluminium sheets which could be relatively easily transported to remote areas dominate the roofing materials market of the sub-region. Further aggravating the situation, secondary industries producing these materials from imported sheets are being established, thus securing the advantages of protection offered to domestic industries. Similarly also welded pipes are being produced locally from imported sections, thus posing stiff competition to asbestos-cement pipes as well as concrete pipes.

42. That the two asbestos-cement factories operate successfully in Nigeria even though they face competition from the secondary metal industries does not invalidate the above observations. On the contrary, the case of Nigeria suggests the conditions which justify the setting up and operation of an asbestos-cement factory. Firstly, the large demand (i.e., large in relative magnitudes) permits the sharing out of the market according to technical specifications and the efficiency of the competing operations. Secondly, the level of urbanization attained makes the marketing of the product relatively easier than when the product is aimed at small, remote, widely dispersed rural markets. Under these conditions, the price of the product ex-factory could be competitive to substitute products. The price of US$1.20 for the cheapest asbestos sheet is competitive to a range of thicknesses of corrugated iron and aluminium sheets. The price of asbestos pipes per metre length is slightly more expensive than equivalent concrete pipes which are much lighter, and much cheaper than iron and steel pipes. Asbestos-cement products ex-factory are priced at US$100-120 per ton for sheet products and at US$130-150 per ton for pipe products.

C. Quantitative Summary of the West African Cement-Based Industry around 1965

43. The current status of the cement-based industries is summarized in Table 6 below, based on estimates of 1965 productions extracted from table 15 later on in the report. Thus the value of gross output is estimated at just over US$32 million and value added at over US$19 million. Some 7,750 persons are estimated to be employed by the industry. These are orders of magnitude that do not do justice to an industry which has a large potential to play an active role in the construction industry of the sub-region, and of which the development is within the reach of each country of the sub-region.

TABLE 6

Summary of Quantitative Indicators of the Level of Activity of the Cement-based Industries in West Africa Around 1965

Country	Est. of Production thousand tons		Gross Value of Output (thousand US$)	Value Added (thousand US$)	Employment
	Conc.Prod.	Asb.Cem. Prod.			
Dahomey	15	-	180	108	100
Gambia	2	-	30	18	30
Ghana	440	-	6,600	3,960	1,800
Guinea	20	-	300	180	100
Ivory Coast	240	-	3,600	2,160	1,000
Mali	50	-	1,000	600	200
Mauritania	65	-	1,350	810	300
Liberia	95	-	1,425	855	400
Niger	55	-	1,100	660	200
Nigeria	740	30	14,700	8,820	2,800
Senegal	110	-	1,650	990	400
Sierra Leone	40	-	600	360	200
Togo	20	-	300	180	100
Upper Volta	35	-	700	420	120
Sub-region	1,927	30	32,535	20,121	7,750

Source: Secretariat Estimate

44. In addition, the cement-based products are highly competitive to substitute materials even under the present underdeveloped status of the industry as is evidenced from the computations of the next section.

D. The Competitiveness of Cement- ased Products

45. In Table 7 below the prices of different cement-based products are compared to those of substitute materials as well as the costs of various building elements using these alternative materials. Ivory Coast has been selected for this exercise and it is thought that the data taken from this country would be representative of the general cost situation in the majority of the countries of the sub-region. The summary of prices and costs is shown in table 7 below.

TABLE 7

Prices[a] of Cement-Based and Substitute Materials and Costs[b] of Building Elements Carried Out with These Materials

Building Element	Material	Specification	Unit	Price per Unit US $	Unit of Measurement of Building Element	Coast of Building Element per Unit US $
Walling Material	1 Hollow Conc. Blocks (250 kg. cement)	20x20x40 (16.2 kg.)	po	0.13	m^2	6.04
		15x20x40 (14 kg.)	"	0.11	m^2	5.06
		10x20x40 (11 kg.)	"	0.09	m^2	4.00
	2 Hollow clay bricks	20x20x40 (11 kg.)	"	0.20	m^2	8.02
		15x20x40 (8 kg.)		0.16	m^2	6.45
		10x20x40 (5.5. kg.)	"	0.11	m^2	4.68
	3 solid bricks	6x11x22 (2.6 kg.)	"	0.11	m^2 (22 cm thick wall)	47.36
Floor Covers	1 Pressed Cement Tiles	20x20	m^2	2.53	m^2	6.76
	2 Ceramic tiles (white)	15x15	m^2	4.38	m^2	12.76
	3 Granolithic Tiles	20x20	m^2	4.56	m^2	10.72
	4 Clay floor Tiles	10x10	m^2	5.57	m^2	13.71
	5 Thermoplastic tiles	2 mm thick	m^2	3.24	m^2	7.87

a/ Prices are those offered to contractors.

b/ Costs are for finished tasks with all necessary additional materials such as mortar, jointing, etc., and making allowance for wastage but exclude complementary works such as excavation for drainage pipes, etc.

TABLE 7 (continued)

Building Element	Material	Specification	Unit	Price per Unit US$	Unit of Measurement of Building Element	Cost of Building Element per Unit US$
Roofing Material	1 C.I. Sheets (12 kg.)	73/100	m^2	1.80	m^2	4.00
	(10 kg.)	63/100	m^2	1.59	m^2	3.68
	(8 kg.)	50/100	m^2	1.36	m^2	3.34
	2 C.Aluminium Sheets Self-supporting	6/10-0.90 width	m^2	1.91	m^2	4.55
		6/10-0.76 width	m^2	2.09	m^2	4.88
	3 Asbestos-cement sheets	6 mm thick,1.25x0.873	m^2	2.20	m^2	3.87
		6 mm thick,1.52x0.873	m^2	1.68	m^2	3.87
		6 mm thick,1.75x0.873	m^2	2.15	m^2	3.87
		4.5 mm thick,1.52x0.873	m^2	1.53	m^2	3.49
		Diameter				
2 Drainage Works	1 Asbestos-cement pipes	10 cm	ml.	1.44	ml	4.43
		15 cm	ml	2.23	ml	6.40
		20 cm	ml	3.32	ml	9.00
	2 Concrete pipes unreinforced	(10 cm	ml	0.91	ml	3.40
		(15 cm	ml	1.42	ml	4.53
		(20 cm	ml	1.86	ml	5.59
	reinforced	(60 cm	ml	8.02	ml.	21.06
		(70 cm	ml	12.96	ml	45.11
	3 Cast Iron Pipes	10 cm	ml	6.08	ml	17.52
	4 Plastic drainage pipes	11 cm	ml	2.88	ml	10.63

