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ENGLISH

UPGRADE THE SKILLS AND CAPABILITEES OF PROFESSIONALS (ENGINEERS AND TECHNICIANS) EMPLOYED IN ROLLING MILL PLANTS TO SHOW AVAILABLE PROCEDURE OF ROLL PASS DESIGN AND ASPECTS OF PLANTS PLANNING

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Turkey.

TECHNICAL REPORT:

PLANNING OF ROLLING MILL PLANTS AND ROLL PASS DESIGN TECHNOLOGY

Prepered for the Government of Turkey by the UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZA. Acting as Executing Agency for the UNDP.

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INDUSTRIAL TRAINING AND DEVELOPMENT CENTRE

ANKARA

ABSTRACT

The present knowledge and experience on rolling mill technology and specifically on roll pass design, as for as Turkish Rolling Mills are concern, are not adeguate to the present demand.

Therefore, in order to upgrade the skills and capabilities of professionals employed in rolling mill plants, UNIDO, on request of the Turkish Government, established and weeks job, executed jointly with the Industrial Training and Development Centre-Ankara.

In order to elaborate suitable programme of training, technical vizits to state and private owned Companies have been organized. During these visits, sets of serious problems facing the Turkish Rolling Mills have been presented, by the managing bodies of the Rolling Mills.

Among others, the following should be mentioned:
- high production costs
- low productivity
- high rejection rate
- relatively poor quality

- Most of these problems may be solved by performing suitably planed and executed modernization, and improving rolling process.

To elucidate the nowadays tendency in rolling mill technology and pass design, three days seminar, plant conferences and lectures have been organized and performed.

The problem of education and training on roll pass design is however larger, and due to its importance to the national economy, should be subject of continuation in the future.

A C K N O W L E D G E M E N T

Autor of this Report, feels deep necessity of his great thanks to the management of the Industrial Training and Development Centre, Ankara, for excellent organization of his duty and co-operation during the whole period of activity of I.T.D.C.

The outhor wishes to express his sincere thanks to the managing bodies of the state enterprises as well as the private plants visited, for their kind attention and exchanging of ideas, for their interest taken during technical visits to the plants,and serious treatment of the conducted conversations. If any of the given recommendations will be of benefit to the plants,this will be my best reward.

I wish to express my deepest thanks to the counterpart MR.Teoman TÜMER, Mr. Ali HAN and all the ITDC staff for their fruitfull and excellent cooperation.

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A N N E X E S

I N T R O D U C T I O N

During the last 10 years, the Turkish economy shows a dynamic development in all: industrial, agriculture, trade and financial sectors. Basing on the production volume, differenciating of products, their technological level and quality, as well as developed intrastructure and avalable service, The Turkish economy should be counted to the last phase of intermediate stage of development, just before reaching the level of developed countries.

In the light of the above, the steel consumption per capita, should be some 250-300 KGS. In spite of the above, the domestic production of liguid steel is less than 100 KGS per capita. Some quantity of billets are imported for further re-rolling. Taken into account that some quantity of finished rolled products is subject of export (mostly neighboring countries, Iran and Irak) as well as direct and indirect import of steel,the present total consumption can be estimated as some 100-120 KGS per capita.This about half of the value mentioned above.

This indicates, that the development of Iron and Steel industry in the next future will be the crucial problem of the country development, and if the development is not to be slow down, domestic production of steel-mostly in the form of finished rolled products must be doubled in the period of the coming 5 to 8 years.

Proper development, and full benification of such development, can be secured only when adeguately trained and experienced professionals and specialists will be avalaible in this country. Up till now the enterprises depends almost entirely on foreign support as for as for as rolling mill technology and process are concerned.

The problem is additionally complicated due to the two sectors that is to say,the state owned steel works and privete rolling mill plants. Intermediate sector (state and prived sheare holdings) are obser as well.

In order to solve the problem, UNIDO on the request of the Turkish Government opened 8 weeks post (in the frame of the large project- INDUSTRIAL TRAINING AND DEVELOPMENT CENTRE -which started 1978) aimed to "upgrade the skills and capabilities of professionals (engineers and technicians) employed in rolling mill plants, to show available procedure of roll pass design and aspects of plants planning.

This report is a result of the above mentioned project, which lasted 8 weeks, begining 31 st March to 25 th of May 1..5.

R E C O M M E N D A T I O N S

1. Training on roll pass design for the engineers employed on the Rolling Mills should be considered as one of the most important issue to be performed in the very next future.

   The training may be organized as post-graduated courses, or specially organized courses on a one year basis.Simultaneously, Rolling Mill specialization on one of the Metallurgical Faculty of the Turkish Technical Universities ought to be established, in order to educate on regular basis specialists on rolling mill technology.

2. Modernization of the Karabük Rolling Mills should be performed if the Rolling Mills are sepposed to produce of accepted costs, and accepted quality, the finished rolled products.

3. For the Continuous Billets Rolling Mill, Continuous Bars and light sections Rolling Mill as well as Continuos Rods Rolling Mill of the Iskenderun Iron and Steel Works, suitable plans for improvement operation of the electronical and electrical equipment should be elaborated and implimented into practice such improvement will create real possibilities of increasing production of the rolling mills in question, Simultaneously decreasing production costs.

4. Modernization of the continuous Rod Mill of the Iskenderun Iron and steel Works should be seriously taken into account, in order to increase production of this rolling mill, as well as improve quality of the rolled rods, up to internationally accepted standards.

5. Suitable marketing survey on domestic present and future demand for speciall quality steels should be performed.This will be the first step for increasing dorestic production of these tuypes of steel grades.

6. Modernization of most of the reheating furnaces should be performed, in order to increase the termal efficiency of the furnaces; and as a result, decreasing of the rolling mill production costs will be achieved.

7. On almost all of the Turkish Rolling Mills, suitable improvement of rolles cooling systems should be performed, in onder to increase life time of the rolles, and thus, decreasing the rolling mill production costs.

I. THE PRESENT STATE OF THE TURKISH ROLLING MILL PLANTS

- RODS, BAPS AND SECTIONS-

- At present, there are three fully integrated steel Workes in Turkey. Two of ther are state owned.
  - The Karabük Iron and Steel Works
  - The Iskenderun Iron and Steel Works

The Third, the is the share State and private holding Enterprise, dealing with that products therefore this plant will be not under consideration in the scope of this report Beside the fully integrated Steel Works, substantial contribution in producing of steel plants and rolling mills.

Some of this plants are semi-integrated, basing on Electric Arc Funaces with or with-out continuous Casting Machines and rolling mills. Output of these steel plants is very differenciated , and very from some 10000 tons/year up to 50 000 tons/year.

It should be added th there are more than 100 small scale rolling (reolling) mills, basing on domestic or imported billets. Output of these rolling mills, some 3000 tons/year to 30 000 tons/year.

- The private owned steel plants and rolling mills are grouped in six regions of Turkey, that is to say.
  - Istanbul
  - Izmir
  - Bursa
  - Denizli
  - Karabük
    Ankara

Production of special/Quality Steels is concentrated of two plants.

- Asil-Çelik - Bursa (state owned)
- Metaş - Izmir (private plant)

Some other enterprises and plants started with production of special/quality steels, but do not succeed.

It is a common belive, that the demand for special/quality steels is very low in Turkey, but due to the relatively high develope of ship-building, cars, tractors, agruculture machinery and tools, as well as defence industries, the demand (at present) must be of some 250 000 tons/year or more, but in most instances is a subject of direct or inderect import.

A. STATE ENTERPRISES

Three State Steel Works have been vizited. Feach of quite different type, technological level of process and production, as well as technological and infrastructure equipment.

The Karabük Iron and Steel Works, is the oldest Turkish fully integrated plant. But due to obsolate proces-which in most cases has not been chaned and developt since almost 50 years, the production costs are high, productivity and quality of products relatively low. Modernization of the plant is at the time being one of the most important problem, if the plant is supose to produce on economically justified level and quality according to international standards.

The Iskenderun Iron and Steel Works , is at present the largest steel Works in Turkey. The plant started with production, of the first erected shop in 1975, and progressively other shops have been put into operation . At the time being, the Medium Section Rolling Mill is under start-up period, and simul-to-neously, the second stage of the works erection is in full progress.

The adopted process of the plant is up to nowadays standards, as far as steel works of capacity over 1 milion tons/year are concern, that is to say Blast-furnace process/with sintering plant, coke ovens), LD convertors, continuous casting machines and Rolling Mills. The problem of this steel Works is the not full utilization of the installed production capacities. This creates serious economical issues. Another problem is the relatively low quality of the rods products (rolled on the continious rod rolling mill) . Improvement in operation of the existing rolling mills should be taken into account.

The Asil Çelik

This is the only one Steel Works (semi-integrated) in Turkey which has been designed and erected to meet the requirements of special/quality steels. The design and erection of the plant is a result of international co-operation.

The design of the plant was based on the Thyssen Edelstahlwerke A.G. of West Germany. The main equipment was supplied by Ishikawajima-Harima Heavy Industries Co LTD. (I H I) - Japan. Erection of plant, instalation of equipment and start-up period was superwized by Keiser Engineers International Inc.-USA. In spite of the fact, that the plant is based on good technological and praduction know-how, some improvement, related to the latest development in manufacturing of special/quality steels ought to be recommended, mostly in order to improve plant economy and create facilities for more flaxible production possibilities.It should be noted that the managing staff of the Plant, is awere of these problems and is seriously considering some modernization aspects of the Plant.

1. Karabük Iron and Steel Works.

Report on Technical visit paid to the Karabük Iron and Steel Works is attached to this report as ANNEX NO 3 . The visit due to the specific subject of the job, has been limited too the Rolling Mills only.

Rolling Mills of the Karabük Iron and Steel Works essentially consists of :

- 34" (863 mm) DIA 2Hi, Blooming Mill
- 28" (711 mm) DIA 2Hi, 3STDS open line Mill
- 28" (711 mm) DIA 3Hi, 3STDS open line Mill
- 16" (406 mm) DIA 3Hi, 3STDS open line Mill
- 12" (305 mm) DIA 3 Hi, 5STDS open line Mill
- 450/260 mm DIA Continuous Rolling Mill.

The 34" (863 mm) DIA 2Hi Blooming Mill

is a relatively modern construction with side quard manipulators on both sides. and tillers on front side. Heating of ingots in pit furnaces. Production per year some 580 000 tons of constructional and structural steels, rolled as blooms of five basic cross-sectional dimensions.

Pass design of rolles "american type" with bullhead of 830 mm and four box type grooves. The adopted pass sequence is the main reason of many defects, occuring on blooms as well as on other finished rolled products. There fore the rejection ratio of blooms, billets and finished rolled products (when the Karabük)

Semifinished products are used is high. Two reasons creating this situation should be mentioned.

- Rolling the ingot on bullhead with 8 passes without turning
- Uncontroled heating conditions.

The 28"(711 mm) DIA 2 Hi, 3 STD Open Line

The rolling mill operation is closly connected with operation of the Blooming Mill using hot blooms. The Rolling Mill is now mostly used for cogging of billets. After performing modernization, the rolling mill may be used for rolling of variety of steel grades, jointly with special quality grades, insted of cagging billets of plain carbon steels.

The 28" (711 mm) DIA 3 Hi, 3 STDS Open Line

This is an old type of rolling mill, used for rolling of variety of medium and heavy sections.

For reheating of blooms, the rolling mill is furnished with two obsolate furnaces, which under any circumstances can not meet nowadays heating requirements. The rolling mill is mechanized to a certen extand.

The rolling mill can be modernized in the scope to meet nowadays requirements for finished rolled products like rails, and reach an output of some 400 000 tons/year on 3 shifts operation of the rolling mill. The modernization can be performed in steps, with not necessarily heavy expenditures. The rolling mill should be foreseen for rolling of rails according to UIC-820 standard, as such rails will be of great demand in Turkey, in the very next future.

The 16"(406 mm) DIA and 12"(306 mm) DIA 3 Hi Open Lines

These two open lines being considered as seperate rolling mills are combined, and are forming one rolling mill complex. Heating of billets for these two rolling mills is performed in two pusher type reheating furnaces. Usually for each rolling mill one furnace is used, but each of the two reheating furnaces can be used for each of the particular rolling mill in cross combination.

The 16"(406 mm) 3 Hi open line consists of 3 STDS, but the first STD is used for cogging for the 12"(306 mm) DIA 5 STDS open line. The 16"(406 mm) open line is used for rolling of light and medium sections. Rolling mill output depending on the product-mix 5÷8 tons/hr. The rolling mill is operated manually.

The 12"(306 mm) DIA 3 Hi open line practically consist of the 16"(406 mm) DIA 3 Hi cogging stand and five 12"(306 mm) DIA 3 Hi, 5 STDS in line. Production programme mostly round bars. Rolling mill output depending on the product mix 8÷11 tons/hr.

Rolling mill operation is mechanized to some extand by means of repeaters. The leader oval is repeated manually. The further operation (existance) of the two rolling mills (the 16"DIA and 12"DIA) should be seriously considered. The rolling mill should be either modernized, either cancel, as the present operation can not meet any ecoromical justifications.

The 450/260 mm DIA Continuous Rolling Mill

This rolling mill is to some extent a modern one, with possibilities of rolling bars and rods.

For rolling of rods, seperate finishing group (an old type DEMAG rod's blok) is instaled. No cooling facilities like STELMOR, for cooling of rods leaving the finishing stand are foreseen. The last, is the almost only one serious disadvantage of the rolling mill. The possibility of modernization of the rods line should be taken under consideration.

All the above mentioned problems, as well as possible ways of future actions, with recommendations, have been submited in the attached Report on Technical Visit to the Karabük Iron and Steel Works - ANNEX No.3

2. İskenderun Iron and Steel Workes

The rolling mills of the İskenderun Iron and Steel Works essentially consists of:

- continuous billet mill
- continuous bar and light sections mill
- continuous rod mill
- continuous medium sections and bar mill (with universal stands) -under star-up period.

The continuous billet mill, and the continuous medium sections and bar mill, are chared by continuous casting billets (cc billets).

The continuous bar and light sections mill, as well as the continuous rod mill, are chared by billets 80x80 mm, which are rolled on the continuous billet mill.

The Continuous Billet Mill

The planed capacity of the mill is some 1550000 tons/year, irrespective the product-mix. Practical achievement are some half of the planed

capacity, however. The problems facing at present the rolling mill, are predominately electronic, electricai and to some extent mechanical ones. Process problems are minor. The continuous billet mill, has the process possibilities to reach the planed 1500000 tons of billets per year, providing that all the necessary electronical, electrical and mechanical modifications and improvements will be executed.

The continuous bar and light sections mill

The planed capacity of the rolling mill is some 450 000 tons/year, but the practical achievements are some 270 000 tons/year. The above is created by process and operation problems as well. The main problems facing the rolling mill, are electronical and electrical ones. The electronical and electrical equipment of the rolling mill ought to be estimated as old fashioned, and should be replaced by modern ones. Some process improvements like introduction initial billets of cross-sectional area 100x100 mm should be implemented as well.

