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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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by

Miles M. Sherover,
Venezuela

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SUMMARY

During the last fifty years there has been a strong wave of industrial development in regions of the world which have since become known as the developing countries. Areas which had hitherto existed with a primitive economy have advanced boldly into the initial stages of modern industrial enterprise. In this development the need was created for construction materials, primarily of the steel required in connexion with the erection of factories, houses, buildings, etc. During the period from 1918 to 1939 a great number of small rolling mills and steel plants, many of them starting in a primitive fashion and with limited means, developed into viable enterprises capable of satisfying local needs.

* This is a summary of a paper issued under the same title as ID/WG.14/52.

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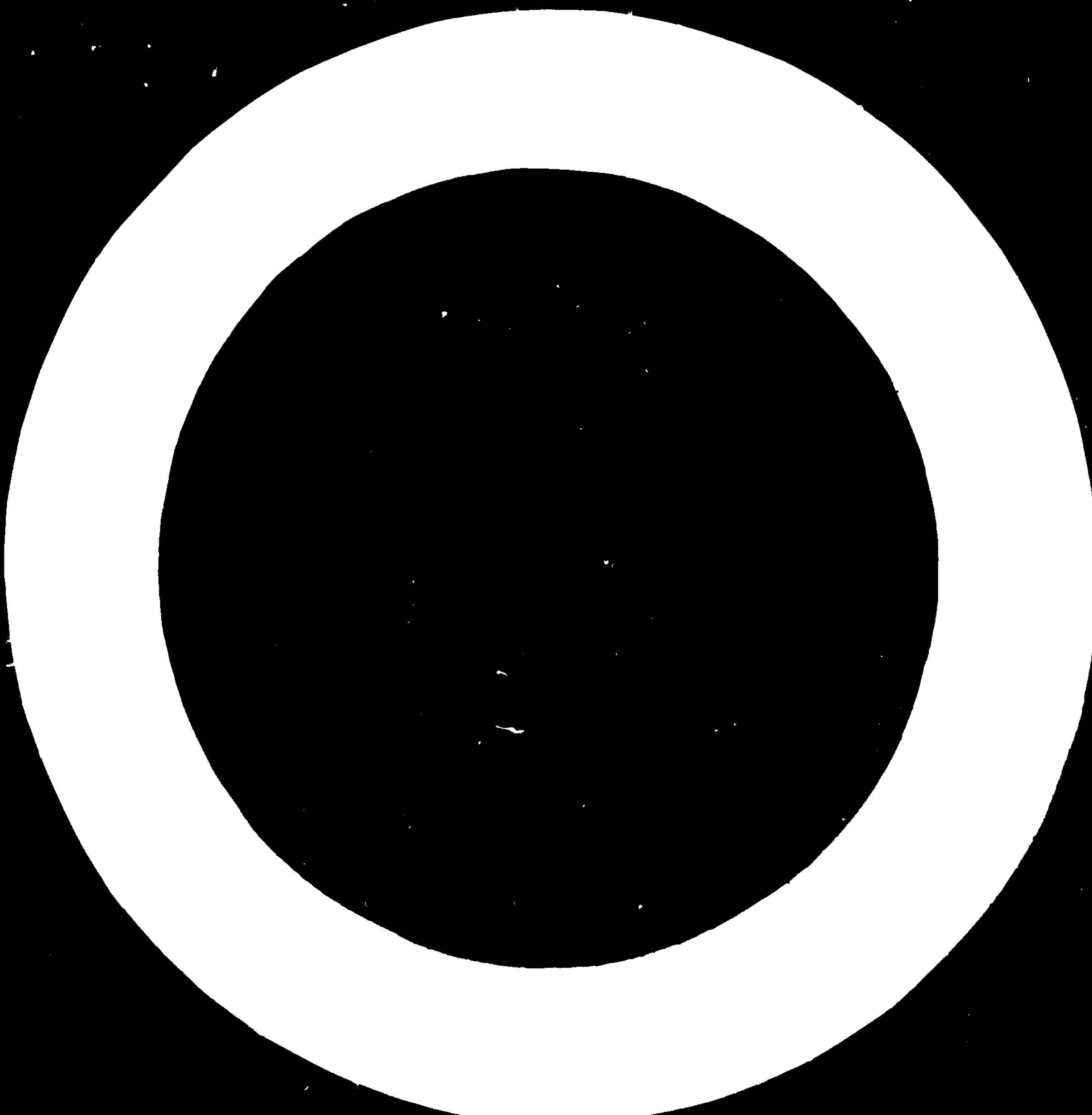


