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LEATHER AND LEATHER PRODUCTS DEVELOPMENT

DP/ETH/78/001

ETHIOPIA

Technical report: Manufacturing and designing of shoe last*

Prepared for the Government of Ethiopia
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Uday Shankar Paul,
Manufacturing expert for shoe lasts

United Nations Industrial Development Organization
Vienna

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ABSTRACT

Lasts are fundamental to shoe manufacture since they dictate the exact shape, size and fit of the shoes made on them. Wood is now used only for model-making. Bul': ɔeries lasts are manufactured from H.D. plastic.

The manufacturing expert for shoe last arrived on site on 5.1.85 for assisting in starting up the operations of the pilot plant for shoe lasts, train designer, supervisor and operatives in the various design & manufacturing aspects of the shoe lasts. There was a delay in commissioning of the machines and thus time available for on-the-job training was too short.

Seminar of one week duration for familiarisation for the principles of shoe last was conducted for the project personnel.

Step by step manufacturing of the shoe lasts on the machinery installed in the pilot plant was demonstrated and carried out. A manual on manufacturing was prepared and distributed.

The design of shoe-last model is a complex process which cannot be taught in such a short period. However the principles of design of shoe-last were explained and a manual on designing was prepared and distributed.

All the objectives of the project was achieved but for the proficiency in operatives training due to shortage of time.

ACKNOWLEDGEMENT

At the outset, I express my thanks to United Nations Development Programme(UNDP), United Nations Industrial Development Organization(UNIDO) and Government of Ethiopia for giving me the opportunity to work on this project.

The National Leather and Shoe Corporation(NLSC) provided all co-operation and help in carrying out my duties. The General Manager Ato Habtemarkos Macco, Head of Technical Operation Division Ato Getachew Zewde and Head of Pilot Plant Ato Tegene Aredo deserve my special thanks. All the staff of the N.L.S.C. including the Pilot Plant have been very cooperative. Without their active participation in the work and brotherly feeling towards me, the task could not be carried out successfuly in the limited time available. Mr. Sylvio Corsico, Installation Expert of Income saw to the proper running of all machinery and had been immensely helpful.

The UNDP office, Addis Ababa provided all administrative support. Mr. K. Vencatachellum, SIDFA was very helpful and always ready to solve any problem which arose. Ato Tadewos Harege-Work, Project Coordinator and Ato Bekele Alemu, National Project Officer saw to the smooth functioning of the project both technically and administratively. Mrs. Meseret Habte, project secretary provided all the secretarial help.

My special thanks are to Mr. Johani Berg, Senior Industrial Development Officer, UNIDO, Vienna who gave his valuable time spending long hours with me for giving much valuable, constructive advices and suggestions which helped me tremendously in fulfilling my assignment.

INTRODUCTION

Ethiopia ranks number one in Africa Continent in terms of total livestock availability and at the same has a large population requiring various sizes and types of shoes. As per 1984 census, the population of Ethiopia was about 42 million. The Government of Ethiopia in its drive for self sufficiency has given high priority for the manufacture of shoes in the Country itself. In addition, there is a large potential for exports also.

The National Leather and Shoe Corporation, a state owned corporation under the Ministry of Industry runs six shoe factories and 8 tanneries. The production of footwear by the units under the Corporation was about 1.5 million pairs. In addition, the production by the private sector was also about 1.2 million pairs. The total production of leather footwear in Ethiopia is likely to go upto 4.18 million pairs by the year 1990. There are ambitious plans for expansion and establishment of new factories. In line with the total manufacture of the shoe, the Government decided to manufacture various components of the shoe in the Country itself, these include shoe last, unit soles, heels, etc..

Last making is generally a centralised manufacturing process because of its uniqueness and because of the determining role of shoe lasts in footwear manufacturing. Lasts are regarded as the starting point, not only for styling and pattern engineering, but also for co-ordination of prefabricated components. Thus, lasts provide special kinds of standards serving as a database for sizing and constructing upper pattern, insoles, counters, heels, unit soles, etc..

As a follow-up of the Tripartite Meeting in 1982 between UNDP, UNIDO and Government of Ethiopia, it was decided to have a Pilot Plant for Shoe Lasts under Project DP/ETH/78/001. Later on in 1984-85, the activities of the Pilot Plant were transferred to the larger project DP/ETH/83/013.

The proper design of the lasts as to their size, volume and shape are specially important in case of children's shoes particularly, because the wrong footwear may cause irreversible deformation of the foot, leading to serious orthopaedic diseases in the adult age.

To be able to produce properly designed footwear, a well elaborated size(length) and fitting(joint girth) system is required. Lasts imported from industrialised countries most probably cannot serve their purpose in this Country, owing to the anthropometric differences of the population.

Not having a long tradition in local footwear trade and no anthropometric statistical data available in local footwear trade on foot sizes of the Country, the current approach was to make thorough foot survey. This was carried out in Ethiopia by an UNIDO Expert during 1983 under UNIDO project No.DP/ETH/78/001.

On the basis of his recommendation of new sizing system, based on mondopoint, and new fitting chart(joint girth measurement or width table) a set of new sample lasts have been received from Hungary. The prototype shoes for mass wear testing are being prepared by Anbessa Shoe Factory.

Based on the results of the survey for acceptance of the new design of the shoe, Government of Ethiopia would like to manufacture all lasts in the pilot plant.

The project envisaged among others an expert for manufacturing and designing of shoe last. The expert joined the position on 1.1.1985 and arrived at site, Addis Ababa on 5.1.1985.

The job of the expert for the shoe last included:-

1. Assist in starting up the operations of a plastic last production plant;
2. Train one or more designers in all the basic work related to the production of sample lasts to be used for the production of series of lasts;

3. Train designers, production supervisors and machine operators in the production of lasts according to internationally established last charts, as well as undertake training in the operation of available equipment for the control of production at various stages;

4. Train operators in all operations from coarse turning of plastic or wooden blocks to finished products.

The expert on arrival on 5.1.1985 found that the building for pilot plant was not ready, none of the machines had been installed and there was unusual delay due to various factor beyond control. Therefore, the expert had to change his time schedule to suit the installation timings . The machines were installed only on 16.2.85 and were operational from 19.2.85.

The expert concentrated on the training for last making/on the design of shoe last up to 15.2.85 and carried out the following:-

-Seminar on Shoe Last Making
-Preparation of Manual for Shoe Last Manufacturing
-Preparation of Manual for Shoe Last Designing

Testing/trial of machines were carried out without workload between 20.2.85 and 25.2.85 and necessary adjustment/repairing was made.

From 27.2.85, the training of supervisor/operatives on the manufacturing of last and designer was undertaken.

Pilot production started from 5.3.1985.

A number of factories and organisations other than Last Pilot Plant, N.L.S.C., Ministry of Industry connected with footwear, lasts and input materials were visited. They are:

1)	Ethiopian Rubber and Canvas Shoe Factory	Manufacturer of rubber & canvas footwear
2)	Awash Tannery	Tanning hides & skins
3)	Anbessa Shoe Factory	Manufacturer of leather footwear
4)	Design Centre	Footwear styling and R & D
5)	Wood Workshop	Training in wood working
6)	Tikkur Abbay Shoe Factory	Manufacturer of leather footwear

The last date of assignment of the expert in Addis Ababa is 27 March 1985.

I. FAMILIARIZATION OF SHOE LAST PRINCIPLES

What is Last? The last is the foot-shaped form over which the footwear is fabricated. It is the 'Last' in the ultimate analysis that ensures the shoe to conform to the desired shape and style (fashion profile), fit (size & width), functional features (many of shoe's performance quality).

For dimensional precision, accuracy, critical fitting properties and uniformity in the production of right footwear, good lasts are absolutely essential. A "good last" is one which is anatomically correct, dimensionally conforms to the given norms and at the same time, in line with the prevailing fashion. Thus, the ultimate quality of the shoe essentially depends upon the "shoe-last".

A seminar was conducted on "Shoe Last Manufacturing and Desigring" as per details given below. The course participants were the engineers of Technical Operation Division, Costing, Purchasing, Quality Control Heads of N.L.S.C.; the Factory, and Production Manager of Anbessa Shoe Factory as well as the trainees who had earlier been trained in Italy.

A technical paper on the seminar was also prepared which was distributed to the participants, project authorities and UNIDO.

Date of Starting	:-	21.1.85
Date of Completion	:-	26.1.85
Numbers of Participants	:-	20
Major Subjects Covered	:-	1. Purpose & Usefullness of Footwear & Last;
		2. Types of Lasts;
		3. Material;
		4. Terminology;
		5. Constructional Requirement;
		6. Dimensional Requirement;
		7. Defects & Deviations;

8. Sampling & Testing Methods;
9. Designing of Lasts;
10. Relation between Manpo Last Making Plant, Anbessa Shoe Factory and Design-Cell;
11. Sales Policy;
12. Layout of the Manpo Last Making Plant;
13. Flow Chart of Production Process;
14. Storage, Material Handling,etc.

II. MANUFACTURING OF SHOE LASTS

Shoe lasts traditionally have been made of hard wood, mainly maple, beech and horn beam though presently the use of plastic materials in gaining ground.

The wood lasts required 8-12 months to be kiln-dried to reduce the moisture content in them from 50-60 percent to 5-6 percent. Even then these lasts were subject to swelling and shrinking from temperature and humidity changes that could alter the last and shoe sizes appreciably.

Wood lasts had other shortcomings. They stained easily, sometimes causing soil damage to shoes in shoe making. They damaged or aged quickly due to repeated tack holing and pressures and jarring from hammers and machines. And there was costly breakage (the plastic last has virtually eliminated this,a saving of another 20 percent in last replacement and repair costs).

Plastic last along with the modern last duplicating lathe, was the most revolutionary development in the history of last industry. Due to the above disadvantages, wood has largely been replaced by plastic for bulk last manufacture, while wood is used only for model making.

By contrast, the plastic last has dimensioned stability, unaffected by temperature or humidity. This insures reliable shoe fit. It also permits "standardized" or uniform fitting of components in shoe making the counters, insoles, box toes, shanks, premoulded bottoms, etc.. This achieves economies for the shoe manufacture, while improving the fit, quality and look of the shoe. The plastic last doesn't soil the shoe. Its waxy surface allows faster and easier removal from the shoe; an important timesaver. It can withstand jarring and pressures without damage. It has longer life and rarely requires repair.

The first step is to bring the plastic block from store to 800 m/m Q Band Saw (M/C No.1) for cutting the excess of the blocks. Then they are ready for rough turning on Fagus Lathe (M/C No.2) to the approximate shape and measurement desired. At this point, the last has extended knobs (called dogs/stubbs) at the toe and heel to serve as gripping points to hold the last securely on the fine turning lathe and other machines.

Two holes are bored in twin drilling (double spindle m/c no.5) machine for hinge-pins. A deep v-cut is made at the top centre or cone and later the last will be cut in half at this point in s-shape in special device attached to 700mm Q Band Saw (M/C No.6).

The back & forepart of the lasts are slitted at the centre in chain mortizer (M/C No.7). Both parts of the last are assembled together by inserting hinge and pins. The hinge permits the last to be "bent" (opened and closed) for removal from the shoe after lasting operations at the shoe factory.

The next step is fine turning in Incoma lathe (M/C No.4). Here the last on the lathe refined to its final shape and precise measurements, duplicating of those of the master model. The turning lathes themselves are extraordinarily sensitive machines.

The toe and heel stubbs are first cut in 700 m/m Q Band Saw (M/C 6) and the trimmed off in Band Scouring (M/C No.8). Final shaping of toe & heel is done by hand with the help of files and graded patterns & profiles.

In wooden lasts leather reinforcer are fitted to the top of the last by nails and later trimmed off in shoulder plate milling (M/C No.11). Plastic last does not need any top re-inforcer (saving in material & operation).

Boring hole for thimble/ferule is done in drilling (M/C No.10) and hand setting these sockets.

Then comes the plating - of metal heel plates, half plates, full plates, etc. on pneumatic vice (M/C No.12) with the help of pneumatic hammer (M/C No.13). Those plates serve as a clinching device for the nailing, tacking or stappling of the parts of the shoe on the last. A great deal of fine machine tooling and precision measurement is required for the exact fitting of these metal parts.

Shoulder plate milling (M/C No.11) is needed for taking off the material at the last bottom according to the thickness and area of plating, provided the tolerance is not given in the master turning modd.

Finishing of last surface in band scouring (M/C No.8) with 60-180 grit abrahsive is needed only in case of wood. Plastic lasts need finishing only at the heel and bottom plate feather edge areas in the same machine.

At present, only one chips exhauster (M/C No.3) is available which is fitted to rougher (M/C No.2) & fine turning (M/C No.4). But, in future both 800 & 700 m/m Q band saws (M/C Nos. 1 & 6), chain slotting (M/C No.7), band scouring (M/C No.8), shoulder plate milling (M/C No.11) and polishing (M/C No.14) should be provided with facilities of chips exhauster.

Finally, there is stamping, marking and controlling. Usually the lasts are rubber-stamped by special ink for size and marking in case of plastic. Wooden lasts are generally marked by iron stamps. Permanent lables can also be affixed instead of stamping. Markers play a key technological role since they are the only means for checking the preciseness of lasts.

Last surface is smoothened, polished and shinned in the polishing (M/C No.14). The lasts are now ready for delivery.

A manual has been prepared: title "Manual for Shoe Last Manufacturing"; which has been distributed to the concerned staff of the pilot plant. A copy of the manual is annexed to this report.

III. DESIGNING OF SHLE LASTS

As an accessory, shoes must blend or co-ordinate with the shape theme of clothing. The clothing cannot be angular or geometric in shape and the shoes rounded or blunt. Fashion is fluid - the shape - the look of the clothing flows into shape - look of the shoe, and vice versa. Thus, shoe shapes change with clothing shapes. No one is quite sure what influences cause these shifts in shape. There is no exact time table on cycle term.

Designing and making of the last is the most scientific and exacting process in the whole sequence of shoe making and thelaunching site of all footwear fashion. The last is a master piece of engineerinp and art.

There is no such thing as a staple or stock last created for permanent inventory to be used when needed. Last designing is a custom business - every last is tailored to each customer's needs, and is constantly adjusting to the shifts in fashion cycles. Every customer is different and hence is given individual treatment.

The last designer must know intimately the manufacturer's category of footwear, material used, construction used, the price brackets, the company's style image, etc. He must have an intimate knowledge of fashion and design, plus a knowledge of the foot, shoe making, shoe fit and materials. Three years training is needed to become a last maker and it takes at least ten years of training to develop a master model maker, the man who creates the original model that is duplicated in the regular production run of lasts. The major subjects of the training are:-

1. <u>Human Foot</u>
   1. The development of feet/function;
   2. Skin - its structure;
   3. Bones in the foot structure;
   4. Muscles - tendons - ligaments;

5. Joints/arches;
6. Tripodal weight bearing points;
7. Flow of weight through active foot;
8. Children's and adults feet;
9. Alterations in feet due to movement;
10. Alterations in feet from infancy to maturity;
11. Knowledge on:- Bunion/hard & soft corns/hammer toe/ tailors bunion;
12. How to keep feet efficient and healthy;
13. Simple foot excercises.

2. <u>Foot and Last</u>

1. Difference between last and foot;
2. The standard technique of foot measurement;
3. The locations that are measured;
4. English size system;
5. American size system;
6. French size system;
7. Centimeter system;
8. Conversions;
9. Mondopoint system;
10. Size comparison chart and different insole length;
11. Girth and fitting;
12. Toe spring/pitch/heel height.

3. <u>Last Model Making</u>

1. Plantograph or correct plan of the foot & last;
2. Types of insole of last;
3. Foot impression and foot draft;
4. Developing bottom shape or insole of last;
5. Last standard or ground model;
6. Profile and pattern making and drawing;
7. Grading of last pattern & profiles;
8. Grading system: Co-ordinated, arithmetic, geometric;
9. Principals of last modelling:
   -Types of last as per different shoe requirements;
   -Characteristics of different lasts;
   -Distribution of wood on the last;
   -Dimensions of lasts
   -Reference points on the last

10. Practical model making by hand:
    - -What is a good last
    - -Where last styles originate;
    - -Original and turning models;
    - -Important check points;
    - -Last model inspection:- Measurement/use of various instruments & devices;
    - -Changes in last shape;
    - -Backpart or 2/3 standardisation of last.

4. Last Making by Machines

    1. Initial process of basic raw materials: wood & plastic
        - -Characteristics;
        - -Types/desired quality;
        - -Formation/manuf. & conversion processes
    2. Method of turning
    3. Manufacturing sequences: sequence of operations
    4. Last components: Bottom plates, hinge, pin, socket, etc.
    5. Finishing operations
    6. Controlling: Visual & instrumental

5. Designing specification, materials requirements, Manufacturing process and utility of:-
    - -Shank
    - -Heel
    - -Toe cap/puff
    - -Counter
    - -Insole & etc.

6. Organisational Work
    1. Denomination & norm chart for codification
    2. Lasts standards/specifications
    3. Footwear designs
    4. Creative work

There is no such thing as a "streight line" on last. It is a continuous flow of contours and configurations. These contours must abide by precise standards of measurements and dimensions, more than 25 different ones, requires precise, accurate and delicate template and gauges with minute tolerances as also meticulous skill of last model maker.

Measurements not only determine, size and fit of shoes, but also influence fashion shape plus comfort, balance of tread and general wear performance.

There are six basic measurements:-

1. Over-all length
2. Joing girth(width)
3. Waist girth) to grip foot and to prevent forward
4. Instep girth) sliding
5. Short heel) for accurate fit and grip of shoe
6. Long heel) back part.

Every pair of last is made for a particular size-width combination. There are standard measurements not only for every size and width, but different standards, each for men's, women's, children's and infant's lasts and shoes.

Each change in size and width proportionately graded up or down. To insure grading doesn't loose proportion as it moves up or down size scale, new 'master' models made for every other or fractional group of sizes: 4,6,8,10 for men's, 3,6 for ladies and 4,7,10,13 for children/infants. This grading system so vital to shoe fit, is a highly complex thing.

Six measurements are "initial" ones. Fit and look of last (and shoe) requires as many as 20 "additional" dimensional checks, made by templates, gauges and other delicate instruments that work to tolerance upto 1/64 inch (0.04 m/m).

Last model should be viewed in two parts: 1) forepart (ball to toe) and 2) back part (ball to heel). In each of these areas there is a group of important measurements, details are given in the manual.

Last modeller works from several fixed "reference" points in taking his measurements. Reference points are:

1. Vamp point
2. Instep point
3. Counter point
4. Heel point

Model is then prepared for turning a pair of sample size lasts. The sample lasts are used for making sample shoes for look, fitting trial and other details. Alterations are made as necessary until the lasts are satisfactory. Then the model is scaled up and down the size range for further tests before bulk production.

Measurements of the master model taken by precision instruments. Main tool is "template" of various kinds. Template is a profile gauge to measure contours. As master model is being carefully brought towards final shape, templates continually check various profiles of last. Measurements and contours of bottom of last must also exactly adhere to given dimensions of sole(insole of last) and bottom patterns.

The curved surfaces of the last invite mistakes in measurements. A slight slip to fore and aft, when placing the tape round the ball joint or instep of a last, makes a world of difference when the measurements of the model last are later enlarged by the pantograph system of the lathe, to produce a full run of sizes. To play safe the measurement points for ball joint and instep girth/width are marked on the basic master model by small pins. These small pin marks will appear in due proportion on every last, in any size, reproduced later from the master model on the lathe.

A manual has been prepared: title "Manual for Shoe Last Designing", which has been distributed to the concerned staff of the pilot plant. A copy of the manual is annexed to this report.

IV. TRAINING

One of the tasks given in job description of the expert was to train the various operatives of the Pilot Plant in operation of machines and manufacture of lasts. The machines in the pilot plant are:-

MC SL.No./Code	Name of Machine	Major Specification
1 (3-2-2)	S.N. 800-Band Saw Machine	4,05 K.W.(1100x600 m/m)
2	BIVLH - Fagus Rough Turner	6,50 K.W.(2400x1300m/m)
3 (1-2-5)	GAM2C - Chips Exhauster	4,05 K.W.
4 (3-5-3)	SF 80M-Incoma Fine Turning	6,50 K.W.(2100x1600m/m)
5 (3-3-1)	TFS -Drilling,Double Spindle	1,20 K.W.(600x800 m/m)
6 (3-3-4)	SN 700-Band Saw	3 K.W.(1100x600 m/m)
7 (3-3-12)	CC1 -Chain Slotting Mortizer	1,90 K.W.(600 x950m/m)
8 (3-9-8)	PNO -Band Scouring	1,10 K.W.(1000x1000m/m)
9	Hinge Assembly Table	L.1940xB.800xH.795 m/m
10 (3-8-5)	TFB -Drilling/Boring m/c	1,20 K.W.(600 x 950 m/m)
11 (3-9-1)	FBL -Shoulder Plate Milling	0,60 K.W.
12 (3-9-4)	MPB -Pneumatic vice	(400x250 m/m)
13 (3-9-6)	MRP -Pneumatic Hammer	(200x100 m/m)
14 (3-7-6)	PUL -Polisher	1,50 K.W.(700x1250 m/m)
15 (3-3-6)	ATSV -S+V cuts device	Zig
16 (1-1-9)	Profile meter 150 mm	"
17 (1-1-10)	Profilemeter 300 mm	"
18 (1-1-11)	AMF -Model Centering device	Zig (500x250 m/m)

Eight persons were to be trained but at present, one supervisor, one designer and three operatives are in position and could only be trained. These are:

1. Sisay Gurmu - Supervisor
2. Kassa Mengistu - Designer
3. Abraham Ghebre - Operative
4. Naizghi Dawit - Operative
5. Alem Goitom - Operative

Three operatives were not in position.

Job specifications and descriptions were prepared for each category of operatives and given to the management. As the number of operatives is less than the required, each one of them was trained in all the operations.

However, it should be emphasised that the period of this on-the-job training was not sufficient. The machines were installed and made ready for operations only on 19.2.85.

The operatives have been shown the various steps in the manufacture of last but have not been able to attain sufficient proficiency due to shortage of time.

V. FINDINGS

1. All the machines for the pilot plant have been installed and made operational except for Fagus Rough Turning Lathe, which requires some repairs. However, the rough turning could easily be carried on the Incoma Turning Lathe which has sufficient capacity for both the works - fine and rough.

2. The minimum regular manpower requirement for the plant is 6 operatives, 1 supervisor and 1 designer. But at present there are 3 operatives, 1 supervisor and 1 designer. The remaining 3 operatives should be selected and trained as soon as possible.

3. The Manpo Last Pilot Plant shed & premises have adequate place and land for expansion for accomodating Design Centre, Sole & Heel Making Unit, etc..

4. Design Centre found under Domestic Sales & Distribution Division--could come under Technical Operation Division along with Last, Sole & Heel Making Plants - under one Head/Management/Division.

5. Anbessa Shoe Factory has Pattern Grading M/C, Pattern Shear, Vice and Insole Moulding M/C - capable of making last bottom plates as well bottom patterns & profiles.

6. Zigba, karararo, wanza, tshid Ethiopian species of timber may be used for last model making and manufacturing purposes.

7. The plant has all the equipment and infrastructure for replacement and repair of broken and damaged lasts. This actually should also be carried out to save the cost on imported materials.

8. The quality of staff of the Pilot Plant is very good and there is enthusiasm to learn all the manufacturing and designing aspects. However, the time for the training was too short.

9. Imported seasoned wood materials for about 260 pairs last blocks are available with the plant. These are suitable for model lasts.

10. The basic objectives of the project was achieved except for sufficient training of the operatives, designer and supervisor.

RECOMMENDATIONS

1. Imported wooden blocks for the lasts should only be used for model making and not for regular production work.

2. Plate making should be carried out either at Anbessa Shoe Factory or at Pilot Plant itself without the necessity of importing them.

3. Design Centre along with Last Pilot Plant, Plastic Sole & Heel Making Unit should be combined at one place under direct management of Technical Operation Division.

4. On-the-job training for the operatives should be much longer, at least for 9 months.

5. Similarly designers should have much longer training including sufficient time in a foreign design centre.

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NATIONAL LEATHER AND SHOE CORPORATION
MANPO LAST MAKING PILOT PLANT
ADDIS ABABA, ETHIOPIA

MANUAL FOR SHOE LAST MANUFACTURING

Prepared by Uday Shankar Paul
Manufacturing Expert for Shoe Lasts
DP/ETH/83/013

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
VIENNA
11TH MARCH 1985

Annexure 1

MANUAL FOR SHOE-LAST MANUFACTURING

CHAPTER I

1. MATERIAL

   a) Wood } Leather footwear
   b) Plastic }
   c) Metal/Aluminum=Rubber/Fabric/Canvas/Moulded type DIP/DVP all plastics footwear.

2. TYPE OF A LAST(See Sketch No.1)

2.1 Basic Type

	1) Solid block/split toe last
Detachable or Articulated	2) C-Link/gap spring hinges
Mechanised footwear	3) Telescopic/slide-o matic verticle hinges
Hand-made footwear	4) Scoop block last with cut wedge.

2.2 Design Wise

Lasts for Footwear	Heel Height(m/m)
2.2.1 With heel for chappals/sandals	Flat bottomed
2.2.2 With low heel	10-25
2.2.3 With medium heel	26-40
2.2.4 With high heel	41-60
2.2.5 With very high heel	61 and above

3. TERMINOLOGY/NOMENCLATURE(See Sketch No.1)

and a) Indian Standard 2050-1967(Glossary of footwear terms)

b) Dictionary of leather technology. Tanners Council of America

4. MATERIAL REQUIREMENTS(See Chapter 2 for Materials)

4.1 Plastic: The basic raw material is high density (ultra high or high molecular weight, low pressure) polyethylene, having a melt flow index of 0.2 and a density of 940-945 kg/m^3 with shor hardness of D55-60.

4.2 Wood: The wood must not be too hard but tough enough, not prone to cracking, be able to withstand the stress and strain of repeated nailing and bear the impact process of shoe manufacture by machine. It should cut clearly, be free from knots, not be liable to split, have a hard texture, have a close grain and not be hygro copic. The moisture content of wood in the finished lasts shall be under 10 percent. Manufacture of lasts shall be carried out in such a manner that there shall be no sap in a finished last.

4.3 Metallic/wood stops
metal stops all categories & sizes = 5 x 20 mm.
wood stop 8 x 30 mm for children & 12 x 40 mm for all others

4.4 Lock or bush spring fastner or split pin

4.5 Alpha/C-Linc/gap spring hinges

4.6 Telescopic/verticle hinges

4.7 Pins

4.8 Top plates or reinforcer only for wood lasts

4.8.1 Vegetable tanned hydraulic leather
4.8.2 Consolidated fibre
4.8.3 Plastic sheet

all 4 to 4.5 t ickness

4.9 Metal tubes/sockets/thimbles/ferrule

4.10 Bottom plates: shall be of galvanised iron sheet of 1 m/m thickness. Shall correspond to the form of the last bottom(contour)

4.11 Nails

4.11.1. Bottom plate attachment

- wood last
- plastic last

4.11.2. Top plate attachment

4.11.3. Model feather edge

4.11.4. Marking quarter height

4.11.5. Measuring points for different girths/etc.

NOTE:- For all the above metal/other fitting parts see Sketch No. 2

5. DIMENSIONAL REQUIREMENT

Sizes and fittings of the last should follow the measurement chart given in Chart No. 2, Manual of Shoe-Last Designing.

6. CONSTRUCTIONAL REQUIREMENTS:

6.1 Manufacturing Procedure: -

1. Arrange and Fill rack with Blocks
2. Saw Block
3. Turn Rough

ALPHA (C) LINK HINGE (see sketch no. 3)

4. Drill
5. Saw V-Gap
6. Saw Round (whirle)
7. Mortise Slit Chain Saw
8. Assemble Hinges and Pins

SCOOP BLOCK SPRING FASTNER

4. Drill for Wood (Metal Stop)
5. Saw Wedge Last Comb
6. Insert Stop
7. Assemble and Pin Block
4b Drill for Spring Fastner
8. Assemble Spring Fastner

SCOOP BLOCK SPLIT PIN (see sketch no. 4)

4. Drill for Wood/ Metal Stop
5. Saw Wedge Last Comb
6. Insert Stop
7. Assemble and Pin Block

VERTICLE HINGE

4. Drill
5. Hinge Saw
6. Chain Saw Slit
7. Assemble Hinge Pins

LAST BOTTOM PLATE CUTTING (FULL or HEEL) (see sketch no. 6)

Guillotine Large Sheets

1. Cut Templates
2. Cut Blanks
3. Rough Cut
4. Fine Cut
5. Tack Hole Punch
6. Nail Hole Punch
7. Stamp Plates
8. Mould Plates

9. Fine Turn
10. Saw Toe stub
11. Shave Toe
12. Shape Toe
13. Saw Heel Stub
14. Shave Heel
15. Shape Heel
16. Mill Top

WOOD LASTS (see sketch no. 5) | **PLASTIC LASTS**

17. Fix Leather/Fibre Plastic Tops
18. Trim Tops

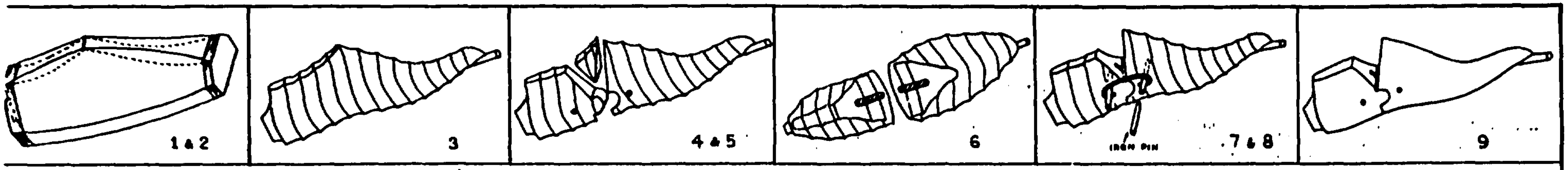
19. Bore Socket Tube
20. Fit Socket/Tube
21. Plate Bottom (see sketch no.6)
22. Guillotine Plate/ Heel Breast
23. Smoothen Plate Feather Edges
24. Finish
25. Stamp and Colour (Size and Fitting) - if necessary (see sketches no. 7 + 8)

WOOD LAST | **PLASTIC LAST**

26. Polish
27. Shine

28. Marking (Back Height, Vamp height, Length etc.) (see sketch no. 9)
29. Checking/Control (see sketch no.10)
30. Despatch

LAST MANUFACTURING PROCESS FOR MECHANISED SHOE MAKING :

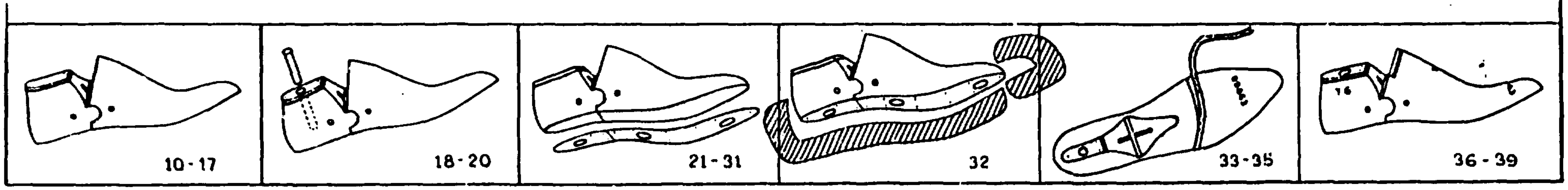


DESCRIPTION OF OPERATIONS :

1) ARRANGE LAST BLOCKS.
2) CUT BLOCKS TO THE ROUGH SHAPE OF THE REQUIRED LAST.
3) ROUGH TURNING.
4) DRILL HINGE PIN HOLES AND CUT 'V' GAP.
5) USING A JIG, SAW THE CIRCLE AND DEVIDE THE LAST.
6) MORTIZE THE HINGE SLOT.
7) MAKE UP AND INSERT HINGE.
8) INSERT HINGE PINS.
9) SMOOTH TURNING.
10) SAW OFF TOE STUB.
11) SHAVE TOE PART.
12) SHAPE TOE TO TEMPLATES.
13) SAW OFF HEEL STUB.
14) SHAVE HEEL CURVE.
15) SHAPE HEEL TO TEMPLATES.
16) MILL TOP.
17) FIX LEATHER/PLASTIC TOPS.
18) TRIM TOPS.
19) DRILL SOCKET HOLES.
20) INSERT SOCKETS.

MAKING FULL PLATE :

21) ROUGH CUT GALVANISED SHEET.
22) FINE-CUT AS PER TEMPLATES.
23) GRIND PLATES.
24) MARK BREAK POINT.
25) STAMP PLATES.
26) TACK HOLE PUNCH.
27) NAIL HOLE PUNCH.
28) FORM LASTS PLATES.
29) PRESS MOULD.
30) RIVETT FULL BOTTOM PLATES.
31) FLUSH PLATES TO LAST SURFACE.
32) GUILLOTINE LAST PLATE AT HEEL BREAST.
33) CONTROL OR EXAMINE
a) ACCURACY OF BOOTTOM.
b) HEEL CURVE.
c) TOE RECADE.
d) LAST. LENGHT.
e) BALL AND INSTEP GIRTH.
34) FINISH.
35) MARK COLOUR FOR SIZE AND FITTING.
36) STAMP - SIZE/FITTING/STYLE CODE/MANUFACTURING DATE.
37) POLISH AND SHINE.
38) INSERT COUNTER POINT.
39) INSERT VAMP POINT.
40) FINAL CHECK - PAIRAGE AND PACK FOR DESPAT-CH.



6.2 Finishing

6.2.1 In scoop block last, the wedge shall fit tightly and shall not come off from the body of the last. All process of fixing and holding the wedge on the last shall be carried out correctly and accurately, so that it shall be possible to remove the wedge quickly and without difficulty from the last and refix it.

6.2.2 In detachable last hinge-pins shall be pushed inside the hole sufficiently, so that it will not project outside the last which may cause damage to the shoe material. The half round section of the crest shall be properly greased (with melted wax, grense, powder, etc.) for easy folding. The hinge spring shall be firmly fixed and shall be sufficiently strength and resistance so that by stretching and folding lasts shall not wobble. The surface of the hinges and slot at the centre of the crust for inserting the hinge shall be in such a manner that the two sections of the last shall not be eccentric, while breaking or folding.

6.2.3 Galvanized plates shall be tightly and evenly riveted to the bottom of last and shall neither be smaller than the insole of last nor project beyond its border.

The last shall be turned and finished in such a way that the feather shall project all round the plate by 0.5 m/m.

The edge of the galvanized plate at the lower cut of the seat bottom shall be filed.

6.2.4 On all wooden lasts small pins/pricks shall be inserted at outside, inside joints, at the base of instep (total 3) for measuring ball/joint girth and one at in step point. Then one pin for measuring quarter ht.