The continuous rod mill

This is a four strand rolling mill. Possible practical output some 500000 tons/year. However the practical achievements of the Iskenderun continuous rod rolling mill are far less, and not more than 250000 to 260000 tons/year. In addition to the above, the rolled rods can not meet the requirements of international standards. The present main problems of the rolling mill are similar like of the continuous bars and light sections mill, but the quality problems are more serious. The shortcomings of the rolling mill can be eliminated by performing suitable modernization, which should be good planed and can be performed in three steps- See ANNEX No.4.

The continuous medium sections and bars mill

This rolling mill is a modern design, with universal stands for rolling of sections and edging passes when rolling of flates is in question.

Output of the rolling mill, depending on the product-mix some 700000 to 800000 tons/year.

At present, the rolling mill is on the start-up period, and trial rolling of different sections.

3. Asil Çelik

The Asil Çelik (Steel Works) is the only one specially designed plant to deal with special/quality steels in Turkey. The plant by no means is a very modern one, suitably equiped, with highly sophisticated laboratory equipment. The plant essentially consist of the following units.

- Steel melting shop
  - (a) two Electric Arc Furnaces
    one 15 tons, one 45 tons raiting capacity
  - (b) one RH-Vaccum degassing unit,
- Blooming mill, 2 Hi 820 mm DIA reversing, of 40 tons/hr output.
  - (a) six soaking pit furnaces
    40 tons/hr output
  - (b) one pusher type furnace
    40 tons/hr output
  - (c) one hot scarfing unit
- One 2 Hi, 750 mm DIA reversing STD as seperate heavy rolling mill with cooling bed of output 40 tons/hr
- One 4 STDS 3 Hi/2 Hi open line with adger 550 mm DIA, finishing stand 2 Hi 420 mm DIA. Cooling bed, not heated cooling pit. Rolling mill output 20 tons/hr.
  Reheating of billets in wolking beam furnace.
- One roller hearth heat-treatment furnace of capacity 20 tons/hr
- Conditioning department
  - (a) shot blasting equipment
  - (b) straitning machine
  - (c) grinding machines
  - (d) cutting equipment
- Non-destructive testing equipment in lines.
  - (a) magno-fux
  - (b) eddy-current
  - (c) ultrasonic

Beside the production units, the plant possed one of the best equiped, physical, metalography and chemical laboratory in Turkey.
Auxiliary units
- Fuel oil, LPC, Oxygen, Argon and Water supply systems.
- Compressed air, power generators
- Dust collectors
- Mechanical, electrical, electronical and measuring instruments workshops are well equiped,to meet the plant requirements.

The everage output of the plant 210000 tons/year of finished rolled products. In spite of the very modern equipment of the plant, adequate to produce special/quality steels of almost all grades, the capacity of the plant is not fully utilizet.

According to the management claim, this is due to lack of orders, for steels of special/quality grades, in the range of dimensions, which can be rolled at the plant rolling mills.

The next problem is, the production costs. Due to the adopted process, all the rolled finished products, to be manufactured, must go through almost the same production flow, begining from melting shop up to the finishing department of the rolling mill shop.This is the reason,that for a lot of steel grades, the production costs are unnecessary high, as when adopting continuous casting process,to cast required sizes of blooms or billets, the production costs will be reduced by much. Such solution,at the time being,is seriously considering by the managing body of the Asil Çelik.

The production costs are for the plant so crucial, that the operation of the 15 tons Electric Arc Furnace is suspended and the melting furnace is used only ocasionally. But this can not be considered as a right solution, for,all the instaled equipment must be utilized to the highest possible ratio.

The above speaks for elaboration of a muster plan for the plant development.

The minimum cross-sectional dimensions which can be rolled up till now at Asil Çelik are rounds 20 mm DIA, squares 20x20 mm, hexagons 20 mm. But there is market demand for smaller dimensions as well, and the demand for these dimensions is relatively high. Rolling of dimensions in the range 5 mm DIA up to 26 mm DIA, or equivallent squares, hexagones, flats or other special profiles, can be performed by instaling a small scale rod and bars rolling mill, using at the first stage billets of 50x50 mm to 80x80 mm comming from the heavy rolling mill (2Hi 1 STD 750 m DIA reversing STD), and on the second stage, from horizontal casting machine, for which the liquid steel will come from the 15 tons Electric Arc Furnace.

Assuming that the 15 tons Electric Arc Furnace may have as an avarege 7 heats per day, the everige production of liguid steel will be some 31000 tons per year, and in billets it will be some 30000 tons/year when the continuous casting machin for co-operation with the 45 tons Electric Arc Furnace will be installed (as according to the present planes of the Asil Çelik) the problem of utilizing the Blooming Mill will arise, beside the problem of heating the blooms coming from the cc caster. There are several possible ways of solwing this problem, but before making any serious steps or elaboration plans of development, an intensive market survey must be performed in order to estimate the real present and future demand for special/quality steels. When elaborating planes for the plant development-mostly in order to utilize and blance the production units- export possibilities should be taken into account as well.

Production of the plant can be balanced to the accepted level, that is to say :

3 shifts operation
- melting shops
- medium section rolling mill (existing)
- small scale rolling mill (to be erected)
- forging shop (to be erected)

2 shifts operation
- blooming mill
- 2 Hi, 1 STD heavy reversing mill

Brake down of the finished rolled product will be:

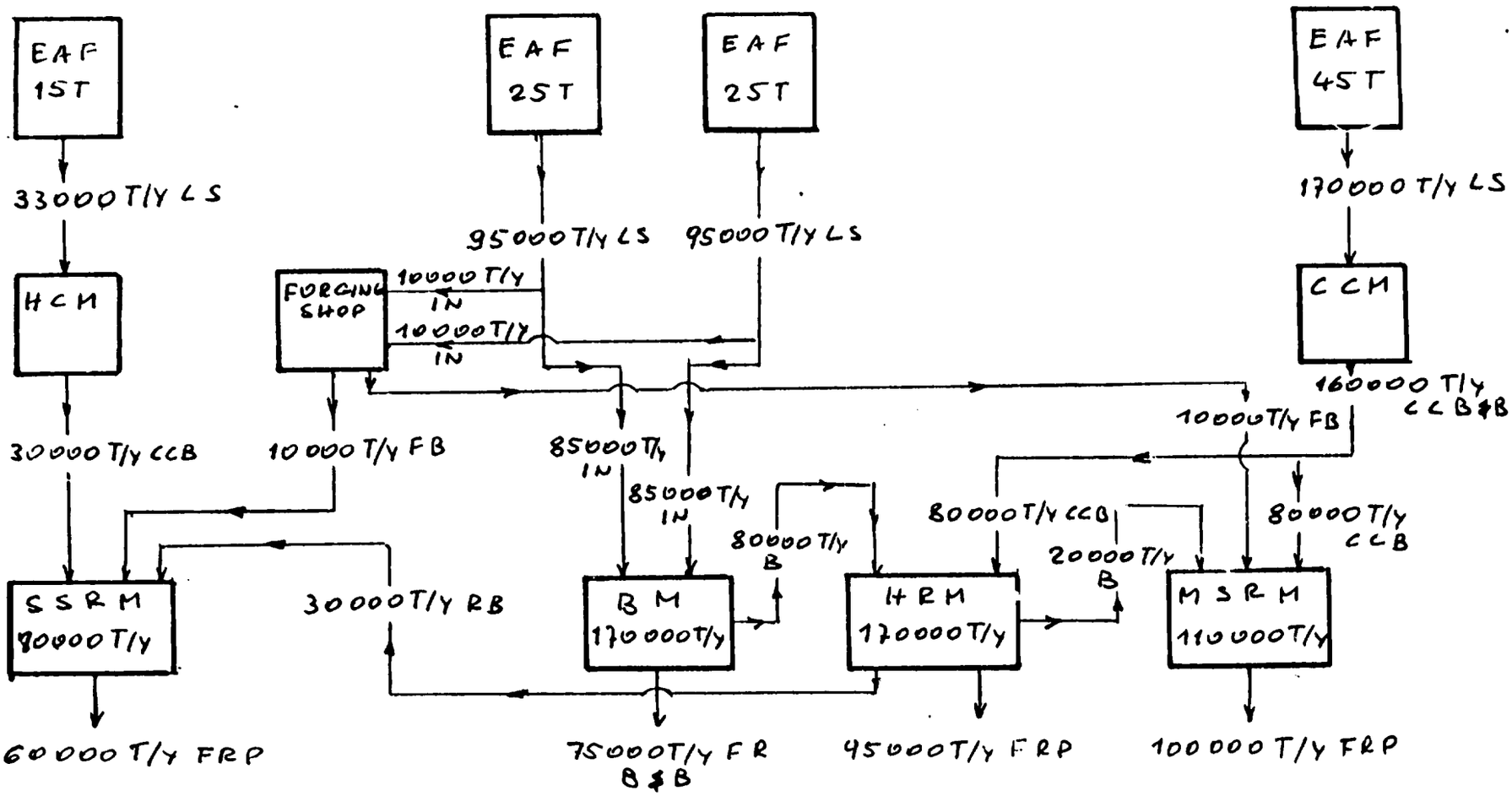
60 000 tons/year, rods and light bars of dimensions 5-26 mm and equivalent of other profiles

100 000 tons/year, light and medium bars of dimensions 25-45 mm and equivalend of other profiles

95 000 tons/year, heavy bars of dimensions 46-150 mm and equvalend of other profiles

75 000 tons/year, billets and blooms from Blooming m ll of dimensions 100x100 mm up to 350x350 mm.

Diagram of material flow of one of the possible solution is given on the attached sketch.



POSSIBLE SOLUTION OF MATERIAL FLOW
FOR DEVELOPMENT OF THE ACIL GELIK
(STEEL WORKS)
ROUGH BALANCIN OF PRODUCTION UNITS

B Private Enterprises

Private owned rolling mills are very differenciated according to the instaled equipment and adapted process, and therefore, thay can not be concidered as one group only.

However, most of the problems which the private owned rolling mills are facing are similar, that is to say:

- uncertain future,
- strong market competition,
- poor quality,
- relatively high production costs,
- low efficiency and productivity,
- unsuitable heating conditions,
- lack of nowadays knowlidge and know-how concerning rolling mill technology.

According to the instaled equipment, grade of technological and process advancement, three main groups of the private owned rolling mills may be listed.

First. Semi integrated mini steel work , with Electric Arc Furnaces continuous casting machines (existing or under erection or consideration)
These are the most advanced plants, with real possibilities to overcome the present short comings.

Second. Rolling (re-rolled) mills which entirely depends on outside charge (billets), but with relatively modern or being modernized equipment

Third. Plain or primitive open line rolling mills, driven by one motor, with roll DIA not suitable to roll standard billets 100x100 mm.

As it has been mentioned previously the private owned rolling mills are grouped in six regions of Turkey, that is to say:

- İstanbul
- İzmir
- Bursa
- Denizli
- Karabük
- Ankara

Most advanced are the mini semi-integrated Steel Works at İzmir and Bursa. Some of these plants are furnished with equipment of European origen or domestic of modern disign and munufacture. Some of the plants may be in position to switch the production for more proritable, that is to say, melting and rolling special /quality steel grades, providing however, that the Steel Works will be adequate equiped to deal with tehese types of steel.

The rolling mills located at İstanbul and Denizli, are among the first instaled in Turkey, and are relatively primitive, however some possibilities of modernization and improving productivity as well as quality of finished rolled product still exist. The most comon problems of these rolling mills are:

- unsuitable heating conditions, reheating furnaces with very low thermal efficiency 10-13 per cent.
- too small roll diameters of the first rolling stands
- unsuitable cooling of rolls.

Rolling (re-rolling) mills located at Karabük, are of the lowest technical level in Turkey. These rolling mills in most cases are using as charge, scraped steel from the Karabük Iron and Steel Works. This material, for which no technical certi-ficate can be given, is re-rolled for reinforcing bars, plain or ribbed. Heating conditions without any control.

Rolling mills grouped at Ankara region, are more advanced in comperision with tehese of Karabük, Denizli or İstanbul. Some of them, are at the time being, under modernization in order to increase production and improve quality of the finished rolled products as well. For one of these rolling mill "ÜSTÜN ÇELİK" a technical paper concerning some aspects of the modernization- being currently under way- have been elaborated and is attached to the report as ANNEX No. 5.

II. THE CINKO KUPSUN METAL SANAYİ A.Ş. KAYSERİ

Responding to a special request of the CINKO KURŞUN METAL SANAYİ A.Ş. plant, a technical visit to the plant was paid, in order to estimate possibilities of starting up with an independent aluminium department, which since 8 years is staying idle.

The CINKO KURŞUN METAL SANAYİ A.Ş.,KAYSERİ, is a fully integrated zinc plant, with independant aluminium department. The aluminium department is essentially consisting of:

- melting furnace
- strip continuous caster with coiling arrangement
- 4 Hi, 13"(343 mm)/34"(864 mm)DIA X 54"(1321 mm)reversing cold mill with coilers on both sides,
- stretching and levelling machine,
- annealing furnace,
- auxiliary department.

All the above mentioned machines and facilities are adequately equiped with measuring and control instruments. Due to market difficulties ,in spite of the fact, that the process, as well as the equipment should be considered as modern, the department has not been put into operation after its erection, that is to say, since 8 years. The idle staying of the department is causing the plant heavy financial losses.

At present, the management is seriously pondering the possibilities of putting the department under operation. The main problem however is to find market for the products of the department.

Considering the still possible market requirements for the flat aluminium finished rolled products, with the thickness 0.3 to 5 mm and width up to 1100 mm, the following should be mentioned.

Aluminium plane grades:

- stripes for production of longitudinal welded pipes-main (distribution)pipes for irragation(artificial rain) systems.

Aluminium grades of special mechanical properties:

- alloy aluminium grades, mostly with high requirements of tensial strength and/or fatigue strength, and high elongation.
  Aircrafts industry, shipbuilding industry.

Aluminium grades of special physical properties:

- electrical and electronic appliences, where beside suitable chemical composition, adequate texture, as a stricture of the aluminium products is required as well.

Simultaneosuly, it should be mentioned, that the best economical results can be achieved, when the plant will manufacture products "ready to sell" on the public market, for instance aluminium pipes for irragation systems(as main pipes) with all necessary and optional accessories. In this respect, the plant can benifit alot from the modern system of manufacturing, for, the production costs will be relatively low, and the profit will be for the plant benifit.

Some more detailed proposals, jointly with descriptions and diagrames can be find in a special report-ANNEX No.6

III. DESIGNING AND MANUFACTURING POSSIBILITIES FOR ROLLING MILL PLANT

At the time being, the designing and manufacturing possibilities for rolling mill plants in Turkey are practically limited to one factory, the ASMAŞ AĞIR SANAYİ MAKİNALARI A.Ş.-İZMİR.

