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FORECASTING IRON AND STEEL DEMAND IN DEVELOPING COUNTRIES 1/

by

Economic Commission for Africa

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FORECASTING IRON AND STEEL DEMAND IN DEVELOPING COUNTRIES

by

R. Robson,
Economic Commission for Africa

SUMMARY

The process of development involves not only an acceleration in the rate of growth of an economy but also in the case of developing countries a considerable change in structure including in particular a rapid expansion of the metal-using industries. It is therefore not appropriate to attempt to forecast future iron and steel demand by a prolongation of previous rates of increase or by linking it to a single index such as that of industrial output generally. On the other hand, the statistical and planning apparatus of these countries is not adequate to employ the end use method used in highly developed countries, namely the construction of an elaborate sectorial forecast of the economy and its evaluation in terms of steel content.

It is therefore suggested that the most suitable procedure in most cases is to relate the demand for iron and steel to the development of the economy as indicated by the Gross Domestic Product and Capital Formation, the latter being important as the major steel-using sector and as a determinant of the rate of growth. It may be assumed that these two factors will always be available even in the most elementary forecasts. The procedure will give an estimate of total, direct and indirect demand for iron and steel and it is necessary in developing countries to subtract indirect

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* This is a summary of a paper issued under the same title as ID/WG.14/12.

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consumption, i.e. imports of machinery and transport equipment and machinery in developed countries usually to add exports). The basis for estimating these imports is the proportion of engineering requirements likely to be met by the domestic industry.

The procedure is described in detail for African countries. It is shown that there is a close relation between increases in total iron and steel consumption and increases in Gross Domestic Product when adjusted by its capital formation content. It is also shown that the division of consumption between construction and engineering uses is remarkably constant so that projected consumption can be estimated in these two categories. For determining the proportion of engineering demand which should be met by local industry a further breakdown of engineering demand is suggested as part of an engineering study or alternatively standard proportions are proposed. Non-ferrous metal consumption which is an integral part of engineering production is estimated at the same time. For the division of consumption into types of steel it is suggested that the proportions obtaining in the engineering industries of developed countries may be used in the engineering sector but that in the construction sector the division should reflect local conditions.

Introduction

The scope of this study includes a description of the various methods available for forecasting iron and steel demand followed by a discussion as to how far they may be adopted to the circumstances of developing countries and by a more detailed account of methods actually employed in Africa.

The methods

Methods of forecasting iron and steel demand may be classified according to the degree of sophistication involved which in turn depends on the statistical and planning apparatus of the country concerned. In the countries which are advanced in this respect it has been practicable to use the end-use method which consists of identifying all the products or groups of products in which steel is used, listing the output targets for these products in the year for which the forecast is required, evaluating their steel content on the basis of current usage with allowance for technological change and then aggregating. Since the steel content of the various products may at the same time be estimated by type the method also results in a breakdown of the aggregate by types. The method implies the existence of a detailed forecast of the prospective structure of the economy in value terms distinguishing not only broad sectors i.e. consumption, investment, imports, exports and intermediate use but also the maximum sub-division by industry such as as given in the input-output table. Such procedures have been employed by the United Kingdom Iron and Steel Board (Development in the Iron and Steel Industry, Special Report 1961) by the Indian National Council of Applied Economic Research (Reappraisal of Steel Demand 1963), more recently in the former Federation of Rhodesia and Nyasaland and in connexion with projections for the Third Turkish Steelworks and in the various planned economies.

Another class of forecasting methods consists of relating steel consumption to some single index of growth for which a projection exists such as industrial output in general. This is not very satisfactory however in developing countries where the metal using industries may be developing at a very different rate from the rest of industry. Moreover it is scarcely practicable to make a forecast of industrial output except as part of a general forecast of the development of an economy.

Reference may also be made to the autogenous method of forecasting steel demand based on establishing a relation between the initial level of steel consumption and its expected annual percentage increase employed by the Economic Commission for Europe (long term trends and problems of the European steel industry).

The method involves a large margin of error it its application to particular countries - although perhaps no greater than the total error of other methods in forecasting the indicator and then calculating the correlation. Its disadvantage is that it is not related in any way to the planned economic development of a country.

Application to developing countries

It would seem therefore that the most useful approach to the problem of forecasting iron and steel demand in developing countries is to link demand to the general development of the economy and to do this in such detail as is practicable. The general development of the economy is measured in the first place by the growth of the Gross Domestic Product, and steel through its use in machines and structures for capital formation, in durable consumer goods and in intermediate goods is involved in all sectors. A projection will exist for G.D.P. and moreover since the growth of G.D.P. is determined by capital formation a projection will also exist for this- or can be readily calculated through the capital-output ratio. (In its simplest form assuming a constant ratio between capital formation and increases in output then

$$c = \frac{I\,dt}{dO}$$ where I is investment and O the gross domestic product

which since $I = p.O$ where p is the proportion of G.D.P. going to investme

$$= \frac{p.O.dt}{dO}$$

or $\frac{1.dO}{O.dt}$ = rate of growth = p/c)

Since capital formation consists of machines, buildings and transport equipment all of which are highly steel intensive this will have identified a major steel user.