6.2.5 Wooden last: Lasts shall be all round(surface) evenly, accurately and correctly ground(scoured) by 100/180 grit abrehsive paper. In order to maintain high precision in dimension, shape & appearances (particularly the good surface finish comes out from modern sopisticated turning m/c) the last surface may leave untouched with feed mark. Only the heel area & bottom plate need slight scouring with blunt 180 grit paper. The same thing applies to plastic last also.

6.3 Marking (See Sketch Nos. 7, 8 & 9)

6.3.1 Sizes:- by number/digit only:- at outside heel, vamp point, inside v-cut, top reinforcer & bottom plate.

6.3.2 Fittings:- by number/digit or latter (See Sketch No. 8):- outside heel & instep point.

6.3.3 Design/style/article No. (customer's identification):- outside heel & body.

6.3.4 Trade mark/name of manufacturer, manufacturing date & height of heel in m/m (in case of ladies last only):- inside heel.

6.3.5 Beside, on every cut wedge and the body of the scoop block lasts at the outside joint surface serial number or any other identification should be marked pair-wise, so that the wedges could be easily traceable.

6.3.6 Colouring to identify sizes & fittings:- Colouring for sizes is done along the top of the last and for fitting on the core surface of the last. The chart is given in Sketch No.8).

6.4 Checking/Controlling(Test Methods Against Model/Specification/Sample):- (See Sketch No. 10).

6.4.1 Visually:- by optical comparison-shape, appearance, finish, markings, hinge & scoop cutting, etc. - comparison of the right hand side last serving as mirror image of the left hand one. Visual characteristics shall be checked in accordance with the model or approved sample.

6.4.2 Dimensional characteristics:-

6.4.2.1 Length of the last - by size stick - the proportions for the contiguous sizes is based on the given standard length.

6.4.2.2 Bottom area - by graded insole of lasts(last bottoms) patterns - incld. toe & heel shape.

6.4.2.3 Toe recede/thickness - on superimposition by graded longitudinal toe profiles.

6.4.2.4 Heel curve - on superimposition by graded longitudinal heel

Back profile - or by a special heel curve measuring device.

Note:- test carefully, graded patterns of last bottoms and longitudinal profile patterns for toe, back curve - used for check-up of lasts.

6.4.2.5 Girth of joint/ball:- by shoe-maker's tape (a special tape of new variable dimensions of 10 m/m width- one side is m/m scale & the other side has English & French size marking) along the circumference of the three joint girth measuring marking in such a way that the measuring edge of the tape fits closely and lies flat on the last along the measuring line.

6.4.2.6 Height of last and dimensions of the tube by calipers.

6.4.2.7 Height of quarter pin mark:- by heel curve profile/tape/special scale.

6.4.3 Moisture Context:- From the middle of the selected lasts, a piece of wood is sawed out and tested by timber moistrue metre or by oven drying method.

6.4.4 Mechanical and other requirements:- Following items shall be tested for mechanical and other requirements by cutting or opening up the lasts:-

6.4.4.1 Dimensions of tube

6.4.4.2 Proper fitting of the tube

6.4.4.3 Measuring position of the tube vertical to the surface of the heel

6.4.4.4 Test the metallic components as per the specification drawn in Sketch No.2.

6.5. Polishing:- After smoothening, all wooden lasts need polishing thoroughly and then shining. Polishing enables the last to resist moisture and provides a surface to assist the shoe upper to slip. First polish the last against motorized wheel made of cloth with beewax(or shellac/resin) and followed by carnauba wax (or furniture wax polish) for lusturing/shirning.

6.6 Packing:- Lasts shall be properly packed in wooden or card board boxes/or returnable - reusable metal container. The lasts shall be packed tightly in rows in such a way that metallic parts of the lasts come opposite to one another. The space between individual lasts should be preferably filled with papers or any shavings. On the lasts packed in this way, a second layer of dry shavings or paper shall be spread and in the same order a second row may be packed.

6.7 Sampling procedure and criteria for conformity:- All last pairs in a consignment of the same style, type, size and fitting and belonging to the same batch of manufacture may be grouped together to constitute a lot.

For ascertaining the conformity of the lot to the requirements of this specification, tests shall be carried out for each lot separately. The number of last pairs, to be drawn from any lot shall depend on the size of the lot and shall be in accordance with col. 1 and 2 of the following table.

Such pairs shall be selected at random from the lot and in order to ensure the randomness of selection, a random number table may be used.

Table Sampling Method (and criteria of conformity)

Scale of Sampling

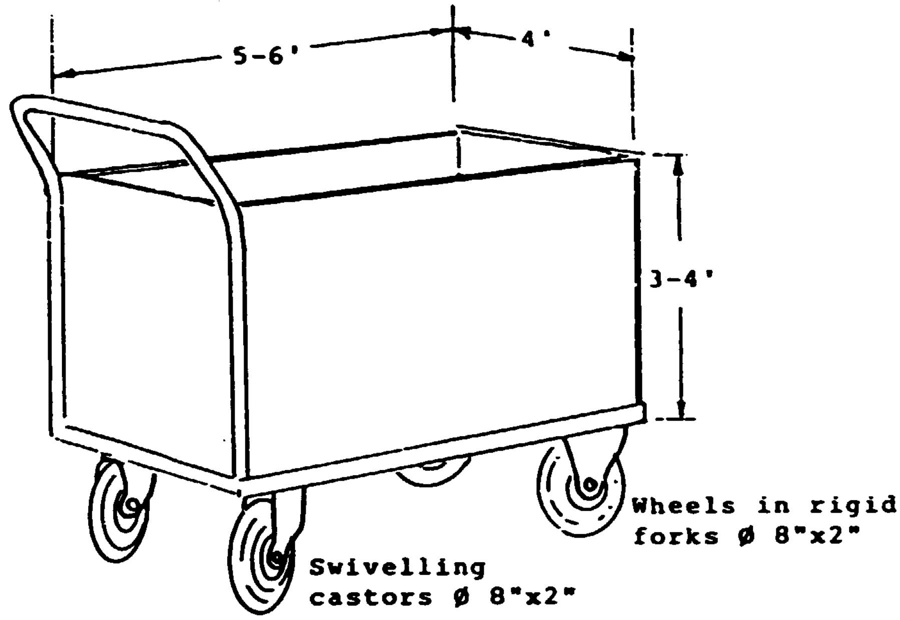
No. of last pairs in the lot	Visual Characteristics		Dimensional Characteristics		Moisture Content and destructive test requirements on components
	Sample pairs	Permissible No. of defectives	Sample pairs	Permissible No. of defectives	
(1)	(2)	(3)	(4)	(5)	(6)
Upto 20	all	0	5	0	-
21 to 50	20	1	8	0	1
51 to 100	32	2	13	1	2
101 to 300	50	3	20	2	3
301 to 1000	80	5	32	3	5

6.8 Permissible Defects:- Wooden lasts shall be free from cracks as far as possible and practicable. But the presence of small cracks, in the heel portion of the last may be permissible. Such cracks shall be adequately filled by homogeneous compound of saw dust and glue/adhesive or by special wood filler compound ready made available.

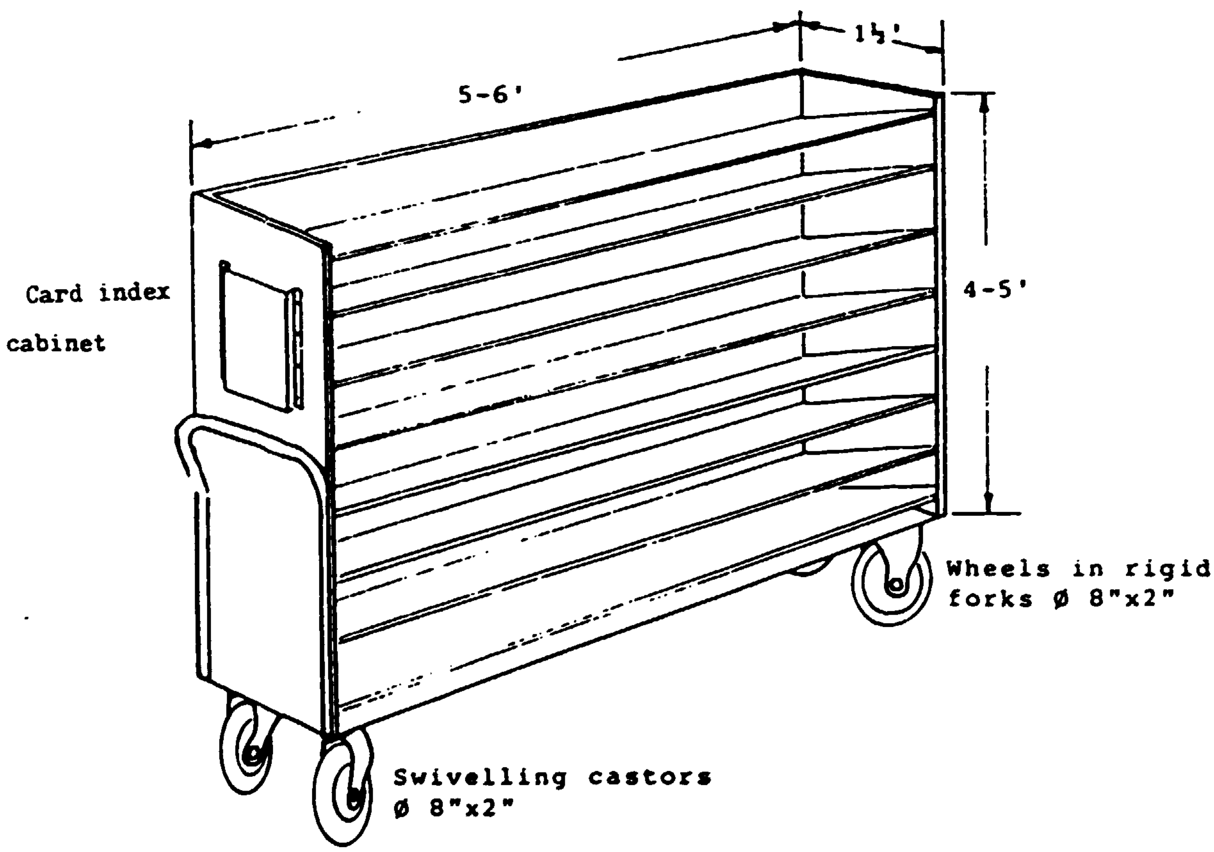
In wooden lasts, knots shall not be permitted along the line of the cut of the wedge, v or round cut, bottom feather edge, heel & toe portion, thimble area along joint/tread line.

In the remaining places/surface, small live knots that are not decayed and loose may be allowed on the condition that the wood around the knots is sound. Shallow knots that are likely to come out or crack, and are surrounded by sound wood shall be replaced by plugs made of same wood tightly fitted with adhesive.

(A) Truck for conveying raw wooden blocks from the raw materials store to the band saw machine

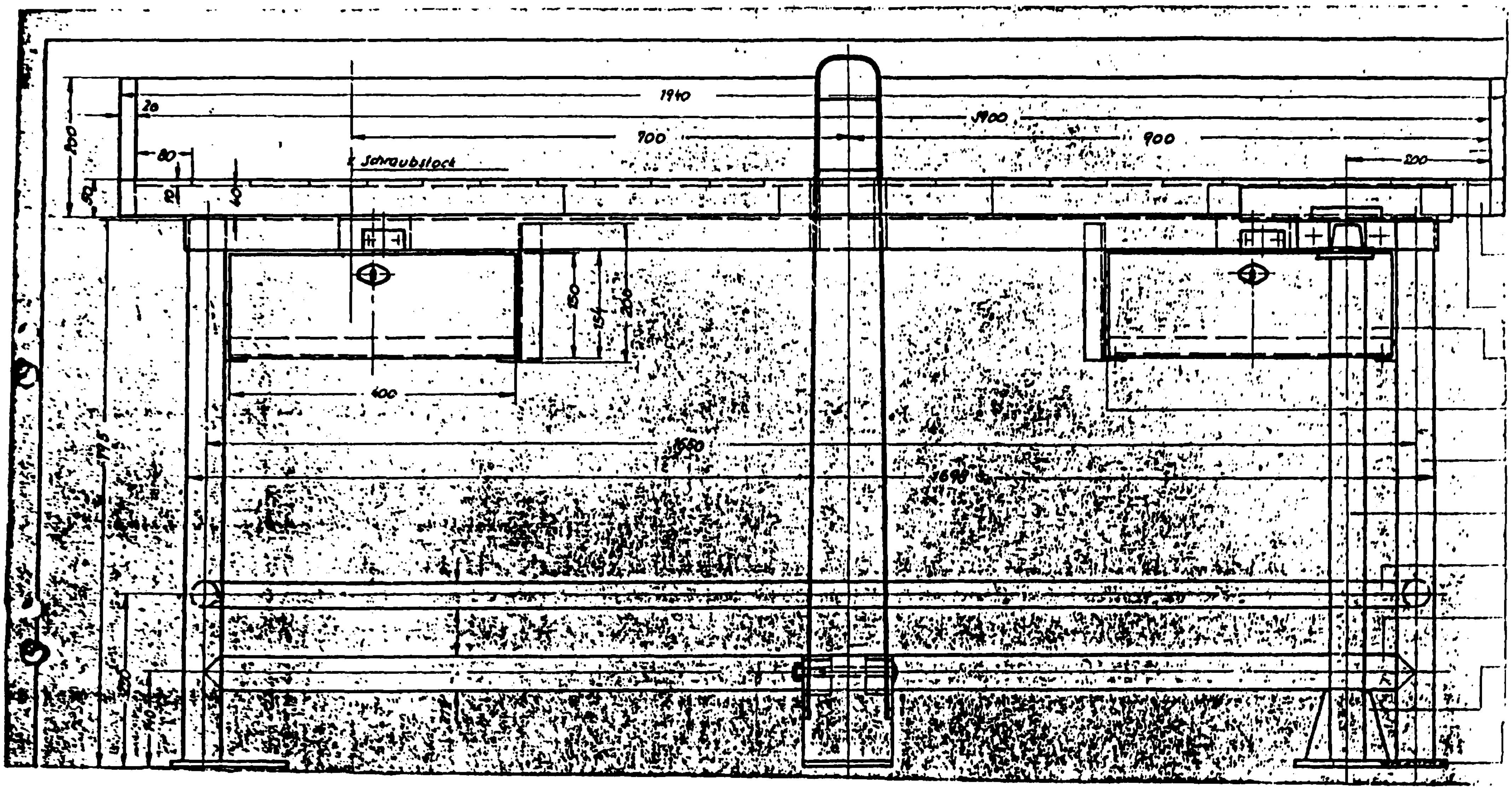


(B) Movable rack (card index cabinet) for transporting lasts



Note: Dimensions are shown in feet (') and inches ("). One foot = 30.480 centimetres; one inch = 2.540 centimetres.

STANDARD WORKING TABLE (L1940 x B800 x H715 m/m)



STANDARD PRODUCTION MINUTES(S.P.M) IN LAST PRODUCTION

1) TURNING LATHE

1.1. Rough Turning: 22 to 25 pairs per hour as per size & quantity.

1.2. Fine Turning : 8 to 10 pairs per hour

BASED ON 100 PIECES

2) Drilling for Hinge

2.1. V-Cut(standard C-type Linkhinge) = 91 mints.

2.2. Telescopic or verticle hinge (special) = 120 mints.

3) Band Saw Cutting for Hinge

3.1. V-Cut - 41 mints. & round-cut - 82 mints. total = 123 mints.

3.2. Telescopic/verticle hinge = 36 mints.

3.3. Scoop block = 36 mints.

4) Slit Milling for Hinge : Chain Mortizer

4.1. V-Cut - 120 mints.

4.2. Verticle Hinge = 124 mints.

5) Pin & Hinge Fixing

5.1. V-Cut - 105 mints.

5.2. Verticle Hinge - 290 mints.

6) Scoop Block Last

6.1. Drilling, milling, pin/peg fixing cementing, etc.

6.1.1. Full plate = 55 mints.

6.1.2. Heel or without plate = 66 mints.

6.2. Bush-spring fastner drilling = 31 mints.

6.3. Bush-spring fastner fixing = 66 mints.

7) Toe & Heel Finishing

7.1. To take-off excess toe & heel portion(stubs/dogs) of the fine-turned last = 18 mints.

7.2. To shave the last bottom at the toe = 27 mints.

7.3. Toe shaping in cutters(Milling m/c) = 12 mints.

7.4. Toe shaping by file(hand)

Standard Last

a) Gents = 213 mints.
b) Ladies/Adolescent = 196 mints.
c) Children = 170 mints.

Extra allowance Plus(+)

a) Sharp edge = +43 mints.
b) Bevelled last = +43 mints.

8) Top-Lift(Re-inforcer) Attachment - One Piece in Case of Wooden Last

8.1. Cutting/clicking of leather/fibre plate in machine = 30 mints.

8.2. Lift cementing & fixing by nails = 68 mints.

8.3. Top-lift trimming = 42 mints.

8.4. Comb area(top lift) scouring = 44 mints.

8.5. Comb filing for scoop block last = 9 mints.

8.6. Comb sawing by special machine in order to make last height same for the whole series = 29 mints.
(not needed at this stage)

9) Thimble/tube/socket drilling & fixing = 60 mints.

10) Bottom Plate Attachment

10.1. Full plate(by nails) = 150 mints.

10.2. Heel Plate(——"——) = 50 mints.

10.3. Cutting Heel Breast = 43 mints.

11) Bottom Plate Filing

11.1. Full plate:-
a) Gents = 215 mints.
b) Ladies = 200 mints.
c) Boys'/Girls = 189 mints.
d) Children = 139 mints.

11.2. Heel plate:- All Category = 53 mints.

12) Scouring(Last Finishing):- (In Case of Wooden Last Only)

	Full Plate	Heel & Without Plate
12.1. Gents	163 mints.	242 mints.
12.2. Ladies	147 mints.	225 mints.
12.3. Boys' & Girls	133 mints.	208 mints.
12.4. Children	118 mints.	193 mints.

12.5. Extra time allowance:- Plus(+)
Bevelled = +30%; very sharp wall = +40%; sharp & half round = +20%

13) Stamping

13.1. With iron stamp:- Length + Fitting = 68 mints.

13.2. With rubber stamp:-
a) Model/Design No. = 19 mints.
b) Length + Fitting = 48 mints.
c) Date = 9 mints.
d) Shape, height of heel, makers' name, etc. = 9 mints. each

14) Colouring (if needed)

14.1. Length/size = 50 mints.

14.2. Fitting = 50 mints.

14.3. ½ size = 50 mints.

15) Polishing(In case of wooden last only):- in Mints.

15.1. 1st operation by natural bees wax

	Gents	Ladies	Boys' & Girls	Children
a) Full plate	38	34	30	27
b) Others	49	45	42	39

15.2. 2nd operation either by carnova wax or by furniture polish.

	Gents	Ladies	Boys' & Girls	Children
a) Full plate	29	24	20	16
b) Others	37	32	27	22

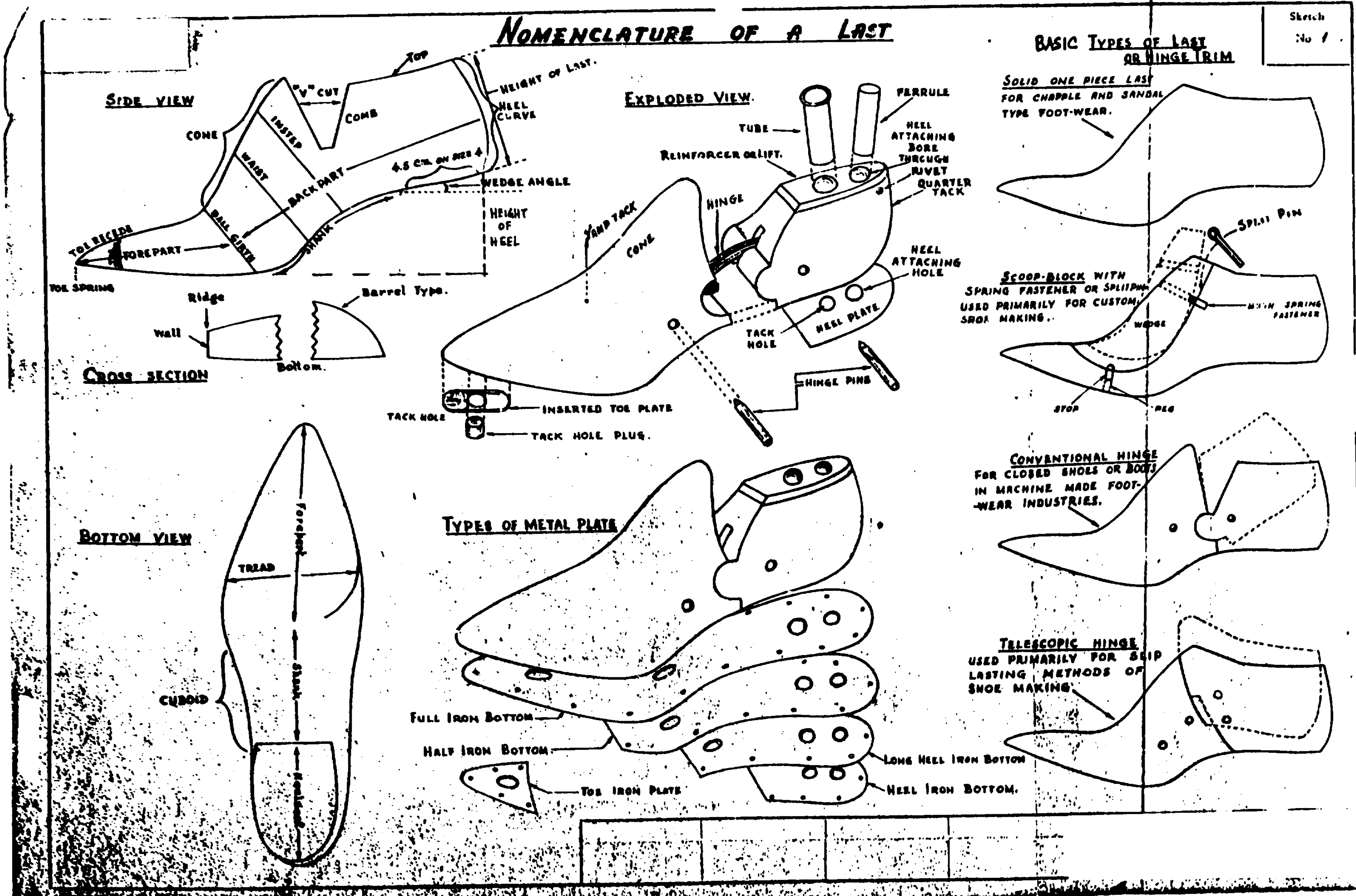
16) Galvanised Bottom Plate Manufacturing

A)			Marking & Cutting	Filing
16.1. Full plate:-	a) Gents	=	122 mints.	102 mints.
	b) Ladies	=	100 mints.	
	c) Boys' & Girls	=	90 mints.	
	d) Children	=	86 mints.	
16.2. Heel plate:-	All categories	=	45 mints.	34 mints.

B) Drilling for nails, lasting hole punching, grinding, stamping, etc.

16.3. Full plate = 149 mints.

16.4. Heel plate = 30 mints.

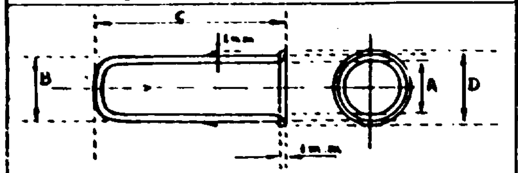

Sketch No 1.
NOMENCLATURE OF A LAST
SIDE VIEW
TOP
"V" CUT
COMB
HEIGHT OF LAST.
HEEL CURVE
CONE
INSTEP
WAIST
BACK PART
4.5 CM. ON SIZE 4
WEDGE ANGLE
HEIGHT OF HEEL
BALL GIRTH
SHANK
TOE RECEDE
FOREPART
TOE SPRING
Ridge
Wall
Bottom.
Barrel Type.
CROSS SECTION
EXPLODED VIEW.
TUBE
FERRULE
HEEL ATTACHING BORE THROUGH
RIVET
QUARTER TACK
REINFORCER OR LIFT.
HINGE
VAMP TACK
CONE
HEEL ATTACHING HOLE
TACK HOLE
HEEL PLATE
HINGE PINS
TACK HOLE
INSERTED TOE PLATE
TACK HOLE PLUG.
BOTTOM VIEW
TREAD
Forepart
Shank
Heelseat
CUBOID
TYPES OF METAL PLATE
FULL IRON BOTTOM
HALF IRON BOTTOM
TOE IRON PLATE
LONG HEEL IRON BOTTOM
HEEL IRON BOTTOM.
BASIC TYPES OF LAST OR HINGE TRIM
SOLID ONE PIECE LAST FOR CHAPPLE AND SANDAL TYPE FOOT-WEAR.
SPLIT PIN
SCOOP-BLOCK WITH SPRING FASTENER OR SPLIT PIN. USED PRIMARILY FOR CUSTOM SHOE MAKING.
WEDGE
SPRING FASTENER
STOP
PEG
CONVENTIONAL HINGE FOR CLOSED SHOES OR BOOTS IN MACHINE MADE FOOT-WEAR INDUSTRIES.
TELESCOPIC HINGE USED PRIMARILY FOR SLIP LASTING METHODS OF SHOE MAKING.

SPECIFICATION OF WOODEN SHOE-LAST COMPONENTS (FOR MANUFACTURING)

Sketch Nº 2

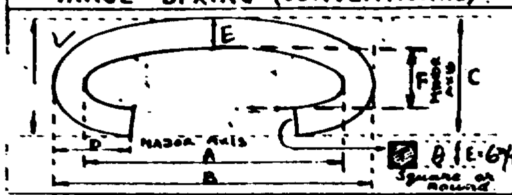
MEASUREMENTS IN m m

TUBES



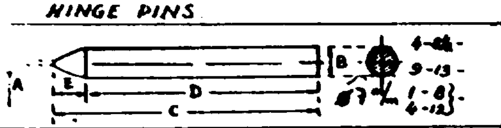
A	B	C	D		THICKNESS OF MATERIAL	TENSILE STRENGTH TONS/SQ INS	HARDNESS	WAY OF USE	MATERIAL
8	11	30	11.5		1.5	36	160° BR	CHILDREN 3 - 11½	M.S OR SHEET METAL
10	14	40	15.5		1.5	36	160° BR	ALL OTHER 12 1½ 2-5½ & 4-12	M.S OR SHEET METAL

HINGE SPRING (CONVENTIONAL)



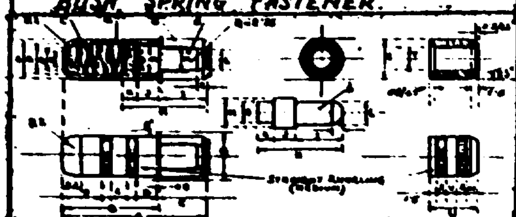
A	B	C	D	E	F	TENSILE STRENGTH	HARDNESS	WAY OF USE	MATERIAL
55	65	25	17	6	15	82	41° R	MENS 4 - 11 LADIES & YOUTHS 1-8 & 2-5½	En - 42 OR En - 43 SPRING STEEL OR C70
40	32.5	22.5	15	6	15	82	41° R	CHILDREN 9 - 13	- DO -
	40	20	13			82	41° R	BABY 4 - 8½	- DO -

HINGE PINS



A	B	C	D	E	TENSILE STRENGTH TONS/SQ INS.	HARDNESS	WAY OF USE	MATERIAL
1.5		30		7			CHILD - 4 - 8½ - FORWARD - BACKWARD	
1.5	7	35	30	7	82	41° R	" 9 - 13 - BOTH SIDE	En - 42, 43 SPRING STEEL OR C70
2.5	7	45	40	10			OTHERS 1 - 8 - BACKWARD; " 1 - 8 - FORWARD	
2.5	7	55	50	10			MENS 4 - 12 - BACKWARD; MENS 4 - 12 - FORWARD	

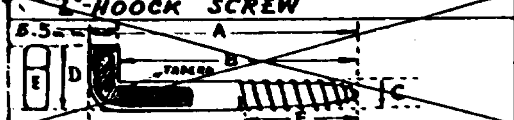
BUSH SPRING FASTENER



	A	B	C	D	E	F	G	H	I	J	K	L	M	WAY OF USE
Nº 1 (BIG)	30	20.8	9.2	5	3	8	⌀ 9.3	17	10	4	3	⌀ 5.3	⌀ 5.5	ALL OTHERS
Nº 2 (SMALL)	26	18.3	7.7	4	2.5	7	⌀ 8	14.5	8.5	3.5	2.5	⌀ 4.3	⌀ 4.5	3 - 8½
	N	O	P	Q	R	S	T	U	V	W				
Nº 1	⌀ 6.5	⌀ 4.8	⌀ 4.3	⌀ 6.7	⌀ 7.0	⌀ 8.3	⌀ 5.4	9.5	2.0	2.0				ALL OTHERS
Nº 2	⌀ 5.5	⌀ 3.8	⌀ 3.7	⌀ 5.4	⌀ 5.7	⌀ 7.0	⌀ 4.4	8.5	1.5	1.5				3 - 8½

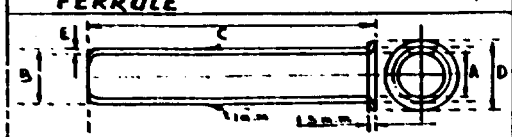
ITEM		SUBJECT	PCS.	MATERIAL	REMARKS
C	Nº 1	SPRING STRIP 6.5 x 0.7 x 6 x 20	1	SPRING STEEL	Nº 1 - BIG & Nº 2 - SMALL
	Nº 2	" " 5.5 x 0.7 x 5 x 17.5			
b	Nº 1	3/8 x 3/4 OR 9.5 x 19 m.m	1	CRS.	
	Nº 2	5/16 x 5/8 OR 7.9 x 15.9			
a	Nº 1	3/8 x 1 1/16 OR 9.5 x 26.6 m.m	1	BRASS	TO BE PRESSED WITH 'b' & 'c' AS PER DRAWING
	Nº 2	5/16 x 1 OR 7.9 x 25.4			

'L' HOOCK SCREW



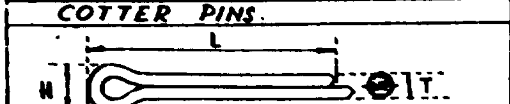
A	B	C	D	E	F (Nº OF THREAD)	WAY OF USE
40	34.5	5	13	4	7	CHILDREN 3 - 8½
55	49.5	6	13	5	8	ALL OTHERS.

FERRULE



A	B	C	D	E	WAY OF USE.	MATERIAL & HARDNESS.	HEEL ATTACHING SYSTEM
6.35	9.35	60	12.65	1	USED ONLY IN LADIES (1 - 8). WHERE HEEL IS ATTACHED THROUGH THE BONE IN LAST FOR LOUIS HEEL	M.S 185° BR OR SHEET METAL	CLAMP HOLE.
9.5	11.5	60	15	1			UNITED HOLE
11.1	13.1	60	16.6	1			COMPO HOLE

COTTER PINS.



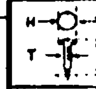
NAME	T	L	H	WAY OF USE	MARKET CODE
35x3	3	35	7	CHILDREN 3 - 8½	35 BY 3 OR 1½ BY 1/8
50x5	5	50	9	ALL OTHERS	50 BY 5 OR 2 BY 3/16

INSOLE ATTACHING PIN

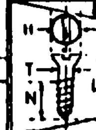
A	B	C	D	E	TENSILE STH. TONS/SQ INS.	HARDNESS	WAY OF USE	MATERIAL
4	6.6	19.6	15	4.5	45	205 BR	ALL SIZES	C.R.S.

NAILS

NAME	T THICKNESS	L LENGTH	H HEAD	WAY OF USE	REMARKS.
IRON NAIL (FLATE HEAD)					
1.6 x 15	1.6	15.0	2.8	CHILD. 1 - 8½	GALV. BOTTOM PLATE.
1.8 x 20	1.8	20.0	2.6	ALL OTHERS.	NAIL PIN INVERTED CONE SHAPE
1.5 x 15	1.5	15.0	2.5	- DO -	FOR TOP LIFT. FLAT HEAD ROUND
1.0 x 10	1.0	10.0	2.5	CHILD. 1 - 8½	
IRON NAIL (HALF ROUND HEAD)					
1.4 x 7	1.4	7	3.6	ALL SIZES NEW MODEL	USED ON THE EDGE OF TURNING MODEL FOR REPRODUCTION
1.4 x 10	1.4	10	3.8	ALL SIZES FOR DAMAGED MODEL	FOR REPAIRING DAMAGED NAILS
BRASS NAIL (ROUND HEAD)					
1 x 7	1	7	2.5	ALL SIZES	MEASURING PRICKS FOR TURNING MODEL
1 x 7	1	7	2		MEASURING PRICKS FOR PRODUCTION LAST



WOOD SCREW (COUNTER SUNK HEAD)



NAME	T THICK.	L LENGTH	H HEAD	N Nº OF THREADS	WAY OF USE	MARKET CODE
3.0 x 10	3.0	10	6.0	5	CHILD 1 - 8½	10 BY 5 OR 3/8 BY 5
3.0 x 13	3.0	13	6.0	6	ALL OTHERS	13 BY 5 OR 1/2 BY 5

METALIC STOP

	T	L	H	WAY OF USE	MATERIAL	HARDNESS
5 x 20.0	5	20.0	3.5	CHILDREN 3 - 8½	MS	205° BR
5 x 20.0	5	25.0	3.5	ALL OTHERS	MS	"

WOOD PEG

T	L	WAY OF USE	REMARKS	MATERIAL
8	30	CHILDREN 3 - 8½	TO BE USED IN CASE OF METALIC STOP NOT AVAILABLE	HARD WOOD
12	40	ALL OTHERS		
4	22	ALL SIZES	TO FILL-UP HOLES FOR WOODEN STOP	

IRON RIVET & WASHER

T	L	H	WAY OF USE	MATERIAL	HARDNESS
5	19	8	CHILDREN 10 - 1½	M.S	180° BR
5	24	8	ALL OTHERS		

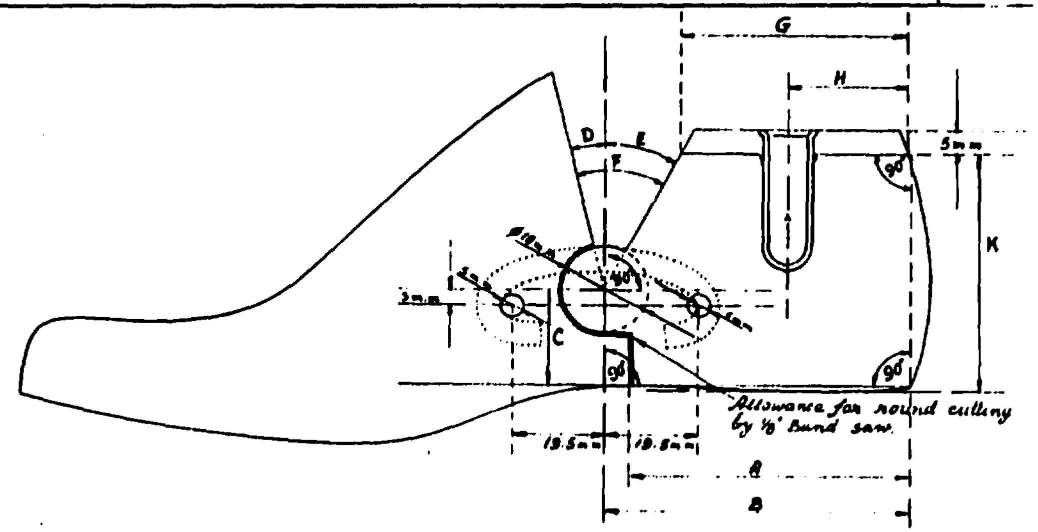
GENERALLY IT IS USED FOR LADIES HIGH HEEL LAST. SIZES - 1 TO 8.