However at some of the steel works or rolling mills, groups of engineers and technicians have been formed in order to elaborate technical documentation far performing modernization of the rolling mill plants, but due to lack of experience in this subject, as well as"only one edition" of the performed job,such activity can not be assumed as possibilities in designing and manufacturing for rolling mill plants.

On the other hand, the ASMAŞ AĞIR SANAYİ MAKİNALARI A.Ş. İZMİR. has been established as a modern manufacturing factory with adequately organized designing office. Since about 8 years of the factory activity in the field of rolling mill technology, suitable knowledge and experience have been gathered and proved in operation of several designed and installed rolling mills.

The factory got suitable experience in designing and manufacturing of small and medium size rolling mills with all necessary operation and auxiliary equipment like,

- rolling mill stands
- rolling mill drives(gear boxes, pinion stands, spindles
- roll equipment(entry and delivery guieds, guardes,strippers, rest bars)
- repeaters
- process mechanization equipment
- roller tables
- shears
- saws
- cooling beds
- coilers

The reheating furnaces, which are at the manufacturing programme of the factory, with the front and side burners can not be concidered as modern ones, however.

The possibilities in eloborating pass designs as well as process programmes are of present limited, and the factory, should performed suitable steps in order to increase its capability in this very narrow but crusial subject .

IV PERFORMED TRAINING ON ROLLING MİLL PLANTS AND ROLL PASS DESIGN TECHNOLOGY.

The training on planing and operation of rolling mill plants and roll pass design technology was performed on the whole project life time and delifered in three basic way.

- seminar (hold on İstambul 13 to 15 of May 1985)
- plants conferences at the visited workes
- lectures(first at the MIDDLE EAST TECHNICAL UNİVERSİTY-ANKARA
  second DENİZLİ-Private Sector Iron Steel ASSOCIATION,
  third- ASİL ÇELİK-BURSA

All the training activity(except the lecture hold of METU-ANKARA, was oriented to practical aspects of rolling mill technology and roll pass design with special emphasis on rolling mill operation.

A. SEMINAR

The three days seminar under the Titel "MODERN ROLLING MILL TECHNOLOGY AND ROLL PASS DESIGN, hold on Istanbul on 13 to 15 of May 1985 was especially planed to be delivered at the end of project activity, and after visiting.

- two integrated steel works
- four semi-integrated mini steel plants
- six rolling (re-rolling)mills at seven steel industry centers.

The freme programme of the seminer has been elaborated four weeks in advance and sent to the potential participants after visiting the above mantioned plants, and performing on most of the vizited steel works or rolling mills-plant conferences, with the managing and engineering staff, detailed programme of the seminar was elaborated. Head lines of the programme and time schedule as under.

First day: 13 of May

9-12 1.Basic aspects of modern rolling mill technology
2.Review on basic phenomena and geometrical relations in rolling.
3.Forces acting during rolling
4.Calculation of rolling forque
5.Pass design for rolling of blooms and billets
6.Pass design for rolling bars and rods.
6.1.Rolling of rounds
6.2.Rolling of squars
6.3.Rolling of flats
6.4.Rolling of hexegons
6.5.Rolling of other shopes

14-17
7.Pass design for rolling of sections
7.1.Rolling of angles
7.2.Rolling of I beams
7.3.Rolling of channels
7.4.Rolling of T beams
7.5.Rolling of rails.

Second day 14 of May

9-12
1.The oretical aspects of roll pass design of sections
2.Analysis of metal distribution and metal flow when rolling of assymetrical sections

3. Practical guidence for elaborating pass design for rolling of sections

4. Some practical aspects of rolling mills operation.

14-17

5. Roll equipment

5.1. Entry guides and guardes

5.1.1. Static guides

5.1.2. Roller guides

5,2, Delivery guardes

5.3. Rest bars

Third day 15 of May

9-12 1. Heating faclities

1.1. Pit furnaces

1.2. Pusher furnaces

1.3. Walking beam furnaces

1.4. Circulating furnaces

1.5. Calculation of furnaces autput

1.6. Heating processes

2. Rolling mill lay-outs

2.1. Blooming mills

2.2. Billet mills

2.3. Open lines

2.4. Semi-cantinuous lines

2.5. Continuous lines

2.6. M.L.(Multi-lines)

2.7. Swedish-lines

14-17

3. Calculations of rolling mill outputs

4. Elements influencing rolling mill outputs

5. Pass-time diagrams

6. Examples

Number of participants - according to the "present list"-28, on the third day of seminar 32.

It should be mentioned, that all the vizited plants, sent their reprezentatives to the seminar.

B. PLANT CONFERENCES

The plant conferences were probably the most effective way of upgraduating the skills and capabilities professionals(engineers and technicions) employed in rolling mill plants. This is due to the fact, that the topics, were chiefly connected with the most important and difficul t problems, which the rolling mills are facing at present, or since a long period at present, or since a long period of time.

Plant conferences have been performed on the following steel works or Rolling mills.

(1) Karabük Iron and Steel Works Main aspects of the conference:
- heating of blooms and billets
- cooling of rolls
- possible ways of increosing the rolling mills output
- improvements in roll poss design of some profiles
- Possibilities of implementation high speed blocks and STELMOR PROCESS LINES for the continuous rolling mill
- Modernization aspects of the.

28"DI/t, 2 H i, 3 STDS open line
28"DI/t 3 Hi 3 STDS open line
16" DI/t 3 Hi 3 STDS open line
12"DI/t 3 Hi 5 STDS open line

(2) İskenderun Iron ard Steel Works Main aspects of the conference.
- Rolling of sections on continuous rolling mills
- Possibility of rolling billets 140 x140 mm, on the continuous billet mill, using the existing roll sets
- Possibility of introducing 12 mm DIA on the continuous Bar and light section Rolling Mill

- Operation at rolls
- Operation difficulties on the rolling mills
- Possibility of modernization the continuous rod rolling mill

(3) ASMAŞ Ağır Sanayi Makinaları A.Ş.-İZMİR

Main aspects of the conference:

- Roll Pass design problems, especially sliting rolling technology
- Design of roll equipment
- Design of rolling mill stands
- Modernization aspects of rolling mills

(4) İzmir Demir Çelik Sanayi A.Ş.-İZMİR

Main aspects of the conference

- Roll pass design of angles
- Rool equipment (entry quides and stripers)
- Cooling of rolles
- Heating of billets
- Developlent aspects of the plant (erection of an Electric Arc Furnace and continous casting machine)
- Some aspects of rolling special/quality steels

(5)ASİL ÇELİK-BURSA

Main aspects of the conference

- Process problems of rolling special/quality steels
- improvements on roll equipment
- cooling of rolls
- hot scarfing and conditioning of semi-finished products
- pass design aspects for special profiles
- modernization aspects of the plant

(6) Detel Demir Sanayi A.Ş.-Istanbul

Demir Çekme Fabrikası

Main Aspects of the conference

- Modernization problems of the rolling mill
- Calculation of seperating forces and rolling forgue
- heating of billets
- cooling of rolls
- possibilities of increasing the rolling mill output

C. LECTURES

During the project activity three two ours lectures on selected topics have been delivered

First: on 11 of April 1985 at the MIDDLE EAST TECHNICAL UNIVERSITY-ANKARA

Topic of the lecture

- Rolling mill technology,
- General aspects of roll pass design
- Heating coonditions
- Forces acting during rolling process
- Rolling mill lay-outs
- Erection costs of different types of Rolling Mills

Second: on 29 of April 1985 at
DENİZLİ-Private sector Iron Steel ASSOCIATION
Topic of the lecture

- Present world situation in metallurgy
- Production costs and possibilities of their reduction
- Heating conditions and possibilities of sawing heating energy.
- Possible ways of modernization the small scale rolling mills.

Third: on 8 of May at ASİL ÇELİK- BURSA Topic of the lecture

Rolling mill technology for rolling of special/quality steels.

V. CONCLUSIONS

1. In spite of dynamic development of the Turkish economy, the consumption of steel per capita is at relatively low level, some 100 KGS. This indicates, that in the very next future the Turkish steel industry will be rapidly developed, and theproducts will be at least doubled.

2. The development of the steel industry may be done faster and with less difficulties if appropiete trained and experienced specialists, especially on rolling mill technology and process will be available in this country.

3. One of the crucial problem for evoiding shortcomings in deveop-ment of the leading industrial branches is domestic production of special/quality steels.

Such Steel Works as Asil Çelik have full possibilities in increasing finished rolled products of special quality steels.

4. The rolling mills at Karabük Iron and Steel Works(except Blooming Mill and continuons Rod and Bar Mill) are to obsolete to keep them at the technical level, as there are just now, mostly due to relatively high production costs. Modermization of the rolling mills seems to be the best solution.

5. Production of the Continuons Billets Mill, Continuous Bars and Light Sections Mill as Well as Continuous Rods Mill, of the Iskenderun Iron and Steel Works can be improved much, when improvement (replacement) of the electronical and electrical equipment of these rolling mills will be performed.

6. The continuous Rod Rolling Mill may be modernized with out spending to much expenditure for such undertaking. Suitably planed and executed modernization as well as improvement of the rolling mill operation will on the one hand increase production, and on the second hand improve quality of the rolled rods, up to the internationally accepted standards.

7. The engineers and technicians employed on the rolling mills are paying high intrest in up graduating there knowledge on rolling mill technology and especially on roll pass design.

8. If the small scale rolling mills will not be in a position to improve :
   - quality
   - productivity

   and decrease :
   - production costs
   - rejection ratio,

   the ejistence of these rolling mills is to be limited to the very nejt future, mostly due to competition with finished rolled products of high quality and low prices, coming to Turkey from the international steel market.

ANNEX No.1

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN THE REPUBLIC OF TURKEY

JOB DESCRIPTION

DP/TUR/77/024/11-03/F3/31.5 A

Post title Expert on Planning of Rolling Mill Plants and Roll Pass Design Technology

Duration 8 weeks

Date required November - December 1984

Duty station ITDC in Ankara, Istanbul, Iskenderun and with possible travel within the country.

Purpose of project The purpose will be to upgrade the skills and capabilities of professionals (engineers and technicians) employed in rolling mill plants to show available procedures of roll pass design and aspects of plants planning.

Duties The expert, together with his counterpart from the Industrial Training and Development Centre (ITDC) will be expected to plan, prepare and implement a training programme on roll pass design and on planning of rolling mill plants.

More specifically, the expert will be expected to prepare a training programme as follows:

A. Planning of rolling mill plants:
Layout and determination of the rolling mill roll line according products and capacity; selection of proper working stand, transfer mechanism and motor, etc.

B. Fundamentals of roll pass design technology

C. Detailed information about the roll pass design of:

1. Angle Sections
2. Other sections

a) Beams
b) Channels
c) Rails and allied sections

..../2.

d) Wire rods
e) Special Sections
f) Squares
g) Rounds
h) Hexagons

With illustrative cases compiled during the preliminary survey.

The above topics will be presented taking into consideration the recent innovations, developments and applications (e.g., computer applications in roll pass design).

The expert will also be expected to:

- Supply back-up materials for the mission in the form of articles and lecture notes, film, slides and books which will be purchased by ITDC if the expert can make these available.

- Prepare a final report, setting out the findings of the mission and recommendations to the Government on the further action which might be taken.

Qualifications

Expert preferably metallurgical or mechanical engineer, should have knowledge and at least 10 years of experience on the rolling mills technology and roll pass design technology. Besides, he should be capable of training engineers in-class and in-plant.

Language

English and/or German

Background Information

1. The proper roll pass design provides for steady conditions of processing and ensures high quality of the rolled products, as well as the most favourable technical and economical characteristics of the production. Sizing of each rolled shape should be in keeping with the principles of the given metal rolling method and with the design features of the given rolling mill. Because the roll products are used as the basic materials in the industry for the purpose of construction and machine design. Rolling mills have a considerable past in Turkey. There are, 3 integrated steel plants and over 200 (two hundreds) small-scale rolling mills (capacity: 2,000 ton - 250,000 ton/year)

2. ITDC conducted a series of complementary programmes in the field of rolling mill and roll pass design technology in 1981 - 1982, 1983 in Izmir in Bursa and in Iskenderun to improve the rolling mill practice in Turkish industry and to enable the rolling mill engineers or technicians to better carry out their jobs.

3. Upon demand coming from industry, this training programmes about roll pass design technology which is surely one of most important chapter of rolling mill technology will be repeated. Additionally, the most recent development in roll

pass design technology and planning of rolling mill plants will be explained in this programme, e.g., computer programming of roll pass design.

4. The theorectical background and practical knowledge of the engineers and technicians about roll pass design technology is insufficient in Turkey. This training programme is aimed to fill this vacancy up to a certain level.

5. It is expected that about 30 engineers will participate. The trainees will be technicians or engineers who have attended the previous ITDC courses in rolling mill technology and are in charge of production in rolling mill firms. Besides, the counterparts who have the theoretical background will be trained to conduct the same programmes in the future.

6. The Industrial Training and Development Centre (ITDC) is a joint project of Turkish Government and United Nations, rendering training and consulting services to the Turkish industry. The aim of ITDC, at highest level, is to upgrade the skills and capabilities of professionals employed in the industry, hence to contribute to the national economy.

ANNEX No.2

SENIOR CONTERPART STAFF

1. MR. TEOMAN TÜMER
   Technical Manager of the INDUSTRIAL TRAINING AND
   DEVELCPMENT CENTRE-ANKARA

2. MR. ALI HAN
   Metallurgical Engineer of the
   INDUSTRIAL TRAINING AND DEVELOPMENT CENTRE
   ANKAPA

ANNEX NO:3

JAN J.GAWLIKOWICZ
UNIDO CONSULTANT
ALİ HAN
SEGEM-ANKARA

R E P O R T

on

TECHNICAL VISIT

to

KARABÜK IRON AND STEEL WORKS

Paid on 15-16.04.1985

1. Technical visit, organized by the management of the SEGEM, Ankara, and basing on the approval of the management of the Turkish Iron and Steel Works Establishment, was paid to KARABÜK İRON AND STEEL WORUS on 15-16 April 1985.

The persons met of the factory where :

Rolling Mill Plant Director Mr. NURELTIN SÖNMEZ, Managers of the particular Rolling Mills. Summerized discution have been held with Deputy General Manager, Technical Manager.

3. Rolling Mills of the KARABÜK IRON AND STEEL WORKS essentially consists of :

- 34" (863 mm) DIA 2Hi Blooming Mill
- 28" (711 mm) DIA 2 Hi 3 STDS Open line Mill.
- 16" (406 mm) DIA 3 Hi 3 STDS Open Line Mill
- 12" (305 mm) DIA 3 Hi 5 STDS Open Line Mill
- 450/760 mm DIA Continnous Rolling Mill.

2.1. 34" (863 mm) DIA 2 Hi Blooming Mill, is a relatively modern constniction with sideguard manipulators on both sides and tilters on front side.

Heating of ingots in pit furnaces. Production per year some 580 000 tons of carbon constructional and structural steels, rolled as blooms of five baisic cressectional dimensions.