Division of total (direct and indirect) consumption of steel into construction and engineering uses in 1951 (1000 tons)

	Federation	United Kingdom
Total steel consumption	250	10959
Construction	109	3726
Engineering	141	7233
of which imports	86	500

The table also shows the proportion of steel going to construction and engineering uses and as will be shown below there is in fact a remarkable constancy in this proportion after taking account of the level of total consumption so that having calculated total iron and steel demand the amount used in construction can be immediately derived, and at the same time the total demand for engineering goods.

There remains the problem of forecasting the proportion of total engineering demand which will be supplied by the domestic engineering industry. In practice a forecast of engineering production will usually be made at the same time as that of iron and steel production. It will be done by breaking down the total demand for engineering goods into types and then deciding for which of these types the market is large enough to permit economic production.

If such a forecast is not available then the same principle may be applied with somewhat less precision to the figure of total demand. It will be noted that in the two examples given above the proportion of total engineering demand supplied by the domestic industry was about 40 per cent and about 93 per cent respectively. The difference is largely due to the much larger market available to domestic producers in the latter case and in fact as will be shown below it is practicable from a consideration of the size of the market to estimate the proportion which domestic industry should obtain.

The position in this regard may be illustrated by calculations relating to the United Kingdom and to the former Federation of Rhodesia and Nyasaland in 1961.

	£ mln	Federation Steel content		£ mln	United Kingdom Steel content	
		'000 tons	kg per £		'000 tons	kg per £
Gross Domestic Product	561	250	0.45	24083	10959	0.45
Expenditure on capital formation	111	143	1.29	4551	7425	1.60
Other expenditure i.e. on consumer goods and on non-capital intermediate goods such as repairs and accessories	450	117	0.26	19532	4134	0.21

The difference between the steel content per £ expenditure on capital formation is sufficiently explained by the transport costs and installation charges on imported machinery. The difference between the steel content of expenditure on non-capital goods is due to the relatively greater importance in the Federation of mining which is a large user of steel.

Taking accordingly the position in the former Federation as typical of that in developing countries it would appear that expenditure on non-capital formation is approximately five times as steel intensive as expenditure on non-capital formation. And it is therefore necessary to make this adjustment in calculating the steel content of the projected Gross Domestic Project.

In this way, as will be shown in detail below, a fairly exact forecast can be made of total iron and steel demand including in this indirect demand i.e. the iron and steel content of imports of machinery and transport equipment which is the case of developing countries and as shown in the following table is very important.

The estimated demand for iron and steel for engineering purposes may then be added to the preceding estimate for construction purposes. A division into types may be made as far as engineering goods are concerned on the basis of the distribution available in developed countries, and for construction uses, on the basis of the current distribution in the country concerned.

Africam examples

The table overleaf gives current G.D.P. per head in African countries adjusted as indicated above for its capital formation content and corresponding to this the consumption of basic metal i.e. ferrous and non-ferrous per head (it is more convenient to take basic metal rather than iron and steel only, because engineering goods necessarily have a non-ferrous metal content and in any event it is useful to obtain a forecast of non-ferrous metal demand at the same time as for iron and steel).

The regression line showing the relation between the logarithms of these two variables is given on the attached chart[1/]. It is a close relation and in fact persists as far as to include the corresponding figures for the United Kingdom.

The equation is Log M = 1.217 Log O - 1.707 kg where M (basic metal consumption per head) is measured in kg and O (adjusted G.D.P. per head) is measured in $.

The elasticity of increases in metal consumption per head in relation to increases in G.D.P. per head is therefore 1.217 (It is surprising at first that the same elasticity appears to represent the position in a developed country such as the United Kingdom but it should be observed that this figure corresponds in absolute terms to one of perhaps 1.1 and after allowing for substitution of iron and steel by non-ferrous metal and plastics would fall below unity as expected).

Some countries lie above this line because of their more steel intensive structure, in particular the petroleum producing countries Algeria and Libya, where consumption of steel in the form of pipe line is important. This may be adjusted-for pipe line construction the average

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1/ Chart not reproducible.