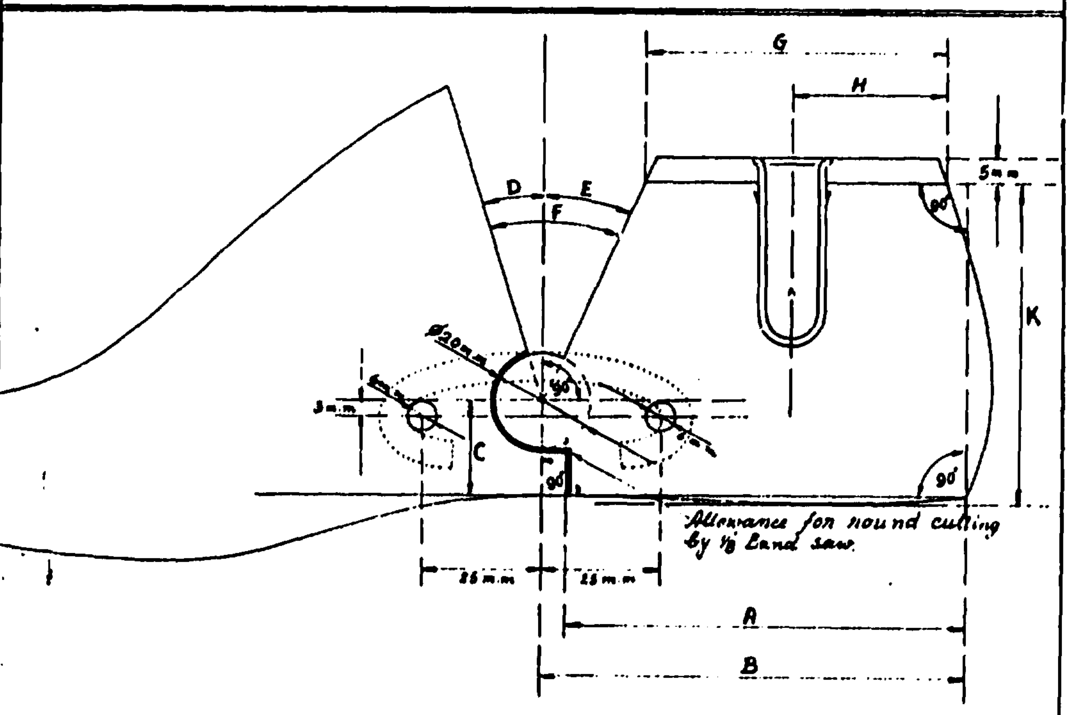
Sketch No 3

SECTIONAL MEASUREMENTS FOR "V"-CUT HINGED LAST.

PRESCRIPTION FOR WOODEN LAST. — Measurements in m.m.

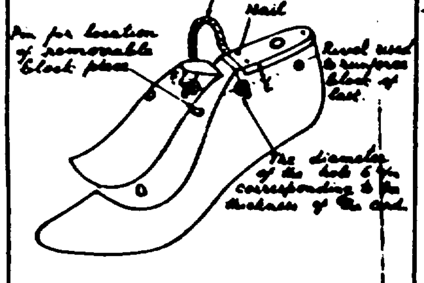
RANGE	ASSORTMENT	A LENGTH OF LOWER CUT	B LINE OF CENTRE OF JOINT	C CENTRE OF JOINT	D ANGLE OF CUT FROM CENTRE LINE TO FRONT	E TO REAR	F TOTALLY	G LENGTH OF TOP LIFT	H CENTER OF SOCKET	K HEIGHT OF LAST
0	1 - 1½	41	46	WITHOUT SHEETING 19 mm	12	9	21	39		
	2 - 2½	43	48			10	22	40		
	3 - 3½	45	50			11	23	41		
	(4) - 4½	47	52	WITH SHEETING 20 mm		12	24	42	20	40
	5 - 5½	49	54			13	25	43		
1	6 - 6½	51	56			14	26	44		
	(7) - 7½	53	58			15	27	45	22	45
	8 - 8½	55	60			16	28	46		
2	9 - 9½	57	62	WITHOUT SHEETING 20 mm	13	17	30	49		
	(10) - 10½	59	64		14	18	32	50	25	50
	11 - 11½	61	66		15	19	34	51		
3	12 - 12½	63	68	WITH SHEETING 21 mm.	16	20	36	52		
	(13) - 13½	65	70		17	21	38	53	27	55
	1 - 1½	67	72		18	22	40	54		
4 5 6	1 - 1½	68	73	WITHOUT SHEETING 20 mm	17	17	34	57		
	2 - 2½	70	75		18	18	36	58		
	3 - 3½	72	77		19	19	38	59		
	(4) - 4½	74	79		20	20	40	60	30	63
	5 - 5½	76	81		21	21	42	61		
	6 - 6½	78	83	WITH SHEETING 21 mm	22	22	44	62		
	7 - 7½	80	85		23	23	46	63		
	8 - 8½	82	87		24	24	48	64		
	9 - 9½	84	89		25	25	50	65		
7 8 9	4 - 4½	78	83	WITHOUT SHEETING 20 mm	20	20	40	60		
	5 - 5½	80	85		21	21	42	61		
	6 - 6½	82	87		22	22	44	62		
	(7) - 7½	84	89		23	23	46	63	32	68
	8 - 8½	86	91	WITH SHEETING 21 mm	24	24	48	64		
	9 - 9½	88	93		25	25	50	65		
	10 - 10½	90	95		26	26	52	66		
	11 - 11½	92	97		27	27	54	67		
	12 - 12½	94	99		28	28	56	68		





SECTIONAL MEASUREMENTS OF SCOOP BLOCK LAST.

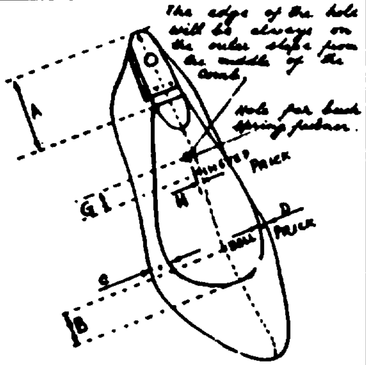
Sketch No 4



Hole I - starts at the outside of the wedge and reach the external slope of the wedge. The distance from the upper top of the wedge (measuring along a straight line), as well as from the line of the cut of the wedge.

Hole II - starts at the inside wall of the heel and reach the outside of the heel point of the last.

The distance from the upper top of the last as well as from the line of cut of the wedge.



G - distance from centre of hole to the prick used for measuring girth of instep.

H - distance from centre of hole to the middle line of the cord.

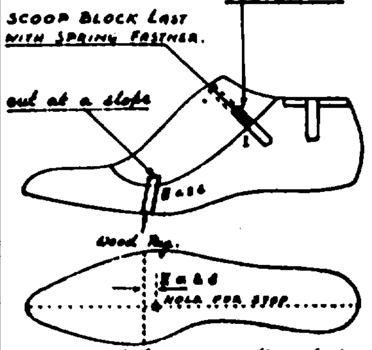
A - Length of the top (the begining of the cut of wedge.

B - Ball prick up to the end of the cut along axial line (the end of the cut of wedge)

C - Outside (height of the cut of the wedge along the line of points at the place of location of the prick of outside joint)

D - inside (along the line of inner joint at the place of location of inside joint prick)

SYSTEM - I



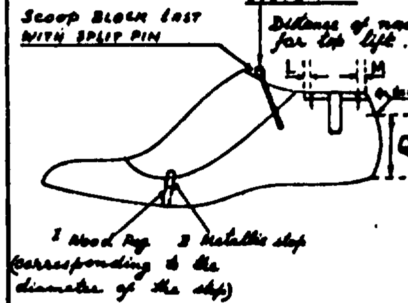
I - The hole under the lock must be made at an angle of 95° to the plan of the cut located above the lock.

II The hole for peg will be always in the centre of bottom of the last.

● 16 m.m towards heel from tread points for Mens, Ladies & Range 4 & 3.

● 8 m.m for Children Range 1 & 2

SYSTEM - II



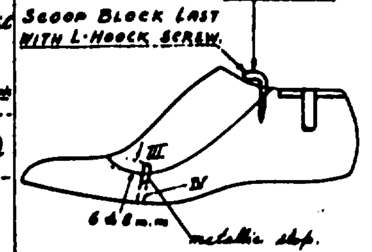
III. The height of the part of the stop projecting above the body of the last 6 to 8 m.m.

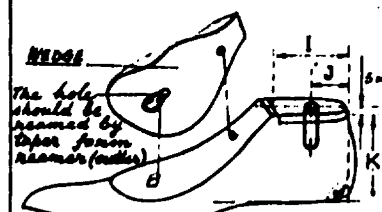
IV. Wood peg may be used to fill up the hole or the hole can be left reached.

The stop must be put in a position somewhat inclined to the heel of the last.

The edges projecting part of the stop (heads) must be slightly rounded.

SYSTEM - III





NOTE :- For retaining the cut wedge on the body of the last a metallic or wooden stop must be provided.

MODEL SIZE	CATEGORY	A: DISTANCE	A: CHANGE FOR CONTIGUOUS SIZE	B: DISTANCE	B: CHANGE FOR CONTIGUOUS SIZE	C	D	E	F	G	H	I: DISTANCE	I: CHANGE FOR CONTIGUOUS SIZE	J: CENTER OF TUBE	K: HEIGHT OF LAST.	Q: HEIGHT OF QUARTER TACK: MODEL SIZE	Q: CHANGE FOR CONTIGUOUS SIZE	L	M
8	MENS' 6 TO 12	67	1'5	21	1'0	33	18	15	22	12 m.m ABOVE THE PRICK	4'6	59	2'0	32	62	58	1'5		
4	LADIES 1 TO 8 RANGE-4 (2-5)	61	1'5	17	1'0	33	18	15	22	6 m.m ABOVE THE PRICK	4'5	49	2'0	30	63	LADIES - 54 RANGE-4 54	1'5 1'5		
13	CATE.-3 12 TO 1	55	1'5	13	1'0	23	18	15	15	AT THE PRICK	4	47	1'5	27	55	47'5	1'5	6	6
10	CATE.-2 9 TO 11	50'5	1'5	10	1'0	24	14	15	12	AT THE PRICK	4	41	1'5	25	50	42'5	1'5		
7	CATE.-1 6 TO 8	46	1'5	7	1'0	24	14	15	10	6 m.m BELOW THE PRICK	4	38	1'5	22	45	38	1'5	6	6
4	CATE.-1 3 TO 5	41'5	1'5	7	1'0	24	14	15	10	"	4	35	1'5	20	40	33'5	1'5		

±2 m.m Change for Contiguous Sizes.

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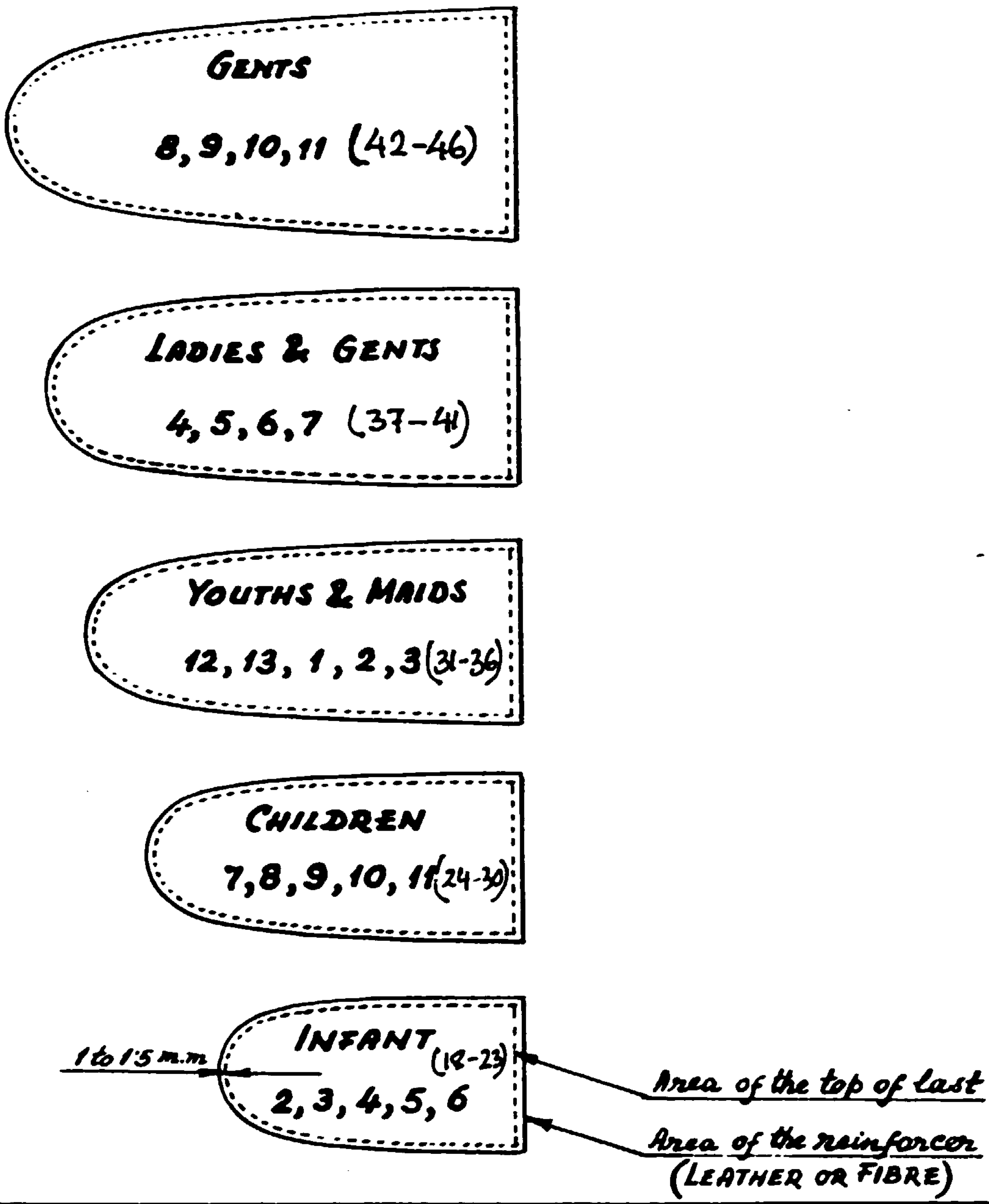
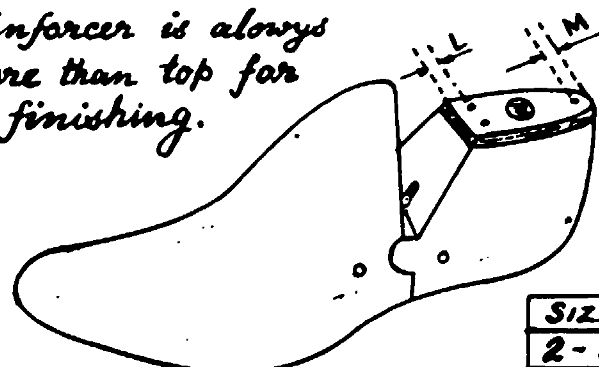
REINFORCER FOR LAST-TOPS. Sketch No. - 5



NB.
Area of reinforcer is always 1 to 1·5 m/m more than top for scouring & finishing.



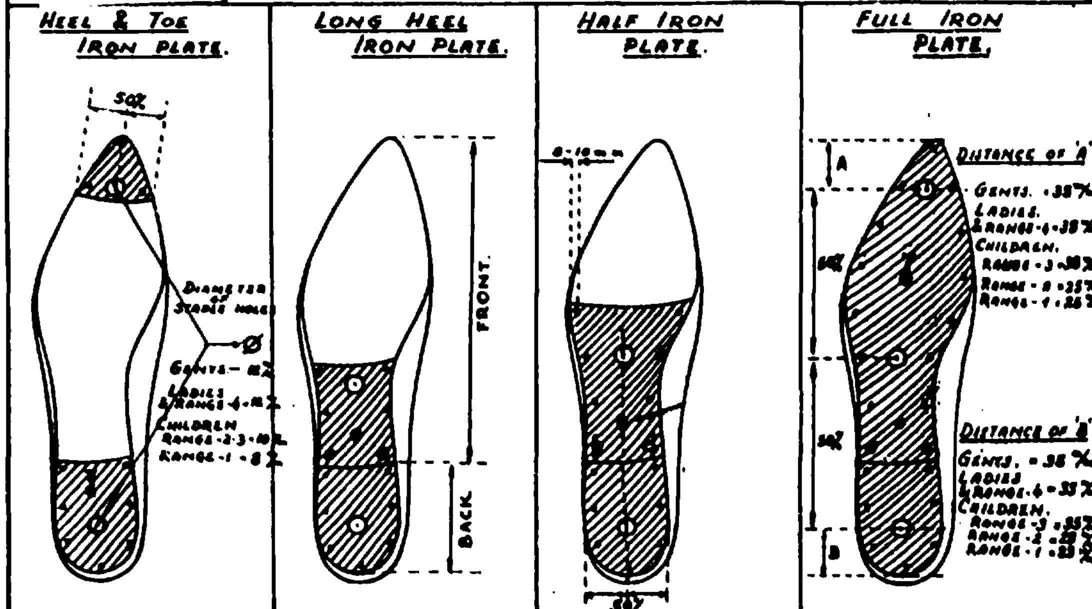
3 nails for all sizes
6 m/m from the edges

SIZES	L	M
2-11	3	5
REST	6	10

SIZES	THICKNESS OF REINFORCER
2 - 11	4·5 m.m
REST	5 m.m.

SPECIFICATION OF LAST BOTTOM PLATE (FIXING BY NAILS)

Sketch No 6



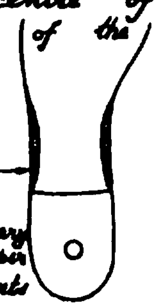
CATEGORY	SIZE ROLL	NUMBER OF HOLES: FULL PLATE FRONT	FULL PLATE BACK	HALF PLATE FRONT	HALF PLATE BACK	LONG HEEL PLATE FRONT	LONG HEEL PLATE BACK	HEEL PLATE	TOE PLATE
GENTS' & LADIES.	6 TO 8	13	7	6	7	4	7	7	3 or 4
" "	11 TO 13	15	7	6	7	4	7	7	3 or 4
LADIES, YOUTHS, & MAIDS.	2 TO 5	11	7	6	7	4	7	7	3
BOYS & GIRLS.	9 TO 1	10	7	-	-	-	-	7	-
CHILDREN	6 TO 8	8	5	-	-	-	-	5	-
INFANT	3 TO 5	7	5	-	-	-	-	5	-
"	1 TO 2	6	5	-	-	-	-	5	-

Metallic plates must be of galvanized iron sheets. The plates must have an even surface without potholes and blisters. The heads of the nails must be flush with the plate.

In the metallic plates holes must be pierced with a countersink for passage of nails and screws fastening the plates. On all bottom plate size and filling to be marked.

Distance from the edge of the plate to the centre of the nail-hole is — 8 m/m to 10 m/m. The distance of the nail-holes in the plates must be uniformly located.

The inside surface at the shank portion of the bottom plate should be grinded for better attachment.



For pointed lasts (spear points) metal plating of toe ends is necessary to preserve the pointed ends of toe and to withstand pressure of upper plate and for reinforcement at toe with some metallic attachments in cement construction.

NAILS

APPROX. DIAGRAM	NAME	T THICKNESS	L LENGTH	H HEAD	WAY OF USE
H, T, L	1·8 x 16	1·8	16.0	2.8	GALV. PLATE CHILD. 1 - 8½
	1·8 x 20	1·8	20·0	2.8	GALV. PLATE ALL OTHERS.
	Diameter of countersink for nails + 0·2 m.m.				

GALVANIZED BOTTOM PLATE

THICKNESS OF SHEET	HARDNESS	WAY OF USE
1 m.m	38-44°R	FULL PLATE.
1·5 m.m	38-44°R	HEEL PLATE.

LAST BOTTOM	BASIC SHOE CONSTRUCTION
ALL BOTTOM METAL PLATED	a) MACHINE SEWN b) STUCK-ON AND VULCANISED
HALF IRON PLATE.	a) FOR VARIOUS COMBINATION CONSTRUCTION VIZ: FORE PART WELTED CONSTRUCTION. b) FEW TYPES OF MOCCASIN CONSTRUCTION.
LONG HEEL IRON PLATE.	
HEEL IRON PLATE.	a) WELTED. b) MOCCASIN. c) SLIP LASTED.
PLAIN OR NO METAL PLATE	a) VELDTSCHOEN b) CEMENT LASTED.
HEEL & TOE IRON PLATE.	a) LITTLEWAY CONSTRUCTION b) STUCK-ON

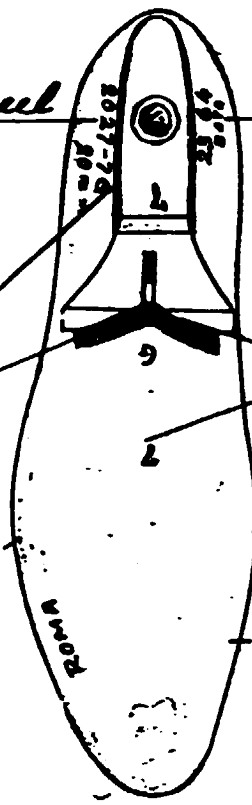
MARKING ON LAST.

Sketch No - 7

CODIFICATION
MODEL (ARTICLE) NUMBER OR DENOMINATION OF A LAST

Outer-side of heel
1. Model No.
2. Size.
3. Fitting.
4. Heel height

SIZING Colour
Fitting colour



Internal side of heel.
1. Trade-mark.
2 Week & year of manuf.
3 Standard symbol

On the cone and inside of V-cut.
2 Bottom Plates
1. Size only.

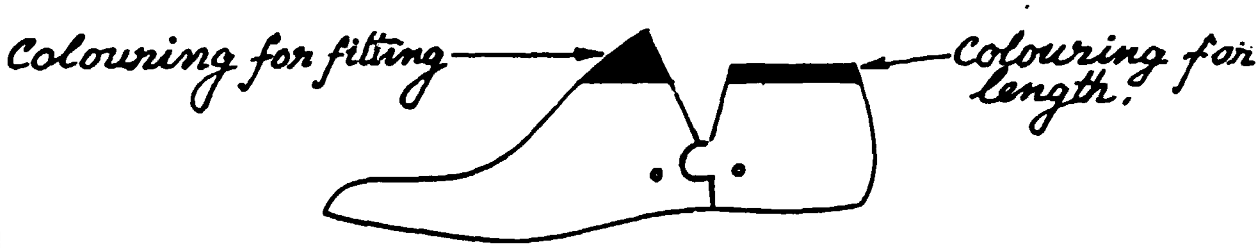
1	2	3	4
Shape of toe	Serial number	Serial number.	Size range.

	RANGE OF LASTS' TOE SHAPE	SIZE RANGE	
0	Nature forms & Asymmetric.	Infants	1 to 3 ; 16-20
1	Pointed	Children	4 to 6 ; 20-23
2	Round	"	7 to 10 ; 24-28
3	Wide (Broad).	"	11 to 1 ; 29-33
4	Rounded Square	Youths (ADOLOSCENT)	
5	Medium Pointed.	Ladies (with full plate)	2 to 7 34-41
6	Square.	Ladies California (without plate)	
7	Long (slim) Pointed.	Mens' - Mkay, staple welted, Stuck on (with full plate)	5 to 11 38-46
8	Medium Round.	" Flexible (sandal) without plate	-"-
9	Almond.	" Welted with Heel plate only.	-"-

COLOUR CHART FOR FITTINGS & SIZES.

Sketch No. 8

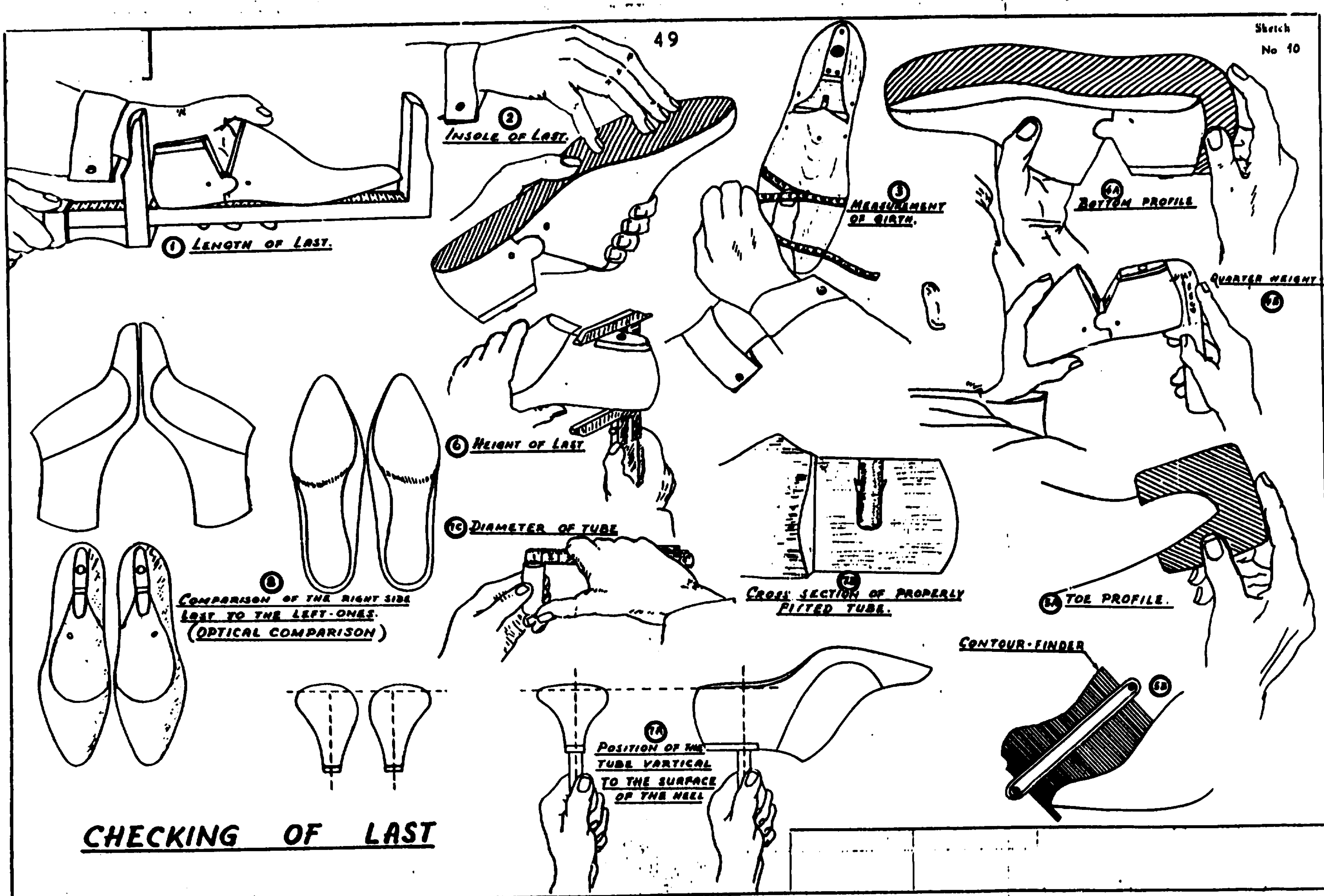
SIZES	FITTINGS			NAME OF COLOUR.	SHADE OF COLOUR
1 11	A	1	EXTRA NARROW	NO COLOUR.	
2 12	B	2	NARROW	BLUE.	
3 13	C	3	VERY SLENDER	YELLOW.	
4	D	4	SLENDER	GREEN.	
5	E	5	VERY SMALL	VIOLET.	
6	F	6	SMALL	BROWN.	
7	G	7	MEDIUM	RED	
8	H	8	LARGE	GREY.	
9	CH	9	EXTRA LARGE	ORANGE.	
10	K	10	X-E.L	WHITE.	
½	½	½	½	BLACK.	



	QUARTER-HEIGHT PIN MARK ON BACK LINE OF LAST.	Sketch No. 9

Measurement for quarter-height pin is determined from the seat-edge (s) of the last.

SIZES. ENG. FR.	MENS INSIDE BACK HEIGHT (SHOE)	MENS QUARTER HEIGHT-PIN ON LAST.	LADIES & RANGE-4 INSIDE BACK HEIGHT (SHOE)	LADIES & RANGE-4 QUARTER HEIGHT PIN ON LAST.	CHILDREN RANGE-0,1,2,3 INSIDE BACK HEIGHT (SHOE)	CHILDREN RANGE-0,1,2,3 QUARTER HEIGHT PIN ON LAST.
1					27.5	29
2 (18)					29	30.5
3 (19)					30.5	32
4 (20)					32	33.5
5 (21)					33.5	35
6 (23)					35	36.5
7 (24)					36.5	38
8 (25)					38	39.5
9 (29)					39.5	41
10 (28)					41	42.5
11 (29)					43	44.5
12 (31)					44.5	46
13 (32)					46	47.5
1 (33)					47.5	49
2 (34)			49	50.5		
3 (35)			51	52.5		
4 (37)	53	54.5	52.5	54.0		
5 (38)	54	55.5	54	55.5		
6 (39)	55	56.5	55.5	57.0		
7 (41)	56.5	58	57	58.5		
8 (42)	58	59.5	59	60.5		
9 (43)	60	61.5				
10 (45)	61	62.5				
11 (46)	63	64.5				
12	64.5	66				


49
Sketch
No 10
1 Length of Last.
2 Insole of Last.
3 Measurement of Girth.
4A Bottom Profile
4B Quarter Weight Pin.
5A Toe Profile.
5B
Contour-Finder
6 Height of Last
7A Position of the Tube Vertical to the Surface of the Heel
7B Cross Section of Properly Fitted Tube.
7C Diameter of Tube
8 Comparison of the Right Side Last to the Left-Ones. (Optical Comparison)
CHECKING OF LAST

CHAPTER II

SHOE-LASTS:- MATERIAL, PLASTIC & WOOD

Shoe lasts traditionally have been made of hard wood. Wood needs seasoning, which requires a long time and sizable inventory for many months (big stock) and steaming/drying chambers. Wood lasts are not sufficiently durable and precise and their manufacture is influenced by climatic conditions. Moreover, seasoning/drying/storing chambers consume lot of energy (as partly they have to run all the day round) and enormous space, godown shed area.

Due to these disadvantages, wood has largely been replaced by plastic for bulk last manufacture, while wood is used only for model making.

Plastic Lasts:- Advantages Over Wooden Lasts

1. The plastic last has dimentional stability, unaffected by temperature, on humidity, which ensures more reliable fitting,
2. Its waxy surface allows faster and easier removal from the shoe, an important time saver. It has longer life and rarely requires repair,
3. Maximum "uniformity" can be achieved by using plastic lasts, which are unaffected by chemicals, solvents, bacteria or steam,
4. It has remarkable "memory" and always tends to return to its original form,
5. The plastic last permits greater refinement of "Fashion Details". Thus, for instance, pointed or tappered toe or skived edges can be made more delicate without fear of breakage or the edges on walled lasts can be sharper and clearer,
6. It requires no periodic waxing because it has its own permanent last slip finish. It has practically no breakage and there is also negligible wastage of material at the manufacturing stages,
7. Waste raw materials/obsolete lasts can be recycled to manufacture new lasts,
8. Not much stock needed - 2/3 weeks inventory,
9. No top reinforcement. Finishing: no polishing, no scouring - lots of manpower & operations saved in production.

Raw Material Required for the Manufacture of Plastic Lasts

1. Some of recommended H.D.P. materials are:-

   1.1. Manufacturer: BASF (West-Germany)

   Commercial Name: LUPOLEN 5021 DX and LUPOLEN 6011D

   Melt flow index: 0.15 - 0.25 approx.

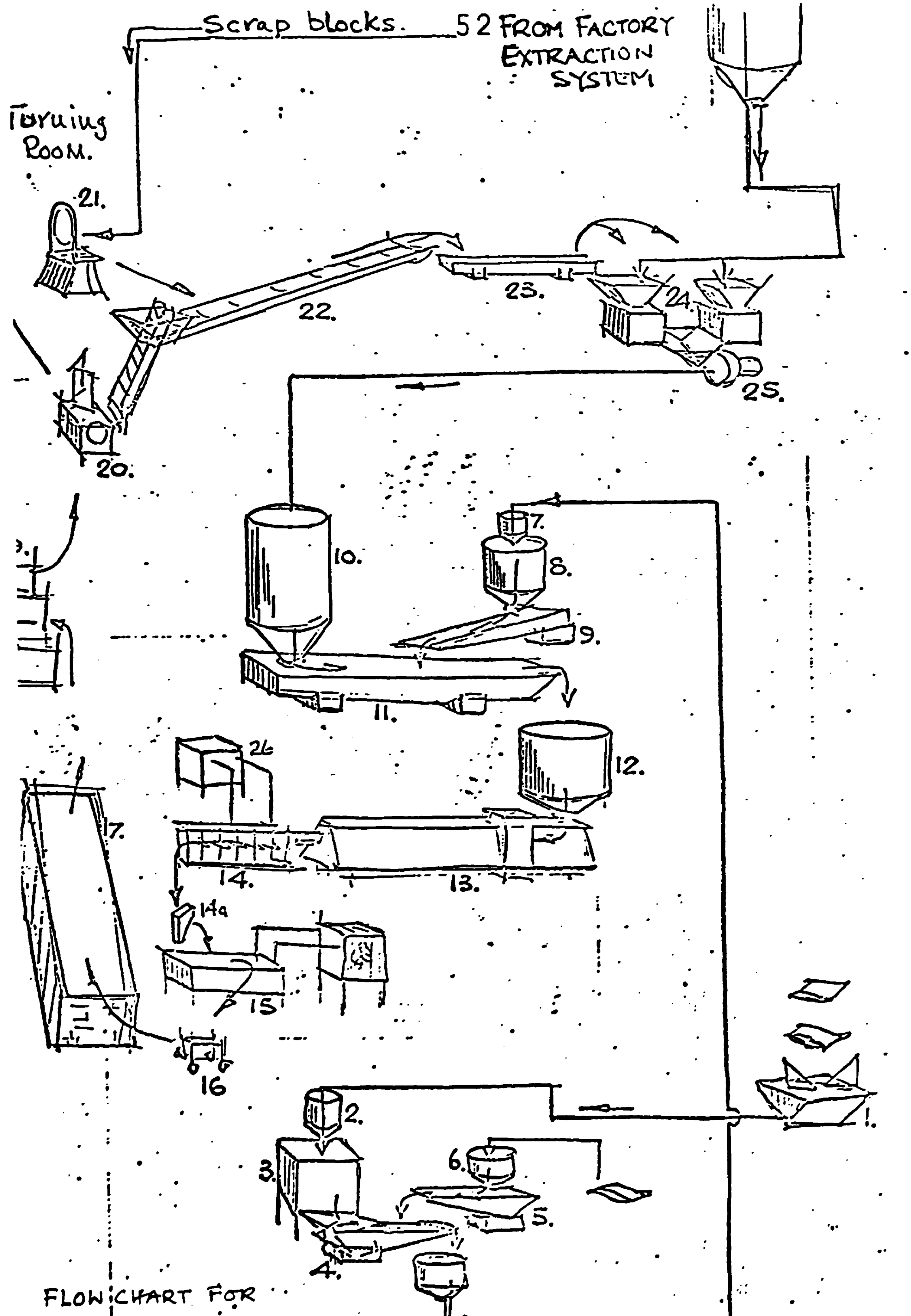
   Density: 0,947 - 0,950

   1.2. Manufacturer: HOECHST (West-Germany)

   Commercial Name: Hostalen GF 470 and Hostalen LDD 2022.