Pass design of rolles, " american type" with bullhead of 830 mm and four box type grooves.

The adopted pass sequence is the main reason of mony defects accuring on blooms as well as on billets and other finished rolled products. Therefore the rejection ratio of blooms, billets and fimshed rolled products (when the Karabük semifinished product are used) is high. Aother reason depreciating the quality of the rolled products, are the uncontroled heating conditions, whot (as it has been observed in many instances) leads to burning the surface of the stock (ingot, bloom or billet-as the case maybe) being heated.

The adopted pass sequence on the blooming milk is characterised by initiating rolling the bloom on bullhead with 8 passes without turning, and than, the turnining of the stock is performed after 4 successive passes. As the pass sequence on the blooming milk must be chaned,in order to produce blooms and billets of accepted qualify, the following general remarks on rolling process of ingots can be considered and taken as general guidence.

The ingot as cast, has usually very coarse structure with marked trans-crystalization zones and it may be to some extent porous, due to blowholes in some areas.

The function of the early passes is to remove the scale of the surfaces, eliminate the taper, break down the corse structure to more workable one, densitise the material by clossing up internal blowholes, and by a general compacting, due to the applied pressure. The early treatment should be gentle, with a reduction in orea of some 8 to 14 percent, which may be increased as the sequence proceeds. The function of the midle passes of the schedule,is to give as speedy reduction as possible e.g. up to 25 percent, without leading to defects such as Ieps from overfills, corner cracking, surface cracking and surface seams. The final passes serve to give a product of the size required within the limits of accuracy demanded in each case and hance the draught on the last 2 passes may be small e.g. less than 10 per cent., if a high degree of accuracy is required, but if shape and exact size are not critical, high reductions may be maintened to the end of the schedule.

Too much deformation initially, may lead to surface defects, and once these are formed, they can only be removed by dressing the bloom after rolling or by mash heating to scale of some shallow defects. Both methods reduce the yield, and increase the cost. If the stock is worked without turning up for several posses, tensions will be set up in the side surfaces due to spreading and differential elongation of the surface and the center. The latter results from lack of work penetration

This causes craks on the faces, so it is advisable to furn the stockof interwals, to work all sides in succession. If is good practice,to turn the stock after every two passes, particularly of the begining and later the turning will be dependent on the grooves available. For the same reason as above, it is advisable to put the stock into a grooved pass as soon as possible to protect the corners aqinst cracking. Detailed information and data,concerning pass design of grooves as elaborating schedule of sequence for rolling on blooming mills,can be fined in the notes elaborated by the author on the head line "Principles of rolling, part one Roll Pass Design" which is available of SEGEM-ANKARA

2.2. 28" (711 mm) DIA, 2Hi, 3 STDS open line. This rolling mill is closely connected with the 28" Blooming mill, and is now mostly used for cogging of billets. The rolling mill has two seperate DC drives, which makes the operation very flaxible.

Such rolling mill, when adequate heating and cooling facilities are instaled, can be effectively used for rolling of special /quality steels. Finished rolled products of special / quality steels are used as charge for forging (drop and die forging) production of seamless tubes, manufacturing of machine parts etc. Operation of the rolling mill may be very flexible, due to electrically operated screw-down of two of the three stands. But unfortunafely the rolling mill is mostly used for cogging of billets of plain carbon steels.

No operational problems have been mentioned and the presently used pass design as well as roll equipment for rolling of billets can be considered as up to standart.

Cooling of rolls is unproper, but as it is a common problem (except the continuous rolling mill) on Karabük mill plants, the issue will be discused in seperate item.

2.3. 28" (711 mm) DIA 3 Hi 3 STDS open line. This heavy rolling mill, being a typical design of the 30 th of this century, is used for rolling variety of medium and heavy sections.

For reheating of blooms, the rolling mill is furnished with two obsolete furnaces, which under any circumstances can not meet nowadays heating requirements.

Mechanization of rolling is performed by tilling table with tillers on front side for the stand No 1 and front side trawelling tilting table with manipulafor for standes No 2 and No 3. These facilities are limiting the output of the rolling mill, cosing as well some operational problems.

No process problems have been mentioned, and during short review of the presently used pass designs, no significant faults was observed.

Cooling of rolles is unsuitable, and many fire cracks on currently used rolls have been developde, and finally the life time of the rolls is to be shorten considerably.

The rolling mill can be modernised, however, in order to meet present requirements, as for as modern rolling technology is concern.

The following are to be obserwed.

- erection of new reheating furnaces.
- instalation of tilting tables with manipulators instead of the present traveling table,
- instalation of skids and manipulators on the rear side of the line.
- rebuilding of the cooling bed (two cooling beds with length of 30 m - for standard length rails and bending skids are recommended)

Such modernization will anable significent increase in production - depending on the product-mix , up to 4000 000 tons/year on 3 shifts operation of the rolling mill.

2.4. 16" (406 mm) and 12" (306 mm) DIA 3 Hi openlines. These two open lines being considered as seperate rolling mills are combined and are forming one rolling mill complex, however . Heating of billets for these two rolling mills is performed in two plain pusher type reheating furnaces. Usually for each rolling mill one furnace is used, but each of the furnaces can be used for each of the particular rolling mill in cross combination.

The 16" (406 mm) 3 Hi open line consists of 3 stands, but the first stand is used for cogging for the 12" (306 mm) DIA 5 STDS open line.

The 16" (406mm) 3 Hi open line, is used for rolling of light and medium sections. Rolling mill output depending on the product-mix, 5 ÷ 8 tons/hr. The rolling mill is operated manually. For cutting the rolled stock to commercial lengths, pendulum not saw is adapted, and for cooling, plain skid type cooling bed is presently under operation. No proces and pass design problems have been reported. The used pass design and roll equipment is a result of many years practical operation of the rolling mill.

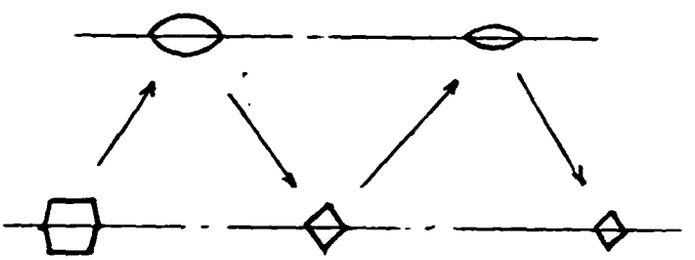
2.5. The 12" (306 mm) DIA 3Hi openline, practically consit of one 16" (406mm) DIA 3Hi cogging stand and five 12" (306 mm) DIA 3Hi STDS in line. Production programme mostly round bars. Rolling mill out-put, depending on the product-mix 8 ÷ 11 tons/hr. Rolling mill operation is mechanized to some extend, by means of repeaters, the leader ovel is repeated manually.

The rolling mill is facing some process problems, mostly due to overfilling the finisher round. After checking the pass design of the 5 stands openline, it has been found, that all the passes (leader, strand, preciding passes) are overfiled. Thes means, that the square comming from the cogging 16" 3Hi STD is to large. Taking this into account, if has been recommended to change the pass design of the cogging 16" 3Hi STD from diamond-diamond type to more

elongated one . Specifically the following pass sequence is to be recommended :

16" (406mm) DIA 3 Hi cogging STD
box-oval-square-oval-square

First pass of the 12" (306mm) DIA open line, gothic. Positioning of the passes as under.



In this case, operation of the stand can be mechanized by using : in front drop-pletes, and in the reare tilting table.
Pass schedule on the 12" (306mm) DIA 3Hi,

5 STDS open line, except the first pass, as up till now, in square-oval sequence.
In order to increase the rolling mill output, as well as to improve the rolling conditions (elimination of toolarge loops and possibilities of mechanized repeating the leader oval to finishing round) it is sugested to devide the drive of the 5 STDS 12" open line to two parts.

First part STDS NO 1,2,3.
Second pard STDS No No 4,5

The STDS NO 4 and No 5 should be changed for modern ones of robust consruction or standless, with rolls on rolling bearings and universal speendels for rolls' driwing.
After modernization of the cooling bed, with possibilities of collection the hot rolled bars in cradles and then controled cooling pits, as well as modernization of reheating furnave, the rolling mill may be used for rolling of special / quality steels.

Schematic lay-out of the rolling mill ofter modernization is given on the atteched sketch.

2.6. The 450/260 mm DIA continuous rolling mill, is to some extend a modern one, with possibility of rolling bars and rods.

For rolling of bars, the rolling mill consists of three continuous qroups, two stands open line with repeaters (for equatization of crosssectional dimensions), and finishing group with horizantel and vertical stands.

For rolling of rods, separate finishing group (an old type DEMAG rod's blok) is instaled. No cooling facilities, like STELMOR, for rods' leaving the finishing stand are foreseen. The last is the almost only one serious disadvantage of the rolling mill.

No process problems, except poor quality of billets, have been reported..

As it has been mentioned, the arrangement for rolling and cooling of rods is on obsolete one, but its replacement or modernization should be connected with general policy for rolling of rods in Turkey, or of least of the Iron and Steel Works Establishment. The requirement for rod is in Turkey high, and will grown up in the next future. In the light of the above, the are two possibilities First- erection of a new modernhigh output rod rolling mill

(of some 600 000 - 700 000 tons/year)

Second-modernization the rod rolling and cooling facilities of the Karabük continuous rolling mill.

The second possibility may be materialized at ones, by buyin relatively new and not expensive second hand, two MORGAN BLOCKS will STELMORS'.

Such instalation will double the Rolling Mill output, when rolling rods', securing simultaneously the quality up to international standard (prowiding,that billets of adequate quality will be availabel).

3. Cooling of rolls.

Unsuitable cooling of rolls, is (except the continuons rolling mill) a common practic of Karabük rolling mills.

It should be stressed, that insu ficient cooling of rolls, is creating fire craks and than, the life time of the rolls is decreased (neccessity of deep grooves' dressing to eliminate the fire cracks). When the fire cracks are not to be romoved by dressing, net of craks is consolidated, and some particals of the groove are fallen out. In other case the crecks are deepening creating the danger of breaking the roll.

By introducing the right cooling system, the roll life time can be increased up to 30 per cent.

The water supply should be placed on the out going side and directed to the pass being used.

The speed (pressure) of the water given on the roll should be very low in order to form similar water flow on the groove of the pass. When the speed (pressure) of the water is high, lot of water is reflected from the bottom of the pass (qroove) or roll, not absorbing the heat from the roll. When the heat is not absorbed by water, fire creks are formed immediatly. Schematic arrangement of cooling system for rolls is given in the aftatched skatch.

4. CONCLUSIONS AND RECOMMENDATIONS

1. The pass design and pass schedule of the blooming mill should be changed in order to improve the quality of blooms, and finally to reduce the rejection ratio of blooms, billets as well as finished rolled products, when for rolling, the Karabük origen blooms or billets areto be used.

2. The cooling systems of rolls on the rolling mills must be improved, in order to increase the life time of the rolls.

3. Heating conditions of the rolling mills, especially of the 3Hi, 28" 3 STDS open line, must be improved.

   The existing reheating furnaces, due to not controled heating process, are on one hand,diminishing the quality of the rolled products, and on the other haud increasing the production costs, due to very low (practically less than 10 per cent termal efficiency of the furnaces.

4. The output of the 28" , 3Hi 3 STDS open line can be increast much by performing not expensive modernization, which ought include :

   - instalation of new furnaces,
   - instalation of tilting tables with manipulators in front of STDS No 2 and No 3,
   - instalation of skids and manipulators on rear side of STD No 2 and No 3,
   - rebuilding of cooling bed.

5. By instalation a reheating furnace for the 28", 2Hi, 3 STDS openline, the rolling mill will be in possition to deal with specialy quality steels. Utilizing this rolling mill for rolling special quality steels, instead as at the time being cogging billets of plain carbon steels, will increase the economy of the rolling mill by much.

6. The 12", 3Hi openline rolling mill, by performing modernization, can be adjusted for rolling of special quality steels. The modernization ought include.

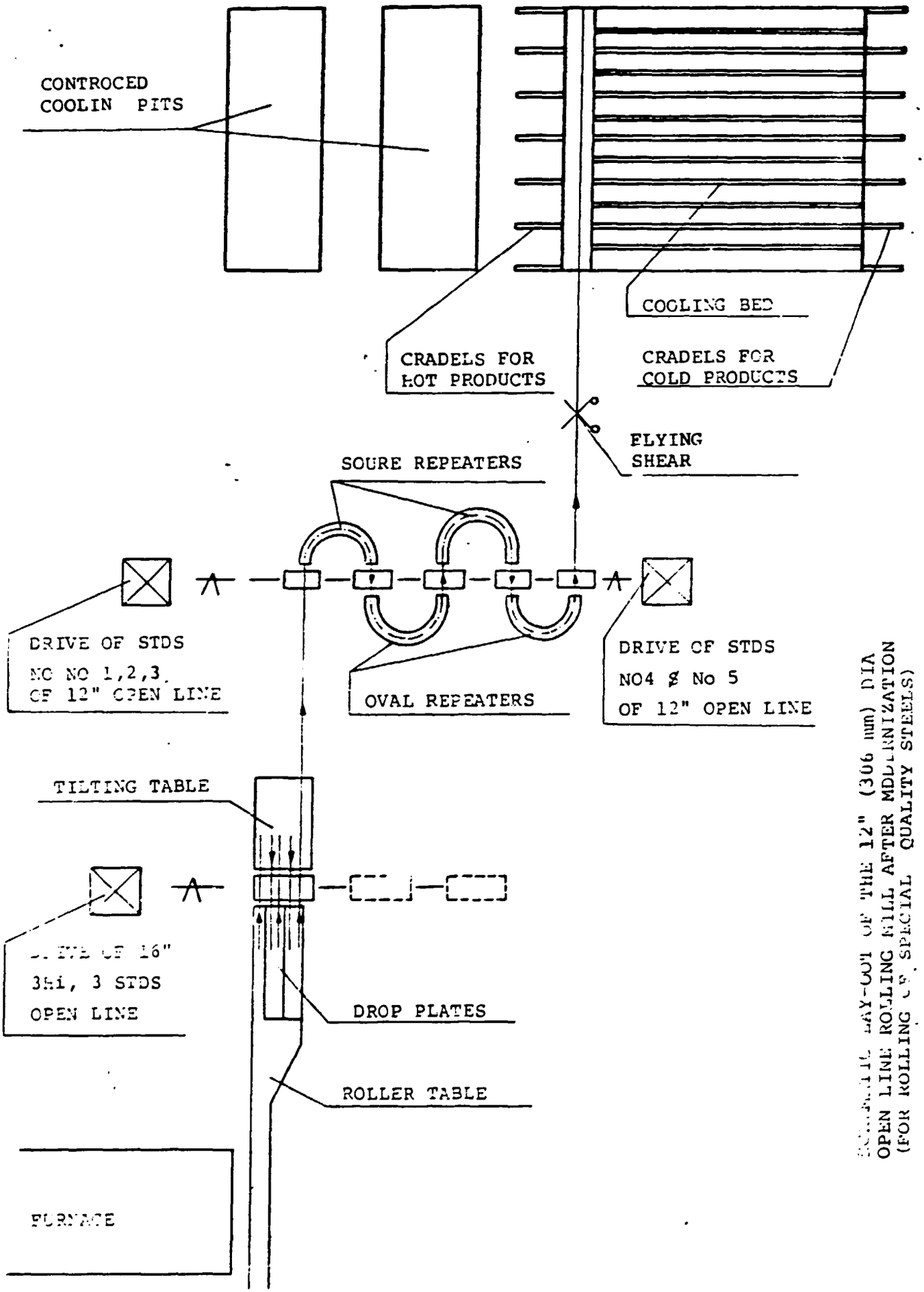
   - improvement of heating
   - changing of pass design and mechanization of the 16" 406 mm) DIA roughing STD
   - spliting the drive of the 12" (306mm) DIA 3Hi, 5 STDS openline, to wto independent drives,
   - Full mechanization of the rolling line operation,
   - instalation of new cooling bed
   - instalation of two cooling pits/for control cooling of special/quality steels).