Following the Second World War the need for establishing simple steel plants that would satisfy immediate essential requirements of easily manufactured steel became obvious in all developing countries.

The requirements for the successful establishment and operation of a semi-integrated steel plant capable of meeting the demand in developing regions are as follows. First of all, a detailed survey must be made of the local requirements and an analysis made of the available resources. Furthermore, a projection of ten to fifteen years' future demands should be established. Primarily, these initial steel requirements will take the form of reinforcing bars, wire and simple shapes. Fortunately, these products are also the easiest to make.

If the estimated requirements of the area which can be served by economically available transportation is a minimum of 30,000 tons, the possibility for a plant exists. If the market has an immediate potential of 100,000 tons of the products mentioned above, the prospects for a viable plant are very good.

Assuming that sufficient electric energy is readily available, the most logical plant would be one based on the melting of scrap by an electric arc furnace and the rolling of the steel so melted into the desired products. A study must be made of what scrap supplies are locally available, and plant should be located to which local scrap can be most easily delivered, and from where deliveries of the finished products to the market can be economically made.

If sufficient local scrap is not available, the plant should be sited at a deepwater port, to which scrap can be shipped from abroad. Since scrap is a commodity freely available in international trade, import of scrap is not necessarily a handicap to the successful operation of a plant erected at or near port facilities for ocean going vessels. If adequate labour is not available at the site, housing must be provided so that labour can be housed near the plant site.

In the planning adequate provision should be made for future growth and expansion. The layout should be such that facilities for increased output can be added without halting production in the existing plant or sacrificing too much of the structures and equipment already in existence. Thought must be given to the flow of materials and product to avoid bottle necks and back cracking.

The most desirable melting practice for such a plant would be to concentrate on low carbon steel (0.12-0.20 C) which would be cast into small moulds producing billet sized ingots of 120 - 200 kilos. The advantages of casting such a small billet sized ingot is that it can be rolled into finished products with only one reheating. This practice has been proved economical and efficient for the rolling of a full range of sizes of reinforcing bars, wire and small shapes, using only one heat.