Source: Série des Prix Applicables aux Travaux de Bâtiment, Ministère des TP, République de la Côte-d'Ivoire 1963

46. It would be observed that cement-based products are competitive for all types of building works. For walling materials, hollow concrete blocks are consistently cheaper than hollow clay blocks and considerably cheaper than solid bricks. Similarly, cement and grano tiles are cheaper than ceramic and other clay tiles. Plastic tiles are more expensive than cement tiles but less expensive than grano tiles. With respect to roofing covers, asbestos cement sheets are highly competitive to both corrugated iron and aluminium sheets. Only the lighter corrugated iron sheets are cheaper than asbestos sheets for a square metre of finished roof. Aluminium sheets are consistently more expensive. Evidently, since asbestos sheets are heavier than equivalent sizes of corrugated iron and aluminium sheets, they would require a slightly more expensive roof supporting framework. Nevertheless, the additional expense is thought to be small and possibly of an insignificant order of magnitude.

47. For drainage works too, cement-based pipes are the cheapest materials on the market. For a metre length of laid drains, concrete pipes are the cheapest followed by asbestos-cement pipes, plastic pipes and cast iron pipes in that order. When it comes to diametres exceeding 60 cms. cement-based pipes require reinforcing with steel rods, but even then their prices are still competitive to equivalent diameter cast iron and steel pipes.

48. It is significant to note, notwithstanding the fact that Ivory Coast in 1963 was not producing cement locally, that cement-based products are, on the one hand, competitive to purely domestic products such as clay products and, on the other, to lighter and relatively more easily transportable materials such as plastics and steel. The prospects for cement-based products will, therefore, improve further as cement and asbestos-cement products begin to be produced locally. While the relative intensity of utilization of coment products would be expected to grow, demand for substitute materials will certainly not disappear. Technical specifications and choices will always ensure markets for each competing material.

49. An active cement-based industry promises reduced construction costs. As has been noted earlier cement products can be used extensively in building and other general construction. In housing, the construction of roofs, walls and floors between them account for over 50 per cent of the total construction cost and cement-products enter into these elements substantially. Furthermore, a large part of drainage works can be satisfied by either concrete pipes or asbestos-cement or by other materials. Therefore, the prospects of reduced prices for these products through the use of cheaper locally produced cement and through the efficient organization of production will mean reduced construction costs as well.

50. Today, the intensity of cement utilization is low in the sub-region. In low-cost urban houses and in rural houses, the predominant materials used are locally found and improvised traditional materials. It has been seen that availability of cement-based products is limited due to the underdeveloped status of the cement-based industries and due also to the problems faced in marketing the products under the prevailing level of transportation and urbanization. Under these circumstances, the substitute materials are more frequently utilized in the sub-region as evidenced from import statistics.

CHAPTER IV

IMPORTS AND THE SCOPE FOR IMPORT SUBSTITUTION

51. Table 8 below summarizes the imports of cement-based materials to the countries of the West African sub-region. Although cement-products are included, by far the major share of the imports are accounted by asbestos-cement products. It could even be suggested that the figures could approximately be taken to represent the asbestos-cement markets of the countries.

TABLE 8

Imports of Cement-Based Products to West Africa in 1963

Country	Quantity (tons)	Value (US$1000)
Dahomey	1,339	120
Gambia	218	13
Ghana	20,187	1,423
Guinea	..	..
Ivory Coast	4,681	434
Mali	469	72
Mauritania	..	-
Liberia	2,120	325
Niger	286	22
Nigeria	7,521	1,356
Senegal	6,804	558
Sierra Leone	400	112
Togo	668	58
Upper Volta	813	69
Sub-region	45,506	4,562

Source: National Statistics

52. Evidently the demand for asbestos-cement products in most of the countries of the sub-region is very small and generally does not even justify a small semi-mechanized productive unit of, say, 2,000 tons per annum output, at which level of production costs would be so high that the products would not be able to compete with the imported material let alone with substitute materials. But it is the extent to which the sub-region is dependent on imported substitute materials that reveals the potentials for the development of the cement-based industries. Table 9 below shows the extent of these imports around 1963.

TABLE 9

Imports of Galvanized Sheets and Steel Tubes and Pipes to West Africa around 1963

Country	Imports of Galvanized Sheets		Imports of Steel Tubes and Pipes	
	Quantity (tons)	Value US$1000	Quantity (tons)	Value US$1000
Dahomey	4,741	1,089	600	187
Gambia	1,172	258	-	-
Ghana	1,768	380	11,400	4,107
Guinea	-	-	-	-
Ivory Coast	10,893	2,256	6,200	1,584
Liberia	1,261	312	4,233	1,077
Mali	1,983	375	-	-
Mauritania	403	78	620	142
Niger	496	107	350	101
Nigeria	14,485	3,069	44,700	11,410
Senegal	8,326	1,625	5,300	1,236
Sierra Leone	5,374	1,224	-	-
Togo	2,778	575	610	176
Upper Volta	3,118	677	-	-
Sub region	45,506	4,562	74,013	20,020

Source: National Statistics, Yearbook of International Trade Statistics, UN, 1963.

53. According to Table 9, the sub-region imported nearly 46,000 tons of galvanized sheets and 74,000 tons of steel tubes and pipes, at a cost of some US$4.6 million and US$20 million, respectively. Nigeria accounted for over 30 per cent of the imports of sheets and as much as 60 per cent of the imports of tubes and pipes. This occurred despite the existence of an asbestos-cement plant in the country. Subsequently, however, the installation of another plant has made it possible for the Nigerian asbestos-cement industry to capture an increasing share of the growing demand of roofing and drainage materials.

54. Import statistics of purely asbestos-cement products do not therefore define the market for these products. To imports must be added the quantity that could be captured from substitute materials given the technical requirements of the competing materials, their relative prices, their availability and - equally important - taking into account policy directives regarding the allocation and utilization of the competing materials. Suppose it is assumed that conditions were such in 1963 that asbestos-sheets could have captured 60 per cent of the galvanized sheet demand, then the hypothetical market for asbestos-sheet products could be computed. This is done in table 10 below, based on the weight of the two materials per square metre of covered space.