7. The problem of rolling and cooling facilities for rods' of the 450/260 mm DIA continnous rolling mill, ought to be considerd, as the persent ones are obsolete, and are not in a position to meet nowadays quality and production costs requirements.

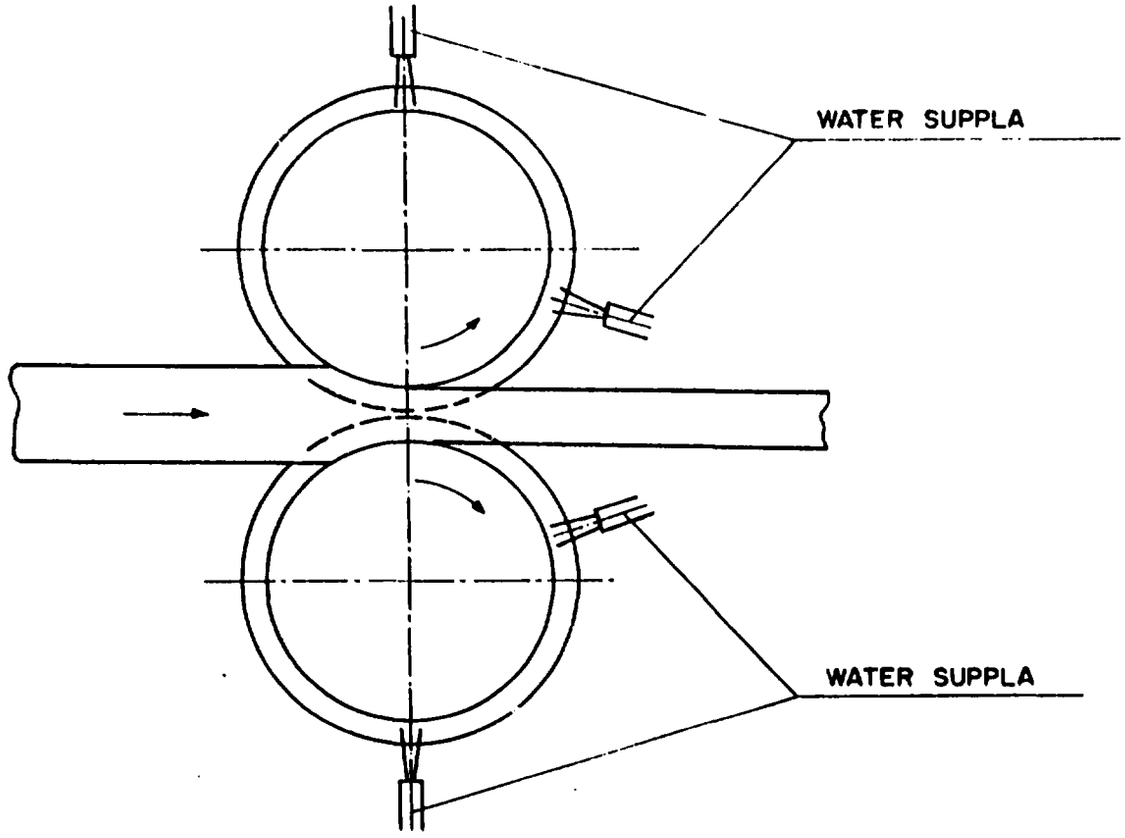
   One of the possibility is to instal two MORGAN TYPE BLOKS with STELMOR LINES.

   Selecting the above mentioned equipment as second hand (being in good technical state of course) the instalation costs may be relatively low.

   Such instalation can dooble the rooling mill out-put when rolling of rod will be in guestion, simultanensly securing the quality of the rods' up to international requirements (standards) -providing that billets of suitable quality will be available.



OPEN LINE ROLLING MILL AFTER MODERNIZATION
(FOR ROLLING OF SPECIAL QUALITY STEELS)



SCHEMATIC ARRANGEMENT OF WATER COOLING FOR ROLLS

ANNEX NO : 4

JAN J.GAWLIKOWICZ
UNIDO CONSULTANT
ALİ HAN
SEGEM - ANKARA

R E P O R T

on

TECHNICAL VISIT

to

İSKENDERUN IRON AND STEEL WORKS

paid on 22 to 26.04.1985

1. Technical visit, organized by the management of SEGEM-Ankara, and basing on the approval of the management of the Turkish Iron and Steel Works Establishment, was paid to İSKENDERUN IRON AND STEEL WORKS on 22 to 26 April 1985.
The persons met of the plant where :
Technical Director of the works Mr.
Rolling Mills Plant Director and managing staff of the Rolling Mills Plant.

2. The Rolling Mills Plant of the İSKENDERUN IRON AND STEEL WORKS essentially consists of :

- continuous billet mill,
- continuous bar and light sections mill,
- continuous rod mill,
- continuous medium sections and bar mill(with universal stands)-under start-up period.

The continuous billet mill and the continuous medium sections and bar mill, are charged by continuous casting billets (CC billets).
The continuous bar and light sections mill, as well as the continuous rod mill, are charged by billets 80x80 which are rolled on the continuous billet mill. The CC billets are of the following basic dimentions:

260x340 mm
260x260 mm
200x200 mm

2.1. Continuous billet mill.
The production programme of the mill are billets of dimensions:

80x80 mm
100x100 mm
120x120 mm
130x130 mm
150x150 mm

For export billets of 140x140 mm are under consideration.

The planned capacity of the mill is some 1550000 tons/year, irrespective the product mix. Practical achievements are some halfe of the planed capacity, however. The problems, facing at present the rolling mill, are predominatly electronical, electrical and to some extand mechanical ones. Process problems are minor, and the staff got suitable operational experience.

During the vizit, the management of the Rolling Mills Plant requested, on possibility of rolling billets 140x140 mm using the existing roll sets (for rolling of billets : 100x100 mm, or 120x120 mm, or 130x130 mm, or 150x150 mm). After examination the pass design for rolling billets of the above mentioned dimentions, a proposal for using the existing set of rolls for rolling of billets 150x150 mm, in order to roll billets 140x140 mm has been submited. PASS SCHEDULE DATA SHEET-OPERATION, is attached to the report.

The continuous billet mill has the process possibilities to reach the planed 1500 000 tons of billets per year, providing that all the necessary electronical, electrical and mechanical modifications and improvements will be executed.

2.2. Continuous bar and light sections mill. This rolling mill, is a clasical design of such type of rolling mill of the 50th of this century. Theoretical rolling mill out put, when the product mix is carefully blanced may be some 500 000 tons/year.

Production programme of the rolling mill:

- rounds 12(10) - 32 mm DIA
- square 10-30 mm
- hexagon 11-27 mm
- flates 12-70x4-12 mm
- angles 20x20x3-50x50x5 mm

The production achievements of the rolling mill are some 270000 tons/year. There are several reasons for the above mentioned performence.

Process. The rolling mill, with the rolls DIA of 320 mm, of the finishing train, is not efficient for rolling of 12 mm DIA bars. Furthermore, due to difficulties in operation of the cooling bed with speed-of the delivered bar- more then 13m/sec, the output of the rolling mill when rolling such light bars is very low. Lack of control of tension between the stands, which leads to difficulties in geting dimensions of the rolled products, in the range of required tolerances, is another reason. Next in line is the short life time of rolls.

Operation. Operation problems of this rolling mill are chiefly connected with the not stable and not precise functioning of elactronic and electrical equipment. As the operation of the rolling mill is a complex one, any distrubance in one place, causes fault operation on other places. Than the coming to normal (synchronized) operation takes time. The main subjects of precised (synchronized) operation of the rolling mill are :

- speed adjustment and correlation between rolling stands as well as groups of rolling stands,
- speed adjustment between the finishing stand and cutting speed of the flying shear,
- speed adjustment of the rolled bar and roller table in front of the cooling bed,
- logical sequence operation (movement) of the ejector and cooling bed collector.

As the operations of electronical and electrical equipment are repeated thousand times a day, a proper and reliable functioning of the equipment is one of the most important factor of the rolling mill operation.

Such operation however, can not be achieved using old fashioned electronic equipment with relays and switches as logically operated elements. For such purpose, nowadays in common use are panels with integrated circuits and processors.

One of the possible way to increase the rolling mill output to a certain extent is to increase the cross sectional area of the charge (billets). Full benefit of such modification can be achieved on continuous rolling mill, when the rolling speed of the following stands can be increased according to the elongation factor "λ". As a result, the speed of the finishing stand will be increased proportionally to the increase of the cross sectional area of the initial billet when increasing the billet size from 80x80 mm to 100x100 mm, the proportional increase of the finishing stand speed will be 1.56. In such a case, the output of the rolling mill can be increased up to 1.4 times that is to say 40 per cent.

But in the case of the İskenderun Continuous Bar and Light Sections Rolling Mill, this benefit can not be utilized, due to difficulties in operation of the cooling bed with speed above 13 m/sec. Thus, in this case, the possible increase of the rolling mill output will be limited to some 10 per cent only.

In order to eliminate as much as possible rolling of billets 80x80 mm on the continuous billet mill, as well as to increase the output of the continuous bar and light sections rolling mill, the management of İSKENDERUN IRON AND STEEL WORKS asked to elaborate pass design for rolling of bars 12 mm DIA, using billets 100x100 mm. Responding to the request, adequate pass design has been elaborated and is attached to this report. Full set of drawings (passes) with pass schedule data sheet-operation- has been handed to the management of the Rolling Mills Plant at the end of the visit.

2.3. Continuous rod mill.

The continuous rod mill, is a four stands rolling mill, a concept of high output rod mills, which are in comon use since 50 years.

For about 20 years -up to the end of 60th- progress in development of this type of rolling mill was locked due to

difficulties in stabilizing the speed of individually driven stands of the finishing group, and simultaneously with difficulties in coiling the rod, when rolling speed exceed 28-30 m/sec. significant progress was made by introducing into rolling practice the non-twisting blocks (as a finishing group of stands) and replaicing the Edenborn coilers by coiling machines (vertical or horizontal) and coiling the rod on moving transporter. These improvements make possible to increase the rolling speed up to 80 m/sec., and finally to get an output of a four strands rolling mill, some 800 000 tons/year, when rolling rods 5-12 mm DIA. Theoretical rolling mill output of the old type continuous rod mill when rolling rods 5.5-10 mm. DIA, is some 500 000 tons/year. Practical achievements of this type of rolling mills are some 450 000 tons/year. However, the practical production achievements of the Iskenderun Continuous Rod Mill are far less, and not more then 250 000-260 000 tons/year. The reasons are very similar to those of the continuous Bar and Light Sections Rolling Mill.

In addition to the above, the rolled rods can not meet the requirements of international standards. The above is valid as well as for tolerances in shape as well as for quality requirements.

The difficulties in geting the rod with required tolerances, are caused by two reasons :

- relatively big roll diameter (260 mm) for rolling of rods 5.5 - 8 mm.
- uncontroled tension between the stands of the finishing group.

The quality problems are mostly related to the used coiling system. The typical quality imperfections are :

- high percentage of scale, up to 3 per cent in comparison of 1 per cent as an international standard,
- differences in mechanical properties along the coiled rod,

- metallographic structure unconvenient for cold- drawing.

All the above mentioned shortcomings, can be eliminated by performing suitable modernization of the rolling mill. It is recommended to perform the modernization in the following steps :

a) replacement of the obsolate electronical and electrical equipment for a modern one:
b) replacement of the existing finishing group of stands and Edenborn Coilers by a modern non-twisting block with Stelmor coiling and processing line(may be second hand equipment)
c) introducing into rolling practice billets of 100x100 mm in cross sectional area.

All the above mentioned improvements will enable :

- increasing the rolling speed up to 42 m/sec, simultaneously increasing the rolling mill output of some 40 per cent.
- improve tolerances of the rolled rods up to requirements of international standards.
- improve the quality up to actually accepted standards.

After concluding the above mentioned improvements the continuous rod mill should easily produce some 600 000 tons/ year of rods 5-12 mm DIA.

2.4. Continuous medium sections and bars mill.

The continuous medium sections and bars mill is a modern design with universal stands for rolling of sections and edging passes when rolling of flat bars is in question. Output of the rolling mill, depending on the product mix some 700 000 to 800 000 tons/year.
At present, the rolling mill is on the start-up period, and trial rolling of different sections.
In spite of the modern design, some improvements, mostly connected with the process may be recommended.

- improwing cooling of rolls with simultaneous decreasing of the supplied quantity of water,
- better fixing of rest bar,
- precise adjustment of entry side guides.

According to the contract, the know-how for rolling mill operation contains only pass design for few sections. For others (sections) completly new pass designs must be elaborated. In order to reduce the possible causes it is recommended to order the needed pass designs in a specialized consulting office or other specialized institutions.

CONCLUSIONS AND RECOMMENDATIONS

1. In order to increase productivity and output of all the rolling mills -at ISKENDERUN IRON AND STEEL WORKS- production programme with product-mix for the particular rolling mills ought to be elaborated, eliminating or shifting to rolling mills of other companies such profiles or sections, which output (due to process specification of the particular rolling mills) is very low, and not economically justificated. As an example, rolling of bars 12 mm DIA on continuous bar and light sections mill can be mentioned.

2. Relatively low production of the :

   - continuous billet mill,
   - continuous bar and light sections mill,
   - continuous rod mill,

   is caused mostly by improper operation of the electronic and electrical equipment (and to same extent mechanical equipment as well) which can be considered as obsolete.

   Systematic replacement of the above mentioned equipment, ought to be performed as soon as possible, in order to create possibilities of increasing production of the rolling mills.