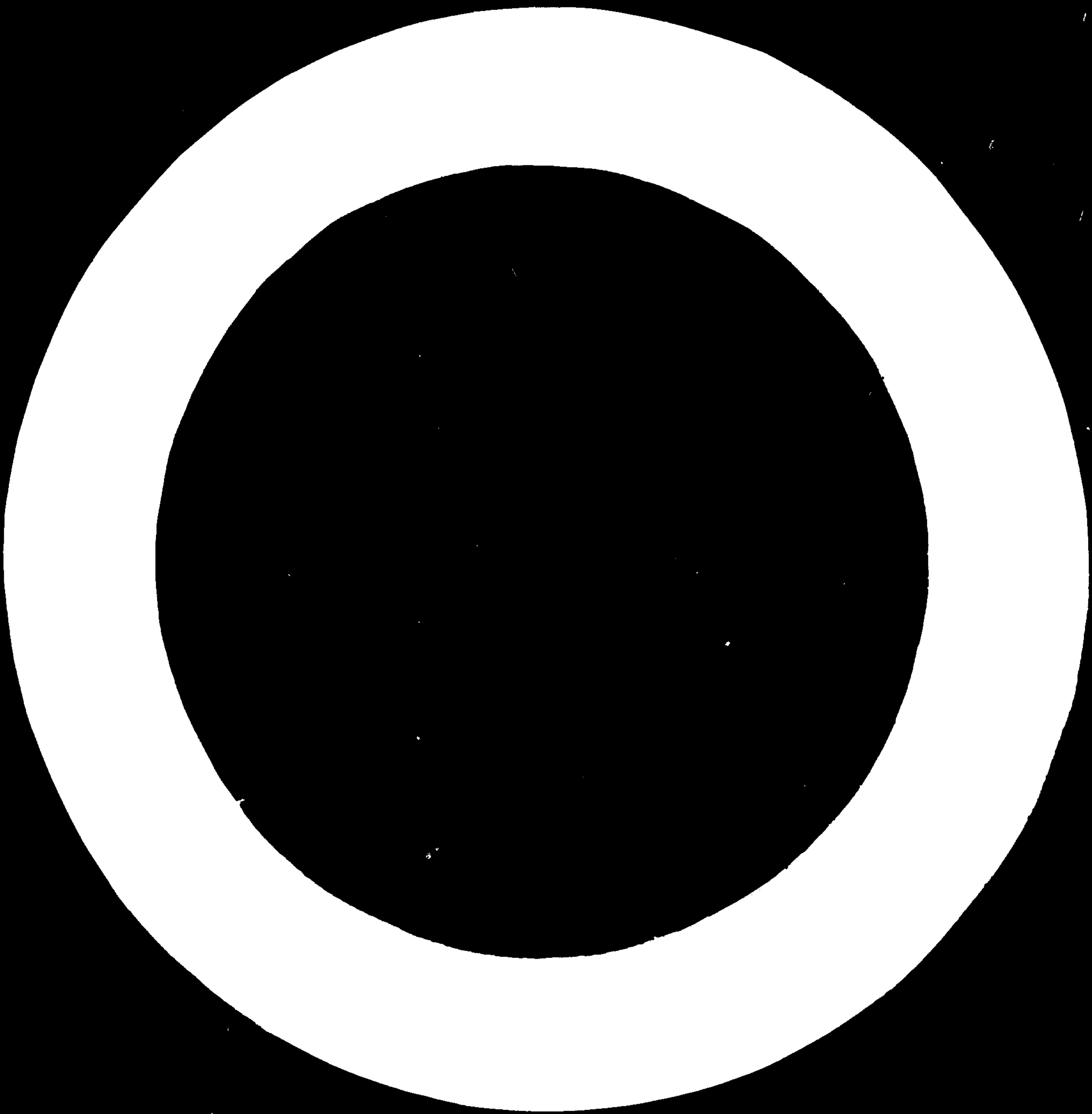
A simple pusher type of reheating furnace with either gas or oil fuel is very desirable. The rolling mill can consist of two or three 16" or 18" stands used as a breakdown mill, leading to a five or six stand 12" cross-country mill and if wire is required, a continuous 6-stand 10" mill. If wire is to be produced, obviously coilers will be required. If production is limited to reinforcing bars, these can be rolled out onto a hand hot-bed or an automatic hot-bed.

In many parts of the world small plants have been started with a small rolling mill capable of producing reinforcing for a range of 8 mm to 25 mm. A mill of this type could start on a basis of importing suitable billets from overseas. Such a mill can be adapted for the rolling of wire and small shapes, in proportion to the quantity of reinforcing bar required by local markets. Obviously a small rolling mill of this type by itself is a very marginal economic proposition. The difference between the cost of importing finished reinforcing bars and importing billets suitable for rolling mill is so small that the margin of profit available hardly meets the cost of rolling.

It is for this reason that practically everywhere that a rolling has been established as the initial stage of a small steel plant, thought has been immediately given to establishing a melting shop for the purpose of supplying the billets to the rolling mill. This development has practically always taken the path of the electric arc furnace. Small open hearth furnaces are definitely outdated, uneconomical and hard to operate, especially so in regions or situations where little or no experience in steel making is available.