55. Admittedly, the table is a crude attempt at quantifying the hypothetical 1963 market assuming that domestic asbestos-cement industries existed and maintained their share of the market. The exercise is directed at assessing the demand for asbestos-cement sheets. For this reason the table might be criticized for not deducting imports of asbestos-cement pipes and other concrete products which are included in the actual figures of the imports indicated in the second column of the table. But it is thought that the magnitude of the deductions is small and would not affect seriously the very broad assessment aimed at by the exercise.

56. It would be noted from the result of the computations that the markets for asbestos-cement sheets could have been much larger than the mere import statistics showed. The majority of countries now reveal potential asbestos-cement sheet markets considerably over 5,000 tons per annum. If to this are to be added asbestos-cement pipes and other moulded products, the national asbestos-cement markets of the majority of countries could be indicated to have a potential current market approaching or exceeding 10,000 tons per annum. Therefore, it would appear that even today most of the countries of the sub-region have the market potentials to install productive units that could be operated profitably.

TABLE 10

Computed Possible Demand for Asbestos-Cement Sheets in West Africa in 1963 ('000 tons)

Country	Actual Imports of Asbestos-Cement Products	60% of Metal Sheet Imports	Equivalent Quantity of Asbestos Cement Sheets	Hence Computed Demand
Dahomey	1.3	2.8	5.6	6.9
Gambia	0.2	0.7	1.4	1.6
Ghana	20.2	1.0	2.0	22.2
Guinea	-	-	-	-
Ivory Coast	4.7	6.5	13.0	17.7
Liberia	2.1	0.7	1.4	3.5
Mali	0.5	1.2	2.4	2.9
Mauritania	-	0.2	0.4	0.4
Niger	0.3	0.3	0.6	0.9
Nigeria	7.5	8.7	17.4	24.9
Senegal	6.8	4.9	9.8	16.6
Sierra Leone	0.4	3.1	6.2	6.6
Togo	0.7	1.8	3.6	4.3
Upper Volta	0.8	1.9	3.8	4.6
Sub-region	45.5	33.8	67.6	113.1

Source: Secretariat Computation.

57. The abandonment of excessive caution in favour of bold decisions based on vision and confidence in the future is thus called for in launching the development of the cement-based industries in West Africa. The assistance and role of governments must be directed to promoting and encouraging the more intensive utlization of a product which is heavily dependent on local resources, which generates savings in foreign exchange expenditure on imports of other substitute materials, and which would eventually lead to lower construction costs. Architects, engineers, training institutions and research organizations could all play important roles in the growth of the industry by elaborating and facilitating the technical solutions adapted to the relevant needs and specified conditions of the sub-region, alternatives, and advantages of using the products in preference to competing materials.

58. These are observations provoked by the evidence of the current market and by the demand that went unsatisfied by cement-based products. But what are the future prospects of the market for cement-based products? To answer this question, firstly, trends in construction activities must be examined and, secondly, the likely changes in the intensity of utilization of cement-based products as economic development proceeds must be assessed. It is on the basis of these two principles that a methodology of projecting future demand is now elaborated.

CHAPTER V

ESTIMATION OF DEMAND

59. It is of basic importance, in the use of a methodology for projecting future demands of cement-based products, to consider first of all the magnitude of investments channelled into the economy, since the over-all construction activity is directly linked with it. This does not mean that the minimum requirements for housing are necessarily going to be satisfied, but only relates the possibility of investment under the present price structure and technical knowledge with the number of dwellings that may be built by a specific date.

60. Starting with the "gross domestic product" (GDP) and the "gross domestic fixed capital formation" (GDFCF),[1] the share of investment on "Housing and Building" can be determined by assuming a percentage that falls in the range of 30 to 50 per cent in the case of developing countries. The ratio of the share of the construction industry in the gross domestic fixed capital formation (GDFCF) tends to decrease when the gross domestic product (GDP) increases. This means that the housing problem begins to be less critical in relative terms. This general trend cannot possibly be justified for some time since the present housing stock in the West African sub-region requires almost total replacement and the high rate of population growth requires doubling of housing facilities every 20 to 30 years, which is critical in urban areas where this population increase appears every ten years. For this reason, the share of housing and building in capital formation must remain at a high level (40 to 45 per cent). The costs that go into public services and other related facilities are around 30 per cent.[2] The investments in housing and building are about 70 per cent for housing and 30 per cent for non-residential buildings.[3] Knowing now the total housing investment, the relationship between low, medium and high income groups must be determined. The percentages proposed, for projecting the

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1/ For further information see "The Construction Industry in Development Programmes - A Techno-economic Review in the West African Sub-region" (E/CN.14/INR/107).
2/ Document HOU/WP/7
3/ Document E/CN.14/INR/93, Annex I.

investment in the three groups of the population are 80 per cent, 15 per cent and 5 per cent, respectively.

61. In order to convert investment into quantity of square metres of floor area, it is proposed to use a building cost of US $50, US $90 and US $120 for low, medium and high income groups, respectively, and US $60 per m2 for industrial constructions. This will amount, in 1980, to approximately 12.3 million square metres of construction for low-cost housing, 1.3 million for medium, 0.3 million for high income and 14.8 million for other constructions or 28.6 million square metres of total constructed area. The above assumptions are summarized in Table 11 below:-

TABLE 11

Estimate of Gross Floor Area of Housing and Building Constructions in West Africa

	1965	1980
	(Million US $)	
1. Gross Domestic Capital Formation	1,231	5,408
2. Investments in Construction (64% of 1)	788	3,461
3. The Share of Housing & Building Investments (40% and 45% of 1 in 1965 and 1980 respectively)	492	2,434
4. Expenditure on Services & Related Facilities (30% of 3)	148	730
5. Hence Investment in Housing and Building Construction Proper (3-4)	344	1,704
6. Investment in Housing and Residential Building (45% of 5)	155	767
of which (i) low cost housing(80% of 6)	124	614
(ii) medium cost housing (15% of 6)	23	115
(iii) high cost housing (5% of 6)	8	38
7. Investments in Non-Residential Building (55% of 5)	189	937
of which (i) industrial building (40% of 7)	76	375
(ii) education & health building (40% of 7)	76	375
(iii) others (20% of 7)	37	187

TABLE 11 (cont'd)