G.D.P. and basic metal consumption in African countries

	G.D.P. per head		Consumption of basic metal per head				
			Total	Constr.	...Engineering..... Total	Prod.	Non-ferrou
	Actual	Adjusted	kg				
Average 1963/65							
Algeria	192	427	22.0	6.2	15.8	3.8	0.6
Libya	485	1273	111.2	36.4	73.8	3.9	0.9
Morocco	181	297	19.6	8.9	10.7	4.7	0.7
Tunisia	197	422	37.9	19.5	18.4	2.8	0.5
Sudan	96	182	11.8	5.0	6.8	0.2	0.1
UAR	141	271	29.4	15.7	13.7	5.8	0.8
Average 1962/64							
Mauritania	137	423	13.5	3.8	9.7	1.1	--
Senegal	167	264	18.0	19.6	8.4	4.4	0.2
Mali	64	108	3.2	1.5	1.7	0.3	—
Ivory Coast	198	380	21.1	7.3	13.8	3.0	0.1
Upper Volta	43	69	2.5	1.0	1.5	0.2	—
Dahomey	69	115	6.5	3.4	3.1	0.6	—
Niger	79	123	2.4	0.8	1.6	0.2	—
Gambia	74	121	10.3	4.1	6.2	0.8	—
Guinea	68	110	7.6	3.7	3.9	1.0	0.1
Sierra Leone	110	249	20.9	8.2	12.7	2.3	0.3
Liberia	238	366	55.5	15.9	39.6	6.8	3.0
Ghana	211	436	28.9	9.4	19.5	9.2	0.7
Togo	82	132	8.5	3.5	5.0	0.7	0.1
Nigeria	68	116	8.3	4.1	4.2	1.4	0.2
Average 1961/63							
Rhodesia/Zambia/Malawi	148	317	35.3	14.8	20.5	6.4	0.7
Ethiopia	40	74	2.6	1.4	1.2	0.2	—
Somalia	45	67	3.1	1.4	1.7	0.4	0.1
Rwanda	42	65	5.3	2.4	2.9	0.6	0.1
Burundi	44	68	5.3	2.4	2.9	0.4	0.1
Mozambique	145	207	9.0	2.0	6.1	0.7	0.3
Tanzania	64	98	5.8	2.7	3.1	0.5	0.1
Madagascar	97	144	8.9	4.9	4.0	1.2	0.1
Uganda	63	99	3.8	1.3	2.5	0.3	—
Kenya	80	132	18.2	10.6	7.6	3.8	0.6
Mauritius	217	419	43.7	20.1	23.6	3.6	0.5
Average 1963/64							
Congo (Democratic Republic)	78	152	6.2	..	..	..	..
Cameroon	125	193	12.4	..	..	..	..
Congo (Brazzaville)	154	270	34.2	..	..	..	..
Central African Republic	108	144	7.5	..	..	..	..
Chad	64	104	3.4	..	..	..	..
Gabon	412	980	63.2	..	..	..	..
South Africa (1964)	560	1160	130.0	..	..	..	..
United Kingdom (1963)	1350	2610	278	95	183	191	33

investment is about £1,500 per inch width mile equal to £15,000 for a ten inch pipe weighing 65 tons per mile and £54,000 for a 36 inch pipe weighing 380 tons per mile i.e. the steel content of £1 investment is from 4 to 7 kg - and making this adjustment the figures conform to the regression line.

Otherwise in applying the formula to the circumstances of a particular country it is probably preferable to use the differential form i.e. that starting from the current position the annual increase in total consumption of basic metal per head will be 1.217 times the annual increase in adjusted G.D.P. per head.

As already indicated the division of basic metal consumption between construction and engineering uses is remarkably constant. In the case of African countries the equation has the form

Log E = 1.029 Log M - 0.36 kg where E is consumption of engineering goods and this equation also represents the position in the United Kingdom. Alternatively since the rate of growth is so small one can write

E = 0.657 M - 0.97 kg i.e. the proportion going to engineering uses tends towards two-thirds.

While either of these equations will provide an estimate of total engineering usage they shed no light on the expected contribution from the domestic engineering industry. For this purpose and failing an independent estimate it is necessary to relate this share to the size of the market. An examination of the figures in the preceding table shows however that there is no constant relation in this regard; in fact as shown by the following table only Senegal, Ghana, Rhodesia and Kenya and to a slightly less extent, Morocco and the UAR, can be regarded as at present fully exploiting the industrial potential of their market. In comparison is shown the position in the United Kingdom and the projected position in the West African and East African sub-regions in 1980 with full development of the engineering industries.

1,000 tons

	Engineering goods	
	Total Consumption	Share of Domestic industry
Senegal	28	50
Ghana	142	47
Rhodesia	125	45
Denya	65	50
Morocco	135	44
UAR	388	42
Average, above countries	140	45
Average, all other African countries	44	19
Projection of West African sub-region 1980	2200	55
Projection of East African sub-region 1980	1575	52
United Kingdom 1963	9900	94

The relation between the total market for engineering goods and the share of the domestic industry suggested by the preceding figures (see attached chart[2/]) is

% share of domestic industry = 5 times consumption in million tons + 44

suggesting that 44 per cent of the market should be virtually a minimum share.