If a sufficiently high grade of iron ore is available and can be easily mined, the possibility exists of further integration in the small steel plant. This consits of the installation of a Norwegian smelting furnace for the production of pig iron from ore. The requirement here, in addition to the good grade of iron ore is sufficient and cheap electric power, some limestone and a cheap and readily available supply of low grade coal or other type of carbon. The Norwegian smelting furnace is a proven instrument for the production of pig iron where the quantities required do not justify the installation of blast furnaces. These smelting furnaoes are comparatively efficient producers of pig iron in quantities as low as 100 ton a day units. If sufficient and cheap scrap is not available and iron ore of good grade does exist, the wisdom of installing a Norwegian type smelting furnace should be considered. The product produced, of course, is pig iron and this requires a further step to convert the pig iron into raw steel. For this purpose modern technique recommends a basic oxygen furnace.

The small integrated steel plant finds difficulty in being oompetitive with the giant fully integrated steel plant known throughout the world. Local conditions and local requirements, however, may make such a small semi-integrated plant viable and profitable. The economic parameter and practical aspects relevant to small integrated and semi-integrated plants are assessed in the latter part of the paper.



During the last fifty years, that is since the end of the First World War, there has been a strong wave of industrial development in regions of the world which have since become known as the developing countries. Areas which had hitherto existed with a primitive economy, have advanced boldly into the initial stages of modern industrial enterprise. In this development, the need was created for construction materials and primarily of the steel required in connection with the erection of factories, houses, buildings and etc. These developing regions which were mainly colonial dependencies of European powers, used to fill their requirements by importing their steel from the large European or American steel giants. With the continuing development of their industrial requirements, these regions turned their thoughts to the possibilities of producing their own steel. As a result, during the period from 1918 - 1939, a great number of small rolling mills and steel plants, many of them starting in a primitive fashion and with limited means, developed into viable enterprises, capable of satisfying local needs.

Following the Second World War, and the disintegration of the colonial regimes in Africa and Asia, scores of newly independent states were established, all looking forward to an increase of their industrial possibilities. The need for establishing simple steel plants that would satisfy immediate essential requirements of easily manufactured steel, become obvious in all developing countries. However, many of the small semi-integrated plants were established without efficient planning and the results have not always been successful.

What then are the requirements for the successful establishment and operation of a semi-integrated steel plant, capable of meeting the demand in developing regions ? First of all, a detailed survey must be made of the local requirements and an analysis of the available resources. Furthermore, a projection of ten to fifteen years future demands should be established. Primarily, these initial steel requirements will take the form of reinforcing bars, wire and simple shapes. Fortunately, these products are also the easiest to be made.

If the estimated requirements of the area which can be served by economically available transportation, is a minimum of 30'000 tons, the possibility for a plant exists. If the market has an immediate potential of a 100'000 tons of the products mentioned above, the prospects for a viable plant are very good.

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In the planning adequate provision should be made for future growth and expansion. The layout should be such that facilities for increased output can be added without halting production in the existing plant or sacrifycing too much of the structures and equipment already in existence. Thought must be given to the flow of materials and product to avoid bottle necks and back tracking.

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Up till now we have been speaking of the semi-integrated steel plant based on domestic supply of scrap or the importation of scrap. However, if a sufficiently high grade of iron ore is available and can be easily mined, the possibility exists of further integration in the small steel plant. This consists of the ihstallation of a Norwegian smelting furnace for the production of pig iron from ore. The requirement here in addition to the good grade of iron ore is sufficient and cheap electric power, some lime stone and a cheap and readily availabe suplly of low grade coal or other type of carbon. The Norwegian smelting furnace is a proveninstrument for the production of pig iron, where the quantities required do not justify the installation of blast furnaces. These smelting furnaces are comparatively efficient producers of pig iron in quantities as low as 100 ton a day units. If sufficient and cheap scrap is not available and iron ore of good grade does exist, the wisdom of installing a Norwegian type smelting furnace should be considered. The product produced of course is pig iron and this requires a further step to convert the pig iron into raw steel. For this purpose, modern technique recommends a basic oxygen furnace.