Estimate of Gross Floor Area of Housing and Building Constructions in W. Africa

	1965	1980
	(Million m^2)	
8. Conversion of Investments into Quantities		
(i) low cost housing at $50 per m^2	2.48	12.28
(ii) medium cost housing at $90 per m^2	0.26	1.28
(iii) high cost housing at $120 per m^2	0.07	0.32
(iv) industrial building at $50 per m^2	1.52	7.50
(v) education & health building at $70 per m^2	1.09	5.36
(vi) other building at $100 per m^2	0.37	1.87
9. Total of Gross Floor Demand	5.79	28.61

62. It is now necessary to translate the above estimates of the volumes of housing and building activity into quantities of cement-based material requirements. For this purpose it would be necessary to make some further assumptions, the justifications of which are primarily based on observations of the current level of the relative utilization of cement-products and the significant change that would come about in this level with the growth of the industry. Particular reference in this connexion is made to the paper on the cement industry in West Africa,[1/] where it was concluded that in so far as cement consumption is concerned, the elasticity of demand is directly and positively related to the growth of the economy as expressed by the ratio of GDFCF to GDP. While the elasticity of cement consumption is currently estimated at 0.62 in the West African sub-region, this is expected to increase to nearly 1.3 in the nineteen eighties. This change in the intensity of cement utilization would result from the need for more durable materials than are used today in constructions as the economy advances. Cement is in the forefront of those materials that are durable and also have a large scope for extensive use in construction activities.

63. The same trend would be expected to characterize the consumption of cement-based products at least for the reason that cement constitutes the single most important ingredient of these products. Thus, the share of cement-based products in such elements of construction as walling, roofing, flooring, drainage works, etc., would be expected to increase substantially.

1/ Document E/CN.14/INR/117, August 1966.

Table 12 below summarizes the percentage shares that could be reserved to cement-products for each construction element in 1965 and 1980 for the sub-region as a whole. The 1965 estimate is based on an appraisal of present material utilization practice in the sub-region and it must be pointed out that the estimation relies heavily on general observations rather than on approximations based on statistical data. The 1980 estimate is arrived at by roughly doubling the 1965 estimate for the reason that the intensity of cement utilization is expected to double in the period 1965-1980.

TABLE 12

Estimates of Percentage Shares of Factory Fabricated Cement-Products in Various Construction Elements

Construction Element	Material	Estimate of Percentage Share 1965	1980
Walling	Concrete Blocks	30	50
	Asbestos-sheets	5	10
	Other materials	65	40
Roofing	Asbestos-sheets	20	45
	Concrete tiles	-	5
	Concrete Block Fills for Slabs	5	10
	Others	75	40
Flooring	Cement & Grano Tiles	20	60
	Others	80	40
	Concrete Block Fills for Slabs	20	60 (of multi-storey buildings only)
	Others (mainly R.C. Slabs)	80	40
Drainage and Irrigation Works	Concrete Pipes	20	30
	Asbestos Pipes	5	40
	Others	85	30

64. The above estimates are taken to represent the average percentage shares of a widely varying range of construction activities. Depending on the type of construction, on its standard and its function, the percentage shares would have to be modified accordingly. But it would be pretentious and futile to attempt sophistications in the use of projection tools when faced, on the one hand, with a complex and diverse pattern of combinations and alternative choices such as is the case of cement-products utilization and, on the other, with a lack of data to lay a firm basis for projection. The basic aim under the circumstances is to be able to arrive at a broad assessment of future demand and to appreciate the over-all direction and possible target for the development of the industry within the broad framework of general growth. It is thought that the coefficients summarized in Table 13 would be adequate for the limited purpose for which they have been elaborated. The scope for the utilization of cement-products is so large in the context of the planned construction growth of the sub-region[1/] that it could safely be said that the question of over-estimation would not arise. Perhaps the more valid argument might be the opposite in which case the projected estimate could be considered as the lower target for developing the industry.

65. The breakdown of housing and building by constructions in individual houses and in multi-storey buildings is required for purposes of estimating the requirements for concrete-block fills in suspended concrete slabs and roofs. The breakdown is assumed to be 70 per cent for individual houses and 30 per cent for multi-storey buildings in 1965 and 60 per cent and 40 per cent, respectively, in 1980. As regards drainage works, the amount to be expended on the acquisition of pipes is taken as 60 per cent of the value of drainage works associated with housing and building which itself is assumed as 30 per cent of the sum left aside for services and related facilities. Prices of US $20 per ton for concrete pipes and US $120 per ton for asbestos pipes are taken to arrive at the quantities required of each product.

1/ Document E/CN.14/INR/107

66. To estimate pipe requirements for irrigation, roadworks and other general civil engineering works, 60 per cent of investments in this sector are taken to represent the expenditure on materials of which 10 per cent is assumed to represent the share of expenditure on pipes. Again the prices noted in the last paragraph are used to arrive at the quantities required of each product.

67. Tables 13 and 14 below thus take up the projection exercise where it was left off in Table 11 earlier. Firstly, based on gross floor areas as indicated in Table 10, the magnitudes of walling, roofing and flooring works are computed. These are then translated into magnitudes of cement-products requirements in Table 13. In the next Table (Table 14) the requirements for cement-based pipes and drains are estimated, based on the broad assumptions and coefficients established earlier and recalled below.

Notes: 1. "Walling superficial areas" are calculated on the basis of coefficients established for the relationship of wall to gross floor area for individual types of construction
2. To convert wall areas into weights of concrete blocks, 400 kg was taken as the weight of concrete blocks per m^2 of walling.
3. Asbestos-cement sheets for walling were computed by making an allowance of 20 per cent for overlaps and by taking 15 kg as the weight of 1 m^2 of useful covered area.
4. Concrete block fill tonnages were arrived at by using 112.5 kg as the weight of the material per m^2.
5. The weight per m^2 of cement and grano tiles was taken as 75 kg.
6. The weight per m^2 of concrete and roof tiles was taken as 30 kg.
7. To arrive at the actual quantity required for roof covers (a) the gross floor area was distributed into individual and multi-storey buildings, (b) the average number of floors in multi-storey buildings was taken as four and (c) allowances were made for roof laps and roof slopes, the medium coefficients being 1.2 and 1.58, respectively.