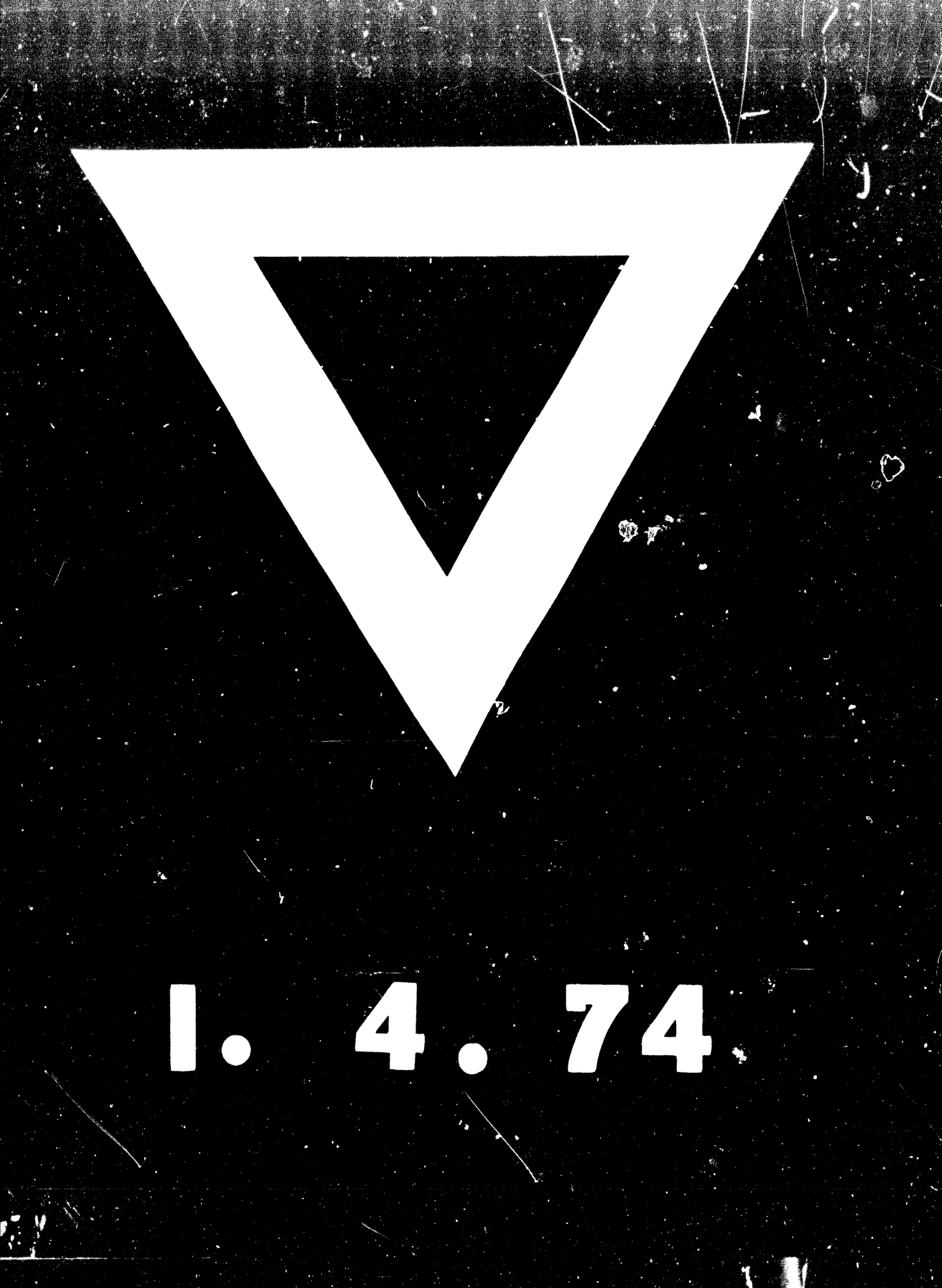
9. While with the exception of small quantitites of lead and copper tubing and some uninsulated wire virtually all construction usage is iron and steel a substantial proportion of non-ferrous metal is used in engineering. The preceding figures for African countries, which also conform to the United Kingdom position, suggest the equation

Consumption of non-ferrous metal per head = 0.165 consumption of engineering goods per head - .02 kg

implying that with increasing engineering development the percentage rises to 16.5. This is a static position however derived from a consideration of the various country statistics at the present time and needs to be modified by changes over time. For this purpose it may be sufficient to adopt the forecasts given in the document UN.ECE 1966, Aspects of competition between steel and other materials, which suggests

2/ Chart not reproducible.

that aluminium usage could increase by a further 1 per cent of steel usage while in addition steel would lose 1.4 per cent to plastics and paper.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