2. The above basic material provides better properties (e.g. durability, hardness retention, and crushing strength), and therefore, is preferred by a number of last manufacturers in industrialised countries. Some last factories mix high and low density polyethelene (like Montedison's/Italy: Fertene 2082-2000; melt flow index 0.25; Density 0.918; hardness 51), however, the quality of lasts is lowered by the increased proportion of low density materials used. The world market price for high density polyethelene is about U.S.$1/kg. while the low density compound or granulate is about 30 - 35%, cheaper.

   Almost all last manufacturers produce their own blocks (see Flow Chart). This requires an additional investment and following machines & equipment which together cost U.S.$180,000/-in addition to moulds which cost U.S.$ 2500/pair, 2.2 to 3.5 kg. polyethelene is required to make one block and of this 45-50% remains in lasts. Most of the wastes may be recycled, regranulated and added to the virgin basic material. The average output of an extruder is 300 - 500 pairs per eight hours shift, depending on the size range. (See Flow Chart for manufacturing plastic shoe last blocks).



FLOW CHART FOR MANUFACTURING PLASTIC SHOE LAST BLOCKS.

++4 <u>Complete List of Machinery & Equipment for a Complete Plant for HDPE Shoe-Last Blocks (from Plastic Granules to Finished items) including moulds for production of 250 - 300 pairs/day of plastic last blocks</u>. (See Shoe Last Moulding Plant Layout)

1. INJECTION MOULDING MACHINES:

   1.1. One automatic horizontal oil hydraulic injection moulding machine with extruder Ø30 x 2000mm injection capacity 3 kg. for manufacturing plastic last blocks.

   1.2. One automatic normalizing cooling tank - 10 mt. length.

   1.3. Last block moulds:- (normal last height and heel height upto 50 m/m) 27/28, 29/30, 31/32, 33/34, 35/36, 37/38, 39/40, 41/42, 43/44, 45/46 = 10 pairs moulds

2. INJECTION MOULDING ACCESSORIES

   2.1. One granules hopper feeder with 2 sections dosing container.

   2.2. One closed cycle water chiller, 21,000 frig/hr = 84,000 BTU/hr for constant mould cooling.

3. PLASTIC WASTES RECOVERY

   3.1. One automatic vertical dry mixer kg. 200 capacity for mixtures with master and dry mixing of granules with recovered plastic materials.

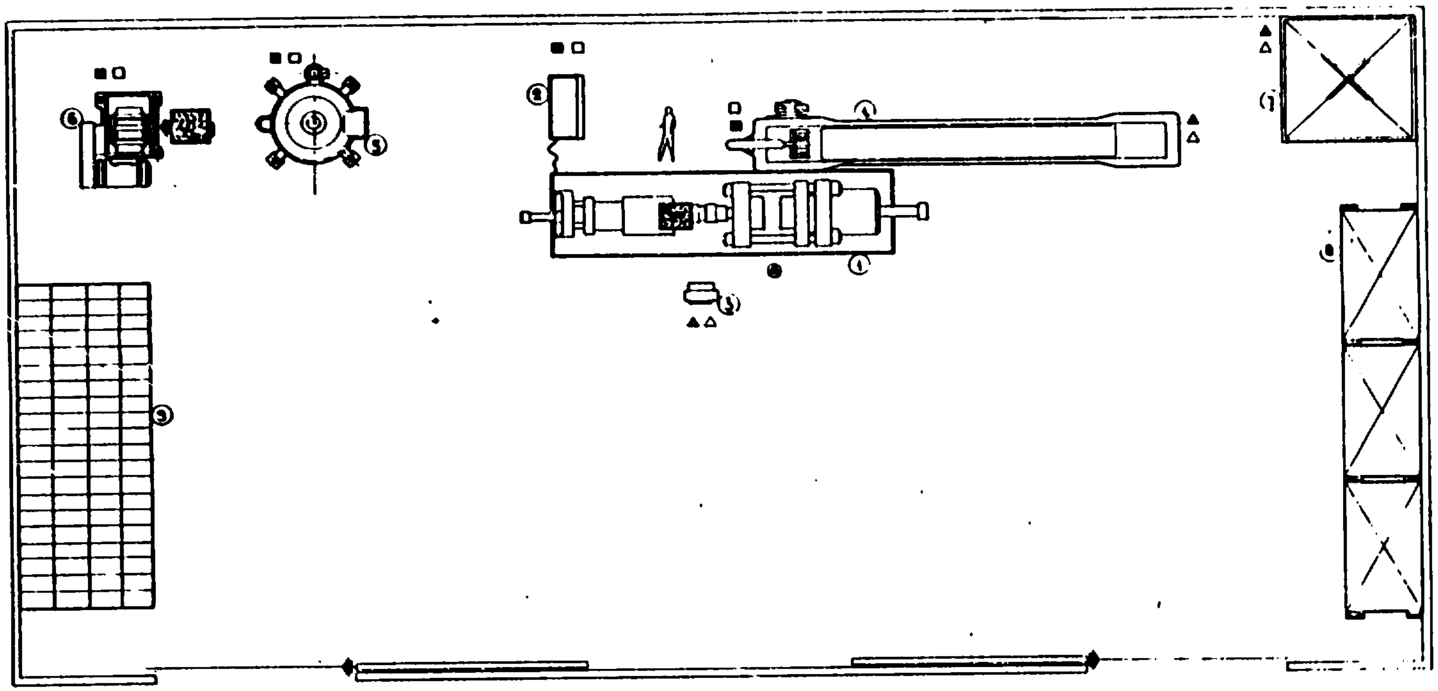
   3.2. One granulater for reclaiming all sorts of plastic scraps.

   3.3. One grinding mill for shoe lasts chips recovery, inlet any size/ outlet homogeneous.

   3.4. One air compressor lt.150/capacity, siltent working with motor protection for air needs of granulater (3.2) and finishing machine.

   3.5. One regeneration granulating plant of PE scraps(as given by dry mixer) formed by a) 1 trafile extruder; b) 1 electric control pannel for temperature reading & adjustment on 5 zones c) 1 spaghetti head d) standworks <u>for extruder cords, granulater</u>

U.S.$ = 180,000/-



■ - Electric Cable
□ - Earth Wire
▲ - Water Inlet
△ - Water Discharge
● - Compressed Air

9 . Plastic Material Storage
8 . M o u l d s Storage
7 . Closed Circuit Water Tank
6 . G r i n d i n g M i l l
5 . D r y M i x e r
4 . Normalising Tank
3 . Water Reservoir
2 . Electric Control Panel
1 . Injection Moulding Machine

- . Thermoplastic Moulding Plant
Positioning
(Lay Out)

■ Cavo linea elettrica
□ Cavo di terra
▲ Entrata acqua
△ Scarico acqua
● Aria compressa

9	Deposito materiale plastico		
8	Deposito stampi		
7	Vasca acqua circuito chiuso		mt³ 5,00
6	Frantoio		
5	Mescolatore		
4	Vasca normalizzazione		
3	Raccoglitore acqua pressa		
2	Quadro elettrico pressa		
1	Pressa		

Posizionamento impianto forme

plastiMAC...

Macchina MF/3000

Disegno N° 3555/EE

CH 24/1/15

Data 1 2 3 4 5 6

5. The majority of plastic lasts are hinge (spring) types, with the bottom bring partly, fully or without metal plated. The world market price of heel plated lasts made of high density material is U.S.$ 12.50 - 17.00/pair plus extras (e.g. extremely large sizes, slot in toe, bevelled edge for veldtschoen construction) making about U.S.$ 0.75 to 1.5/pair. The delivery time is 4-6 weeks. Transport costs (for about 7000 km) are U.S.$ 0.3 to 0.4/pair by sea (requiring 4-6 weeks) and U.S.$ 3 to 3.5/pair by air (requiring 2-4 days).

The main operations required by plastic last manufacture are the block extrusion, cooling and heating, cutting the forepart and the back parts of the blocks, rough turning, drilling, link cutting, hinge slotting and setting, fine turning, taking of toe & back stubs, toe & heel shaving/shaping, setting the thimble, plating, marking and checking.

6. The following three variants of manufacturing units may be considered as economical approaches when starting last manufacturing:-

A. 80-100 pairs/8 h. output of lasts, when plastic blocks are supplied from a petrochemical industry, polyethelene/plastic component manufacturing plant or some last manufacturers in Europe (rough turned or rough turned with hinge spring fitted). Only the most important operations are performed by machines;

B. A semi-mechanised unit producing 250-300 pairs/8 h. when the extrusion is done within the last factory.

C. A mechanised last production unit with an output of 400-500 pairs/8 h. and using up-to-date machinery for all operations.

The following figures provide an indication of production and input requirements of each of the three variants.

	(A)	(B)	(C)
Output, pairs/8 h.	80-100	250-300	400-500
Equipment, U.S.$ No #	100,000	400,000	600,000
Working area, m^2	200	600	1000
Direct labour	10	20	30
Electric power, kw	25	60	75

Besides the main manufacturing facility, each last making unit needs a model making department including pattern grading facility.

Equipment for last manufacture are supplied by Donzelli, Fagus, Incoma, Seidl and Zuckermann. They offer complete plants as well.

Equipment for HDPE shoe-last block manufacture are supplied by Donzelli, Plastimac of Italy.

Equipment for pattern grading are supplied by Albeko, UCICA, USM, OVIC Lince, SIDECO, Pedersen.

7. Machining of Polyethylene

Polyethylene has good machinability and can be machined on conventional equipment. But as formulations and grades of polyethylene differ in flexibility and stiffness, machining speed and techniques must be adjusted to suit the physical characteristics of the material used.

The major problem in machining polyethylene is that of heat. In order to overcome this problem three procedures are generally advised.

1. Use coolants wherever possible,
2. Use tools designed to provide adequate clearance,
3. Operate machinery or tools at relatively high speeds with light cuts and slow feeds.

Following recommendations apply to all types of machining operations.

1. Coolants: A water soluable cutting oil or compressed as jet which also clears chips out of the cut make the best coolants for cutting tools.

2. Tool Design: Generally turning tools should be groundto a zero or slight(-5^{o}) top rake and should have a scrapping rather than cutting action. Clearances should be much greater than those normally used for metals. High speed steel tools especially designed for work with plastics are available but where length of run justifies the cost, carbide tipped tools are recommended.

Tools should be kept extremely sharp, preferably diamond lapped to eliminate nicks and burns, a major cause of chipping and frictional heat build up.

Sawing

Most of the saws used for cutting metals may be used for polyethelene and in some cases, conventional wood working blades may be used. The proper rate of feed is important in all sawing operations and can be learned only through experience. To prevent the saw blades from becoming jammed, the teeth must be set at approximately 0.5 mm. The higher the cutting speed the cleaner the out surface.

Band Saws

The possibility of overheating is less with band saws because individual teeth have a longer time to cool before re-entering the material.

Work Material	Type of Blades	Teeth per inch	Speed(r.p.m)	Feed(ip.r)
Polyethelene	Metal(high speed spring steel)	6-10	1200-2000	8-12

Turning

Semi-finished polyethylene product can be machined without difficulty on the high speed last copying lathe, and high quality finish attained. Cooling is not usually necessary but care must be taken to remove all swarf; only for large depth of cut is cooling with compressed air likely to be required. Tools should be kept as sharp as possible to ensure clean cuts. All the cup cutters in one cutter head should have same weight.

Tools with radiused edges eliminate scores on the work. Alignment of the work and die/cutters must be perfectly well balanced.

Side relief angle 5-20^{o}	Side rake angle 0-15^{o}
End relief angle 0.5-10^{o}	Speed r.p.m. 6000-8000
Back rake angle 0-15^{o}	Feed i.p.r. 0.005 - 0.006

Drilling

Twist drills specially designed for plastic materials are readily available and are suitable for polyethylene, also conventional steel drills can be used if properly sharpened. Such drills provide maximum clearance for the cutting edges. Work should be securely held and a slow careful feed used to avoid chipping.

Helix angle	10-20^{0}	Rake angle	0^{0}
Point angle	70-90^{0}	Speed r.p.m.	2000-3000
Lip relief angle	9-15^{0}	Feed ipr.	0.005-0.010

Wooden Lasts

In spite of having manifold advantages for using plastic block as basic raw material for shoe-lasts, but a country where plastic (petro chemical) industry is not so well developed, where necessary high density polyethylene is not manufactured, where required large capacity extruder/granulating equipment is not available - everything has to be imported, be it H.D.P. granules, plastic raw blocks/rough turned blocks/rough-turned & fitted with hinge-pins. In that case available raw material in the country to be properly & rationally explored i.e. Timber.

The selection of suitable timber for manufacture of footwear lasts has an important bearing not only with respect to the life of the lasts but also their workability and behaviour during use. Consequently, the last manufacturer is left with only a few selective range of timbers at his disposal.

The Quality Requirements

For wooden shoe lasts the timber used must embody certain special characteristics as following:-

1) Durable, & have a hard texture:- can absorb considerable stress/ strain/bumps & blows; 2) Easy clean cut & machinability; 3) Straight

parallel & close grain for better finish & high polishing 4) Good holding capacity for nails & screws; 5) Not liable to split while turning; 6) Immune to insect attacks, borer, termites & fungus; 7) Not be hygroscopic - doesn't absorb moisture quickly (less porous & compact grain); 8) Non-refractory & easy seasonable.

The timber species used as follows:-

Europe/U.S.A.	India	Ethiopia
1. Beech (Fagus Sylvatica)	1. Sisham (Dalbergia Sissoo)	1. Wanza
2. Maple-N. America (Acer Sachharum)	2. Kala-siris (Albizzia odoratissima)	2. Kararo
3. Ahorn/white maple/beech (Acer platanoides)	3. Pitraj (Aphanamixis polystachya)	3. Tshid(Tid)
4. White Birch (Betula Pendula)	4. Benteak (Lagerstoremia Lanceolata)	4. Zigba
5. Horn Beam (Carpinus betulus)	5. Amari (Amoora Wallichii)	

COMPARATIVE SUITABILITY INDICES OF TIMBERS, WITH TEAK TAKEN AS 100

Sl.No.	Species	Specific Gravity (mass oven dry volume green)	Weight lb/cft of seasoned timber at 12% moisture content	Retention of shape	Shear	Hardness	Splitting co-efficient	Shock resistance ability	Holding Power Nail Screw
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Teak	0.596	43	100	100	100	100	100	100
2	Maple	0.423	44	135	145	110	76	135	-
3	Beech	-	45	70	130	90	-	130	-
4	Sisham	0.654	48	96	140	135	120	140	115
5	Kala-siris	0.632	46	96	180	159	97	180	-
6	Pitraj	0.576	44	66	107	118	97	-	-
	Ethiopian								
1	Wanza								
2	Kararo								
3	Tshid(Tid)								
4	Zigba								

The following defects in the wood should be avoided:-

1. Dirt of any sort and degree
2. Decay and knots
3. Fungal attach
4. Worm holes and insect damages
5. Cross & spiral grains
6. Pith and splits (honey combing)

Conversion and Selection (See Sketch No.11 to 13)

The logs for the preparation of blocks for lasts shall be reasonably free from flutes, spiral or wavy grain, big knots, shakes, deep cracks, decay or rot and insect attacks. The bigger girth(4' & up Ø) shall preferably be converted into blanks of triangular section. This shall first be cross-cut into small bolts (according to length of lasts to be manufactured), avoiding objectionable defects. The bolts shall then be converted into triangular sections, avoiding pith, on a vertical band saw. Smaller girth logs can be converted into beams of required width (breadth). Then this beam can be split into desired length or size of lasts. The triangular sections or rectangular blocks so obtained may be rough shaped to the profile of the last. Selection of blocks should be made after conversion. Defective blocks which are not likely to yield finished lasts conforming to the required quality should be first tried to reduce into smaller sizes(rejecting defective portions) for making smaller sizes of lasts. If not possible they may be totally rejected. The last blocks shall be end coated, immediately after conversion, either by coal-tar or molten wax to prevent end splitting during seasoning. The date of conversion of block shall be marked on each block.

APPROXIMATE DIMENSIONS FOR ECONOMIC CONVERSION OF LOGS

SL.NO.	SIZES OF LASTS	MEASUREMENT OF BLOCKS LENGTH	BREADTH	HEIGHT	VOLUME PER PAIR	USED FOR LASTS
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		CM.	CM.	CM.	m^3	
1	42 to 47	34	11.5	13	0.0102	Mens
2	38 to 41	30.5	11.0	13	0.0086	Mens/Women/Adoloscent
3	34 to 37	28	10	11.5	0.0064	Adoloscent
4	30 to 33	25	9.5	10	0.0048	Boys' & Girls
*5	25 to 29	21.5	9	9	0.0034	Children
*6	20 to 24	18.5	8.5	9	0.0028	Infants

* can be obtained from wastages and rejected/defective block nos. 1 to 4

SEASONING

To ensure that timber and timber products maintain their shape and size and to eliminate losses through cracking, splitting and wrapping in service, it is essential to "season" the timber, i.e. to reduce its moisture content to near equilibrium with the atmospheric conditions of the locality of use. Seasoning thus upgrades the timber affecting considerable economy in utilisation.

Timber for general purpose needs to be seasoned to about 10% moisture content for satisfactory service in most seasons in Ethiopia.

Thorougn seasoning of last blocks free from defects is a prolonged process. They may be fully air seasoned, partly air and partly kiln seasoned or completely kiln seasoned. Lasts shall not be made unless moisture content of last blocks remain between 8 to 10 percent.

The green tree trunk which has moisture content of 50-55% can come straight from the forest to the factory and then they are sawn into appropriate blocks or spokes or blanks. The blocks are then kept in a well ventilated shed for a year minimum. At the end of this curing process, the moisture content is generally reduced to 10%.

This lengthy process of natural seasoning was reduced by about six months taking recourse to artifical drying/seasoning of the blocks. They were first allowed to dry naturally 3 to 4 months. Then they were put inside a seasoning kiln where in about two months, the moisture content was brought down to the desired level.

In tropical countries, where there are at least 8 months clear sky, the entire process of seasoning can be further hastened by using solar driers or solar heated kilns. A solar kiln can be used to reduce the moisture content from 50 to 55%(i.e. greenwood) to approximately 35% in about a month. After this pre-drying, the blocks can be further dried to the desired level either in an indigeneously manufactured Timber Drying Kiln or an imported High Frequency Drier.

The entire seasoning procedure can be expedited by adopting any of the following artificial methods - either individually or partly in conjunction with natural seasoning or two of them in tandeur - which can reduce the drying time from a year to as low as a month, depending upon the process:

1) by using Solar Heated Timber seasoning kiln,
2) by using Timber Seasoning Kiln utilising steam or pre-heated water.

1) SOLAR HEATED TIMBER SEASONING KILN
   (See enclosed drawing, literature & specification) (See Sketch No.14-16)
2) TIMBER SEASONING KILN USING PRE-HEATED WATER (Enclosure I)
   The drawing of the masonry seasoning kiln and allied equipment for artificial seasoning of timber using steam or pre-heated water is attached herewith. It is based on hot water for which hot water generators are being used. The hot water generator can be run by coal/wood waste and are more economical than steam boilers. It works on the basis of uniform air current flowing through wooden stacks and the usual heat exchange.

3) Timber seasoning based upon well established principle of dehumidification using refrigeration techniques. Details are enclosed in Enclosure II .

1. SOLAR TIMBER DRYING

Solar energy is already indirectly made use of in the air seasoning process in which naturally heated atmospheric air is employed for drying. The efficiency of solar energy utilisation in this process is, however, very poor. Solar heated kilns are designed to use the available solar radiation more efficiently.

$7m^3$ Solar Heated Timber Seasoning Kiln:- Constructional Details and Operation of Solar Kiln:

The $7m^3$ solar heated kiln works on the glass house "principle. It employs forced air circulation, effected by means of two 91 cm. dia, 550 RPM, 1KW propeller fans mounted on the floor of the N.Side of the stack. The roof, S-, E-, and W- walls are sheathed with double covering of 5.5 mm plain clear glass on the outside and 0.25 mm. polythene sheet on the inside, with an intervening air gap of 37 mm for thermal insulation. The kiln length is oriented East-West, with the roof sloping towards the south at an angle equal to 0.9 times the latitude with the horizontal, for optimum year - round solar energy collection.

A Blackened 'V'- corrugated G1 sheet solar absorber is mounted above the stack, which also creates on overhead cross channel for return of air from the leaving air-side of the stack to the entering air-side in a re-circulating system. The air gets heated up in passing over the solar heated absorber and then is made to flow through the timber stack, where it transfers heat and causes evaporating. The cool and moist air leaving the stack is then again passed over the solar absorber re-heating and the circuit is repeated continuously. As the kiln humidity builds up, part of the moist air is exhausted and fresh dry air is taken in through manually regulated vents provided at floor level.

The outer sheathing of 5.5 mm glass withstands hailstorms of sufficient intensity. The kiln may also be provided with an industrial water spray humidifier for additional humidification of the kiln air to prevent cracking of timber. The humidifier can be successfully worked to relieve case - hardening stress in the solar drier timber for precision uses, as in the steam heated kilns.

The solar kiln fans and humidifier should ordinarily be driven electrically. However, in locations where electric power is not available, the fan may be driven by suitable coupling to a diesel engine.

The glass and polythene sheathing of kiln naturally possess selective transmission properties for radiation. Solar radiation between 0.4 to 2.0 microns in wave length, which constitutes almost 80% of the sun's energy is transmitted to the extent of 90% through the sheathing into the kiln. This radiation is absorbed on the blackened v-corrugated solar panel which gets heated up and emits longwave heat energy (2 to 50 microns wavelength) to which the sheathing is relatively opaque. The incoming solar radiation is thus trapped as heat in the kiln and the temperature rise depending upon the prevailing weather, the sky condition, the moisture content, thickness and drying rate of the timber, etc.

Kiln Performance: Timber can be solar dried to low moisture contents up 10%, which is not possible even by prolonged air drying. The performance of the kiln has been found to be not seriously affected even in humid coastal belt at lower latitudes, where intermittent sunshine is available daily.

Economies of solar drying

The initial installation and establishment cost of a $7m^3$ solar kiln is only 40% of the initial installation costs of a small steam heated kiln ($3.9m^3$) capable of an identical output. Operating costs of a solar kiln are largely confined to the electrical energy required for driving the kiln fans. Personnel engaged on other jobs can meet the casual skilled attendance required.

Solar drying costs(assuming solar drying times of 12 to 20 days depending upon the drying characteristics of the species, initial moisture content and latitude of the locality) is only about of 40% of drying costs in steam heated kilns(assuming drying times between 8 to 12 days for planking of different species).

The solar heated kiln can also be used, in the form of long narrow sheds of low height fitted with internal side fans, for partial pre-drying of timber to reduce kiln drying times. Pre-drying can be appreciably accelerated with reduced risk of cracking and splitting in solar kilns compared to normal air drying or fan-air drying.

Limitations of Solar Drying

The performance of the kiln is adversely affected during spells of continuously cloudy weather. This means that the kiln can only be advantageously used in locations which enjoy at least 8 months of clear skies. Fortunately, conditions happen to be favourable over the major part of the country for its operation. It may be mentioned that the performance keeps near normal even when intermittent sunshine is available daily.

Another drawback is that the process needs rather large space, if more than one kiln have to be installed, in order to adapt it on a large scale. Adequate spacing has to be maintained between adjoining solar kilns to avoid shadows of one on the other. Sites with continuous availability of sunshine during the day are also hard to find in congested localities.

How to increase solar kiln capacities

The capacity of a solar kiln may be increased if desired for large scale work, by repeating the basic $7m^3$ unit in length and adding the requisite number of extra fans.

Scope for further improving energy efficiency of glasshouse type solar kiln:

Generally it is found that only about 25-45% of the incident solar energy was usefully employed for water evaporation from timber in the glasshouse type kilns 40-52% of the incident solar energy of the kiln actually may be utilized for raising the temperature of the kiln structure and simultaneously making good the convective and radiative heat losses to the ambient and the conductive heat losses to the kiln floor, when the floor was insulated with a covering of 25 mm thick wooded boards. The kiln witn an insulated floor needed 14-21% less energy to maintain the same temperature as the kiln with a bare floor.

Constructional Material, Equipment & Erection Cost fcr 7m^3 Capacity Solar Kiln

1. Concrete platform 20' x 28' x 1'
2. Timber for wall and roof studs framing and foundation
3. Plywood(BWR grade) for covering north side of the kiln
4. Polythene sheet 0.25 m/m thick
5. Glass, rubber-heading, hexagonal wire-netting, G.1. sheet, channels folded from sheet etc.
6. Fans(91 cm. diameter) with shafts, plummer blocks, pulleys, etc.
7. 2 motors with starters(2H.P. each), reversible switches, and v-belts
8. Black paint, nails, screws, iron sheets, etc.
9. Labour charges(carpenters and labour)
10. Spinning disc humidifier.

U.S.$ 10,000/-

Specification of ASCU-BOLLMANN design

Timber Seasoning(Masonary) Kiln Components(See Enclosure I)

A. ASCU-BOLLMAN Model H.T. 70 MKO/420 Masonry Kiln Components

1.	Tvpe	Side Mounted
2.	Maximum Capacity	Approximately 100 cft. per charge using 4 "thick planks with 1" thick crossers.
3.	Chamber Size	Internally, 4.2 meters length x 4.6 metres width x 3.5 metres height.
4.	Stack Size	Two stacks of 4.0 metres length x 1.5 metres width x 3.0 metres height, will be accomodated in the chamber.

B. HOT WATER GENERATOR (For operating the above kiln components)

Type	Coal/wood fired
Maximum Capacity	1,000,000 k.cals/hour, approx.

C. Other Items(for the kiln):-

1. One set of laboratory equipment.
2. Temperature recorder for each kiln.
3. Loading system for each kiln.
4. Masonry work for one chamber for installation of one set of kiln components approx. 280 sq. ft. plinth area.
5. Necessary shed and masonry work for installation of the above hot water generator (floor area about 150 sq. ft.)
6. Power:- 10 KW, 400/400 volts, 3 phase, 50 cycles, Ac Industrial type.
7. Water:- 20 gallons approximately per day.
8. Labour:- One operator and four unskilled labourers will be required.
9. Land:- About 5000 sq.ft. of open levelled land will be required and a shed of about 20 ft. x 20 ft. for each kiln chamber.

STORING OF WOODEN LAST BLOCKS

The floor of the shed may be made by levelling the ground and ramming lime single foundation to a depth of 3" over which brick flooring may be laid and cement painted. As a precautionary measure all along the sides of the shed and underneath the floor area water dispersibleGammaxane may be sprayed. If any timber is used in the construction of the shed, it should be from the heartwood of some durable species or otherwise should be used after suitable preservative treatment.

The last blocks should be stacked over foundations raised about 1 ft. above ground level. For this, concrete pillars of height 1 ft. and cross section 1' x 1' may be built suitably spaced along the length and breadth of the shed. 4" x 4" beams of the heartwood of some durable timber may be placed over the pillars longitudinally as well as cross-wise at suitable intervals so as to make a stable platform over which the last blocks may be stacked (see attached blue print). A blue print No. 1072 showing the layout of concrete prillars for stacking of timbers is enclosed. (See Enclosure IV)

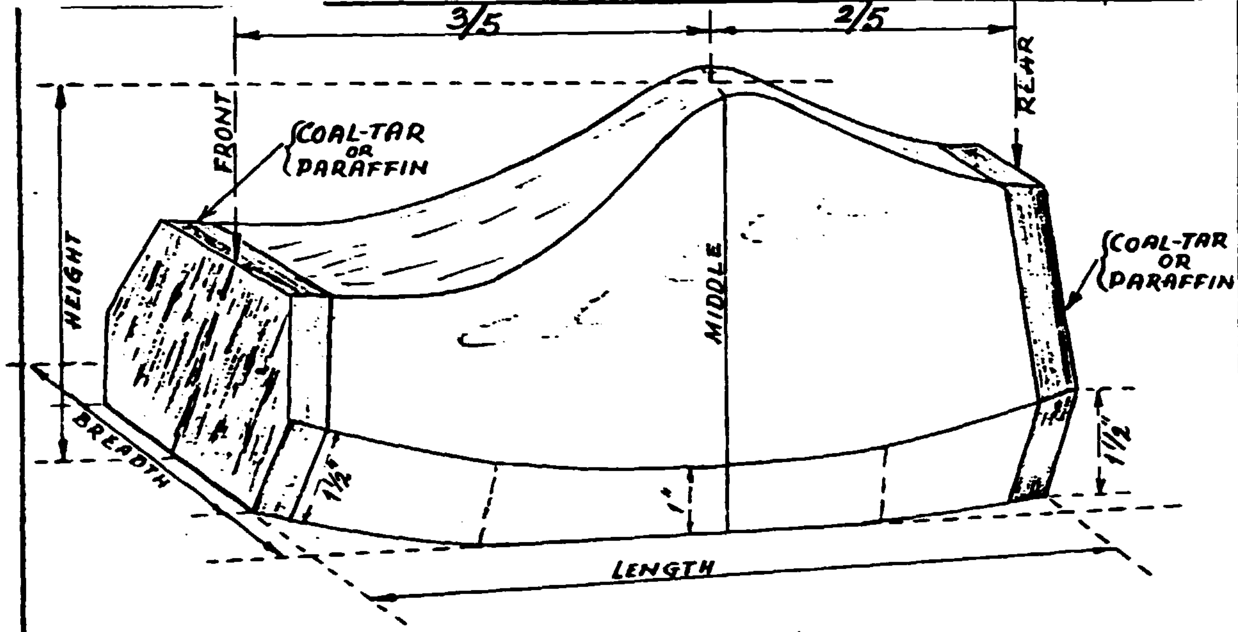
Adequate ventilation of the shed as well as prevention against rain water spraying into the shed is necessary to prevent humid air stagnating within. If the sides are walled, ventilators should be provided in adequate locations to enable ample circulation of air, but it must be ensured that rain water does not spray into the shed.

Artifically heated rooms are idealy suitable for storing seasoned blocks.

For additional protection when the period of storage is long, the blocks may be sprayed every 2-3 months with PCP/Dieldrin emulsion available from Burmah-Shell.

WOODEN BLOCK FOR SHOE LAST.

Sketch No 11



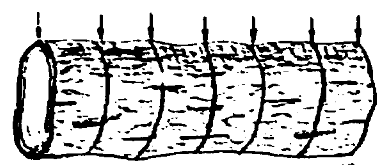
BLOCKS SIZES	m^3 CFT. PER PAIR	C.M. LENGTH	C.m. HEIGHT FRONT	MIDDLE	REAR	C.m. BREADTH FRONT	MIDDLE	REAR	USED FOR LAST SIZES	REQUREMENTS IN %
1	0.0102 0.345	34 13¼"	3¼"	13 5"	4"	3½"	11.5 4½"	3¾"	ENG. FRENCH 8, 9, 10, 11 (42-47)	
2	0.0086 0.295	30.5 12"	3"	13 5"	3¾"	3¼"	11.0 4¼"	3½"	5, 6, 7, ~~8~~ (38-41)	
3	0.0064 0.229	28 11"	2½"	11.5 4½"	3½"	3"	10 4"	3¼"	2, 3, 4, ~~5~~ (34-37)	
4	0.0048 0.169	25 9¾"	2¼	10 4"	3¼	2¾	9.5 3¾"	3	30 to 33 and below CHILDREN SIZES.	

[redacted]

Sketch no. 12

SPECIFICATION OF LOGS FOR MANIPULATING BLOCKS FOR LASTS.