TABLE 13

Demand Estimate of Cement-Based Building

Materials for Housing & Building in W. Africa

Construction Element	Gross Floor Area: Type of construction	Quantity in million m^2 1965	Quantity in million m^2 1980	Total Quantity of construction element million m^2 1965	Total Quantity of construction element million m^2 1980	Requirement of cement-based products mill.m^2 1965	Requirement of cement-based products mill.m^2 1980	Requirements Converted into Tonnage million tons 1965	Requirements Converted into Tonnage million tons 1980
Walling Materials	(i) Low cost housing	2.48	12.28	6.20	30.70				
	(ii) Medium cost housing	0.26	1.28	0.46	2.24				
	(iii) High cost housing	0.07	0.32	0.10	0.45				
	(iv) Industrial housing	1.52	7.50	2.43	12.00				
	(v) Educational etc.	1.09	5.36	1.91	9.38				
	(vi) Other buildings	0.37	1.87	0.52	2.62				
	All constructions	5.79	28.61	11.62	57.39				
	Asbestos sheets					0.70	6.89	0.01	0.10
	Concrete Blocks					3.49	28.70	1.40	11.48
Flooring Materials	All construction	5.79	28.61	4.92	24.32				
	Cement & Grano Tiles					0.98	14.59	0.08	1.09
	Concrete Block Fills					0.10	6.49	0.01	0.73
Roofing Materials	All construction	5.79	28.61	5.09	26.32				
	Asbestos sheets					1.93	22.45	0.03	0.34
	Concrete Tiles					-	2.24	-	0.07
	Concrete Block Fills					0.26	3.95	0.03	0.44
Totals of cement-based materials for Housing and Building	Concrete Blocks & Concrete Block Fills (million tons)							1.44	12.65
	Cement and Grano Tiles							0.08	1.09
	Asbestos-cement Sheets							0.04	0.44
	Concrete Roof Tiles							-	0.07

TABLE 14

Demand Estimate of Cement-Based Pipes and Culverts in Drainage & Irrigation Works in West Africa

		1965	1980
		(million US$)	
A.	1. Investments in Drainage & Services, etc., Works related to Housing & Building	148	730
	2. Share of the Above Investments in Drainage Works Alone (30% of 1)	44	110
	3. Expenditure on the Acquisition of Pipe and Drainage Materials (60% of 2)	26	66
	of which the share of pipes (20% and 30% of 3 in 1965 and 1980, respectively)	5.2	19.8
	of which the share of asbestos pipes (5% and 40% of 3 in 1965 and 1980, respectively)	1.3	26.4
	4. Conversion into quantities:		
		(million tons)	
	Concrete Pipes at $ 20 per ton	0.26	1.00
	Asbestos Pipes at $ 120 per ton	0.01	0.22
		(million US$)	
B.	1. Investments in Construction other than Housing and Building	296	1,027
	2. Expenditure on the Acquisition of materials (60% of 1)	178	616
	3. Share of Pipe & Drainage Materials (10% of 2)	18	62
	- of which concrete pipes (as A.3.above)	3.6	18.6
	- of which asbestos pipes (as A.3.above)	0.9	24.8
	4. Conversion into quantities:		
		(million tons)	
	Concrete Pipes at $20 per ton	0.8	0.93
	Asbestos Pipes at $120 per ton	0.01	0.21
C.	Totals of cement-based pipes for Drainage & Irrigation works (i) Concrete Pipes	0.44	1.93
	(ii) Asbestos Pipes	0.02	0.43

68. The above estimates do not encompass all the possible applications of cement-based products. Among the items which are not included, for example, are precast elements for electric and telephone transmission poles, fencing grills, claustras, road kerbs, paving slates, etc. as well as cement-products used for temporary structures such as building site sheds, etc. That the above estimates are on the low side is further evidenced from the observations that (a) the unit costs of building used throughout the projection period are those prevailing currently, i.e., the prospects of reduced construction costs are not taken into account; (b) similarly, for the market prices of pipe products; and (c) the estimates being based on completed work of a given building element, no adjustment has been made for wastage of materials in delivering to and handling at the building site. For these reasons, the estimates of projected demand as they emerged in tables 14 and 15 ought to be considered as representing the minimum within the assumed growth of the construction industry.

69. The breakdown of the sub-regional estimates of demand are shown in Table 15 below. This was arrived at simply by allocating demand according to the share of each country of the sub-regional investments in construction in 1965 and 1980.[1/] This method has of course a drawback in that it does not make allowance for differences in intensity of utilization of cement-products amongst countries. While this should not give rise to objections in so far as the 1980 country distribution of the sub-regional demand is concerned because the country differences in the relative utilization of cement-products would have narrowed by then, the 1965 distribution might be seriously questioned. It is possible, under the prevailing wide differences among countries in the relative utilization of the products, that the 1965 demand might have been under-estimated for some countries and over-estimated for others. It would, therefore, be more advisable to consider the 1965 country distribution as purely indicative of a broad order of magnitude and give more reliance to the sub-regional total as representative of the 1965 market for cement-based products.

1/ For further data see document E/CN.14/INR/107

TABLE 15

Estimates of Demand[a/] by Country

Country	Share of Each Country of the Sub-regional Construction Investment (%)		Distribution by Country of Estimated Demand of Cement-Based Products (Thousand Tons)		
	1965	1980	Material	1965	1980
Dahomey	1.0	1.1	(i) Concrete Blocks & Fills	14.4	139.2
			(ii) Cement & Grano Tiles	0.8	12.0
			(iii) Asbestos-Cement Sheets	0.4	4.8
			(iv) Asbestos-Cement Pipes	0.2	4.7
			(v) Concrete Pipe Products	4.4	21.2
Gambia	0.1	0.2	(i) CBF	1.44	25.3
			(ii) CGT	0.08	2.18
			(iii) ACS	0.04	0.88
			(iv) ACP	0.02	0.86
			(v) CPP	0.44	3.86
Ghana	22.5	14.8	(i) CBF	324.0	1,872.2
			(ii) CGT	18.0	161.3
			(iii) ACS	9.0	65.1
			(iv) ACP	4.5	63.6
			(v) CPP	99.0	285.6
Guinea	1.0	2.2	(i) CBF	14.4	278.4
			(ii) CGT	0.8	24.0
			(iii) ACS	0.4	9.6
			(iv) ACP	0.2	9.4
			(v) CPP	4.4	42.4
Ivory Coast	12.3	12.6	(i) CBF	177.1	1,593.9
			(ii) CGT	9.8	137.3
			(iii) ACS	4.9	55.4
			(iv) ACP	2.5	54.2
			(v) CPP	54.1	243.1
Liberia	5.3	4.0	(i) CBF	76.3	506.0
			(ii) CGT	4.2	43.6
			(iii) ACS	2.1	17.60
			(iv) ACP	1.1	17.20
			(v) CPP	23.3	77.20
Mali	2.8	2.6	(i) CBF	40.3	328.9
			(ii) CGT	1.8	28.3
			(iii) ACS	1.4	11.4
			(iv) ACP	0.7	11.2
			(v) CPP	12.3	50.2