Up till now, we have outlined the basic physical units required for beginning a semi-integrated steel plant. Now what about the economics? It goes without saying that any small integrated steel plant cannot be competitive with the giant fully integrated steel plants, known throughout the world.

However, local conditions and local requirements may make such a small semi-integrated plant viable and profitable. This depends on many factors.

Many of the developing countries are faced with a continuous shortage of foreign exchange. Import of steel as well as many other industrial products would be much cheaper if sufficient foreign exchange were available. Developing countries however, must go through the phase of stimulating infant industries, even though these may not be competitive with identical products imported from abroad. Providing employment and industrial training for its population and the saving of foreign exchange may be the factors which will induce developing countries to provide tariff or licencing protection to a newly established steel plant.

However, the differences in cost of the finished product to the consumer need not be exhorbitant. The writer has checked cost figures of many small plants similar to the kind described in this paper. There are of course wide differences in the cost of scrap, in the cost of labour, power and supervision.

However, assuming the cost of scrap at the mill to be $ 30.-- per ton, electric power $ 0.01 per KWH and average wage rates for skilled and unskilled labour of $ 1.50 per hour, it has been shown that the cost of producing billet sized ingots need not be more than $ 70.-- per ton, and the total production cost of reinforcing bar about $ 82.-- per ton.

The figures given above do not include overhead, sales and capital costs. If we add reasonable depreciation of capital costs and keep overhead cost to a minimum, we should still be able to produce reinforcing bars and small shapes at a price of $ 100.-- per ton in a semi-integrated plant with a total output of approx. 100'000 tons a year.

This price under today's conditions is about 15% higher than landed cif prices of imported reinforcing bars. However, we must not lose sight of the fact that the biggest part of the outlay for domestic production is in local currency, thus creating a substantial foreign exchange saving for the domestic economy.

To insure the successful design and operation of a small integrated steel plant in a developing country, the organising group would be well advised to secure the know-how and cooperation of a presently operating and successful semi-integrated plant in some other developing country. The know-how of large fully integrated multi-million ton steel plants in developed countries is of little practical value to a project for a small semi-integrated plant in a developing country. The problems and the experience required are totally different to the problems of the small semi-integrated plant. Conditions in developing countries provide a base, to which the experience of a plant which has been started in another developing country can be applied more successfully. In the training of unskilled labour, a supervisory personnel of an already operating steel plant in a developing country can be of decisive help.

Taking into consideration that the cost of labour in developing countries is substantially lower than that of developed countries, the new plant should be designed with the simplest and least expensive equipment, capable of reasonably efficient production. High capital cost, labour saving equipment can be postponed until basic industrial training has been achieved. Sophisticated equipment used in modern steel plants to eliminate costly labour hours, will not justify itself in the initial stages of a developing country's plant. Thus, for instance, the installation of continuous casting. Though this process has proved itself, it would be inadvisable to install at the initial stage of a small semi-integrated plant. Experience has shown that the small plant is better off casting a small billet sized ingot, weighing approximately 150 kilos. True, this involves much more labour, but for the new plant in a developing country with inexperienced and unskilled labour, this is a more desirable method of producing its billets. The same can be said of a mechanized highly sophisticated hot-bed. Many plants in developing countries have operated successfully without a mechanized hot-bed, but admittedly this required additional labour.

A final caution to the sponsors and organizers of steel plants in developing countries. Consider carefully the proposed capital outlay. Over investment in highly sophisticated modern equipment, suitable only for intensively industrialized countries, can be very dangerous to the stability of the enterprise.

Last but not least may I stress the importance of good management. Without efficient and experienced management, the best planned enterprise can end in disaster. Good incentives to proper management can be the key to the successful semi-integrated steel plant in a developing country.

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