BLOCK NR	SIZE ROLL	LENGTH OF BLOCK L		REQUIRED LOG Ø DIAMETER		CIRCUMFERENCE 2πR		LENGTH OF THE LOG FOR 1 m³ VOLUME		NR OF SECTION IN 1 m³ CONTENT WITH 0.5 c.m FOR BANDSAW CUTTING.	QUANTITY OBTAINED IN 8 DIVISIONS	WEIGHT PER PAIR SEASONED
				EXCLUDING SHAP-WOOD.								
		c.m	INCH (Approx)	c.m	INCH (Approx)	c.m	INCH (Approx)	METER	FEET		SPOKES.	KILOGRAMME
1	8½ - 12	34	13 6/16"	44	17 5/16"	138.2	54 7/16	6.60	259' 14/16"	19	152	
2	5½ - 8	30.5	12 3/16"	40	15 12/16"	125.7	48 8/16	7.90	311' 1/16"	25	200	
3	1 - 5	29	11 7/16"	37	14 9/16"	116.2	45 12/16	9.30	366' 3/16"	32	256	
4	8 - 13	25	9 14/16"	35	13 13/16"	110.0	43 5/16	10.40	409' 8/16"	41	328	

1

LOG

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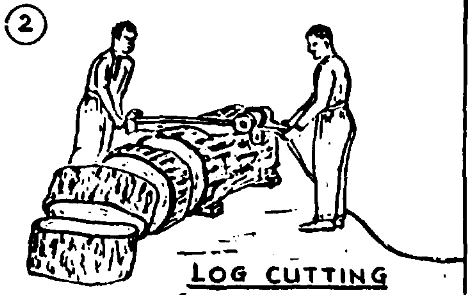
LOG CUTTING

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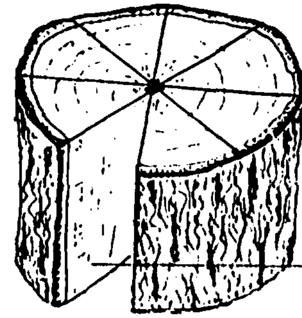

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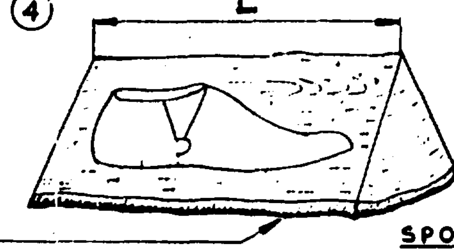

SPOKE

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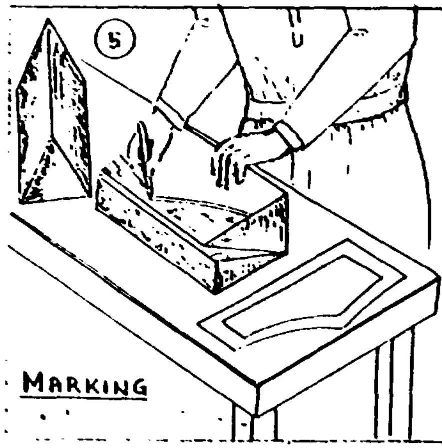
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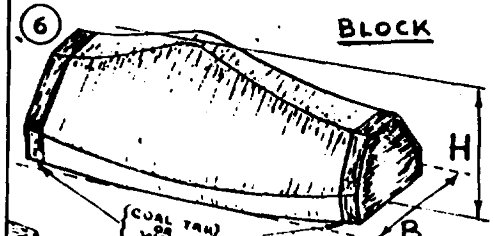

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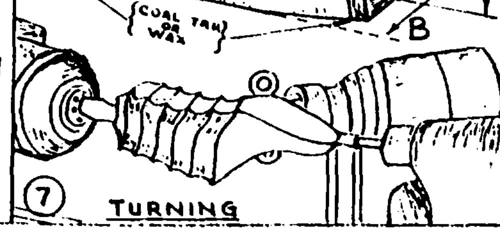
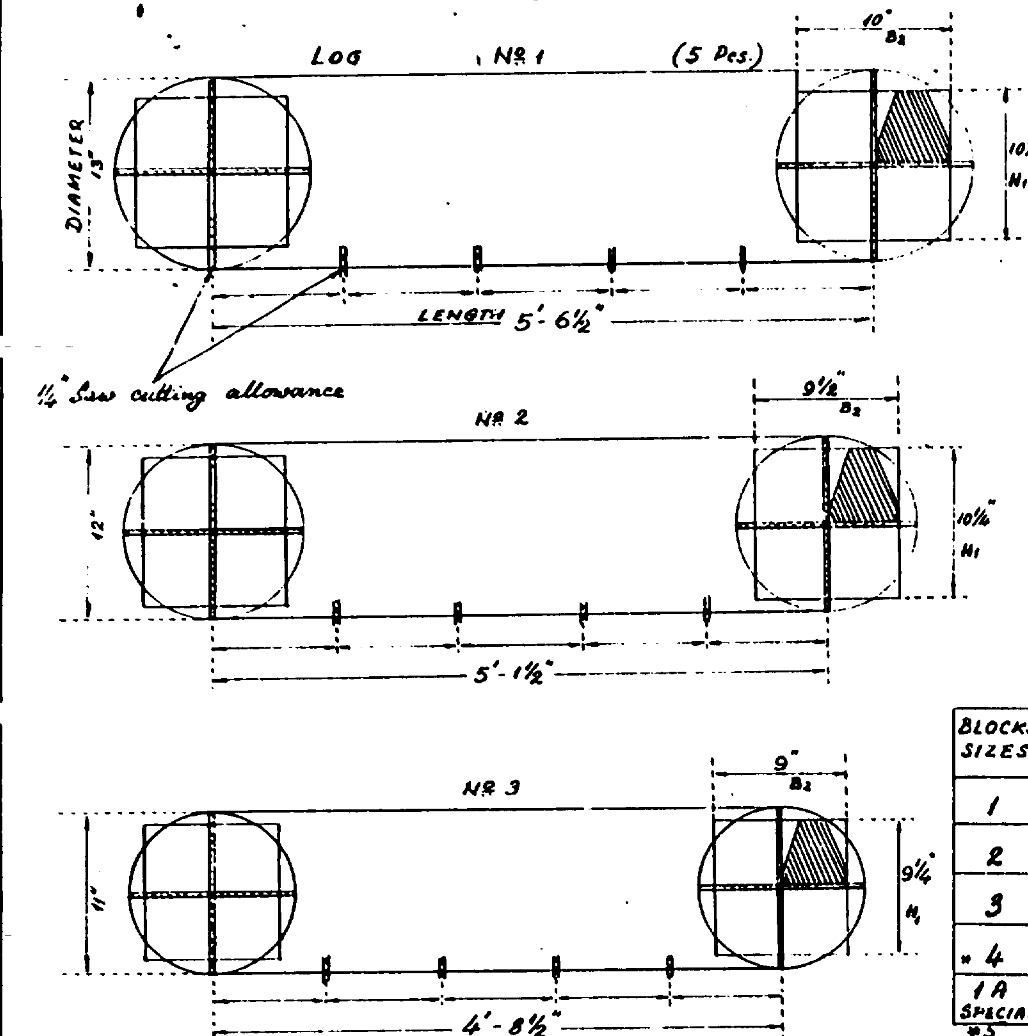
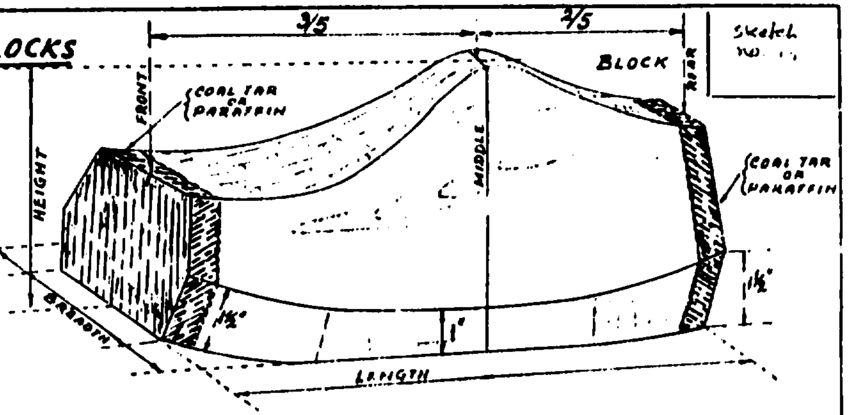

TURNING

L → LENGTH
B → BREADTH
H → HEIGHT

BLOCK NR	B		H	
	c.m	INCH.(Appr.)	c.m	INCH(Appr.)
1	12.5	4 12/16"	13	5 2/16
2	11	4 5/16"	13	5" 2/16
3	10	4 15/16	12.5	4" 12/16"
4	9.5	3 3/16"	10	4" 5/16

SPECIFICATION OF LOGS FOR MANIPULATING BLOCKS FOR SHOE LAST.





MEASUREMENTS OF BLOCKS.

BLOCKS SIZES	Cft. PER PAIR	LENGTH	HEIGHT FRONT	HEIGHT MIDDLE	HEIGHT REAR	BREADTH FRONT	BREADTH MIDDLE	BREADTH REAR	USED FOR LAST SIZES. ENG. / FRENCH	Required Log @
1	0.0102 m³ 0.345	34,0 cm 13¼"	3¼"	13 cm 5"	4"	3½"	11.5 cm 4½"	3¼"	8, 9, 10, 11 (42-47)	40
2	0.0085 m³ 0.295	30,5 cm 12"	3"	13 cm 5"	3¾"	3¼"	11.0 cm 4¼"	3½"	5, 6, 7, 8 (38-41)	36.5
3	0.0064 m³ 0.229	28,0 cm 11"	2½"	11.5 cm 4½"	3½"	3"	10.0 cm 4"	3¼"	2, 3, 4, 5 (34-37)	38
* 4	0.0048 m³ 0.169	25,0 cm 9¾"	2¼	10,0 cm 4"	3¼	2¾	9,5 cm 3¾"	3	30 to 33 and below. CHILDREN SIZES	32
1 A SPECIAL		14¼"		5½"			5¼		SIZE 12 AND UP (GENTS IN ALL FITTINGS)	
*5	0.0034 m³	21.5 cm		9.0 cm			9 cm			28
*6	0.0028 m³	18.5 cm		9.0 cm			8.5 cm			25

* SHOULD BE UTILISED FROM WASTAGE ONLY.

N.B Unstandard logs others than described can be utilised for beams in combined assorted blocks (Size roll as per prescription)

APPENDIX I - 1

SOLAR DRYING KILN

SKETCH No. 14

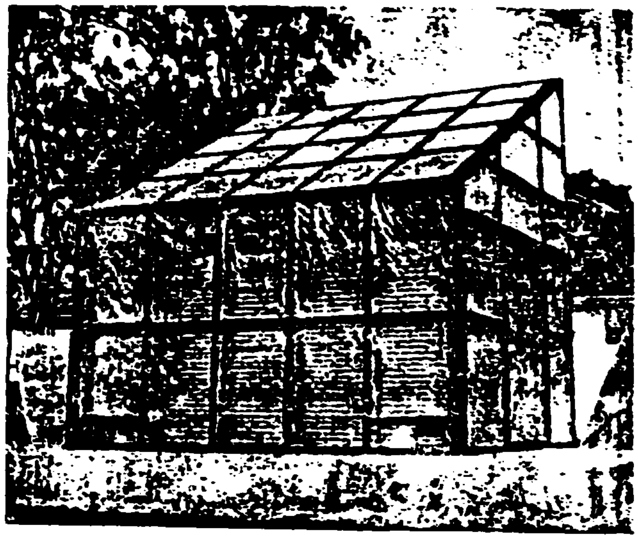
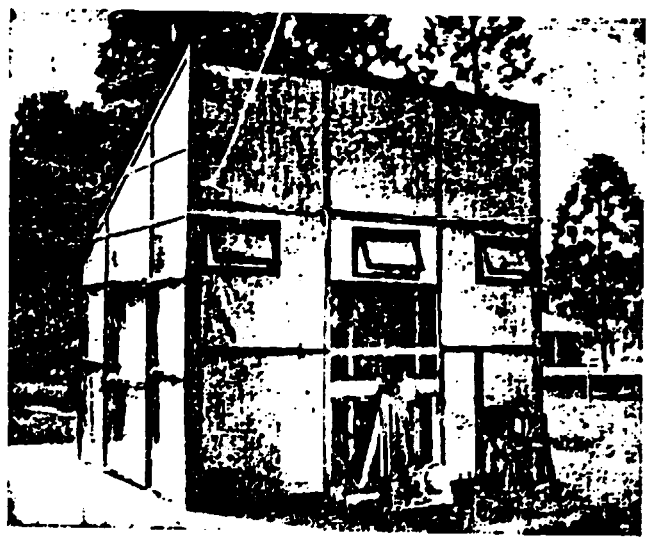


Plate I. Solar kiln, recirculating system with partial air venting. Sheet reflectors partially visible on the east and west sides.



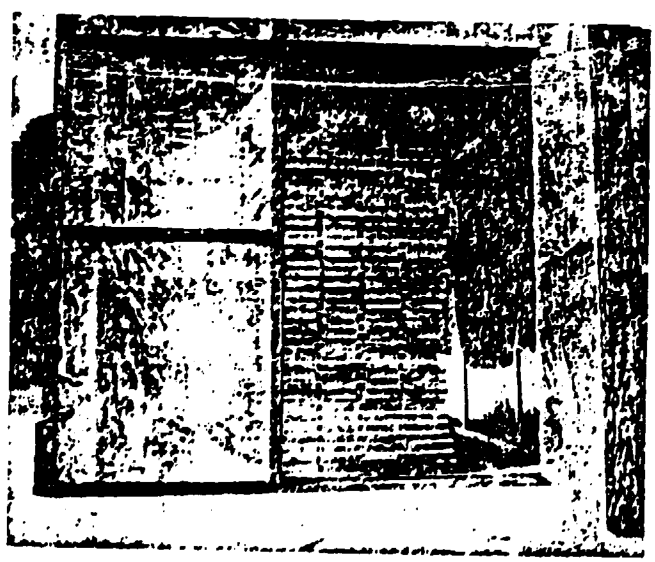
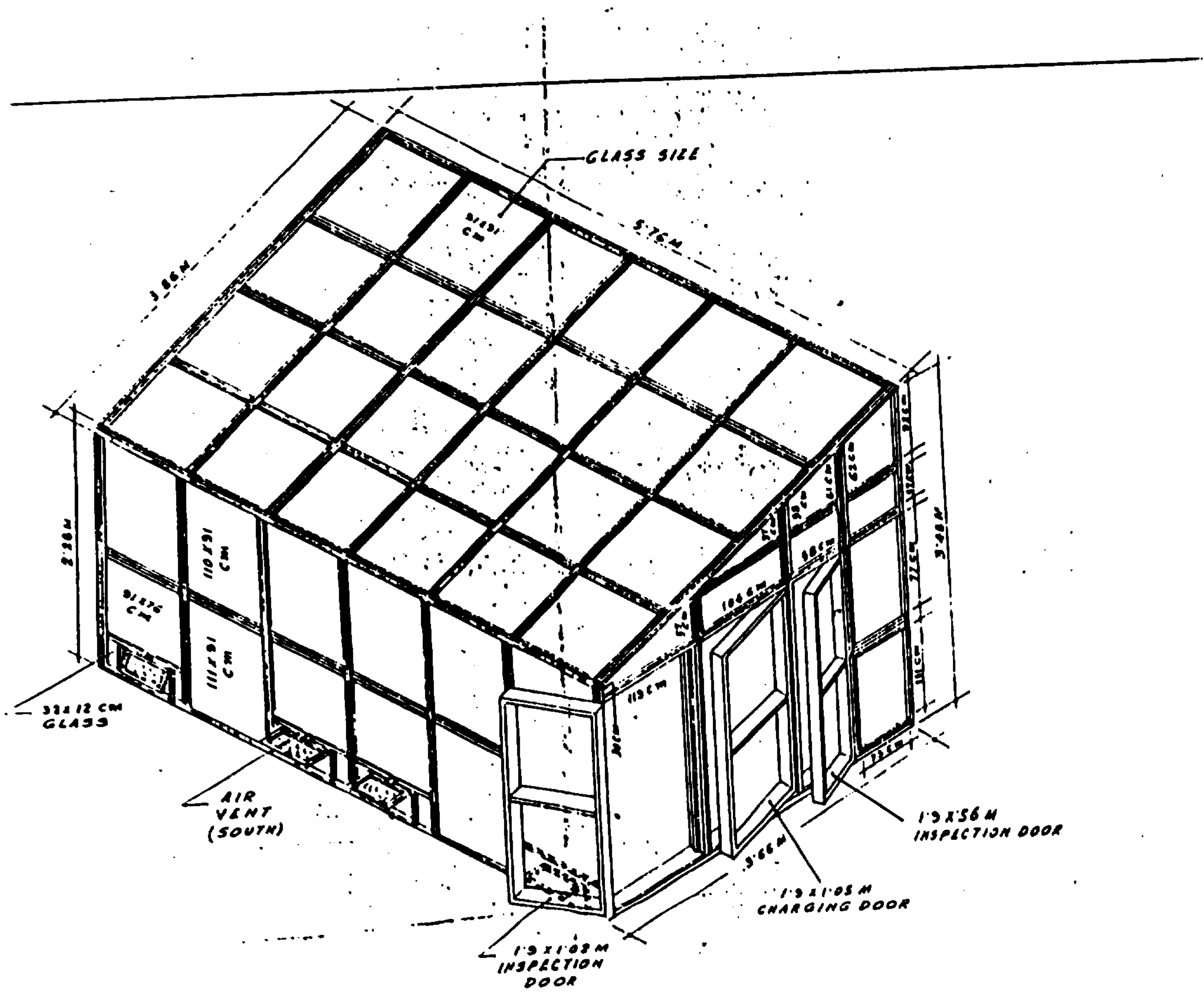


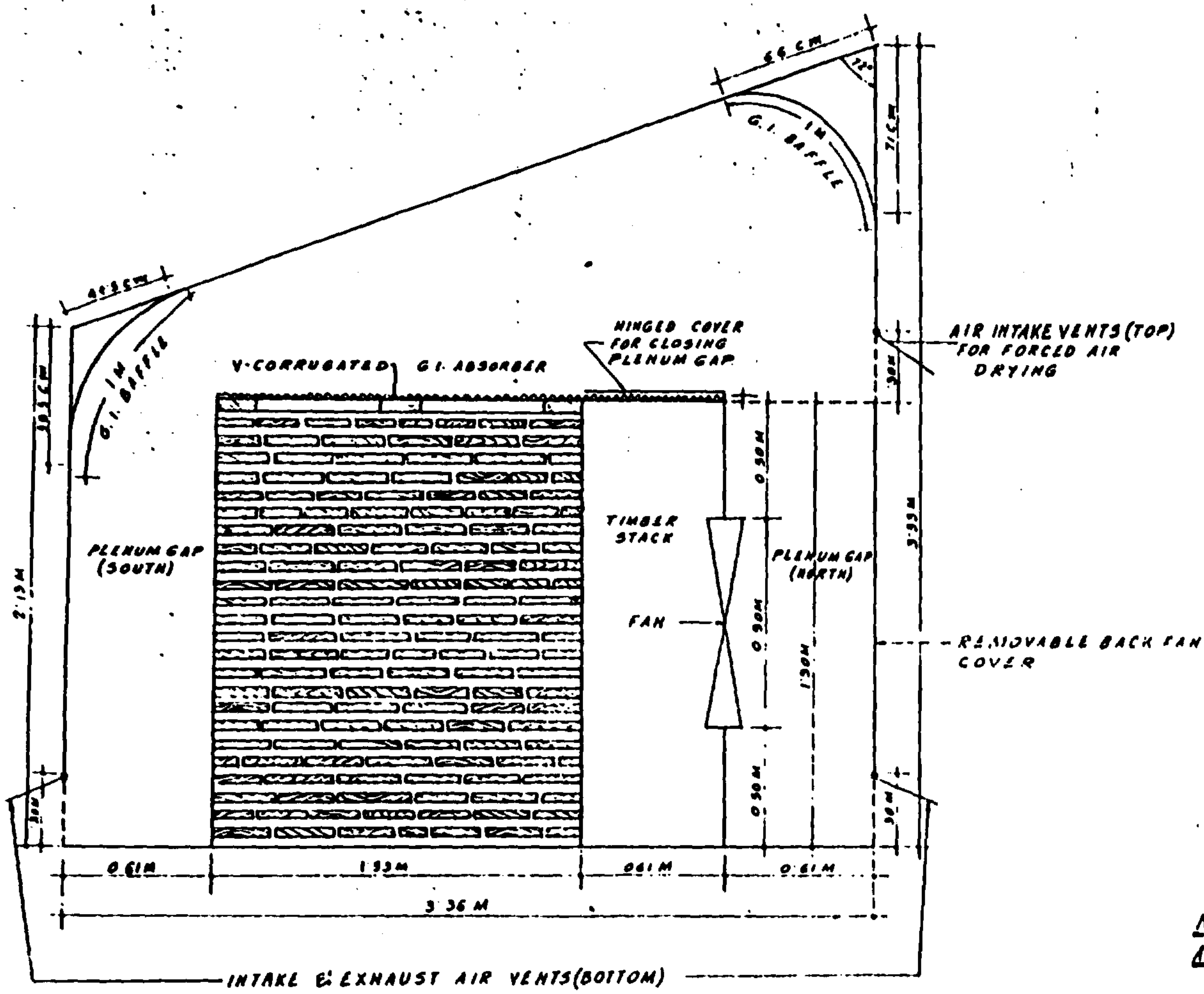
Plate II Solar kiln converted to forced drying arrangement with solar heat.

SKETCH 15



ISOMETRIC VIEW SHOWING CHARGING & INSPECTON DOOR, AIR VENTS & GLASS SIZES.

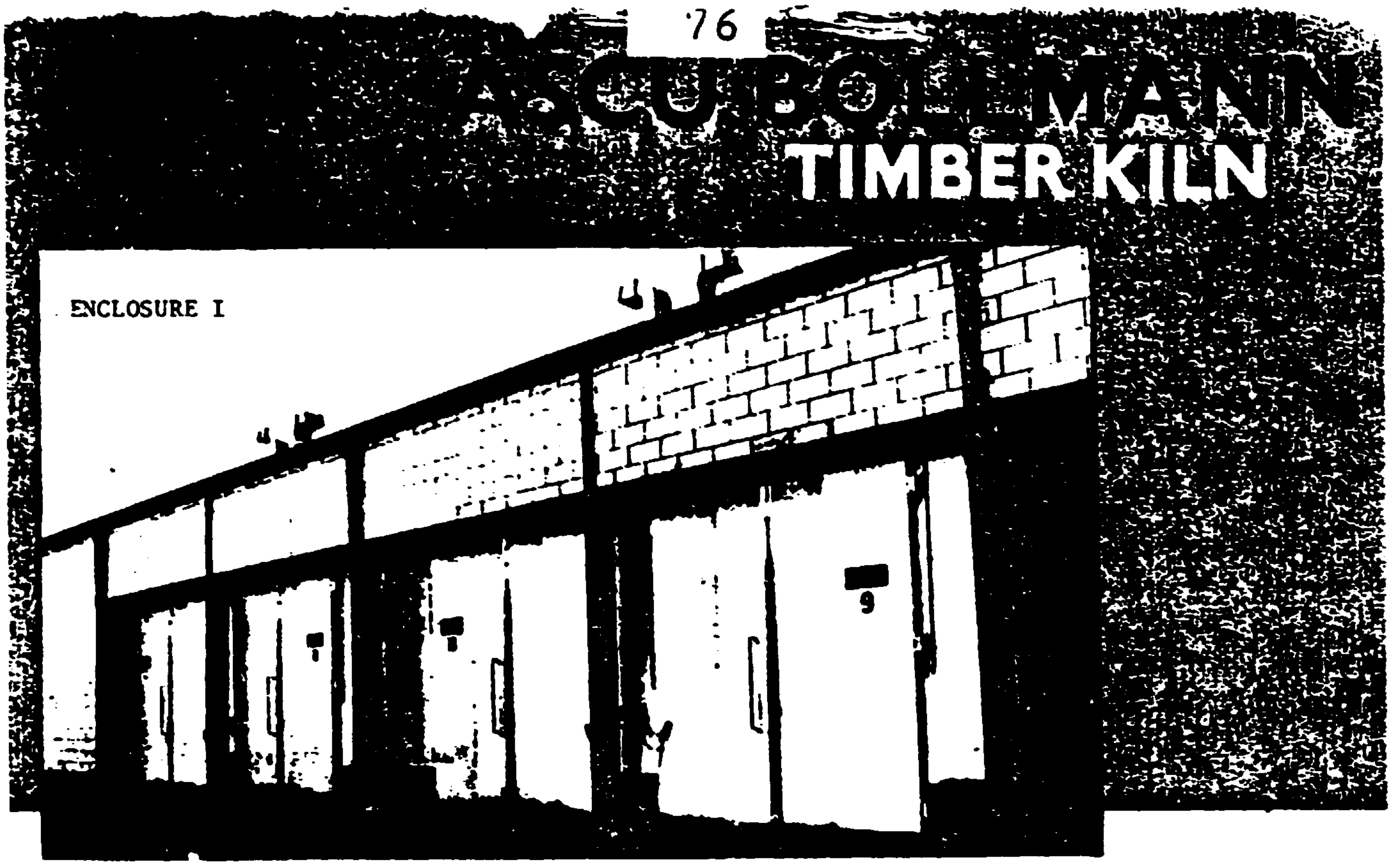
SKETCH 16

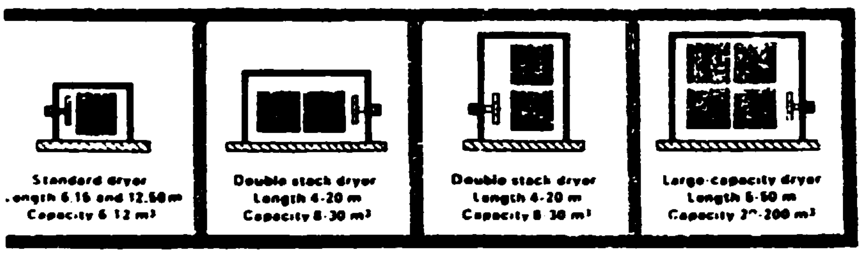


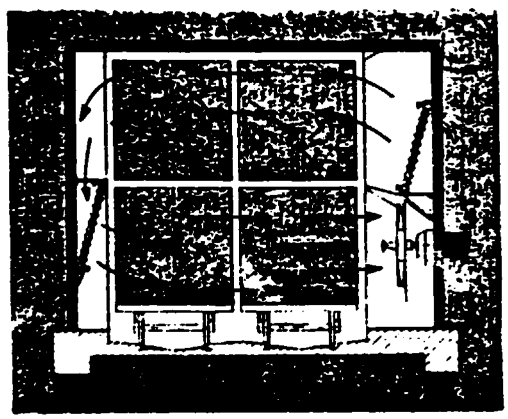
END CROSS SECTION (INTERNAL DIMENSIONS)

NOTE
ALL

ENCLOSURE I







Bollmann of West Germany, leaders in Kiln design in Europe jointly with Ascu Hickson Limited, in India, now give you the best kilns for drying your timber. These Side Mounted Kilns are operating in hundreds in many parts of the world.

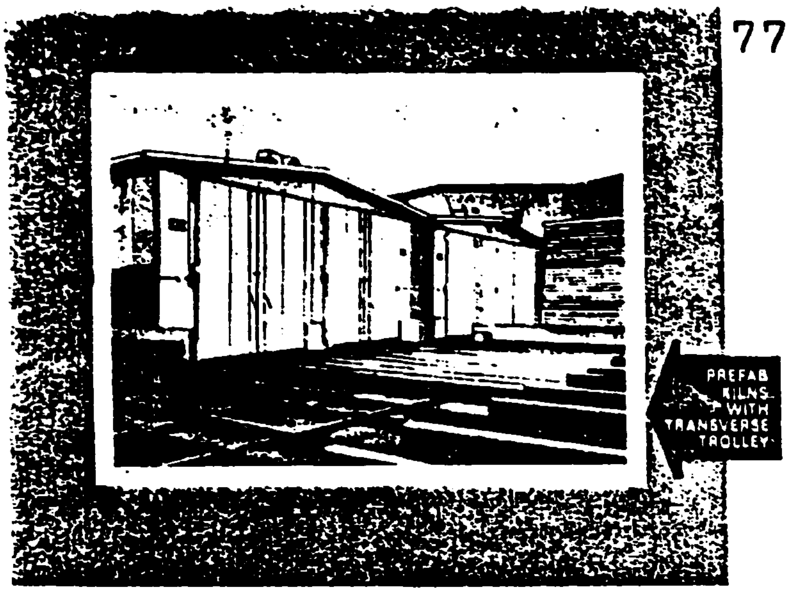
We have been licenced by Bollmanns to make their design of such kilns—both of masonry and prefabricated types. The Ascu-Bollmann kiln is distinguished for the very uniform air current flowing through the stack, because of the high performance of their aerodynamically designed fans. It is not therefore needed to reverse the fans. The fans used consume least amount of electricity, making the system very economical and thereby lower the drying cost considerably

The Ascu Bollmann Kilns DO NOT NEED BOILERS AND USE HOT WATER. They could also be operated with steam and thermo-oil.

Careful design of the heat exchange between the finned pipe and the stack make it possible to see that the heat is radiated through the stack uniformly. This reduces the number of coils owing to the special finned pipe and thereby less power is required for the fans.

Faster drying time is achieved because of better drying factors.

Bollmanns have also a fully automatic electronically computerised system to run the kilns without a kiln-operator, known as 'TROMATIC' system. It is the most advanced design, available in Europe—It is now available to you in India.



Prefabricated design of Ascu-Bollmann Kiln Chambers incorporate several 'BESTS'—in that chrome-nickel steel screws, aluminium components with special "tie-up methods" make it fully selfsupporting chambers.

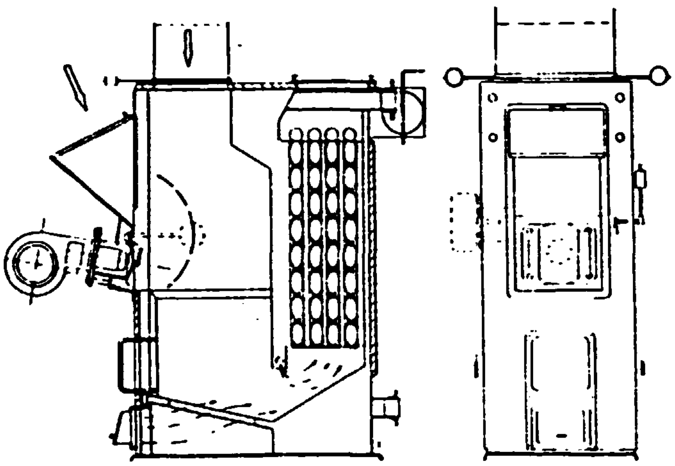
High degree of insulation conserve heat and keeps down the waste to the minimum possible.

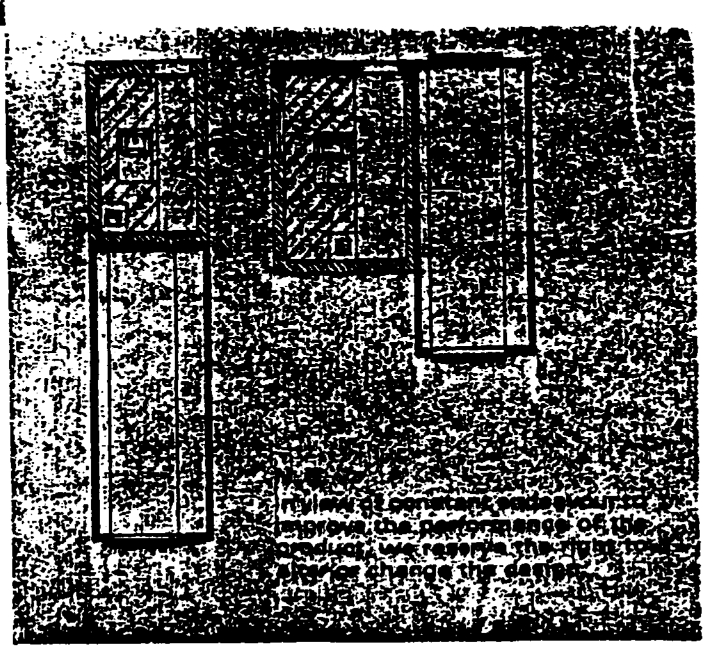
Installation is faster and simpler, and the time-taken for this purpose is much less

Corrosion is kept to the minimum because of the above design features.

These kiln chambers can be supplied with folding/sliding or collapsible doors. The chamber elements can be easily transported–with/without forklift or by manual handling.

SKETCH OF WATER HEATER





ASCU HICKSON LTD.
7A, ELGIN ROAD, CALCUTTA-700 020
PHONES : 440509, 440598 & 433253
GRAM WOODTREAT, TELEX 021-7938

OTHER ADVANTAGES OF THE HOT WATER GENERATOR ARE THE FOLLOWING:

Hot Water Generators work between 70 to 100°C. There are no dangers as in the case of Boiler operated kilns.

* It does not come under Boiler Act.
* No pre-treatment of water required.
* Same water is circulated — only with little quantity of fresh water and hence minimum quantity of water is required.
* Installation cost is about 20% less expensive than a boiler and fittings such as reducers, steam traps are 60% less expensive.
* Humidifying is done by atomizing water.
* Boilers bleed steam resulting in drop of pressure and abrupt change of temperature. With Hot Water Generator no such problems encountered

The advantages and cost savings of drying by the Westair System

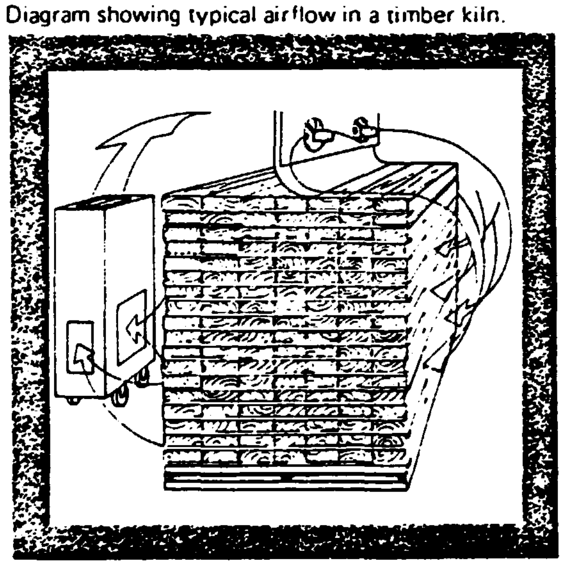
The Westair System of timber seasoning is based upon the well established principle of dehumidification using refrigeration techniques. It has been developed over a period of more than ten years and has been proved by the successful operation of nearly one thousand installations in over forty countries throughout the world.

The problems encountered in timber seasoning are complex and varied but, with the Westair System, hardwoods or softwoods, fresh sawn or air dried, of all thicknesses and of varied moisture content, can all be dried economically and efficiently with the minimum amount of degrade.

The Westair System is completely flexible, since it is based upon a comprehensive range of mobile, self-contained units which can be readily installed in new or old buildings alike, easily adapted for use as a drying chamber. The only services required are a three phase or single phase electrical supply and a drainage point for the water extracted from the timber. There is virtually no limit to size and proportions of the chamber since an efficient system can be built up using a number of individual units. For example, there are softwood drying systems in operation in Scandinavia that extract up to 2.5 tonnes of water in a 24 hour cycle.

The capital cost of an installation is very much less than the traditional steam plant and day-to-day energy consumption is also very much reduced, largely due to the heat pump principle utilised. Drying times for the two methods are similar but, due to the more temperate conditions created by the dehumidification process, far less problems of splitting and checking are encountered. Only a very simple drying schedule is necessary in the Westair System and unskilled labour can be used quite adequately.

Diagram showing typical airflow in a timber kiln.



Drying by dehumidification

There is a range of Westair Timber Seasoners of various capacities to suit any size and layout of drying chamber. All the models in the range operate on the same basic principle.