TABLE 15 (Cont'd)

Estimates of Demand[a] by Country

Mauritania	3.9	1.6	(i) CBF	56.2	202.4
			(ii) CGT	3.1	17.4
			(iii) ACS	1.5	7.0
			(iv) ACP	0.8	6.9
			(v) CPP	17.2	30.9
Niger	2.7	3.1	(i) CBF	40.3	392.2
			(ii) CGT	1.8	33.8
			(iii) ACS	1.4	13.6
			(iv) ACP	0.7	13.3
			(v) CPP	12.3	59.8
Nigeria	37.8	43.9	(i) CBF	544.3	5,553.4
			(ii) CGT	30.2	478.5
			(iii) ACS	15.1	193.2
			(iv) ACP	7.6	188.8
			(v) CPP	166.3	847.3
Senegal	5.8	6.6	(i) CBF	83.5	835.2
			(ii) CGT	4.6	72.0
			(iii) ACS	2.3	28.8
			(iv) ACP	1.2	28.2
			(v) CPP	25.5	127.2
Sierra Leone	2.1	2.9	(i) CBF	30.2	366.9
			(ii) CGT	1.7	31.6
			(iii) ACS	0.9	12.8
			(iv) ACP	0.5	12.5
			(v) CPP	9.2	56.0
Togo	1.0	1.2	(i) CBF	14.4	151.8
			(ii) CGT	0.8	13.1
			(iii) ACS	0.4	5.3
			(iv) ACP	0.2	5.2
			(v) CPP	4.4	23.2
Upper Volta	1.7	3.2	(i) CBF	24.5	404.8
			(ii) CGT	1.4	34.8
			(iii) ACS	0.7	14.0
			(iv) ACP	0.4	13.8
			(v) CPP	7.5	61.8
Sub-Region	100.0	100.0	Concrete Blocks & Fills	1,440	12,650
			Cement & Grano Tiles	80	1,090
			Asbestos Cement Sheets	40	440
			Asbestos Cement Pipes	20	430
			Concrete Pipes	440	1,980

a/ Net demand, i.e., excluding breakage, wastage and allowances for overlaps of Sheeting materials, etc., also excluding precast elements such as kerbs, Slabs, transmission poles, moulded products, etc.

CHAPTER VI

THE EXPANSION NEEDS OF THE CEMENT-BASED INDUSTRIES

70. Although it is likely to have been under-estimated as pointed out in the last chapter, the magnitudes of the 1980 demand for cement-based products as it has emerged is nevertheless one that would require a major expansion of the cement-based industries. Table 16 overleaf first estimates the magnitude of shortages of each product and secondly proposes sizes and distribution of productive units for each country of the sub-region. Although the major share of the sub-regional expansion is envisaged to take place in Nigeria and to a lesser degree in Ghana and the Ivory Coast, each country of the sub-region is seen as participating in the over-all development of the industry. In fact only Gambia is expected not to be in a position to set up an asbestos-cement industry in 1980.

71. The proposed expansion of the industry thus foresees 492 concrete products installations in units varying from an annual capacity of 10,000 tons to 200,000 tons, 114 cement and grano tiles installations in units of 5,000 - 40,000 tons per annum capacity, 7 concrete roof tile installations of 10,000 tons per annum capacity, and 25 asbestos-cement products plants in units varying from 15,000 - 100,000 tons per annum capacity. The smaller units are more numerous, thus complying with the need to widely distribute production to minimize transport costs of these heavy and bulky products.

72. The production from these units would require a supply of cement of the order of 3.2 million tons (2.4 million tons to the concrete products industry and 0.8 million tons to the asbestos-cement industry). This amount is estimated to be over 25 per cent of the 1980 estimated consumption of cement in the sub-region[1/] and contrasts with the current level of 15 per cent accounted for by the cement-based industries of total cement shipments. This change is a manifestation of the increasing intensity of the utilization of cement-based products as the construction industry grows within the framework of over-all economic growth.

1/ See "A Development Programme for the West African Cement Industry" (E/CN.14/INR/117).

TABLE 16

Proposals for the Expansion of the West African Cement-based Industries, 1965-1980

	Dahomey	Gambia	Ghana	Guinea	Ivory Coast	Liberia	Mali	Mauritania	Niger	Nigeria	Senegal	Sierra-Leone	Togo	Upper Volta	Sub-region
1. 1980 Shortages: '000 tons															
Conc. blocks and fills	140	30	1860	320	1700	520	346	175	425	5990	900	405	165	460	13436
Cement and Grano tiles	13	3	160	26	140	43	30	20	35	490	74	33	14	37	1118
Concrete Pipes	20	4	186	40	190	60	50	30	60	680	100	60	25	60	1565
Asbestos-Cement Products	13	2.5	170	25	142	45	30	18	35	430	74	33	14	36	1068
Concrete roof tiles															70
2. No. of New Plants by Capacity in '000 tons															
Conc. blocks and fills (one 8-hr shift)	1x60 1x40 4x10	1x40	4x150 4x100 8x60 10x40	2x80 2x40 8x10	2x150 4x100 8x60 10x40 12x10	4x60 5x20 8x10	2x80 2x40 3x20 5x10	2x60 6x10	2x60 4x40 15x10	4x200 10x100 15x60 25x40 50x20 120x10	2x150 2x100 6x60 10x20	2x60 4x40 14x10	2x60 5x10	2x60 4x40 2x20 14x10	4x200 8x150 20x100 61x60 63x40 70x20 215x10
Cement and Grano tiles (one 8-hr shift)	3x5	1x5	10x5 4x20 1x40	2x5 2x10	10x5 5x20	4x5 1x20	2x5 1x20	2x10	3x5 1x20	20x5 10x10 5x20 4x40	6x5 2x20	3x5 1x20	3x5	3x5 1x20	71x5 15x10 22x20 6x40
Concrete Roof Tiles (one 8-hr shift)	-	-	2x10	-	1x10	-	-	-	-	2x10	1x10				1x10
Asbestos-Cement Products (Three 8-hr shifts)	1x15	-	2x60 3x20	1x30	2x60 1x20	1x40	1x30	1x15	1x40	2x100 4x60	1x30 1x40	1x30	1x15	1x40	3x15 4x20 4x30 4x40 8x60 2x100
Concrete Pipes (one 8-hr shift)	2x10	1x5	10x10 4x20	2x10 1x20	10x10 5x20	2x10 2x20	3x10 1x20	3x10	2x10 2x20	30x10 10x20 5x40	6x10 2x20	2x10 2x20	2x10 1x5	2x10 2x20	2x5 76x10 31x20 5x40
3. Investments Required: '000US$															
Concrete Blocks and Fills	700	150	9300	1600	8500	2600	3460	875	4250	29950	4500	2025	825	4600	73335
Cement and Grano tiles	300	100	3400	600	3000	800	900	400	1050	6900	1400	700	300	1050	20900
Concrete Roof Tiles	-	-	300	-	150	-	-	-	-	300	150	-	-	-	900
Asbestos-Cement Products	1500	-	14400	3000	10400	4000	3600	1800	6000	28800	7000	3000	1500	6000	92800
Concrete Pipes	300	100	2700	450	3000	900	1000	450	1200	10500	1500	900	300	1200	24580
4. Total of Investments '000 US$	2800	350	30100	5650	25050	8300	8960	3525	12500	76450	14550	6625	3005	12850	212515