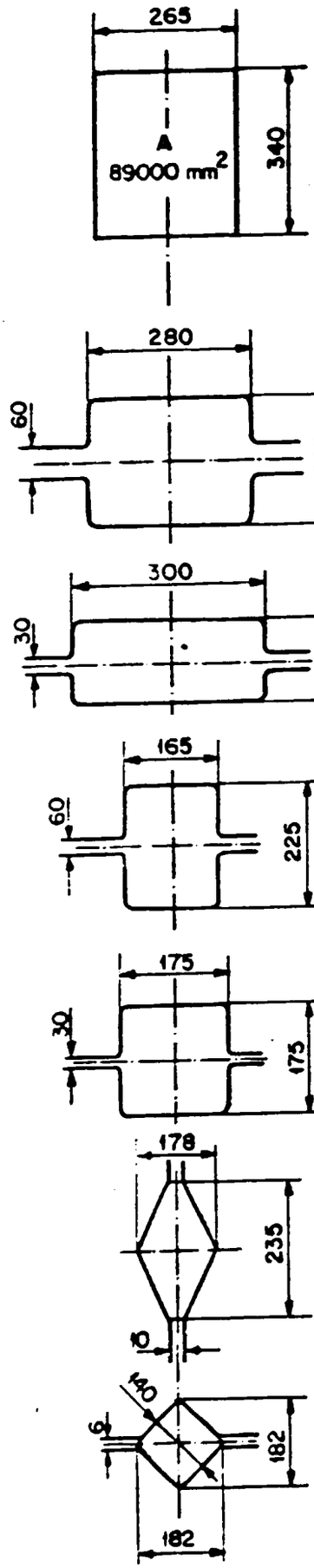
3. In order to increase quality of the rods and output of the continuous rod mill, long term modernization of this rolling mill ought to be elaborated. The main items of such modernization are as under:

   - replacement of the present electronical, and part of electrical equipment, by modern ones, including panel type integreted systems and processors,
   - replacement of the present group of finishing stands and Edenborn coilers by modern non-twist blocks and Stelmor coiling and processing lines.
   - introducing as a charge, billets of cross-sectional area 100x100 mm.

4. In order to mininize the possible cosses and shorten as much as possible the time of implementation of rolling new sections, that is to say, for sections for which the pass design has not been submited by the supplier of the continuous medium sections rolling mill, it is recommended to order the necessary pass designs in a specialized consulting office or other specialized institution.

5. At the time being, for the continuous medium sections rolling mill the following improvements are to be recommended:

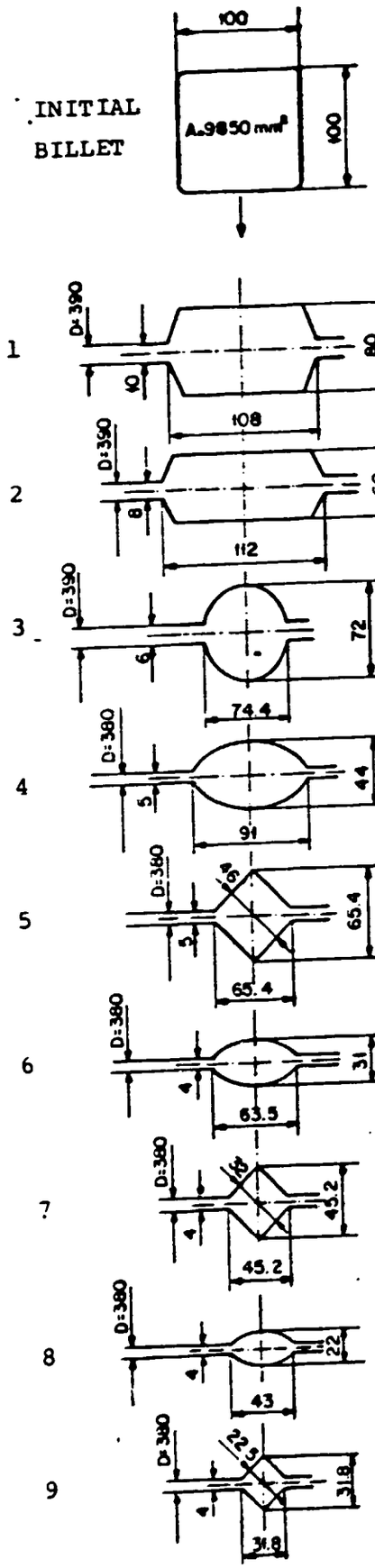
   - improving cooling of rolls with simulateneous decreasing of the supplied volume of water
   - introducing the lubrication system for hot rolling(leader and finishing stands only)
   - better fixing of the rest bars
   - precise adjustment arrangement for entry guides.



	ARE A MM²	ELONGA-TION	REDUC-TION %
ROLLS AS UP TILL NOW			
1	67.400	1.32	24.3
2	44.500	1.51	34.0
3	35.800	1.24	19.6
4	30.000	1.29	29.3
ROLLS FOR ROLLING			
5	23.200	1.29	29.3
6	18.800	1.23	19.0

PASS SCHEDULE DATA SHEET -OPERATION-

FOR ROLLING 140 mm USING THE EXISTING SET OF ROLLS

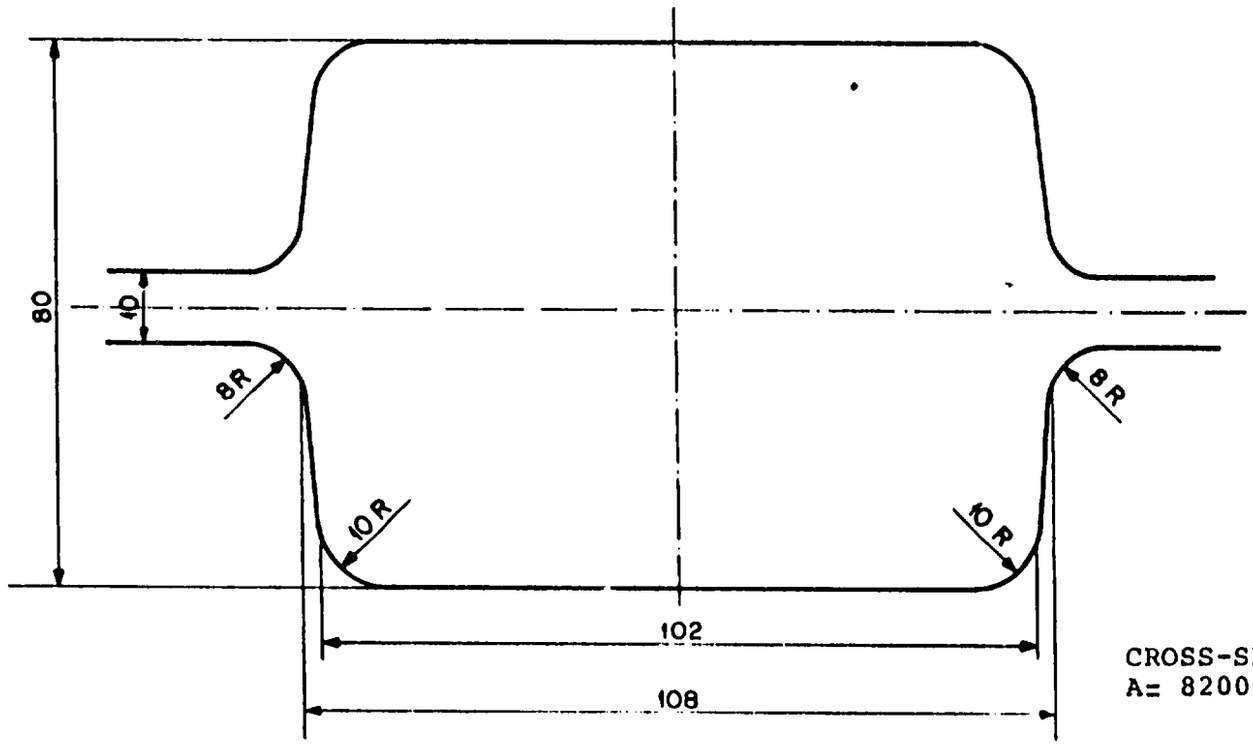


	ROLLS RPM	ARA A MM^2	REDUCTION %
1	9.12	8200	16.75
2	11.00	6560	20.00
3	16.10	4560	30.48
4	25.60	2882	36.80
5	39.00	2066	28.31
6	51.75	1394	32.52
7	72.46	1010	27.54
8	104.7	683	32.37
9	145.7	495	27.52

PASS SCHEDULE DATA SHEET - OPERATION

ROLLING OF 12 mm DIA ON COOLING BED WITH SPEED 15 m/sec.