The air in the chamber, which in passing over the surface of the timber has absorbed some of its moisture, is drawn into the unit by a fan, passing through the evaporator section of a refrigeration circuit, constantly maintained at a temperature of around freezing point. The temperature of the air is thus reduced rapidly to its Dew Point – the temperature at which the water vapour it contains is condensed into a liquid – and the excess moisture is then collected in the

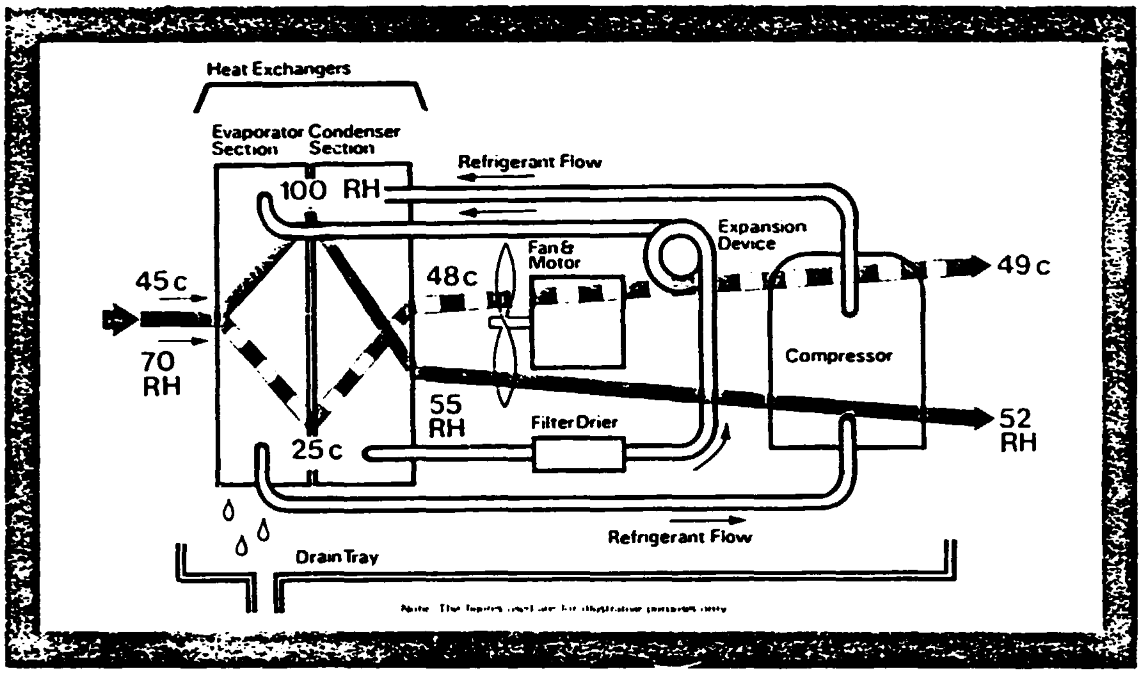


Diagram showing the main components of a timber seasoner and typical air flow conditions.

bottom of the unit and piped to the drain.

The air then passes over the condenser section of the refrigeration circuit, rapidly regaining heat, and then over the electrical components of the unit, with the dual effect of both cooling the components and gaining yet more heat itself.

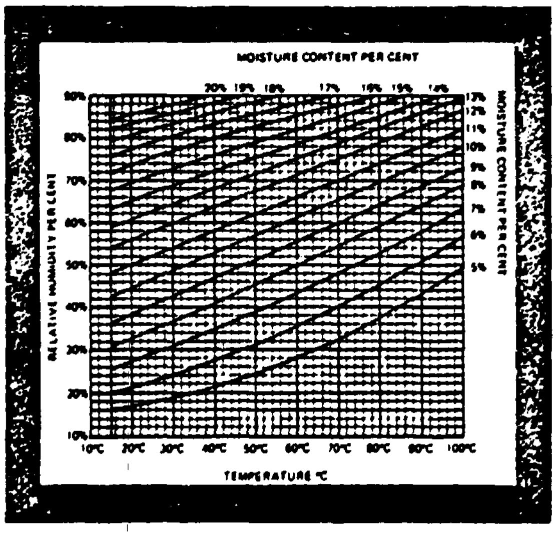
It finally passes through a heating coil before recirculating into the chamber, drier and at a temperature marginally higher than when it entered the unit. The cycle continues until timber is dried to the required degree.

Controlling the system

The Westair units include a humidistat and a thermostat which control the switching of the refrigeration and heater circuits to suit the particular timber being dried. Periodic adjustments to controls may be required as the timber is dried, depending upon the moisture content. In some cases it is not necessary to adjust the controls at all during the drying process. All necessary information required to control the drying of specific woods is supplied by Westair.

Conditions can be 'spot checked' by means of a whirling hygrometer or recorded on a thermohygrograph chart to ensure that the recommended conditions are being achieved. Throughout the process the moisture content of the timber should be checked, using strategically placed test pieces. (See graph opposite for moisture content levels). Once the desired level has been reached the controls should be adjusted to ensure an equilibrium condition for a short time before the timber is removed from the chamber. (See graph below for required equilibrium conditions).

Equilibrium chart showing the relationship between the moisture content of wood and the temperature and humidity of the surrounding air.



The drying chamber

The chamber itself can be constructed from ordinary building materials such as timber, brick or concrete, or indeed, an existing building can be converted quite easily. The important requirement is that it must be well insulated and as near air-tight as practical. The floor, usually concrete, and other internal surfaces should be waterproof to prevent absorption of moisture. This can be achieved easily by bitumastic paint, alternatively, for the walls and ceiling, insulation board with a plastic coating can be used.

In addition to the fans incorporated in the Westair units it is necessary to install fans for primary air circulation in the chamber. These are normally mounted above the timber stack (see drawing on Page 1) and, in order to ensure the most efficient air flow through the stack, it is important to partition off open spaces around and above it. This can be achieved by means of flexible polythene or canvas baffles.

Examples of typical chamber layouts are shown on the back page. However, the flexibility of the Westair System ensures that an efficient drying chamber can be provided to suit a client's individual requirements and facilities.

Planning and costing

The drying capacity of the installation is determined entirely by the layout and construction of the chamber and by the client's requirements in respect of the following factors.

1. Wood types to be dried.
2. Starting and finishing moisture content.
3. Quantity of timber to be dried per week/per month etc.
4. Dimensions of timber and standard stacks if applicable.

Based upon the above information Westair Systems will advise on every aspect of the chamber layout and construction and recommend the most suitable model or models from their range of Timber Seasoners. Layout drawings and specifications can be supplied, together with installation costings and an estimate of running costs.

Obviously it is difficult to estimate costs without specific details since they depend on a great many factors. However, for complete installations, it is normal for significant savings in capital investment to be made compared with conventional systems.

Running costs also depend on many variable factors, especially the initial and final required moisture content of the timber but a reasonable average power consumption figure would be approximately 180 kWh per cubic metre.

Maintenance

An extended life span can confidently be anticipated for Westair Timber Seasoners — in fact, the longest running installation (in Norway) has been in operation for a period well in excess of ten years without any service work beyond routine maintenance.

Westair Systems offer an economic Service Agreement on all installations (see separate leaflet for details).

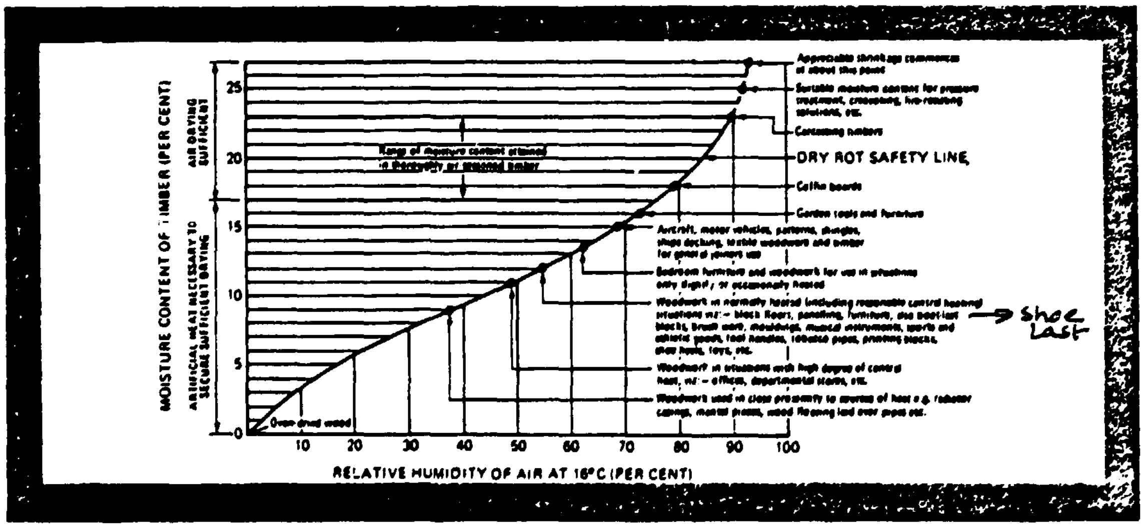
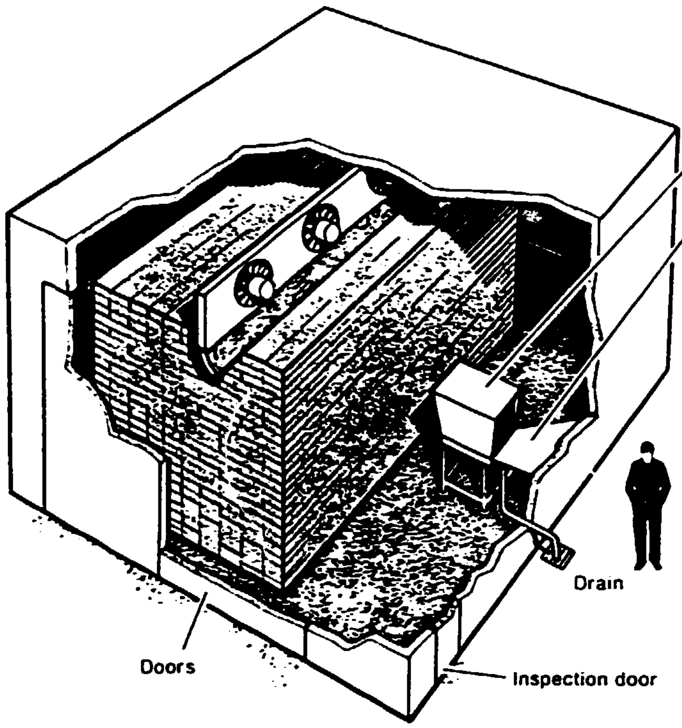


Chart showing the moisture content of timber for various purposes.

A small kiln of simple construction using a single Westair HTS2 Timber Seasoner



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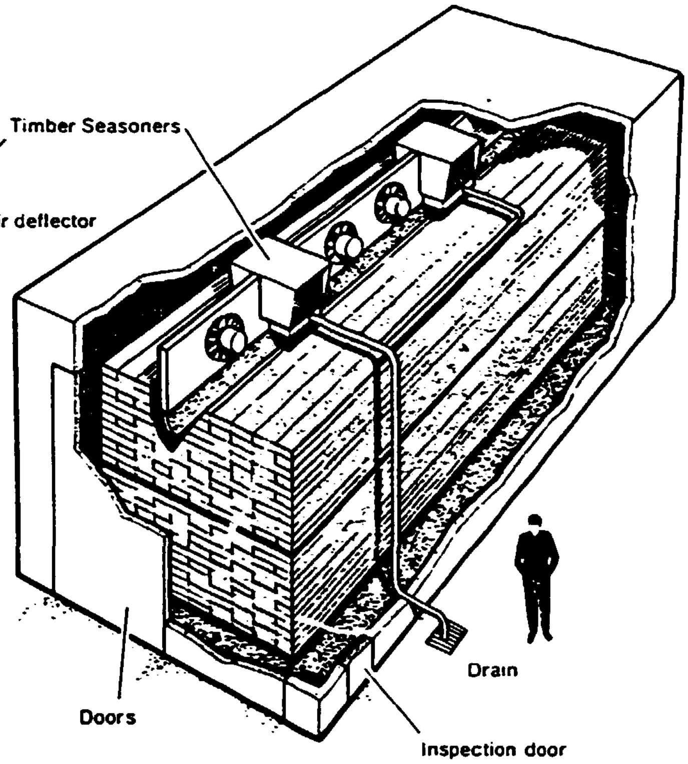
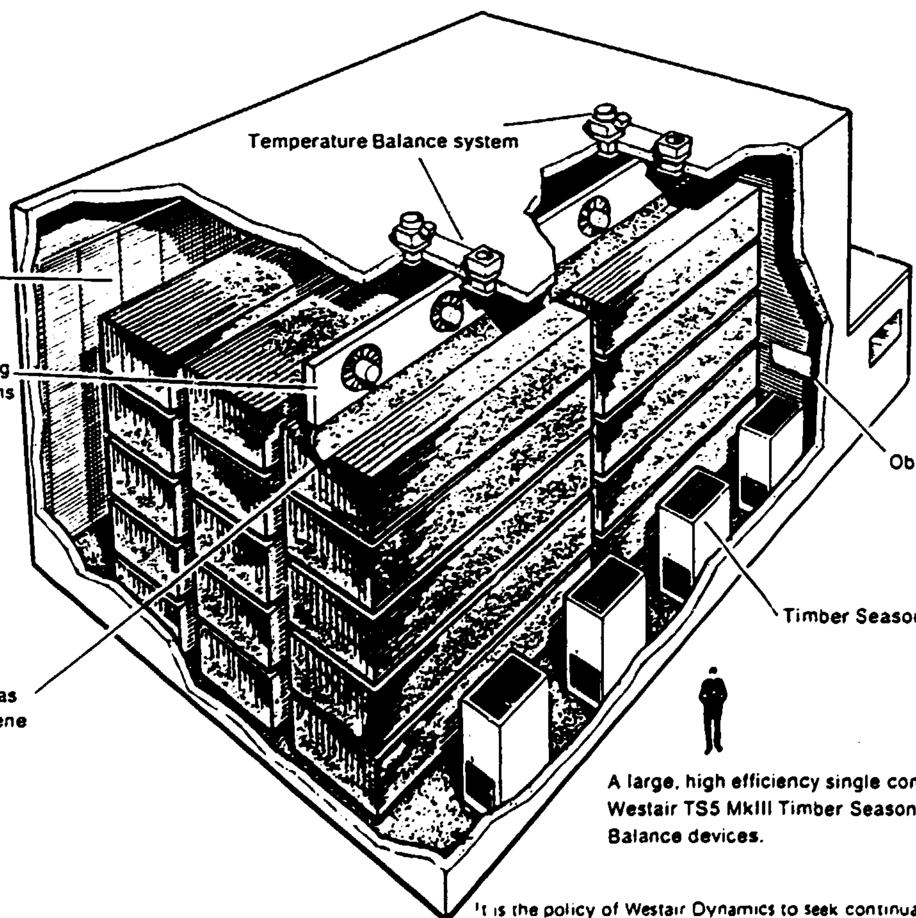
A small kiln of simple construction using two Westair HTS2 Timber Seasoners mounted above the stack.





A large, high efficiency single compartment kiln using four Westair TS5 MkIII Timber Seasoners and Temperature Balance devices.

It is the policy of Westair Dynamics to seek continually for ways to improve its products and the right is reserved to alter specifications at any time without prior notice.
This leaflet is issued for guidance only. Any order will be subject to Westair Dynamics' conditions of sale applicable to same.

Westair Systems A Division of Westair Dynamics Limited

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RMP 4/77/2K

Printed in England

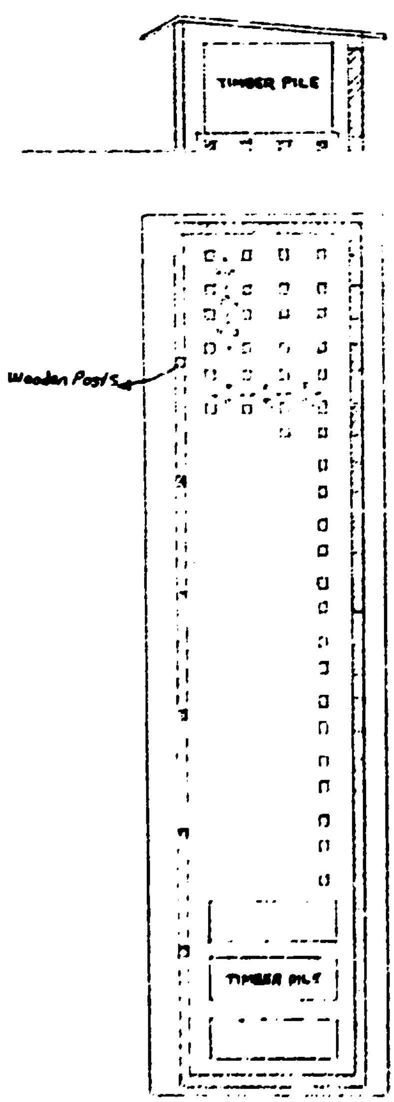
ENCLOSURE III

AIR SEASONING SHED TYPE 3
SUITABLE FOR MEDIUM REFRACTORY WOODS UNDER DAMP CLIMATE

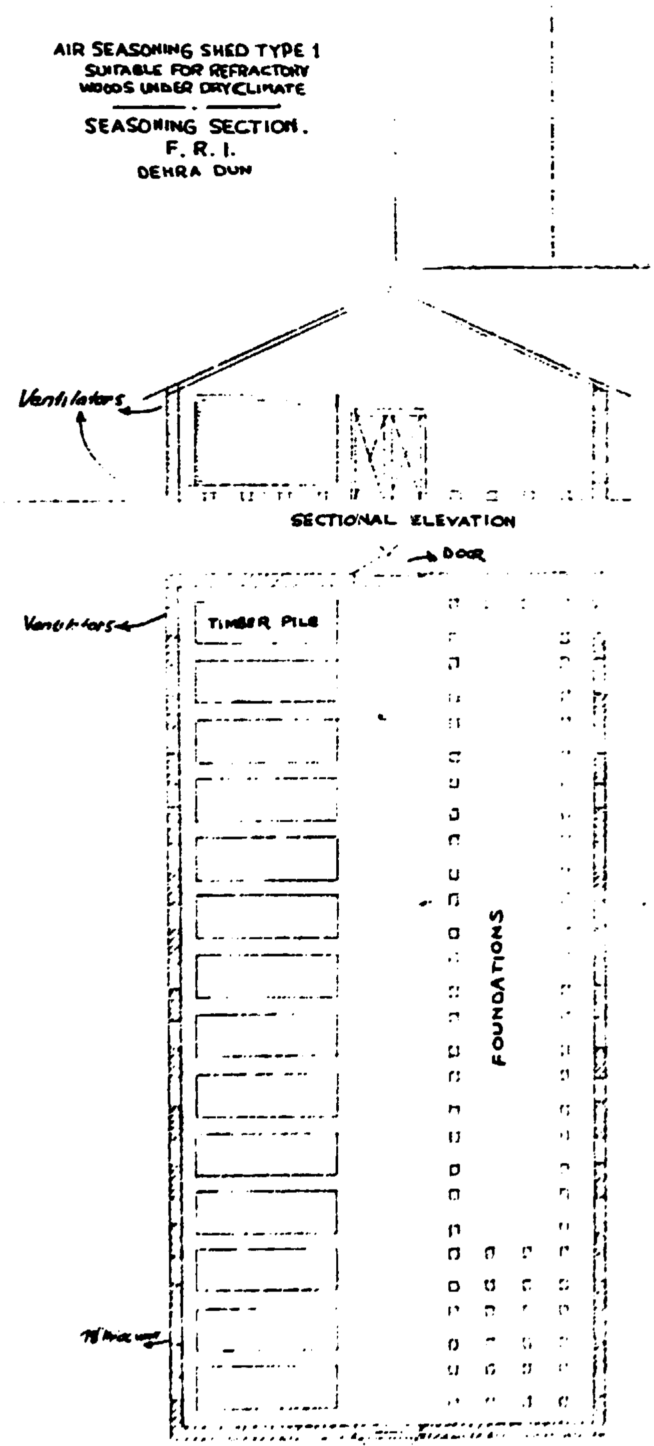
SEASONING SECTION.
F. R. I.
DEHRA DUN

AIR SEASONING SHED TYPE 1
SUITABLE FOR REFRACTORY WOODS UNDER DRY CLIMATE

SEASONING SECTION.
F. R. I.
DEHRA DUN



SECTIONAL PLAN



SECTIONAL PLAN

83

NATIONAL LEATHER AND SHOE CORPORATION
MANPO LAST MAKING PILOT PLANT
ADDIS ABABA, ETHIOPIA

MANUAL FOR SHOE LAST DESIGNING

Prepared by Uday Shankar Paul
Manufacturing Expert for Shoe Lasts
DP/ETH/83/013

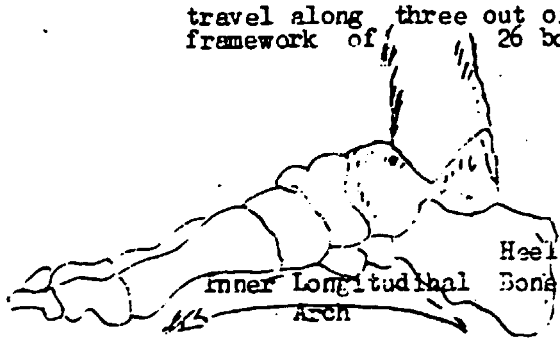
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
VIENNA
11TH MARCH 1985

1. THE FOOT WE SERVE

1.1 HOW A FOOT SERVES A HUMAN BODY

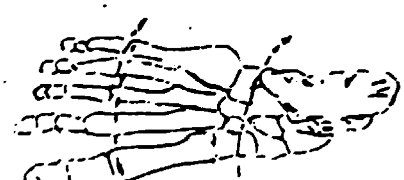
1. The human foot has <u>three</u> main functions:-
   - (a) Bears the weight of the body
   - (b) Propels the body - forward, backward, or sideways
   - (c) Absorbs the initial impact = shock= when the weight of the body is vertically applied on it .

2. <u>Distribution of the weight and shock absorbption</u>
   - (a) When standing still -body weight is spread over the sole of the foot over an area hinged on three points -called Tipodal bearing points .
   - (b) When a foot moves and is placed on the ground , the heel part touches first and taken on the body weight. To bring a balance and cause the body to stand ,the weight is distributed from the Heel foward . The forces travel along three out of four natural arches of the foot formed by a framework of 26 bones :-



gives Elasticity to absorb shock from vertical travel of the force of the weight.

Body weight from the Heel forward travels in greater amount along the low arch upto the joint of the small toe near which the ball of the foot pivots the line of force along the Exterior Transverse Arch upto the ball of the foot below the big toe to complete the Tripodal Points .



The Interiror Transverse Arch gives strength to Ankle joint and the upper part of the arch holds major blood vessels and nerves to protect them from pressure on rough ground.

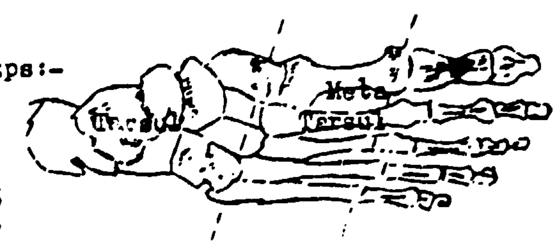
Thus the 4 arches provide: For weight bearing-strength ; For propulsion-flexibility ; For shock absorbtion - elasticity .

26 bones of the foot are in three groups:-

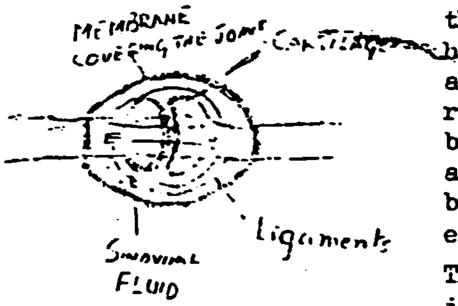
(a) Tarsul Group-7 including the heel Bone

(b) Meta-tarsul -5

(c) Toe Group -14 (Big two 2,others-3 each.

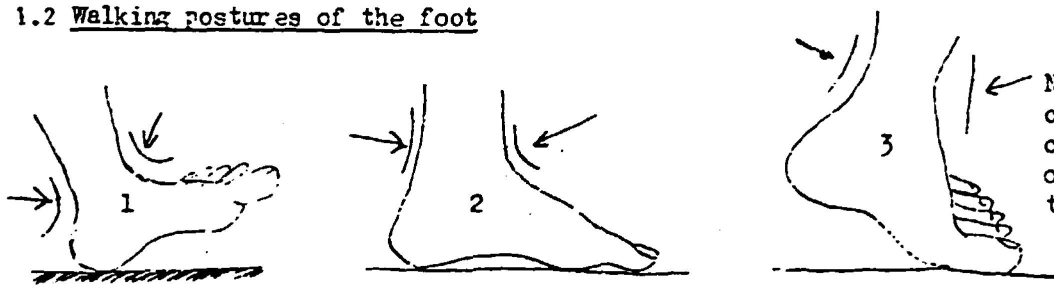


The 26 bones of the foot are attached to each other to maintain the permanant shape of the foot , and to distribute body weight ,i.e. imposed force evenly and proportionately to bear among them . Between two pieces bones is a joint formed by non-stretchable strings of tissues -called Ligements - across the ends . Covering the joint is film of tissue forming a leakproof bag . This bag covering the joint is filled with a fluid to give the lubrication effect , to reduce heat and friction where the ends of the bones meet at the joint . The ends of the bones at the joint also are covered with a soft lair of bone tissue called Cartilage to give the cushion effect to reduce friction and shock .



The joints of the 26 bones together with the joint with the lower ends of the two leg bones permit not less than 137 different articulations for the different movements of the foot in action. This is a point to remember in shoe making -- the position of the joints , specially the ankle joint , the joints of the big toe and the small toe , and the lines of the forces play in the strains and stresses which the foot undergoes . The bones are moved by muscles working in pairs to "pull" towards different(opposite) directions . The centre of the muscle is a lump to store power and two ends taper to become non-stretchable which are fixed on the two bones across their common joint . A muscle acts on the electro-chemical command from the brain which controls the physical behaviour of the man , inlcluding his foot.

1.2 <u>Walking postures of the foot</u>



Note the curves changed opposite to fig. 1

Forward move. Heel touches first and starts taking over the body weight from the other foot at halt. Note the sharper curve at the front of the ankle

The balls of the foot have touched the ground. Body weight presses the two logtitudinal arches down. The peremeter of the foot touching the ground becomes larger than when it is free. Note the change of the curves at the ankle.

The foot lifts its heel part on <u>two hinges</u>-the joints of the big toe and the small toe (points of maximum flexing of the vamp) the toes bites into the ground to allow the foot and the leg to propel the body forward. There is a to-and-fro movement of the toes .

1.3 <u>Why man wears shoes ?</u>

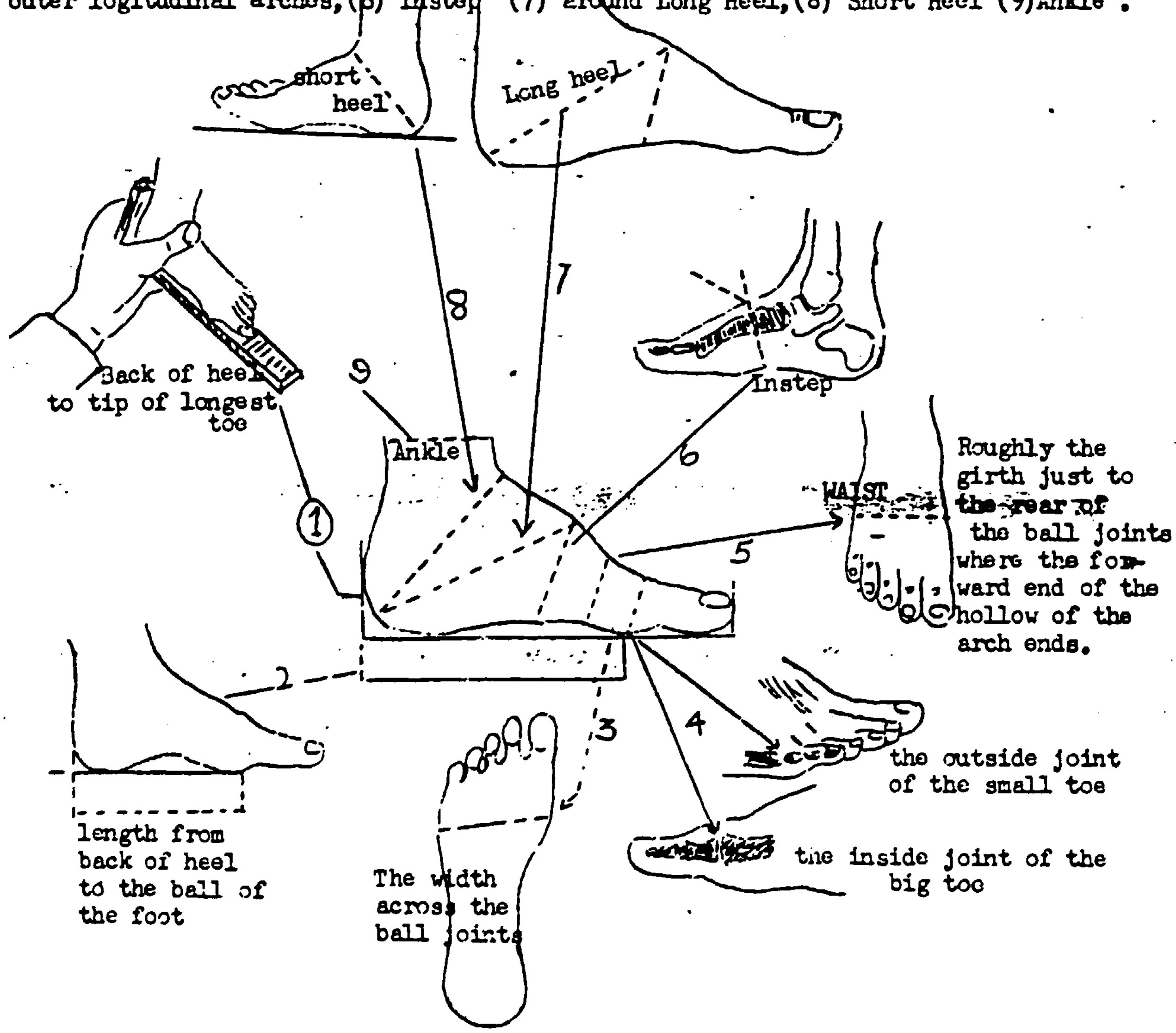
1. Protection of the foot - -agaist climate / -against hurts - primarily the sole of the foot / - secondarily, according to the need, the top part of the foot.
2. Help the foot in special functions,e.g. climbing,hockey etc
3. Compensate for deformed foot for comfortable movemennt besing so designed
4. As a part of a dress, conform to the style,clolour and social needs.

2. MEASUREMENT OF THE FOOT

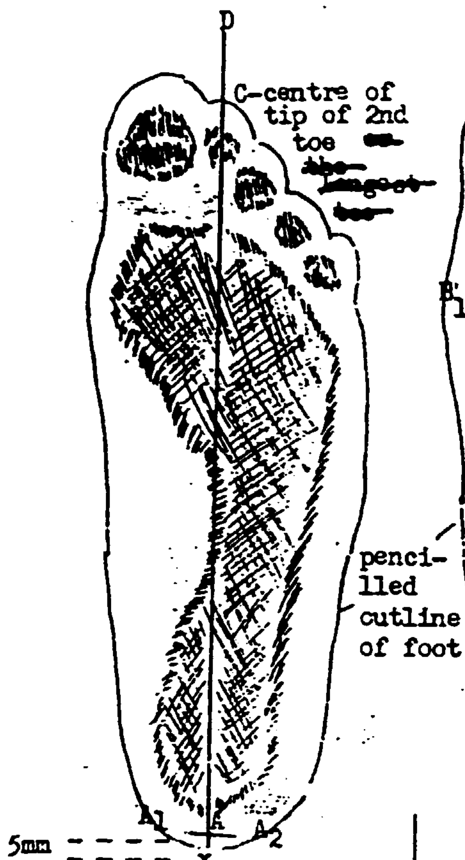
The length of a human foot is not the length of the shoe that it wears but with certain allowances. Similarly, a foot with 26 bones having 137 different articulations, the muscles in pair causing those articulations towards different directions, must have free movements of its normal functions while seathed in a shoe. A shoe is shaped on a last which is a near representative only, catering for the allowances for shape, comfort, freedom of movement etc. The length of the insole of the last determines the length of a shoe indicated by a size number. Therefore, to make a last first the insole of the last must be drawn accurately which also will correspond with the size and shape of the insole of the shoe

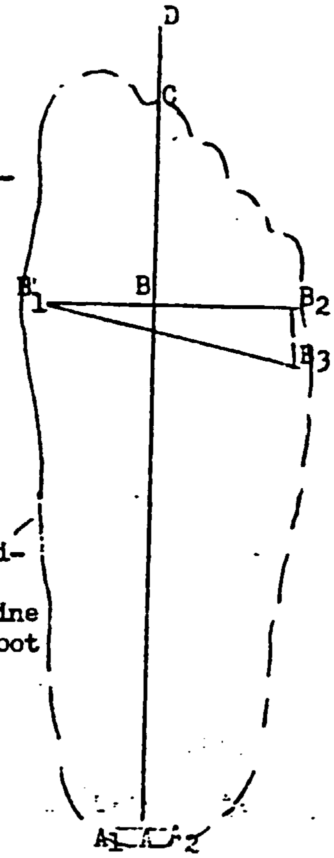
2.1. The basic measurements of a foot

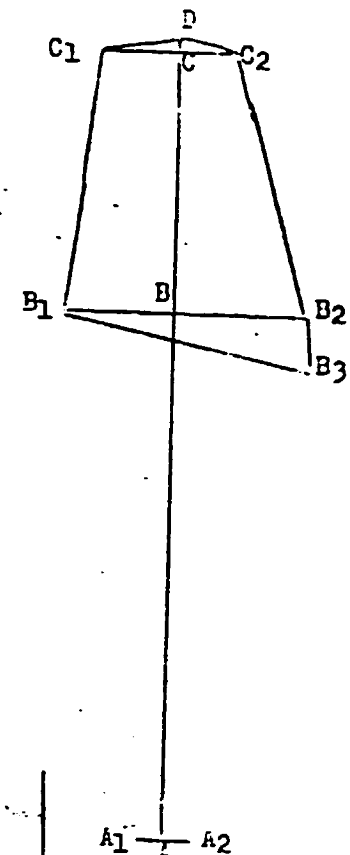
These are nine in number : (1) The length of the foot (2) The length from Heel to Ball, (3) The Width of the Foot at the broadest points, across the Balls of the foot. These three are flat measurements, straight lines from point to point. The girth measures are : (4) Around the Big Toe and Small Toe joints (5) around the Waist - just beyond the Balls of the foot where it meets the forward end of inner and outer logitudinal arches, (6) Instep (7) around Long Heel, (8) Short Heel (9) Ankle.



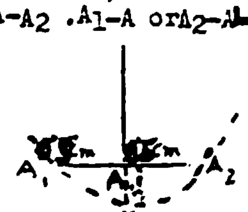
3. BASIC DRAWING OF THE INSOLE OF THE LAST



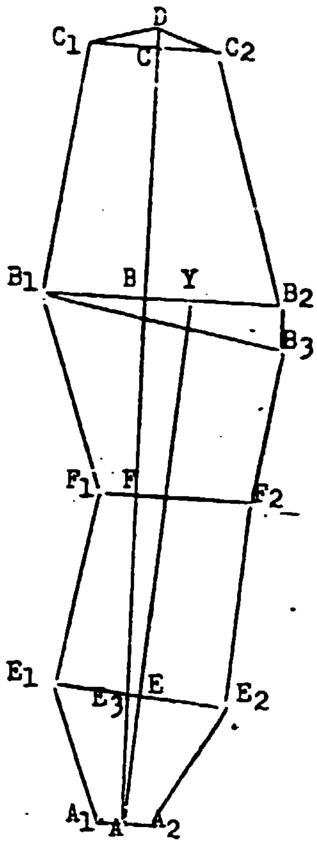




1. From X, centre of curve of outline at heel to C centre of tip of 2nd toe draw a line. From X 5mm on XC is pt. A. AC is Foot Length.
2. Extend AC to D, CD being Toe Allowance 10 to 15 mm for comfort, free play of fingers and style. AD is shoe (insole) length
3. With centre A at right angle to AD, draw line A_1-A-A_2. A_1-A or A_2-A = 1cm.