Table 16 - continued

Notes: 1. Shortages for concrete blocks and fills calculated by first deducting the 1965 demand from 1980 and then adding 20 per cent for other products, e.g. road kerbs, fencing grilles, etc., and also for breakage.

2. Shortages of cement tiles done likewise but adding only 10% for wastages.

3. Shortages for asbestos-cement products are calculated by adding 30% for moulded products, overlaps and wastage.

4. Unit costs of investments estimated as follows:

US$ 5-10 concrete blocks
20-30 cement tiles
15-20 concrete pipes
70-150 asbestos-cement products

Furthermore, the 1980 percentage share of cement delivery to the cement-based industries compares to the share that is observed in developed countries currently. From scant evidence available, cement delivery to the cement-based industries, excluding ready-mix concrete bales, is in the range of 20 - 25 per cent of total deliveries.[1/]

73. The over-all estimates of the main raw-material inputs required for the 1980 level of production can be summarized as follows:-

Mainly domestically available items		Mainly import items	
Cement (million tons)	3.2	Asbestos (million tons)	0.2
Sand " "	4.4	Additives etc. " "	0.2
Aggregates " "	9.0	Reinforcement bars "	0.3

By 1980, cement is expected to be available from domestic sources in the majority of the countries of the sub-region. By and large, good quality sand is extensively found in the sub-region and should not pose a problem of supply. But the high estimated level of demand for sand and aggregates should be recognized by the pit and quarry industry so that it could organize itself for efficient production.

74. Geological surveys have not established asbestos deposits in the sub-region. This material is, therefore, expected to constitute an import item. The traditional sources for asbestos are Canada, South Africa and Rhodesia, but promising deposits have also been recognized in some East African countries. Additives for colouring and for treating asbestos-cement products and concrete roof tiles are also likely to remain import items; so also marble chips for floor tiles. With the proposed expansion of the iron and steel industry, reinforcing bars are, however, expected to be available within the sub-region by 1980.

75. Raw material inputs represent the single most important item of the cost of production of cement-based products. Fuel and power inputs represent a small share of the cost of production. Generally, the composition of the cost of production has the following pattern:-

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1/ Cement in the Commonwealth, London 1963; Mineral Industry Surveys Washington 1962.

Raw material inputs	60 - 70%
Fuel and power	2 - 5%
Labour and overheads	15 - 20%
Depreciation and maintenance	10 - 18%

76. Cement inputs account for nearly 70 per cent of the raw material inputs in concrete products manufactures and 60 per cent of asbestos-cement manufactures. Although raw material inputs are thus preponderant in costs of production, this does not mean that the industry should be raw material resources oriented. On the contrary, the industry is market oriented because the long distance transportation of the products is an expensive proposition since they are heavy and bulky in addition to being characterized by fragility in handling. On the other hand, most of the raw materials inputs - at least the most important ones from the standpoint of costs - could be transported over long distances relatively more cheaply. The fact that cement, asbestos or reinforcing rods might have to be imported would not hinder the development of the industry. Fuel and power do not influence locations either since the quantities required are small. Fuel can be brought from distant sources without incurring unduly high expenses and if power is not locally available a small generator could be installed relatively cheaply. But it is essential that the location of concrete products industries be near sources of sand and aggregates for these are materials which could incur high costs in long distance haulages.

77. Table 16 also estimates the investments that would be required over the period 1965-1980 to develop the cement-based industries. These are estimated on the basis of current evidence of unit costs per ton of product manufactured. The average unit costs assumed are indicated in the notes to the table. The total investment requirements are thus estimated at nearly US $213 million of which the concrete block and roof industries account for US $ 74 million, the cement tiles for US $ 21 million, the concrete pipes for US $ 26 million and the asbestos-cement industries for US $ 93 million.

78. The magnitude of the investments is high, but it nevertheless is thought to be the minimum that is compatible with the rapid growth of the construction industry as envisaged for the period 1965-1980. If the cement-based industries are to play their allocated role in this growth then the planned expansion must be undertaken, and the magnitude of the investments must rather be viewed against the perspectives of the benefits that will accrue to the economy.

79. The major and most significant benefits cannot be quantified meaningfully. But it could be appreciated that it is of outstanding importance to improve productivity in the construction industry. One of the prime determinants of rates of economic growth is the level of productive investment and it is against this background that economies in construction must be appraised. Developments in cement and concrete production and technology are of central importance to the objectives of reduced building costs.

80. Productivity is greatly improved by the transference of labour from site to factory. The effect on productivity of the use of precast elements is seen not only in the direct reduction of building costs and elimination of wastage but also in the improvement in quality of finished constructions. In developing countries where trained manpower is in inadequate supply, the factory production of construction elements thus has obvious advantages. Also of great importance for productivity in the building industry is regularity in delivery of building materials. This is essential to eliminate idle time, and the availability of domestic cement-based industries goes far to alleviate this problem. Domestic production further opens a wide scope for major economies in the design.