INITIAL BILLET 100X100 mm

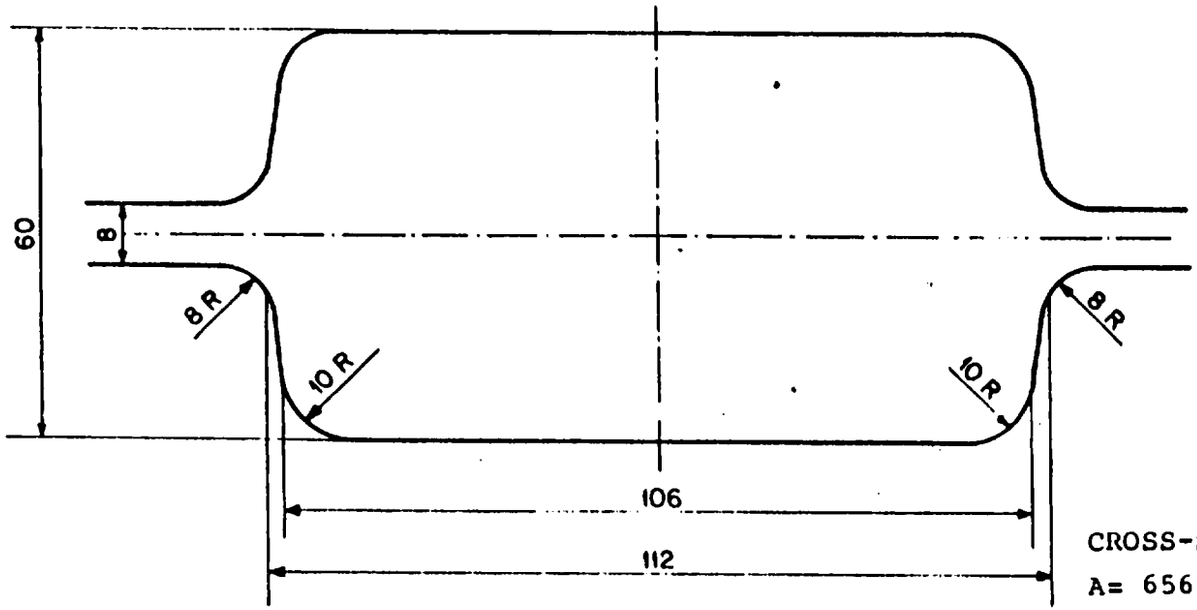


CROSS-SECTIONAL AREA
A= 8200 mm^2

PASS NO 1 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100x100 mm

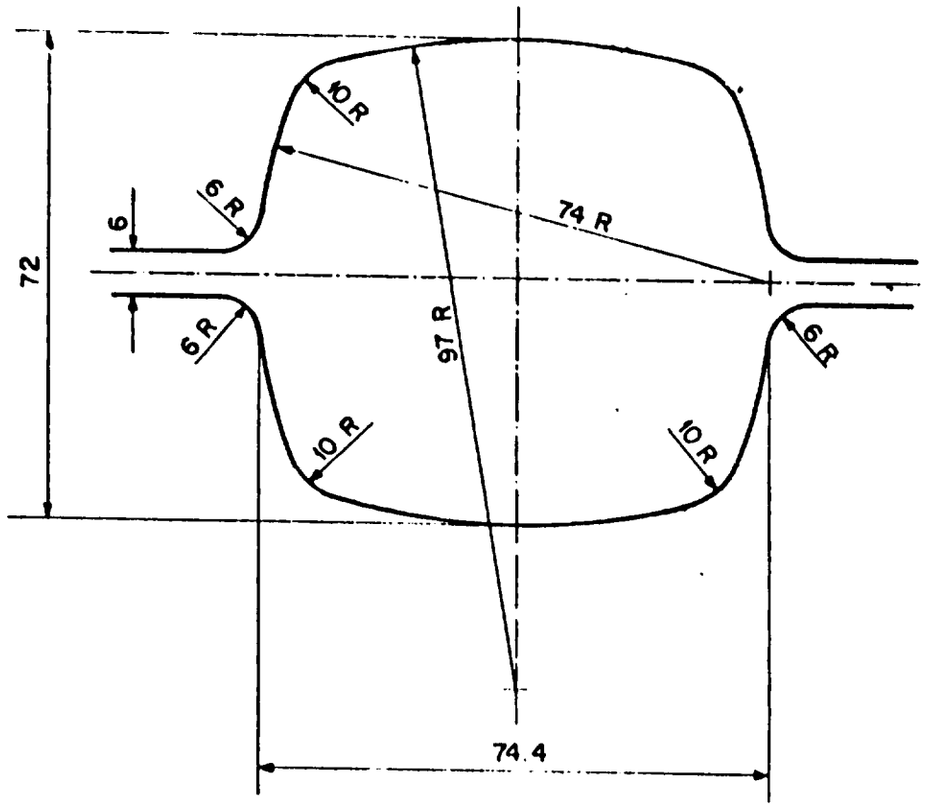


CROSS-SECTIONAL AREA
A= 6560 mm^2

PASS NO 2 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100 X 100 mm^2

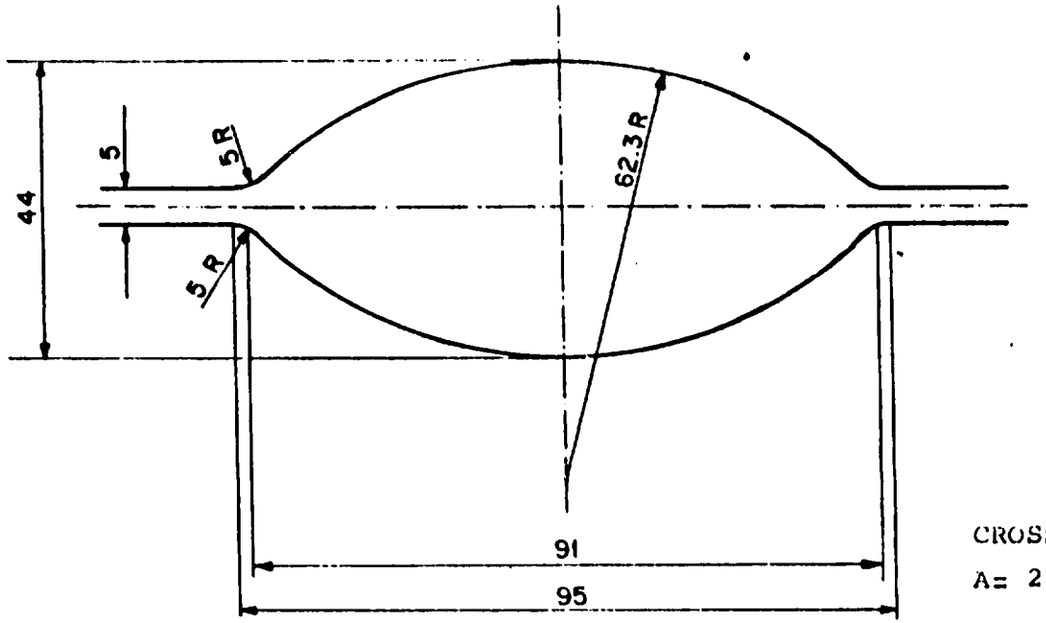


CROSS-SECTIONAL ARE A
A= 4560 mm^2

PASS NO 3 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100X100 mm

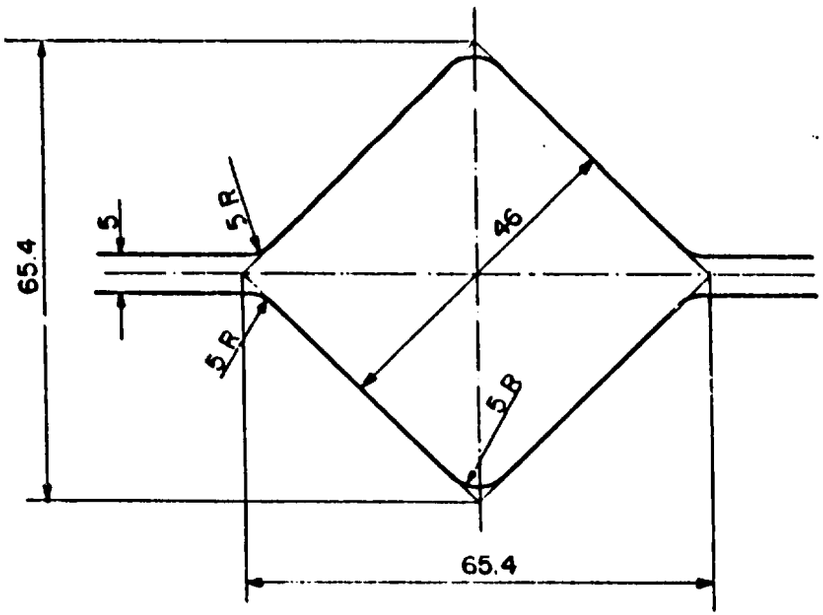


CROSS - SECTIONAL AREA
A= 2882 mm^2

PASS NO 4 BAR 12 mm D/A.

SCALE 1:1

INITIAL BILLET 100 X 100 mm



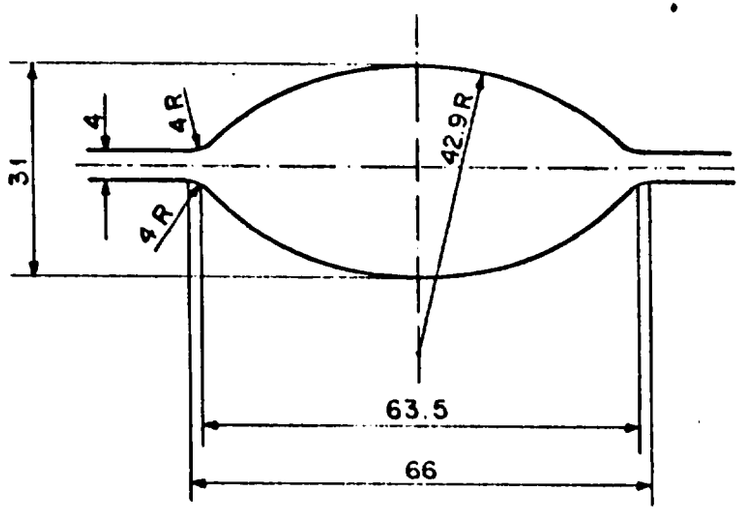
CROSS - SECTIONAL ARE A

$A = 2066\ mm^2$

PASS NO 5 BAR 12 mm DIA

SCALE 1:1

INITIAL BILLET 100 X 100 mm



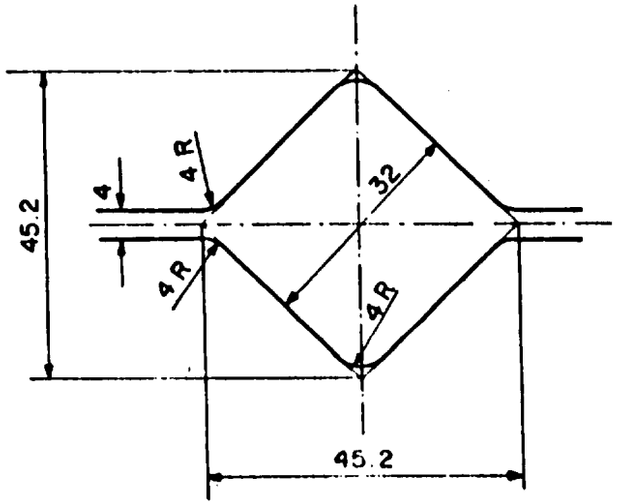
CROSS-SECTIONAL AREA A

$A = 1394\ mm^2$

PASS NO 6 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100 X 100 mm



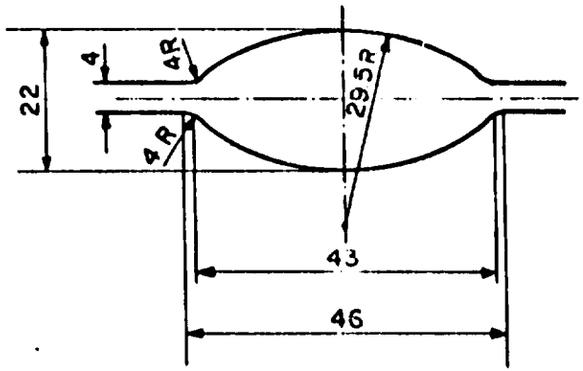
CROSS - SECTIONAL AREA

A = 1010 mm^2

PASS NO 7 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100 X 100 mm

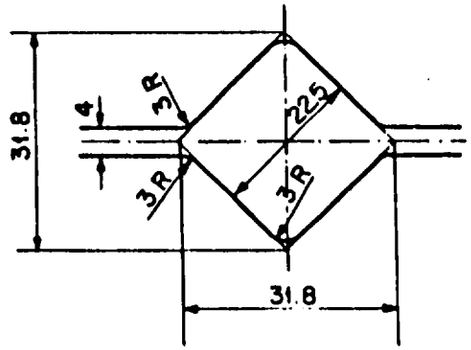


CROSS - SECTIONAL AREA
A = 683 mm^3

PASS NO 8 BAR 12 mm D/A

SCALE 1:1

INITIAL BILLET 100 X 100 mm



CROSS - SECTIONAL AREA

$A = 495\ mm^2$

PASS NO 9 BAR 12 mm DIA

SCALE 1:1

ANNEX NO: 5

Jan J. GAWLIVOWICZ
UNIDO Consultant
Counterpart : Ali Han, met.Eng. (SEGEM)

TECHNICAL PAPER
on some questions which arised
during technical visit to

ÜSTÜN ÇELİK
Malzeme İmalat ve Montaj Sanayii A.Ş.
11 April 1985

1. Calculation of reheating furnace dimensions of the ÜSTÜN-ÇELİK. Bar and Rod Rolling Mill under reconstruction.

The Rolling Mill output after performing the modernization is considered to be 250 tons/one shift, that is to say 31.25 tons/hour.

The reheating furnace out-put should be at least 10% higher than the average rolling mill out-put. This is in order to secure smooth rolling mill operation.

Due to the above the out-put of the reheating furnace should be not less than 34.5 tons/hour.

Calculation of the reheating furnace dimensions is based on the following formula :

$$O_F = \frac{L \cdot B \cdot q \cdot y \cdot n}{1000} \text{ (tons/hr)}$$

where :

O_F - Furnace out-put (tons/hr)
L - Length of the furnace hearth (m) calculated from medium of the combustion gases exhaust to the discharging place

B - Width of the furnace hearth (m)

q - Permissible unitary loading of the furnace hearth (Kg/m^2 . hr)

y - Coefficient of the rolling mill yield

n - Coefficient of the hearth utilization, computed as ratio of the real (used) to the maximum permissible charge (billets) length.

The permissible unitary loading of the furnace hearth "q" is to be taken according to the kind and charge (billetes) thickness, way of heating and steel grades. Values of the permissible unitary loading, taken from the industry practice are given below.

Charge Type	Way of Heating	Plain Carbon	Carbon Higher Quality and Low Alloy	High Alloy
Ingots	1-Side	160-210	110-150	70-100
	2-Sides	280-400	190-270	110-180
Semi Products (Blooms Billets)	1-Side	200-300	140-230	80-140
	2-Sides	350-600	230-400	140-250

Taking into account, the billets length as 3000 mm that is 3.0 m the width of the furnace hearth should be some 3.5 m. Therefore the length of the reheating furnace can be calculated as :

$$L = \frac{Q_r \cdot 1000}{B.q.y.n} \quad (m)$$

where :

O_F - 34.5 tons/hr
B -- 3.5 m
q - 300 kg/m^2 . hr
(taken from the above given data)
y - 0.95 (coefficient of the rolling mill yield - assumed)
n - 0.85 (ratio 3:3.5)

then :

$$L = \frac{34.5 \cdot 1000}{3.5 \cdot 3000 \cdot 0,9 \cdot 0,85} = 42.95$$

L = 43 m.

Such length of furnace can not be accepted, so two rows furnace of the following hearth dimensions should be selected :

Width 6.8 m
Length 22 m

But there is a question, whether rolling mill of such constriction can reach production at 31.5 tons/hr. After only a rough estimation, the possible out-put of the rolling mill after its reconstruction is to be evaluated as not more than 20 tons/hr.

In this respect, the dimensions of the furnace will be when selecting on row furnace :

O_F = 20 tons/hr
B = 3.5 m
q = 300 kg/m^2 . hr
y = 0.95
n = 0.85

$$L = \frac{20 \cdot 1000}{3,5 \cdot 300 \cdot 0,9 \cdot 0,85} = 24.89$$

L = 25 m.

For the pusher type furnace, the length 25 m can not be recommended, due to possible difficulties in pushing the charge through the furnace (possibilities of billets piling). Taking the above into account, two rows furnace of dimensions of the hearth as under should be selected :

Width 6.8 m.
Length 13 m.

But in order hot to lock the further development of the rolling mill, the furnace should have an out-put of some 30 tons/hr.

In this respect, the dimensions of the hearth of the two row pusher type reheating furnace will be

Width 6.8 m
Length 18 m.

The presented type of furnace, with the front and side burners is not to be recommended. Better heating conditions will be achieved with two tones furnace and additionally instaled flat-flame burners on the roof at the pre-heating zone of the furnace.

A general concept of such furnace is given on the attached sketch.

2. Steel grades recommended for rollers of the entry roller guides and delivery twisting rollers.

A. Recommended Steel Grade

Denomination acc. to DIN STD
X 30 WCr V93

Chemical composition

C	Mn	Si	Cr	W	Ni	V	P	S
0.3	0.3	0.3	2.7	9.0	1.5	0.3	Max0.03	Max0.03

Heat treatment
Quenching
(to be performed after machining but before grinding)

Temperature	1050°C - 1120°C
Hardening medium	- Oil
Hardnes min.	45 HRC

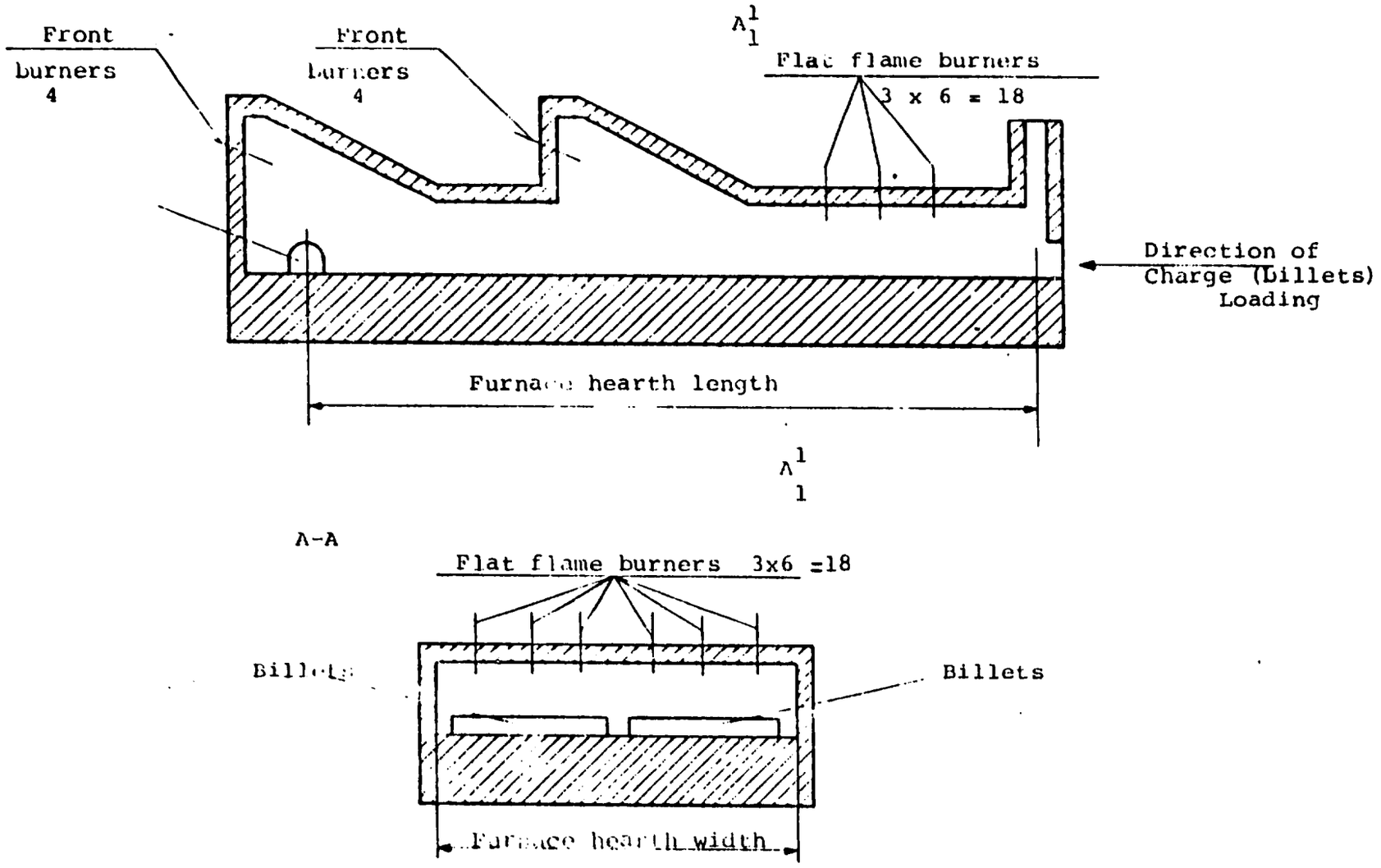
B. Accepted - but with less life- time

Denomination acc to DIN STD
55 NiCrMo VG
Chemical composition

C	Mn	Si	Cr	Ni	Mo	P	S
0.55	0.7	0.2	0.7	1.6	0.25	Max 0.03	Max 0.03

Heat treatment
Quenching
(to be performed after machining but before ginding)

Temperature	820°C - 860°C
Hardening medium	- Oil
Hardness min.	45 HRC



...the pusher two row
reheating furnace

ANNEX NO:6

JAN J.GAWLIKOWICZ
UNIDO CONSULTANT
ALİ HAN
SEGEM-ANKARA

R E P O R T
on

TECHNICAL VISIT
to

ÇİNKO KURŞUN METAL SANAYİ A,Ş.
KAYSERİ

Paid on 19.04.1985

1. Technical visit, organited by the management of SEGEM, Ankara, and basing on the management approved of the ÇİNKO KURŞUN METAL SANAYİ A.Ş., KAYSERİ, was paid to the above mentioned fully integreted zinc plant, with independent aluminium department. The person met of the plant was, Assistent General Manager, Technical Director MR. YAŞAR CANER.