4. Locate Pt B on AD. Length A-B is $\frac{2}{3}$rd of A-D.
5. From measured Girth of the Ball of the foot, calculate one-third of the length. Add 10mm. This will be B_1-B-B_2 length. Through B at right angle to AD draw B_1-B-B_2 with
   $B\text{-}B_2 = \frac{1}{2} B_1B_2 + 5$ mm
   $B\text{-}B_1 = \frac{1}{2} B_1B_2$ minus 5mm
6. At B_2, draw B_3 perpendicular of length :
   2 cm for men
   1.5mm for ladies
   1.2cm for 2&3 articles
   10mm for 1 article
   Join B_1- B_3.
7. Through C draw at right angle to AD, line C_1- C- C_2 of length
   4 to 4.5cm for narrow toe
   5 to 6 c.m. for broader toe
   and off-set the line from centre as follows:-
   C_2-C = $\frac{2}{5}$th the length
   C_1-C = $\frac{3}{5}$th the length
8. Join :
   D - C_1- B_1
   D - C_2- B_2
   BD is $\frac{1}{3}$rd the shoe length AD and B1-C_1-D-C_2-B_2-B_3 constitutes the framework for the toe part of the insole and shoe.

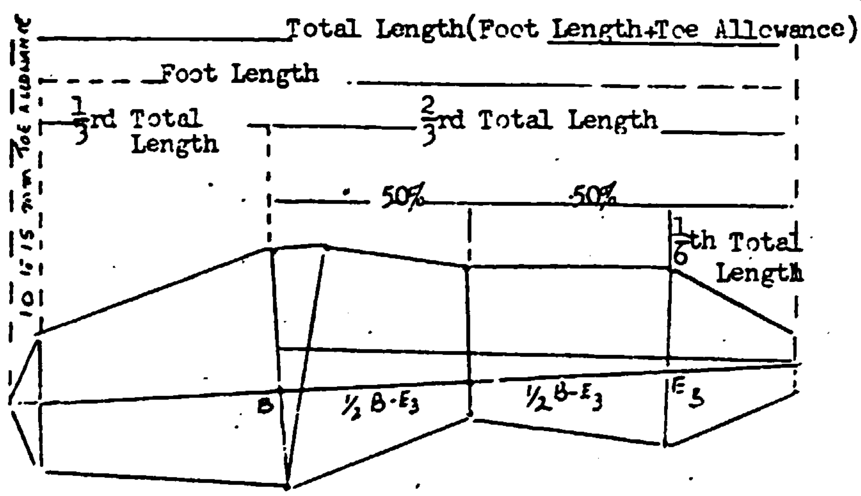


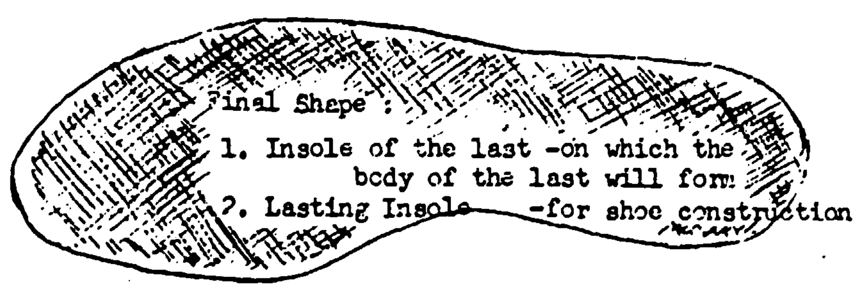
9. From B on line $B-B_2$, 10 to 15mm from B mark Y . Join AY. The Axis Line .

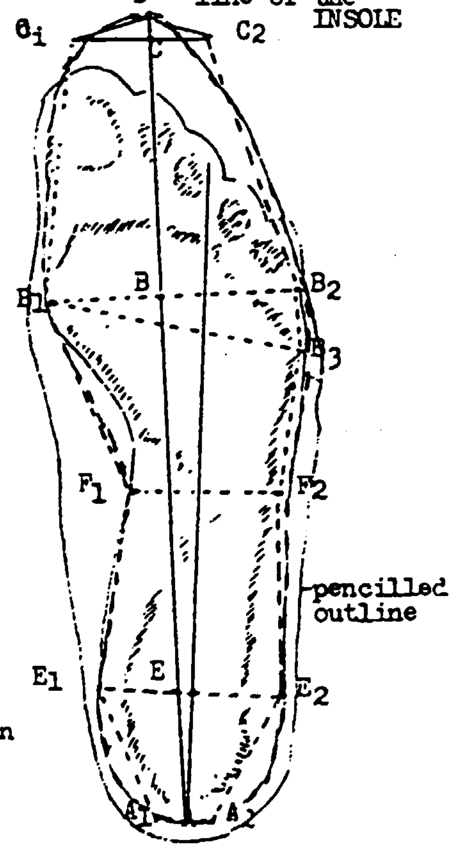
10. On Axis Line AY, mark point E, length A-E being = $\frac{1}{6}$th of Total Lenth AD. With centre at E, at right angle to Axis Line AY, draw line E_1-E-E_2 as follows :-
   (a) Calculate from premeasured Girth of the Heel- $\frac{1}{5}$ th of the length.
   (b) Line E_1-E-E_2 =
   $\frac{1}{5}$ of the length <u>minus 5 mm</u> -for mens'&children
   ,, <u>minus 6 mm</u> -ladies, with heel height 1 to 3 cm.
   ,, <u>minus 6.5mm</u> -ladies with heel height over 3 cm.
   (c) Devide line E_1-E-E_2 to make $E_1-E = E-E_2$

11. Bisect $B-E_3$ to mark point F. At right angle draw line F_1-F-F_2 ,as follows :
   (a) F_1-F = 5 to 15mm according to heel height.
   (b) $F-F_2$ = to edge of foot impression ,or ,upto a point 5mm before the line touches the pencilled outline.
   Height of the heel dictates the length F_1-F-F_2 and particularly that of F_2

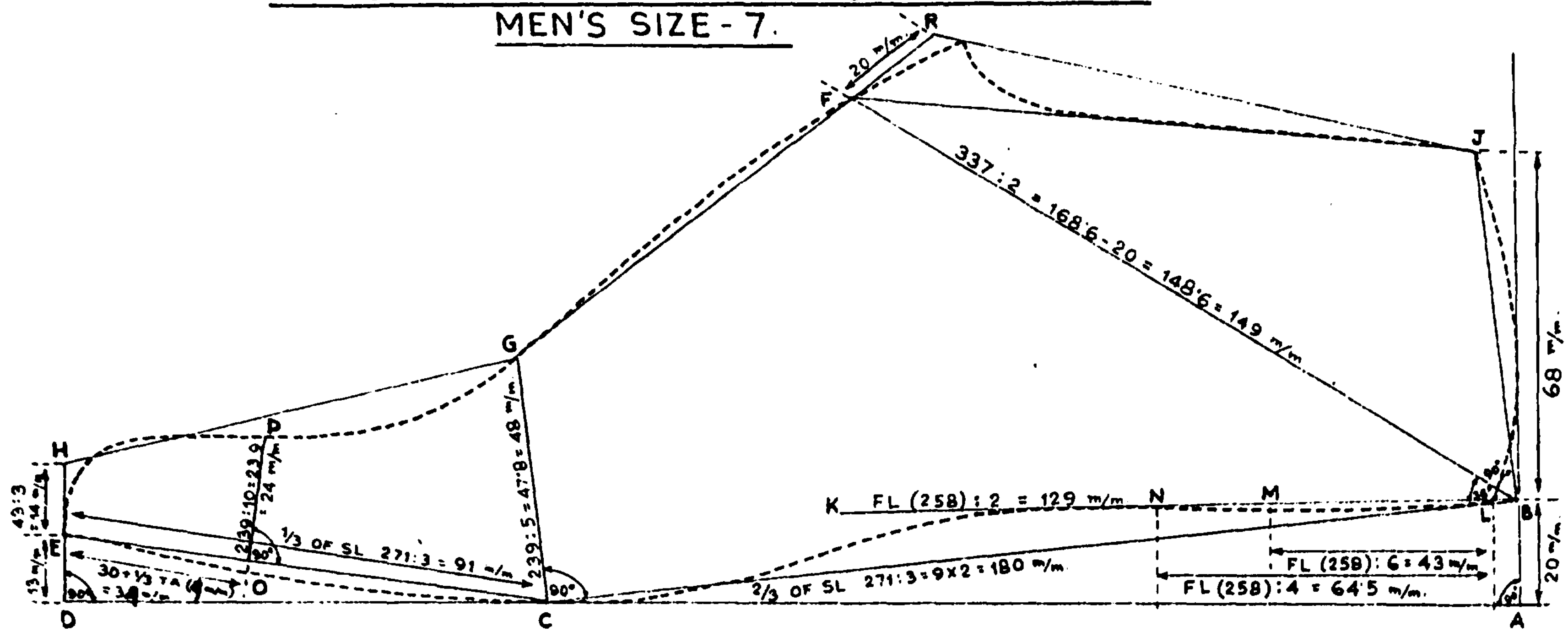
12. ~~Join~~ $A_1-E_1-F_1-B_1$ and $A_2-E_2-F_2-B_3$. Now shape the edge line of the INSOLE







STANDARD LAST PROFILE CONSTRUCTION:
MEN'S SIZE - 7.



HEIGHT OF HEEL	HEEL ANGLE LCBF	WAIST ANGLE LCB'	BACK-CLOSING ANGLE LCBJ
10 m/m.	37°	4°	89°
20 m/m.	38°	5°	90°
30 m/m.	39°	6°	91°
40 m/m.	40°	7°	92°
50 m/m.	41°	8°	93°
60 m/m.	42°	9°	94°
70 m/m.	43°	10°	95°

MEASUREMENTS OF FIG. 'A'

1.	FOOT LENGTH	258 m/m.
2.	LENGTH OF LAST (FOOT LENGTH + 13 m/m.)	271 m/m
3.	GIRTH OF BALL	239 m/m
4.	" " INSTEP	245 m/m.
5.	" " HEEL	337 m/m.
6.	HEIGHT OF HEEL	20 m/m
7.	TOE SPRING	13 m/m.

5. Sizes & Fittings

5.1. Size System

A size system can be defined as a method of measuring, recording and marking the various lengths of the foot, the last and footwear. Different countries employ different systems:- using a special size unit as well as a method of marking or notation.

5.1.1. English or British Sizing:- The British size scale for reasons not known to us, has no size numbers for the first four inches of its length. Size '0' of infant range occurs exactly at 4 inches and from there size number from 1 to 13, complete the "lower" or 'Junior' half of the scale which ends at $8\frac{1}{3}$ inches. Then, there is the repition of size numbers from $1=8\frac{2}{3}$" (which is illogical and confusing) and there is then continuation 11, 12, 13, 14, etc,. It often helps to remember that in children size 12 at 8", ladies 5 at 10" and gents 8 at 11". Unit increase or size interval in the English size system is as follows:-
$\frac{1}{3}$" or 8.45 m/m between "Full" and $\frac{1}{6}$" or 4.2 m/m between "Half" sizes.

5.1.2. American Size System:-
In North America, the footwear industry also uses the English size system but with the following small variation:-

a) The zero position is at $3\frac{11}{12}$" instead of 4", thus all American sizes are $\frac{1}{12}$" shorter than the corresponding English sizes,

b) The matter is being more complicated by practising different notation i.e. Men's, Boys, Girls lasts are stamped 1 size up and Ladies, Maids are stamped 2 to 3 sizes up than English counterpart.

5.1.3. The French Size System:- France has always used a sizing system of its own which is accepted standard foot measuring system throughout Europe. The present French sizes which are also known Paris Points and stich(in Germany) measure $\frac{2}{3}$ of a cm. between each or 6.67 m/m. The P.P. scale notation starts at beginning of metric scale at 0 cm. and then goes on to 1 which $\frac{2}{3}$ cm. and continuous up to size 50 at 33.33 cm.

5.1.4. The Centimetre Size Scale:- Widely used at present in Eastern part of Europe and Japan/China. The unit is straight-forward one centimetre of metric scale and half sizes (5 m/m) in between. The notation is consecutive and continuous without repetition.

5.1.5. The Mondopoint System:- A name which suggests a world system and I.S.O. (International Standard Organisation) thinks - "The shoe size system of the future". With the exception of the U.S.A. most countries in the world are changing their weights and measures to the metric system known as - the SI or System International.

In SI the basic unit of length is the metric and multiples and sub-divisions of 1000 are used such as - the mili-metre or 1/1000 of metre for short distances. The c.m. is not used. Thus the m/m is the appropriate unit to express the dimensions of the feet, the shoes and the lasts.

Mondopoint rests on the principle that the markings on a shoe should also refer to the measurements of the foot which will fit it. This size marking consists of two numbers, such as 240/95. The first number represents the size or the length of the foot. The second number is the width index, the indication of the joint girth of the foot, expressed as percentage of length.

Example:-	Shoe Marking	Foot Measurement
	240/95	Length = 240 m/m; Girth = 228 m/m.

Since 228 is 95% of 240, therefore, the shoe 240/95 fits a foot having a length of 240 m/m and girth 228 m/m.

In order to have a clear understanding about the measuring systems in vogue, it would be worth while to refer to the chart attached(No.1). This chart provides a comparative study in a very lucid manner.

5.2 Fittings:- To fit both wide and narrow feet a variation in girth for any one size is used. These variations are known as fittings.

Fittings are usually given in letters in:

a) English Sizes		A	B	C	D	E	F	G	H
b) American Scale:	AAA	AA	A	B	C	D	E	EE	EEE
or	ES		S		M		L		EL
c) In French & C.M. size system by numbers		1	2	3	4	5	6	7	8

Half fittings are also made.

5.2.1 Girth Table Generation:-(See Chart No. 2)

Size system	Increment of Girth in m/m From size to size	From Fitt to Fitt.
a) British/American-all category	$\frac{1''}{4}$	$\frac{1''}{4}$
b) Our standard-Junior 1 to 1	5 m/m	5 m/m
c) Our standard-Senior 2 to 11	6 m/m	6 m/m
d) French size system	3.5 to 5 m/m	5 m/m
e) Our standard	4 m/m	5 m/m

6. Difference Between Lasts and Feet

There are many differences between lasts and feet, although lasts are developed for the making of footwear which must fit the feet correctly and comfortably, under different conditions of use.

The foot is flexible and pliable to some extent. It is irregular in outline and the surface is also irregular.

Whereas lasts are regular in outline, the surfaces are smooth, the toe end is solid and has a feather edge, which is a distinct line where upper surface ends and the bottom begins. The human foot doesn't have this distinct line it is rounded.

The curve of the heel is greater on the last than on the foot to help the shoe grip the heel.

The girth at the joints is greater on the last to allow the foot to flex inside the shoe.

The last is longer than the foot to prevent pressure from the shoe on the toes. It is also deeper than the foot again for the same reason.

The last has heel pitch and toe spring in order to reduce creasing across vamp of shoe and to give extra top line clip.

The comb area is thinner on the last than the corresponding part of on the foot in order to provide extra grip to the shoe.

The toe and forepart of the last gradually decreases to the feather edge but this is not so on the foot.

The measurements of a pair of last and all the pairs in the same size are identical, with the feet these may vary.

The girths and size intervals on a last are regular but on foot they are irregular.

The last is an average shape taken from the average of many thousands of foot measurements.

7. <u>Reference Points on the Last</u> (See Sketch No.17)

7.1. The standard length of the last(S.L.):- is the length in m/m of any given size which is generally the length of the foot plus 10 to 15 m/m addition depending upon the toe shape. This relates to the last for closed type of shoes only. Open type of footwear (like sandals) the length may be same or even less than foot length(See specification of standard length in Sketch No.13).

The size of the foot is not the same as the size of the corresponding shoe. A shoe needs to be longer than the foot because of the need for fitting, comfort and for the sake of style. The difference between the last and the foot obviously introduces a complexity of a some what uncertain and undefined nature.

7.2. The seat(heel) point:- It is located by judgement. This is the point at which the line is drawn down the centre of the back of last intersects the seat curve.

7.3. The counter point:- determines the back height of the shoe It is a point up the back curve of the last which $\frac{1}{5}$ of the S.L.

7.4. The tip of toe:- is the toe end of the last. It is the joint at which a line drawn the front centre of the last intersecting the toe curve. This is located by judgement.

7.5. The instep point:- at ½ S.L. draw a perpendicular along the line between counter point and tip of toe, towards upward to meet the front centre line.

7.6. The vamp point:- by drawing a perpendicular joining the counter point and tip of toe. This time from a point which is 7/10 S.L.

7.7. The comb of the last:- is the narrow area at the top of the last, above the line joining the vamp and counter points.

7.8. The centre line:- is a line joining the seat point and the tip of toe in a last bottom pattern/outline. This line corresponds to S.L. Measure S.L. always from the seat point for its variation from the actual length of last bottom.

7.9. The breast of heel:- is the line that cuts the centre line at right angle at a distance of $\frac{1}{6}$ S.L. from the seat point to meet the edges of the insole outline.

7.10. The tread line:- is the connecting line between two joints.

8. Variation Due to Foot Movement

8.1. Changes in Last Shape

The last shape we want to develop must provide for freedom of foot movement during wear of shoe. Therefore, changes must be made in last from natural shape of foot.

Provision for expansion in forepart has to be greater for heavy type of footwear than for lighter.

Foot movement bends the footwear. Bending of any cylindrical object reduces inside space.

Hence, the internal capacity of a shoe, made from firm material, should accordingly be made.

These are reasons why lasts are made of different shapes and distinct types for different purpose.

The big toe extends or moves forward during walking which must be accomodated. That is why foot draft is increased beyond toe end.

The big toe also tends to turn up at the finish of a step. Extra toe length conceals thickness of last at that point where it is needed for freedom of movement.

Total amount of length to be added depends on: shape of toe required in finished shoe. Slim, thin toe appearance needs more extension than does a square, thick effect.

Less increase is required for high heels than for low heel shoes.

In high heel shoes toes crowd together which, in low heel, tend to spread out.

The toe and heel action, during walking, is greater in low heel shoes than in high heels.

9. Principles of Last Modelling

There is no such thing as a straight line on a last. A last is a continuous flow of contours and configurations. Yet these contours - every style with its own variations to meet fashion specifications - must abide by precise standards of measurements. This requires not only delicate templates and gauges with minute tolerance, but the meticulous skills of the model maker.

These measurements not only determine the size and fit of the shoe, but influence the fashion shape, plus the comfort, balance or tread, and general wear performance of the shoe. They further set the stage for the fitting of many of the shoes component parts, and hence influence the shoe making process itself.

The last model maker must think in terms of "volume". A solid block of a given weight and volume can have thousands of different shapes simply by a different distribution of volume. Art of model making does not consist in making a shape just to agree with measurements. Art consists in putting wood where it is required. This is the basis of the fashion shaping-the sculpting of that block to create a distinctive piece of shoe fashion architecture.

The model maker views the last in two parts: Forepart (ball to toe) and backpart(ball to heel). In each of these areas is a group of important measurements. Shank - curve to assure a hugging fit under the arch; back curve, to conform to the contour of the back of the heel; the heel seat length and width, so that heel of the foot 'sits' properly inside the shoe; the heel wedge angle, adjusted to each heel height, to prevent the foot from sliding forward into the shoe.

The ball and heel tread must set on proper planes so foot and shoe rest securely on the ground and in walking. The toe spring, the raised portion under the toe tip, is a built in allowance to permit the foot and shoe to "spring" forward easily with each step. The depth of the toe is measured to allow toe room inside the shoe.

The last must be perfectly adjusted for every heel height - and each height requires corresponding adjustments in other parts of the last.

Over and above the general shape of the foot, disposition of wood depends on particular style of shoe a) design of upper, and b) shoe manufacturing process. A tie and a pump of the same size and heel made over the same last will fit differently. Again, the lined and unlined shoe will fit differently.

9.1. Provisions of Heels in Footwear:- It is necessary to raise the back part of our model last, from a level surface according to the height of heel wanted. The amount of this raising, we remember, is known as the pitch.

Because of pitch, alterations are caused in the positions of: a) contact or tread line, b) slope of seat and waist, and c) curvature of back.

General practice is: to provide a heel suitable in height and shape, and then to blend lines according to requirement. Pitch of last is regulated by height of heel and the seat portion is required to be parallel to the ground.

Theoretically, the seat must itself be level, whatever its elevation, since level seat allows the heel of foot to have a firm and solid base. Should the seat be inclined forward, heel would tend to slide forward towards toe of shoe.

In practice, however, these are not always absolutely true. In the case of high heels, if seat were kept level with the ground line, waist spring or curve would become too acute. And this would be out of all conformity with the requirements of the foot. Therefore, the pitch is made:- considerably shorter than the height at back compensation is made in the heel itself. The heel is wedged to give the back increased height. This arrangement allows: the top lift to sit square on the ground.

9.2. The Heel & Its Height:- The heel, of course, is stationary. The joints must, therefore, slide forward on the inner sole of the shoe at every step taken in walking. Instead of lengthening the waist of the last, the last modeler lengthens last at the toes.

The heel is an integral part of a footwear. If the heel is lifted even a very little, it throws the point of treading pressure forward; and the higher the heel the more shift forward of the joint positions.

The height of the heel, therefore, is a large factor in determining the bottom shape of the last.

A higher heel requires a shorter forepart, the tread line being shifted forward, than a low heel, yet the entire shape of the insole must be proportional.

9.2.1. Shifting of Tread Line:- While designing the insoles of high heels, the tread line is moved foreward, which varies as the variation in heel height. There are two schools:-

a) One thinks an equal variation for inside and outside joints;

b) According to others, the inside moves slightly more forward than the outside, owing to the structure of the longitudinal arch of the foot, and they recommend unequal variation of the inside and outside joints.

9.3. Waist Spring:- Curvature of waist is also regulated according to the height of heel: higher heel - greater waist spring and longer arch. In the Louis Heel:- The curvature must be made more acute immediately behind the joint than ordinary medium heel. Acute curve is necessary to allow the outsole to be curved sufficiently to be infront of heel.

Lasts for Louis and other heels of same type are usually made with a distinct ridge. This ridge divides forepart and waist. Degree of curvature at this point has influence on instep curve of last.

9.4. Toe Spring(See Sketch No. 19)
In relation to pitch varies under certain conditions and following specifications are normally maintained:

a) Normal men's shoes = 12 to 14 m/m
b) Standard women's/juniors low heel shoes = 10 m/m
c) Women's medium heel shoes = 8 m/m
d) Women's high heel shoes = 6 m/m

Use of toe spring serves two very important purposes:
a) Prevents creasing or crumping across front of shoe, and
b) aids feet in walking.

High heel shoes require less spring. Low heel demand a higher toe spring. Low-cut shoes also require a greater toe spring.

When the pressure of toe is brought to bear on the front of shoe, that pressure tightens the top and thereby prevents gaping or bagging round the ankle.

Stout footwear should have more spring than light ones, since stout footwear are stiffer and less yielding to the action of foot.

9.5. Deviation of Instep:- In making the side and front lines of a last, the object is: to attain the disposition of wood which will ensure the blending of the curve in the waist, top & sides, while satisfying the girth measurement. This part is concerned: both with fulfilling the design of upper and with certain manufacturing process.

The deviation of the instep is varied from: a central position to an inside one. Deviation of instep means: the line of the well-defined curve between the joint and the instep:- a) central - when it points to the centre of the toe; b) and the "inside" if pointing towards the side of the big toe. Two lasts of the same girth and width of bottom can yet be disimilar in shape. The shape of the top is no indication of that of the bottom, because bottom of unusual shapes are disguised by the formation of the top and big - looking shapes do not necessarily imply big fitting. The space available for the foot is governed by: the thickness of the last as much as with the width.

9.6. Deviation in Dimensions

9.6.1. In the production of shoe lasts for men's oxford (low heel) instep girth may be 3 to 4 m/m higher or same to joint girth,

9.6.2. In the production of shoe lasts for Derby, Balmoral, casuals(with elastic gore) instep girth may 6 to 10 m/m more than joint girth,

9.6.3. In both above cases, the upper heel part shall be thinner than boot lasts,

9.6.4. In the production of lasts for sandals, width of insole at the joints may be increased by 2.5 to 3.5 m/m and in the heel by 1.5 to 2.5 m/m. The instep girth may be increased by 10 m/m than joint girth,

9.6.5. In the production of lasts for ladies low heel footwear (up to 25 m/m), width of insole may be decreased at the tread line by 1 to 2 m/m and at heel by 1 m/m,

9.6.6. In the production of lasts for ladies medium heel footwear (25 to 40 m/m), width of insole may be decreased at the tread line by 2 to 3 m/m and at heel by 2 m/m,

9.6.7. In the production of lasts for ladies high heel (45 to 60 m/m), width of insole may be decreased at the tread line by 3 to 4 m/m and at heel by 2 to 3 m/m,

9.6.8. The main bearing surfaces of foot are formed by: ball of big toe, outer margin of foot and heel. In abnormal cases, however, whole of bottom may form the bearing surface. If bottom surface is suitably raised at bearing points then two important advantages are obtained:

i) The outer sole of shoe will be worn more evenly, and

ii) The wearer will walk more firmly and in greater comfort.

Therefore, wood of last must be judiciously put where it is required. Should the distribution be incorrect, the value of any increase in measurement will be impaired. Comfort depends more on the shape of last than on measurements. Excessive pressure of foot in a shoe at one part causes distortion at another.

Measurements are usually reduced for fleshy and increased for boney feet. Measurements are increased in a last for heavy materials and rigid forms of attachment. Increase must also be made to the amounts of measurements in case of children lasts.

To impart good lines to the finished shoe, increase last dimensions with such a graduation as to blend them into most pleasing appearance.

9.7. Profile of Last:- Heel profile must agree with the height of heel. But, last profile varies considerably from actual profile of foot. And then, to connect the slope of seat with profile of heel. It is usual to vary the profile for boots and shoes of different weights according to substance of wood at counter point.

Depending on the type of footwear, whether it is a strap shoe, an Oxford, a Balmoral, or a Derby Boot, numerous profile shapes are made at instep. Therefore, the disposition of wood on the last also shows considerable variation.

Not a single last may be wanted for two different designs. In that case alter disposition of wood at instep and waist to suit the design, maintaining girth measurement same for both the designs.

In order to ensure good fittings joint and toe profiles may be altered - governing by three considerations a) substance of upper; b) thickness of bottom: and c) purpose of footwear.

9.8. Practical Model Making:- LAST MODELERS

Last model maker should continually search for models which should be adjudged as good fitters by footwear manufacturers.

Last stylist may:

a) create his own style by moulding from a last with a smooth turned standard backpart and rough turned fore-part. The moulding is carried out by rasping, filling, sanding and packing,

b) obtain a wonden model from a leading last stylist, perhaps from Italy and copy forepart shape for blending to his customer's standard backpart. This is done by copying the model in lathe, cutting the forepart off the copy and attaching it by adhesive to a standard back part,

c) make a mould of the forepart of an actual shoe sample and then copy by hand onto last with a standard back part.

Before sending the model to the machine for reproduction and grading the following jobs must be performed:-

a) Last bottom pattern or insole of last:- This insole is foundation of last. Therefore, make the insole first which must satisfy specifications for curvature, spring and pitch,

b) Making different profile templates to test accuracy of reproduction,

c) Establishing important reference points for applying tape measure; and

d) Providing protection to feather of model by tacks, (the heads of which are filled to give a square edge) against possible damage from pressure of metal tracer wheel.

9.8.1. Template Making:- It is essential that a last modeller must develop ability to cut accurate patterns of insole and profiles. Accurate pattern shapes are integral to model making. These patterns are employed for the purpose of controlling the accuracy and precision of reproduction. The following profil (templates) are normally required:-

a) Toe profile - over front centre line of model and a little way under toe,
b) Back/heel curve or bottom profile - over back centre line of model and sometime also along bottom centre line to the tip of toe.

9.8.2. Reference Points(See Sketch No.20):- Mark the reference points on joints(3 = insole/outside/ middle) & instep girths, points for sawing wedge of scoop block and v-cut hinge last on the model by round headed brass pins. Each pin head is reproduced on all lasts, in course of turning, in the form of tiny bumps.

9.8.3. Types of last models:- The usual practice is to make combination lasts. They are suitable in general character for more than one kind of footwear. Ladies court shoe, ladies strap or bar shoe, ladies sports shoe, men's Derby boot, Belmoral boot, Oxford shoe all have their own distinctive characters & features for which lasts modelers have to bring powers of observation to bear on the characteristics of lasts for these footwear, and take note of the disposition of wood on them, as well as their general appearance of profiles and shapes. Lasts for open tab boots, such as football, cricket, running, hiking, hunting, riding, tennis and all forms of sportwear, have some special characteristics of their own.

Similarly, occupational and safety footwear have their own specific features.

9.9 Grading of insole patterns and last profiles(See Sketch No.21 a,b,c)

When insole(last bottom shape) and profile patterns of model size are ready, they are machine graded into required number of sizes(range).

Grading means proportional increase and decrease of patterns or profiles according to sizes. The pattern grading works on pantograph system.

So far 'arithmetic' grading has been conventional system. Other grading systems based on metric plan have been introduced: Geometric, proportionate grade, dynamic, DFC(Dynamic Fitting Group), precision grading, etc..

9.9.1 Arithmetic Grade: A grading system in which the increments per size and/or width of any particular dimensions are specified as constants which are independent of the grade of any other dimension,

9.9.2 Geometric Grade: A grading system in which the increment per size and/or width of any dimension is specified as constant percentage of the dimension (not including margins or other areas which do not grade).

The increments of the principal geometric grade now in use are specified in geometric points. One geometric point is approximately 0.003 times the original dimension, which increases for each point as does compound interest.

9.9.3 Proportional Grade: A grading system in which the increments of all dimensions, per size within a size run, are a constant percentage, or proportion of dimensions. For a geometric grade, this means that the number of geometric points per size specified for both length and girth must be equal.

9.10. 2/3 Standardization(See Sketch No. 22 a,b,c)

The ball or joint position is on the average 70 percent of foot length. For all practical purposes it is compute as 2/3 of standard length. All the changes in a last normally relates to the forepart only. The back, therefore, 2/3 of SL, for any given heel height remains the same. The rear being the least mobile part of the foot needn't change with fashion, hence modern factory is - to standardize the back for a particular heel height, for importand economic reasons for having standard components as heel, counters (stiffners), shanks, quarter upper, etc. etc.

9.11. Co-ordination

As the lasts are turned in larger sizes from a sample size model, the heel pitch and toe spring increase.

Thus, to maintain a constant heel pitch and toe spring, the last must be cut (a) to lower the heel, and (b) to lower the toe. Similarly, sizes below the model size will have a decreased heel pitch and toe spring, and it is necessary to cut the last in order to raise them to the model dimensions. Generally speaking, models are co-ordinated every 1½ sizes(English), Example:- From a size 4 model, size 2½ and 5½ lasts are turned and then co-ordinated.

From the co-ordinated size 5½ last, the size 7 last is turned and co-ordinated, etc, etc,.

Co-ordination is normally carried out by making saw cuts at the forward end of the back comb and at the bottom of the instep curve. Wedges are then driven into the saw cuts until the heel pitch and toe spring are correct. Any resulting holes are filled and smoothed and finally the shank curve is readjusted to atemplate.

10. <u>Where do last styles originate?</u>

Lasts styles originate in the minds of many men, in many lands and from many events, all of which can be put under following five headings.

a) Last Model Makers

b) Last Salesmen

c) Shoe Manufacturers and Designers

d) Shoe Retailers

e) Foreign Influence:- Various shoe fashion fairs, designer's model studio, fashion magazines, clothing fashion houses, etc.

INCH MEASUREMENT IN INCH	ENGLISH SIZES ENGLISH	FRENCH SIZE, PARIS POINT STICK	MEASUREMENT IN M/M	MONDOPOINT SIZE INTERVAL 5%	MONDOPOINT SIZE INTERVAL 7.5%	AMERICAN SIZE MENS BOYS CHILD. INF	AMERICAN SIZE LADIES MAIDS GIRLS	C.M. SIZE SCALE
4⅓	1					2		
4⅔	2	18	120			3		12.0
5	3	19	127	110		4		12.5
5⅓	4	20	133	115	112	5		13.5
5⅔	5	21	140	125	120	6		14.0
	5½	22	147	130	127	6½		14.5
6	6	23	153	135	135	7		15.5
	6½			140		7½		
6⅓	7	24	160	145	142	8		16.0
	7½					8½		16.5
6⅔	8	25	167	150	150	9		17.0
	8½	26	173	155	157	9½		17.5
7	9	27	180	165	165	10		18.5
	9½					10½		
7⅓	10	28	187	170	172	11		19.0
	10½					11½		
7⅔	11	29	193	175	180	12		19.5
	11½	30	200	185	187	12½		20.0
8	12	31	207	190		13		20.5
	12½					13½		21.0
8⅓	13	32	213	195	195	1		21.5
8⅔	1	33	220	205	202	2		22.0
	1½					2½		
9	2	34	227	210	210	3	4	22.5
	2½					3½	4½	23.0
9⅓	3	35	233	215	217	4	5	23.5
	3½	36	240	225	225	4½	5½	24.0
9⅔	4	37	247	230	232	5	6	24.5
	4½					5½	6½	25.0
10	5	38	253	235	240	6	7	25.5
	5½					6½	7½	
10⅓	6	39	260	245	247	7	8	26.0
	6½	40	267	250		7½	8½	26.5
10⅔	7	41	273	260	255	8	9	27.0
	7½					8½	9½	27.5
11	8	42	280	265	262	9	10	28.0
	8½					9½		28.5
11⅓	9	43	287	270	270	10		29.0
	9½	44	293	275	277	10½		29.5
11⅔	10	45	300	285	285	11		30.0
	10½					11½		
12	11	46	307	290	292	12		30.5
	11½					12½		31.0
12⅓	12	47	313	295		13		31.5

COMPARATIVE SIZE CHART NO. 1

CHART NO. 1

TOTAL NO. OF SIZES

MENS' SIZE RANGE:-

ENGLISH SIZES :- 5 - 6 6½ 7 8 9 9½ 10 11 = 7

FRENCH SYSTEM :- 38 39 40 41 42 43 44 45 46 = 9

C. M. SIZE SCALE:- 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5 30.0 30.5 = 11

MONDOPOINT = 5%:- 235 240 245 250 255 260 265 270 275 280 285 290 = 12

MONDOPOINT = 7.5%:- 240 247 255 262 270 277 285 292 = 7

WOMENS' SIZE RANGE:-

ENGLISH SIZES :- 3 3½ 4 5 6 6½ 7 = 5

FRENCH SYSTEM:- 35 36 37 38 39 40 41 = 7

C.M. SIZE SCALE:- 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 = 8

MONDOPOINT = 5% 220 225 230 235 240 245 250 255 260 = 9

MONDOPOINT = 7.5% 217 225 232 240 247 255 262 = 7

TOTAL NO. OF SIZES.