81. Once launched on the right path of development, the concrete industries can continuously offer economies in construction. Building costs could be reduced through the use of light weight concrete, ready-mix concrete, prefabrication, standardization and modular co-ordination. Important savings can be made in building costs by the reduction of the deadweight of structures through the use of lightweight concrete. The production of ready-mix concrete is fast gaining in importance for the

advantages of quality, reliability and economy of production and use that it offers. In many of the developed countries cement delivery for ready-mix concrete currently accounts for some 20 per cent of total delivery.

82. The factory fabrication of whole sections of building has gained momentum in the developed countries for its obvious advantages derived from mass production methods. Although at present the size of the centralized markets in developing countries might not justify the adoption of modern prefabrication technology, its future development cannot be overlooked. The planned growth of the construction industry in West Africa in the period 1965-1980 is of such a magnitude that one effective way of coping with the huge problem of supply that it is expected to pose towards 1980 would surely be the adoption of prefabrication technology.[1/]

83. Often involving a measure of standardization and prefabrications, much use is being made of concrete even today in housing and building. Already two panel prefabrication plants have been erected in West Africa, and the use of precast components has been gaining ground in many parts of the sub-region. Urbanization is taking place on a large scale and industrialization is creating new industrial areas. To provide the necessary housing and related facilities on the desired scale without imposing an undue burden on the national or household budgets, progress will need to be made with advanced building techniques and the requisite materials and adapted to the needs of the developing countries.

84. Table 17 overleaf is an attempt at quantifying the gains that are expected in employment and value added through the expansion of the cement-based industries in addition to those mentioned above. The Table is an indicative model and does not claim to reflect actual magnitudes in 1980. This is because the coefficients used to calculate gross business output and value added are based on 1965 estimates and do not take into account changes in prices or structural changes in the composition of gross business output. Thus gross business output has been calculated

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1/ (E/CN.14/INR/107).

TABLE 17 - Indicative Estimates of the Contribution to the Economy of the Proposed Expansion of the Cement-Based Industries

	Dahomey	Gambia	Ghana	Guinea	Ivory-Coast	Liberia	Mali	Mauritania	Niger	Nigeria	Senegal	Sierra-Leone	Togo	Upper Volta	Sub-region
Investments mill.US $:-															
(i) Concrete products	1.3	0.35	15.7	2.65	14.65	4.3	5.36	1.73	6.5	47.65	7.55	3.63	1.51	6.85	122.75
(ii) asbestos-cement products	1.5	-	14.4	3.0	10.4	4.0	3.6	1.8	6.0	28.8	7.0	3.0	1.5	6.0	92.8
TOTAL	2.8	0.35	30.1	5.65	25.05	8.3	8.96	3.53	12.5	76.45	14.55	6.63	3.01	12.85	212.52
Value of Annual gross output mill.US $															
(i) concrete products	3.5	0.8	46.2	8.0	41.6	12.0	12.9	4.5	15.6	147.2	23.5	10.0	4.1	11.2	340.0
(ii) asbestos cement products	1.6	-	20.4	3.0	17.0	5.4	4.2	2.2	4.9	51.6	8.9	4.0	1.7	5.4	129.9
TOTAL	5.1	0.8	66.6	11.0	58.6	17.4	17.1	6.7	20.5	198.8	32.4	14.0	5.8	16.2	470.8
Value Added mill.US $															
(i) concrete products	1.9	0.5	27.7	4.8	25.0	7.2	7.7	2.7	9.4	88.3	14.1	6.0	2.5	6.7	204.5
(ii) asbestos-cement products	1.0	-	13.3	2.0	11.1	3.5	2.7	1.4	3.2	33.5	5.8	2.6	1.1	3.3	84.4
TOTAL	2.9	0.5	41.0	6.8	36.1	10.7	10.4	4.1	12.6	121.8	19.9	8.6	3.6	10.0	288.9
Employment number															
(i) concrete products	600	100	8020	1300	7430	2080	1430	750	1730	24,500	3910	1660	680	1850	56,040
(ii) asbestos-cement products	150	-	1400	300	1000	350	300	150	350	2,600	650	300	150	350	8,050
TOTAL	750	100	9420	1600	8430	2430	1730	900	2080	27,000	4510	1960	830	2200	64,090

on the basis of 1965 prices of the products and value added has been assumed to be 60 per cent of gross output for concrete products and 65 per cent for asbestos-cement products. Labour employment has been computed on the basis of an average annual output of 300 tons per employed for concrete products and about 100-150 tons for asbestos-cement products.

85. On the basis of these assumptions it will be noted that the annual gross output of the cement-based industries is expected to exceed US $ 470 million by 1980 and value added to reach nearly US $290 million. Equally significant, the industry would be expected to offer employment to some 64,000 persons. The distribution of this by occupations is estimated as follows:-

Managerial and Professional Personnel	1500
Technicians, Supervisors and Maintenance Personnel	4000
Clerks and Administrative Staff	8000
Skilled labourers	23,000
Others	27,000

86. Besides these important contributions to the economy, the savings in foreign exchange would also be expected to be considerable. The expansion of the industry would enable it to capture 35 per cent of the market of roofing materials (mainly metal sheets) and 55 per cent of the market for drainage and irrigation pipes (mainly iron and steel tubes and pipes). It will be recalled that in 1963 alone, imports of galvanized sheets and iron and steel tubes and pipes amounted to nearly US $25 million. With the continuing growth of the construction industry, this will be multiplied several fold and will give rise to a serious foreign exchange drain if the substitute cement-based products are not developed as indicated.

87. Finally the proposed development of the cement-based industry still falls short of its full possibilities. Further scope for development exists within the framework of the possibilities of the industrialization of building as referred to earlier. The preparation of ready-mix concrete, panel prefabrication, and the fabrication of still more precast elements to substitute currently imported materials such as metal sheets for water reservoirs, kitchen and sanitary installations etc., or to reduce costs of traditionally constructed elements such as septic tanks, etc. all remain to be explored and developed.

88. The magnitude of the expansion programme also suggests the feasibility of sub-regional manufacture of the industry's needs for machinery, tools and equipment. For example if it is assumed that one block press can produce 10,000 tons per annum, then the requirement for block presses in the period 1965-1980 would be of the order of 14000 units or approximately 900 units per year. In addition, there is no reason why tile presses, pipe making machinery, machinery for roof tiles, etc., should not also be manufactured within the sub-region. Clearly then the expansion of the cement-based industries also opens up prospects for the development of the engineering industries in the sub-region.