2. The ÇİNKO KURŞUN METAL SANAYİ A.Ş. KAYSERİ is a fully integrated zinc palnt, with independant aluminium department. The zinc plant, being a modern factory, is under normal production operation, reaching production figures according to the possibilities created by chemical composition of the ore burden. Finished products, zinc bars, of all required alloy grades and quality grades, jointly with ultra purre zinc some trials of producing zinc sheets have been performed, but due to lack of market in Turkey for such sheets, the production was suspended, however.

   The aluminium department is a completely independent one and essentially consisting of :

   - melting furnace,
   - strip continuous caster with coiling arrangement,
   - 4Hi 13"(343 mm) / 34" (864 mm) x 54" (1321 mm) reversing cold rolling mill with coilers on both sides
   - Strething and levelling mechine
   - annealing furnace
   - auxiliary department

   The melting furnace, being adequately equiped with measuring and control instruments is capeble to melt all required aluminium grades.

   The strip continuous caster is in a position to cast strips of width up to 1100 mm width, thickness 3.17 ÷ 6.35 mm, and coil size 1270/805 mm. Casting speed 0.5 - 1.5 m/min.

Maximum coil weight(reffering to zinc) 9 ton. The max. entry thickness (gauge) for the 4 Hi reversing cold rolling mill is 6.35 mm.

The min. rolled thickness (gauge) 0.25 mm. The thickness of 0.25 mm with working rolls of 343 mm will be diffucult to obtain, and should be considered rather as an extreme possibility of the rolling mill,practical min thickness (gauge) will be some 0.35 mm.

Rolling speed 0-138 m/min and 0-366 m/min. max coil OD 1270 mm. Core DIA 478/508 mm. The rolls may be subject of dressing (grinding) up to 8 per cent of OD.

The rolling mill is furmished with closed medium cycle, for process labrication and cooling, with all necessary filtration and regeneration devices.

The rolling mill is equipped also, with the all necessary up to date measuring and control devices like :

- temperature measuring of labrication and cooling medium
- dust (smoke) indicator,
- strrain gauge loadmeter
- thickness (gauge) constance measuring (on the whole strips' width)
- rolling speed indicators
- front and back tension indicators
- coil diameter indicators

All the measuring and control devices anable automated or semi-aufomated operation of the rolling mill.

The stretching and levelling machine permits elimination of bulges, and obtaining dead flat strips.

Grinding mechine for rolls, anables dressing (grinding) of rolls, both working and back-up as convex or concave.

2. Due to market difficulties, in spite of the fact, that the process, as well as the equipment of the aluminium department should be considered as modern, teh department has not been put into operation after its erection, that is to say, since 8 years. The idle staying of the department is cousing the plant neavy financial losses.

   At present, the management is seriously pondering the possibilities of putting the department under operation. The main problem however is, to find market for the products of the department.

   It is obvious, that the market for aluminium strips or sheets in the range of thickness (gauge) 0.3 to 5 mm exist in Turkey, but is captured by other producers, however, and therefore, it is impossible to enter the market directly.

3. Considering the still possible market requirements for the flat aluminium finished rolled products, with the thickness 0.3 to 5 mm and width up to 1100 mm, the following should be mentioned :

   Aluminium plane grades

   - strips for production of longitudinal welded pipes- main (distribution) pipes for irragation (artificial rain) systems.

   Aluminium grades of special mechanical properties

   - alloy aluminium grades, mosthy with high requitements of tensial strength and/or fatique strength, and high elongation. Aircrafts industry, shipbuilding industry, automotive industry.

   Aluminium grades ofspecial physical properties

   - electrical and electronic appliences, where beside suitable chemical composition, adequate texture, as a structure of the aluminium product is required as well.

Simultaneously, it should be mentioned that the best economical results can be achieved, when the plant will manufacture products "ready to sell" on the public market, for instance aluminium pipes for irragation systems (as main pipes) with all necessary and optional accessories.

In this respesct, the plant can benifit alot from the modern system of manufacturing for, the production costs will be relatively low, and the profit will be for the plant benefit.

The domestic market, as well as the market of neighbouring countris for foil of thickness 0.04-0.10 mm used for household porposses (mosthy wraping of food) should becarefully observed. When the market will be going to developed, it will be profising to instol an additional, cold rolling mill with working DIA of some 40-60 mm (a MKW 4 Hi rolling mill seems to be the most suitable one) in such a case, slitting line for foild and packing machine or re-realing machine ought to be instaled as well. Aluminium grade for this purpose is the plain one and the continuously cast sfrip may be the thinest one (3.17 mm) with 7 to 19 reversing passes to be rolled to 0.3mm on the existing 4 Hi mill, and than with some 5 to 7 reversing passes on the additional 4 Hi mill to some 0.04-0.08 mm.

4. In order to elecidate a little bit more the production of longitudinally welded aluminium pipes for irragation systems, a material flow diagram and hypothetical orrangement of equipment are given in the attached charts.

CONCLUSIONS AND RECOMMENDATIONS

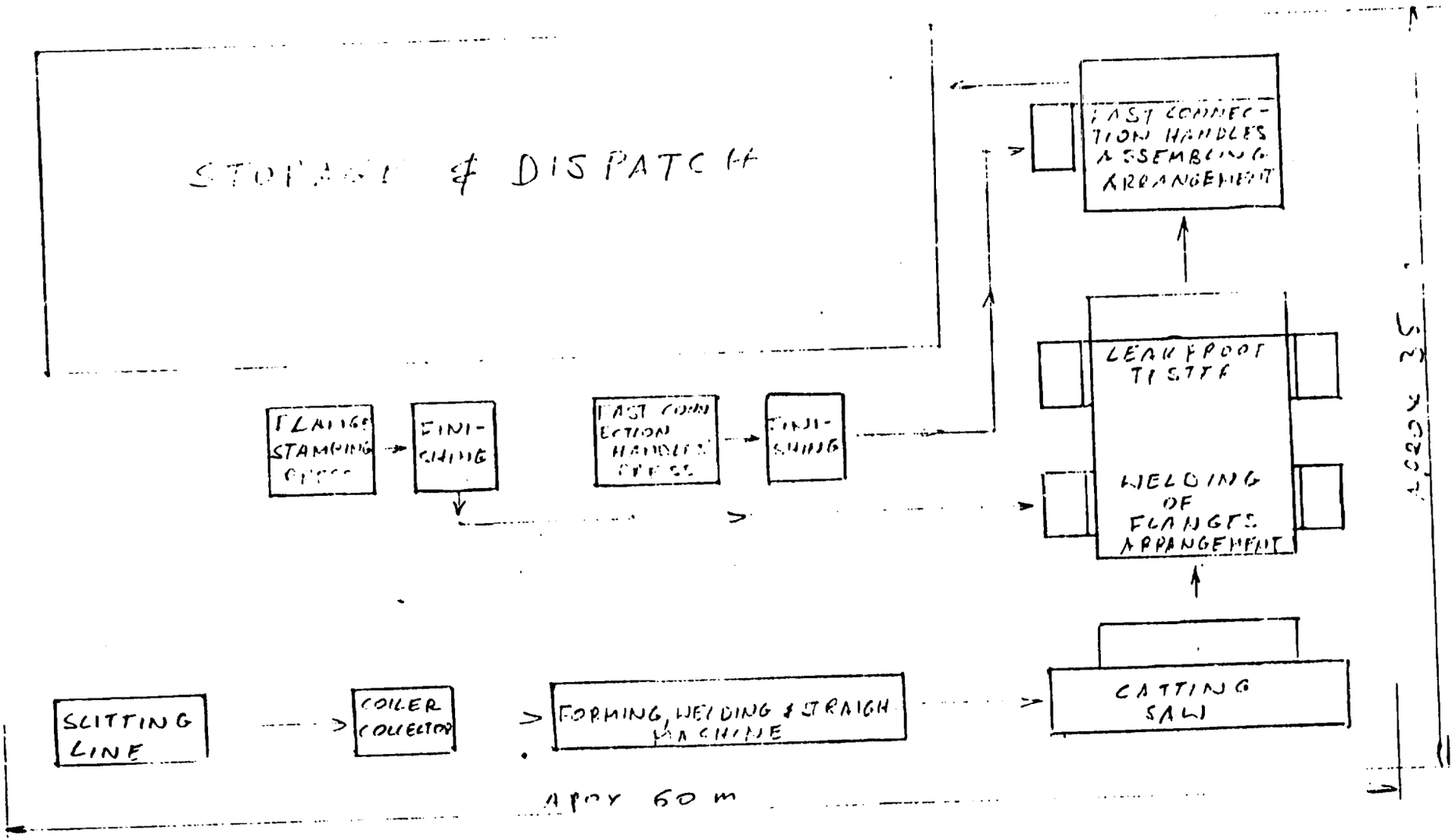
I. The aluminium department of the ÇİNKO KURŞUN METAL SANAYİ A.Ş., KAYSERİ is a modern one, based on adwanced thechnology which permits low poduction cost for manufacturing of aluminium strips in the range of thickness (gouge) 0.3 to 5 mm and width up to 1100 mm.

2. From the technical point of view, there are no obstacles in starting up the departments operation, but of the initial stage, technical assistance of experts acquainted with operation of such equipment will be necessary.

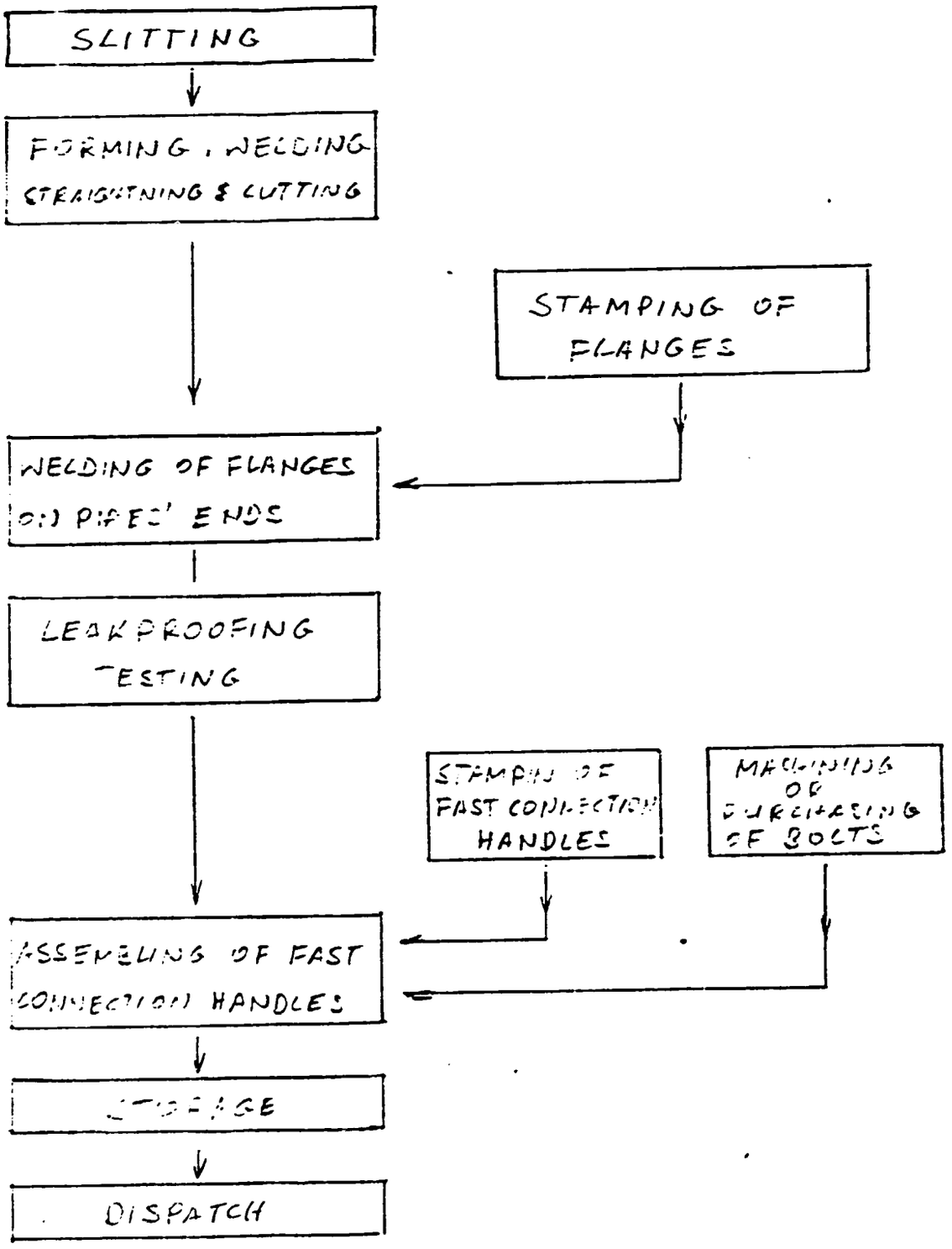
3. Before taken any decission on starting up with operation of the aluminium department full market research for the possible scope and range of products (either semi products)

   - aluminium strips, sheets or foil-either ready to sell" products - irragotion pipes for instance).

4. Baising on the results of market research full feasibility study on the start up undertaking and further operation of the department ought to be performed.
   The feasibility study, should give univocal answer, for the further destiny of the plant's aluminium department and its future role in the plant's economy system.
   Procrastination with the final decision, as far as the future of the aluminium department is concern, will create only, not necessary continuous financial losses.



HYPOTHETICAL ARRANGEMENT OF EQUIPMENT FOR PRODUCTION OF ALUMINIUM LONGITUDINAL WELDED PIPES OF 80-150 (200) mm DIA WITH FLANGES AND FAST CONNECTORS



MATERIAL FLOW DIAGRAM
FOR PRODUCTION OF ALUMINIUM LONGITUDINAL
WELDED PIPES OF 80-150 (200) mm DIA