CHILDREN SIZE RANGE:-

ENGLISH SIZES :- 9 10 11 11½ 12 13 1 2 = 6

FRENCH SIZES :- 27 28 29 30 31 32 33 34 = 7

C.M. SIZE SCALE :- 18.0 18.5 19.0 19.5 20.0 20.5 21.5 22.0 22.5 = 10

MONDOPOINT 5%:- 165 170 175 180 185 190 195 205 210 215 = 10

MONDOPOINT = 7.5%:- 165 172 180 187 195 202 210 217 = 8

TOTAL NO. OF SIZES.

INFANT SIZE RANGE:-

ENGLISH SIZES :- 4 5 5½ 6 7 8 8½ = 5

FRENCH SIZES :- 20 21 22 23 24 25 26 = 7

C. M. SIZE SCALE :- 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 = 9

MONDOPOINT = 5%:- 120 125 130 135 140 145 150 155 160 = 9

MONDOPOINT = 7.5%:- 120 127 135 142 150 157 = 6

TOTAL NO. OF SIZES.

CHART NO. 2

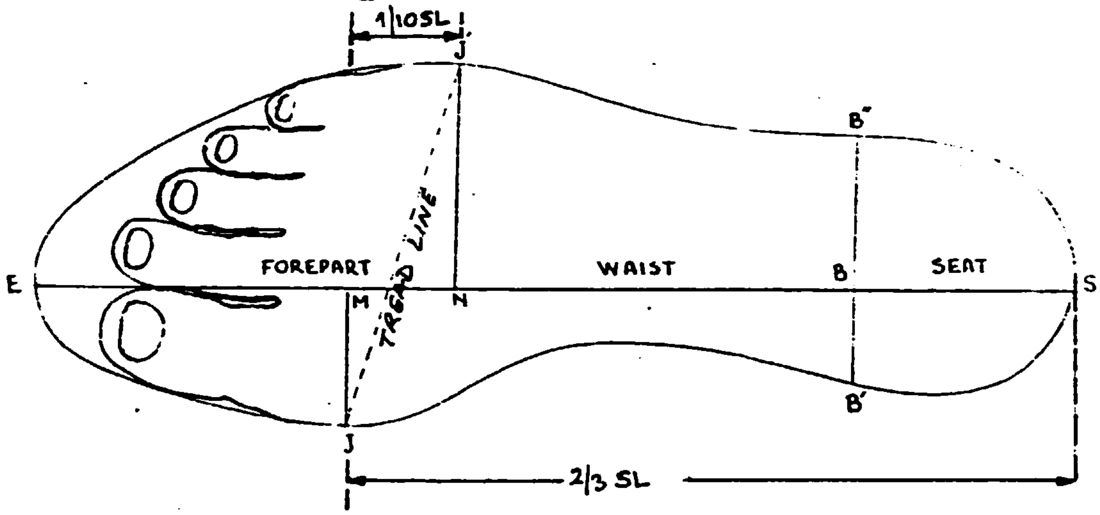
CB 32 ← JOINT-GIRTH MEASURING TABLE → No. 112

ENG. SIZES	FITTINGS C	D	E	F	G	H
			MENS			
12	24,55	25,05	25,55	26,05	26,55	27,05
11½	24,3	24,8	25,3	25,8	26,3	26,8
11	24,00	24,5	25,00	25,5	26,00	26,5
10½	23,75	24,25	24,75	25,25	25,75	26,25
10	23,45	23,95	24,45	24,95	25,45	25,95
9½	23,2	23,7	24,2	24,7	25,2	25,7
9	22,9	23,4	23,9	24,4	24,9	25,4
8½	22,65	23,15	23,65	24,15	24,65	25,15
8	22,35	22,85	23,35	23,85	24,35	24,85
7½	22,1	22,6	23,1	23,6	24,1	24,6
7	21,8	22,3	22,8	23,3	23,8	24,3
6½	21,55	22,05	22,55	23,05	23,55	24,05
6	21,3	21,8	22,3	22,8	23,3	23,8
			WOMENS JUVENILE			
8	22,35	22,85	23,35	23,85	24,35	24,85
7½	22,1	22,6	23,1	23,6	24,1	24,6
7	21,8	22,3	22,8	23,3	23,8	24,3
6½	21,55	22,05	22,55	23,05	23,55	24,05
6	21,3	21,8	22,3	22,8	23,3	23,8
5½	21,05	21,55	22,05	22,55	23,05	23,55
5	20,75	21,25	21,75	22,25	22,75	23,25
4½	20,5	21,00	21,5	22,00	22,5	23,00
4	20,2	20,7	21,2	21,7	22,2	22,7
3½	19,95	20,45	20,95	21,45	21,95	22,45
3	19,7	20,2	20,7	21,2	21,7	22,2
2½	19,45	19,95	20,45	20,95	21,45	21,95
2	19,2	19,7	20,2	20,7	21,2	21,7
			BOYS GIRLS CHILDREN			
2½	19,55	20,05	20,55	21,05	21,55	22,05
2	19,3	19,8	20,3	20,8	21,3	21,8
1½	19,05	19,55	20,05	20,55	21,05	21,55
1	18,8	19,3	19,8	20,3	20,8	21,3
13½	18,55	19,05	19,55	20,05	20,55	21,05
13	18,3	18,8	19,3	19,8	20,3	20,8
12½	18,05	18,55	19,05	19,55	20,05	20,55
12	17,8	18,3	18,8	19,3	19,8	20,3
11½	17,55	18,05	18,55	19,05	19,55	20,05
11	17,3	17,8	18,3	18,8	19,3	19,8
10½	17,05	17,55	18,05	18,55	19,05	19,55
10	16,8	17,3	17,8	18,3	18,8	19,3
9½	16,55	17,05	17,55	18,05	18,55	19,05
9	16,3	16,8	17,3	17,8	18,3	18,8
8½	16,05	16,55	17,05	17,55	18,05	18,55
8	15,8	16,3	16,8	17,3	17,8	18,3
7½	15,55	16,05	16,55	17,05	17,55	18,05
7	15,3	15,8	16,3	16,8	17,3	17,8
6½	15,05	15,55	16,05	16,55	17,05	17,55
6	14,8	15,3	15,8	16,3	16,8	17,3
5½	14,55	15,05	15,55	16,05	16,55	17,05
5	14,3	14,8	15,3	15,8	16,3	16,8
4½	14,05	14,55	15,05	15,55	16,05	16,55
4	13,8	14,3	14,8	15,3	15,8	16,3
3½	13,55	14,05	14,55	15,05	15,55	16,05
3	13,3	13,8	14,3	14,8	15,3	15,8
2½	13,05	13,55	14,05	14,55	15,05	15,55
2	12,8	13,3	13,8	14,3	14,8	15,3
1½	12,55	13,05	13,55	14,05	14,55	15,05
1	12,3	12,8	13,3	13,8	14,3	14,8

FRENCH SIZES	FITTINGS 1	2	3	4	5	6	7	8
48	23,9	24,4	24,9	25,4	25,9	26,4	26,9	27,4
47	23,5	24	24,5	25	25,5	26	26,5	27
46	23,1	23,6	24,1	24,6	25,1	25,6	26,1	26,6
45	22,7	23,2	23,7	24,2	24,7	25,2	25,7	26,2
44	22,3	22,8	23,3	23,8	24,3	24,8	25,3	25,8
43	21,9	22,4	22,9	23,4	23,9	24,4	24,9	25,4
42	21,5	22	22,5	23	23,5	24	24,5	25
41	21,1	21,6	22,1	22,6	23,1	23,6	24,1	24,6
40	20,7	21,2	21,7	22,2	22,7	23,2	23,7	24,2
39	20,3	20,8	21,3	21,8	22,3	22,8	23,3	23,8
38	19,9	20,4	20,9	21,4	21,9	22,4	22,9	23,4
37	19,5	20	20,5	21	21,5	22	22,5	23
36	19,1	19,6	20,1	20,6	21,1	21,6	22,1	22,6
35	18,7	19,2	19,7	20,2	20,7	21,2	21,7	22,2
34	18,3	18,8	19,3	19,8	20,3	20,8	21,3	21,8
33	17,9	18,4	18,9	19,4	19,9	20,4	20,9	21,4
32	17,5	18	18,5	19	19,5	20	20,5	21
31	17,1	17,6	18,1	18,6	19,1	19,6	20,1	20,6
30	16,7	17,2	17,7	18,2	18,7	19,2	19,7	20,2
29	16,3	16,8	17,3	17,8	18,3	18,8	19,3	19,8
28	15,9	16,4	16,9	17,4	17,9	18,4	18,9	19,4
27	15,5	16	16,5	17	17,5	18	18,5	19
26	15,1	15,6	16,1	16,6	17,1	17,6	18,1	18,6
25	14,7	15,2	15,7	16,2	16,7	17,2	17,7	18,2
24	14,3	14,8	15,3	15,8	16,3	16,8	17,3	17,8
23	13,9	14,4	14,9	15,4	15,9	16,4	16,9	17,4
22	13,5	14	14,5	15	15,5	16	16,5	17
21	13,1	13,6	14,1	14,6	15,1	15,6	16,1	16,6
20	12,7	13,2	13,7	14,2	14,7	15,2	15,7	16,2
19	12,3	12,8	13,3	13,8	14,3	14,8	15,3	15,8
18	11,9	12,4	12,9	13,4	13,9	14,4	14,9	15,4
17	11,5	12	12,5	13	13,5	14	14,5	15
16	11,1	11,6	12,1	12,6	13,1	13,6	14,1	14,6

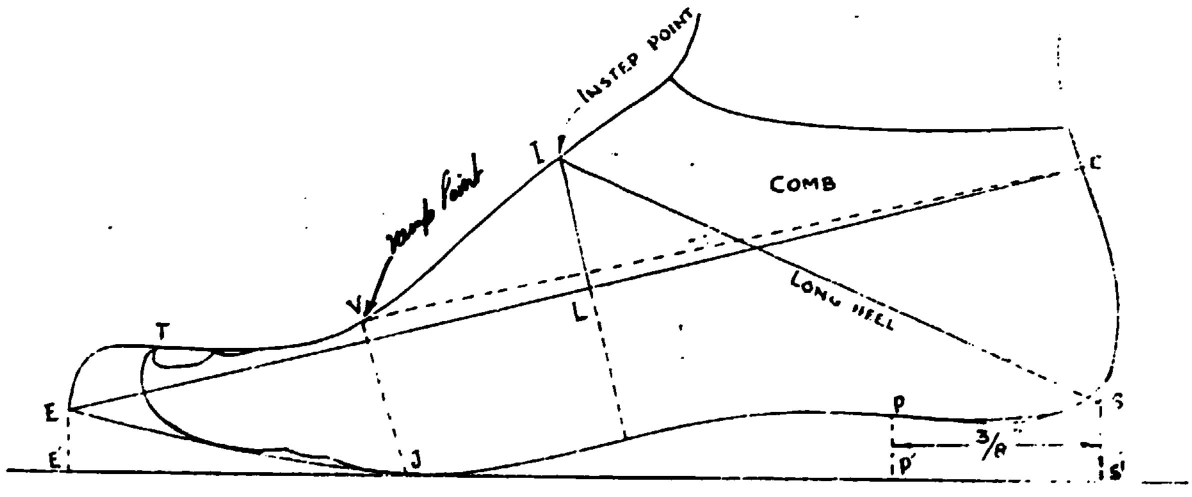
SKETCH NO. 17

THE BOTTOM OF THE LAST



E = Centre of Toe shape; S = Centre of Heel shape; SP = ½ SL (Std.length); B'B" = Breast of heel; SM = ⅔ SE; MN = 1/10 SL; SMJ' = 90° (outside joint); SNJ = 90° (inside joint).

THE PROFILE OF THE LAST



J = Point of contact or tread; PP' = Pitch; EE' = Spring; SS' = Height of heel.
S = Seat position; E = End of Toes; C = Counter point; [illegible]
V = Vamp position; CV = 7/10 SE; I = Instep; L = ½ SL from [illegible]
T = Top of Toes; CLI = 90°

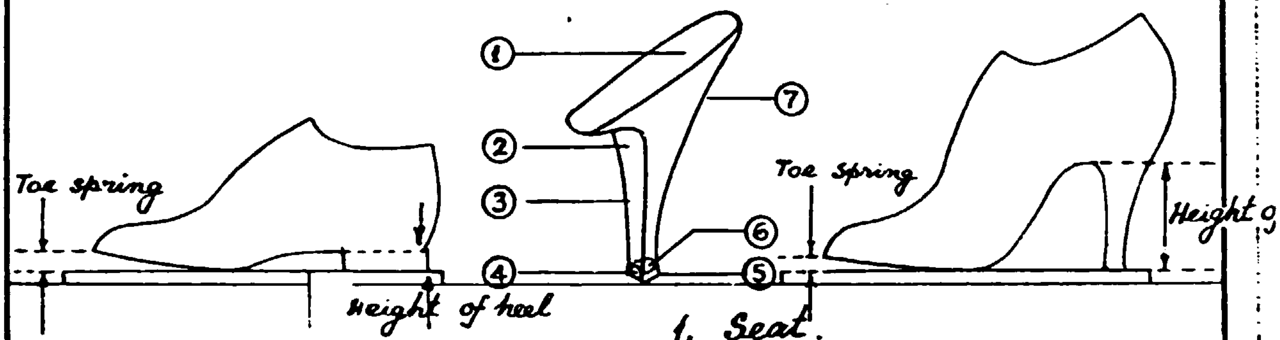
SPECIFICATION OF STANDARD INSOLE LENGTH

Sketch No 18

NORMAL ALLOWANCE OF INSOLE		LENGTH IN m.m. FOR DIFFERENT TYPES OF FOOT-WEAR.				
A	B	C	D	E	F	G
ENGLISH SIZES	STANDARD LENGTH IN m/m	1/2 SIZE LESS	1 SIZE LESS	1½ SIZE LESS	½ SIZE UP	1 SIZE UP
3	127.005	122.771	118.538	114.304	131.238	135.472
4	135.472	131.238	127.005	122.771	139.705	143.939
5	143.939	139.705	135.472	131.238	148.172	152.406
6	152.406	148.172	143.939	139.705	156.639	160.873
7	160.873	156.639	152.406	148.172	165.106	169.340
8	169.340	165.106	160.873	156.639	173.573	177.807
9	177.807	173.573	169.340	165.106	182.040	186.274
10	186.274	182.040	177.807	173.573	190.507	194.741
11	194.741	190.507	186.274	182.040	198.974	203.208
12	203.208	198.974	194.741	190.507	207.441	211.675
13	211.675	207.441	203.208	198.974	215.908	220.142
1	220.142	215.908	211.675	207.441	224.375	228.609
2	228.609	224.375	220.142	215.908	232.842	237.076
3	237.076	232.842	228.609	224.375	241.309	245.543
4	245.543	241.309	237.076	232.842	249.776	254.010
5	254.010	249.776	245.543	241.309	258.243	262.476
6	262.476	258.243	254.010	249.776	266.709	270.943
7	270.943	266.709	262.476	258.243	275.176	279.410
8	279.410	275.176	270.943	266.709	283.643	287.877
9	287.877	283.643	279.410	275.176	292.110	293.344
10	296.344	292.110	287.877	283.643	300.577	304.814
11	304.814	300.577	296.344	292.110	309.047	313.278
12	313.278	309.047	304.814	300.577	317.511	321.745

COLUMN	DESCRIPTION
A	English Sizes.
B	Length of Insole in m/m Medium toe closed shoe with toe-puff and counter.
C	,, ,, ,, in m/m Stitch down or Veldtschoen, flatties, casuals.
D	,, ,, ,, in m/m Slippers & Sandals open toe or open back or both open
E	,, ,, ,, in m/m Chappals open toes and backs.
F	,, ,, ,, in m/m Medium pointed closed shoe with toe puff & counter.
G	,, ,, ,, in m/m Pointed (extreme high fashion slim toe) closed shoe - with toe-puff and counter.

PITCH & SPRING OF LAST. | Sketch No - 19



1. Seat.
2. Waist.
3. Brest line and height.
4. Half moon.
5. Top lift.
6. Walking surface.
7. Heel line.

HEIGHT OF HEEL.	TOE SPRING.
10 m.m	13 m.m
20 "	12 "
30 "	11 "
40 "	10 "
50 "	9 "
60 "	8 "
70	7 "

N.B. Last built for heavy type of foot-wear 2 to 4 m.m toe spring should be added into it.

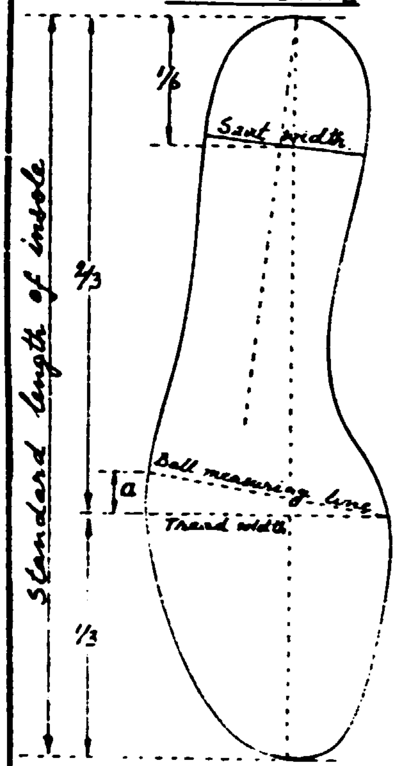
TYPES OF SHOES.	TOE SPRING
Mens heavy boot last	35 m.m
Mens sports shoes	31 "
Mens walking boot	28 "
Mens walking shoe	28 "
Mens dress shoe.	25 "
Maids & youth - size - 4	23 "
Boys & Girls - size - 13	20 "
Children size - 10	18 "
Infant size - 4	15 "

These toe spring of the last is measured without putting any heel under the seat of the last.

LOCATION OF GIRTH MEASURING POINTS.

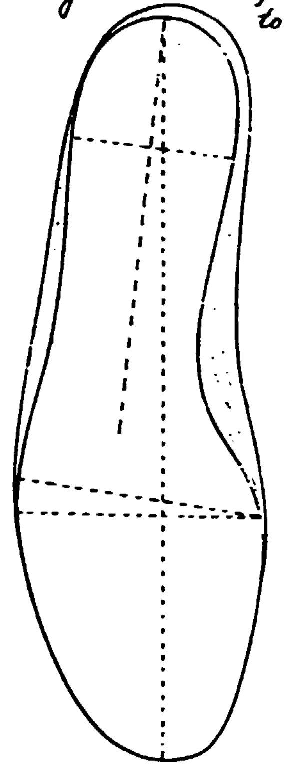
Sketch No. 20

INSOLE SHAPE



'a'
MENS - 20 m.m
LADIES & RANGE-4 } 15 m.m
RANGE 2-3 = 12 m.m
RANGE -1 = 10 m.m

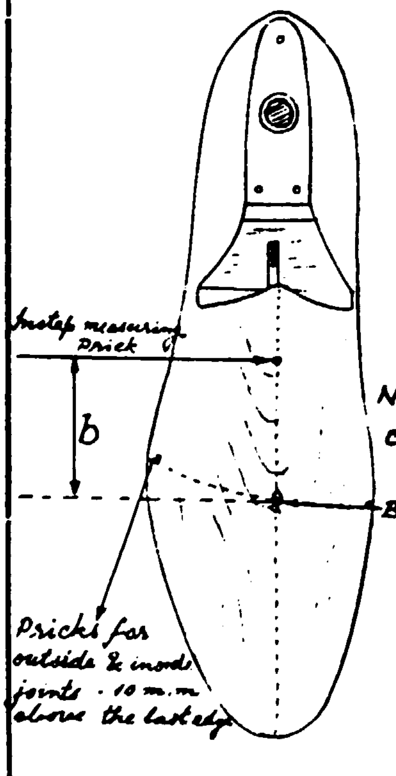
Marking when transfered to last bottom.



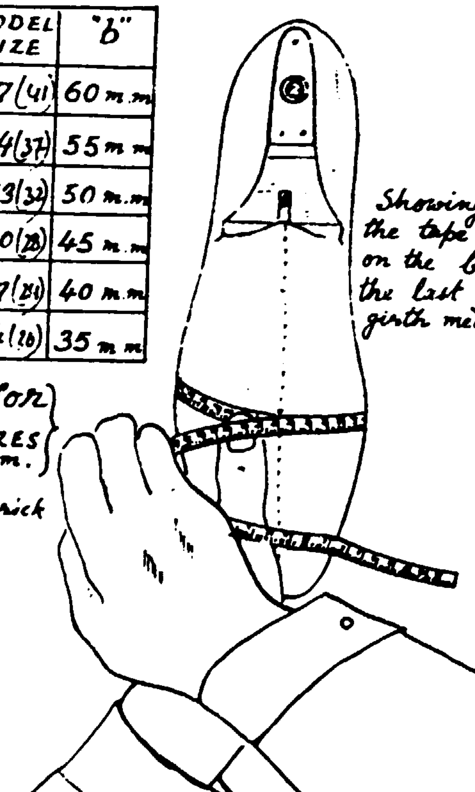
(b) DISTANCE BETWEEN INSTEP & BALL PRICK.

CATEGORY	MODEL SIZE	"b"
MENS	7(41)	60 m.m
LADIES & RANGE-4	4(37)	55 m.m
RANGE - 3	13(32)	50 m.m
RANGE - 2	10(28)	45 m.m
RANGE - 1	7(24)	40 m.m
RANGE - 0	4(20)	35 m.m

N.B Change for contiguous sizes ± 2 m.m.



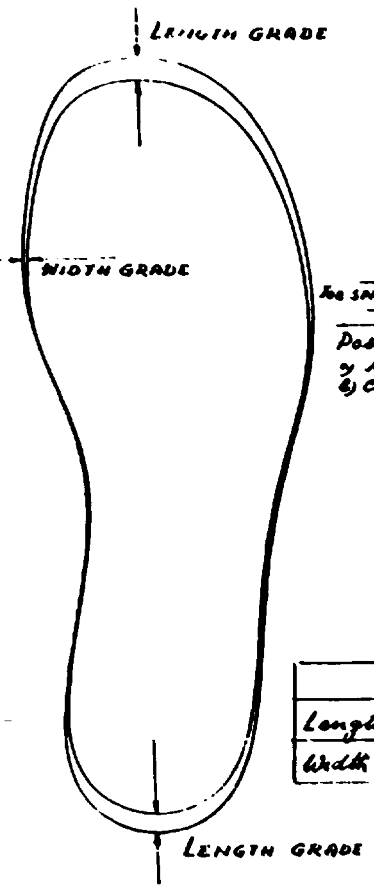
Showing how the tape is placed on the body of the last for Ball girth measurement

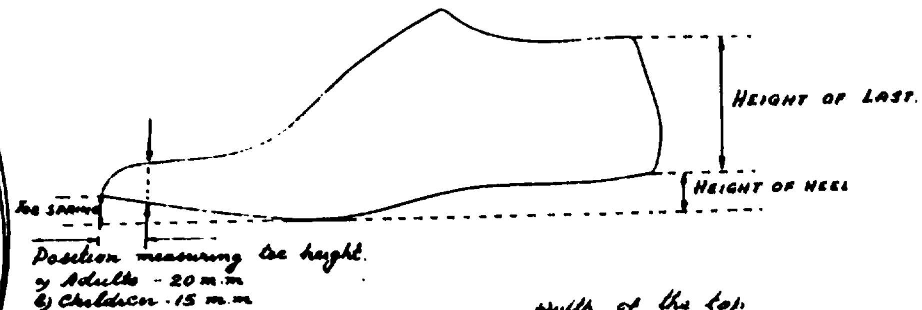


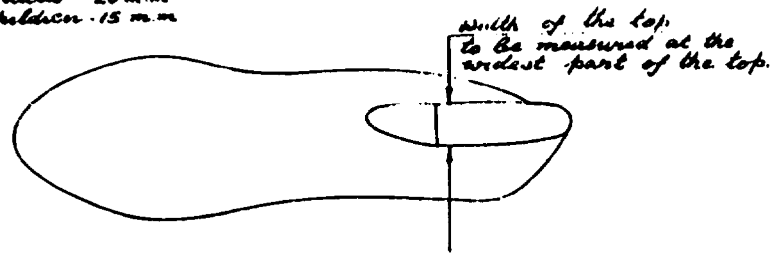
Sketch No. 21a.

GRADING OF LAST PROFILES

(ARITHMETICAL)







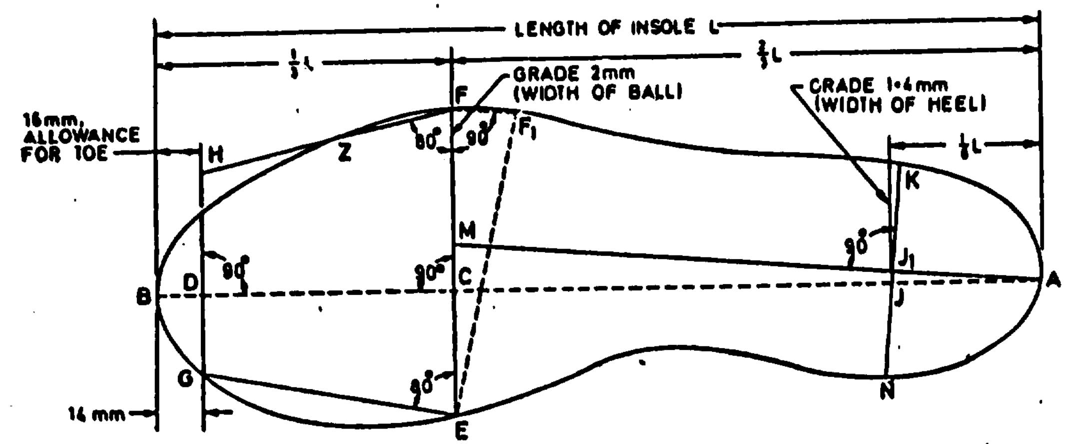
English Scale	JUNIOR Adults & Range-4 FR. ENG.	Children Range 0,1,2,3 FR. ENG.
Length grade for size & fittings	6,67 OR 8·4 m.m	6.67 OR 8·4 m.m.
Width grade for size & fittings	1.6 OR 2·0	1.3 1·6 m.m

The ratio between the toe-spring and the height of heel during the increasement and decreasement for size to size :—

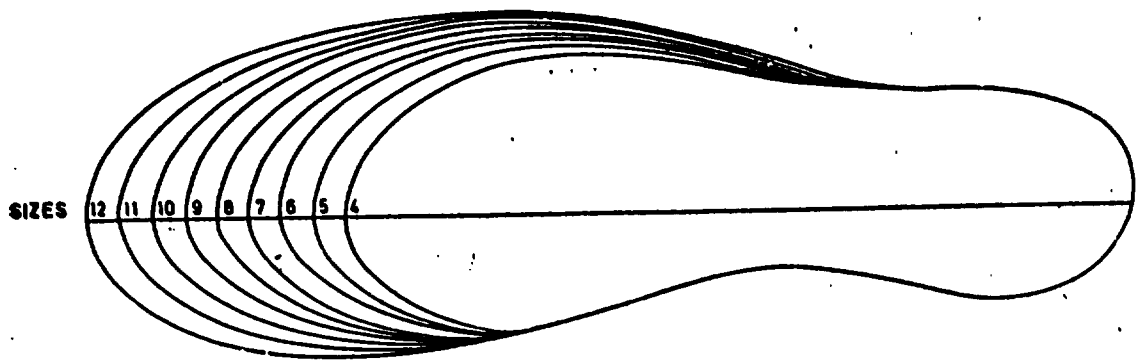
Pitch	Spring
10 - 30 m.m	= 0·5 m.m.
30 - 60 m.m	= 1·0 m.m.
ab - 60 m.m	= 1·5 m.m.

For every half inch (12.7 m.m) increase in pitch, the ball point moves foreward for 1/8 of an inch (3·2 m.m)

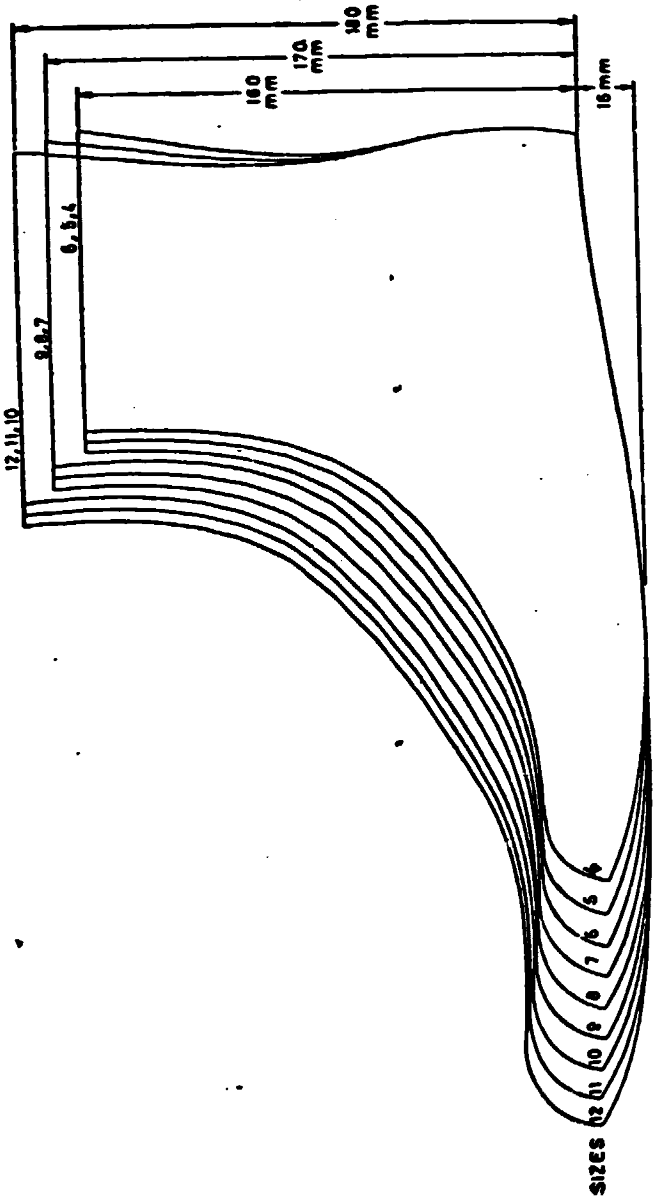
CATEGORY	MODEL SIZES	TOE HEIGHT OR THICKNESS	CONTIGUOUS SIZES	HEIGHT OF LAST	CONTIGUOUS SIZES	WIDTH OF TOP.
MENS....	7(41)	23	± 0·8 m.m	68	± 2 m.m	23-25
LADIES & RANGE-4	4(37)	21	± 0·8 "	63	± 2 "	19-21
RANGE-3	13(32)	19	± 0·5 "	55	± 2 "	18-20
RANGE-2	10(29)	18	± 0·5 "	50	± 2 "	16-18
RANGE-1	7(24)	16	± 0·5 "	45	± 2 "	15-17
RANGE-0	4(20)	14	± 0·5 "	40	± 2 "	14-16



INSOLE CONSTRUCTION (SIZE 7 LAST)



Sketch no. 21 b. INSOLE GRADING

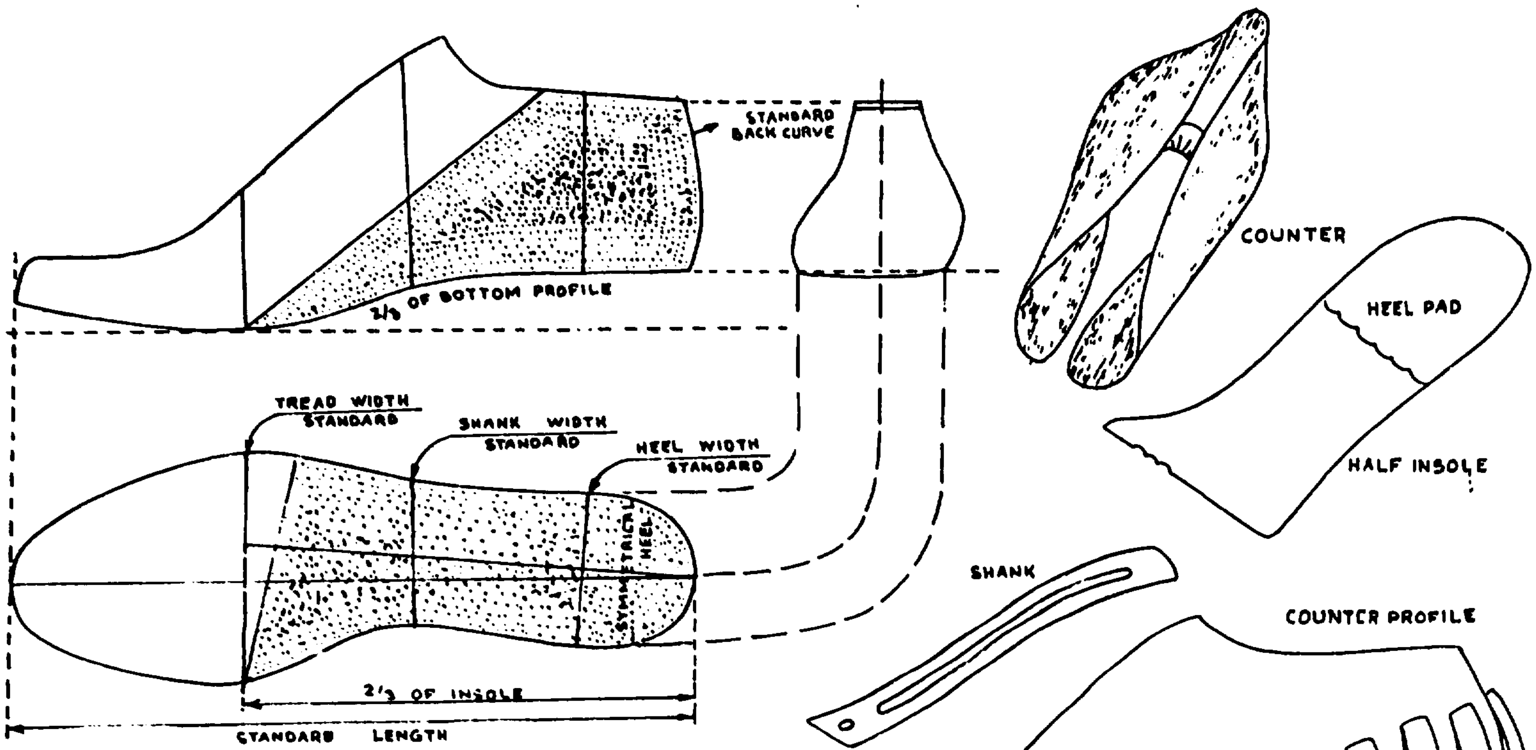


Sketch. 21c. Graded Profile Patterns

Sketch No. 22a

ADVANTAGE OF 2/3 LAST STANDARDISATION :

(MEN'S SIZE = 7)



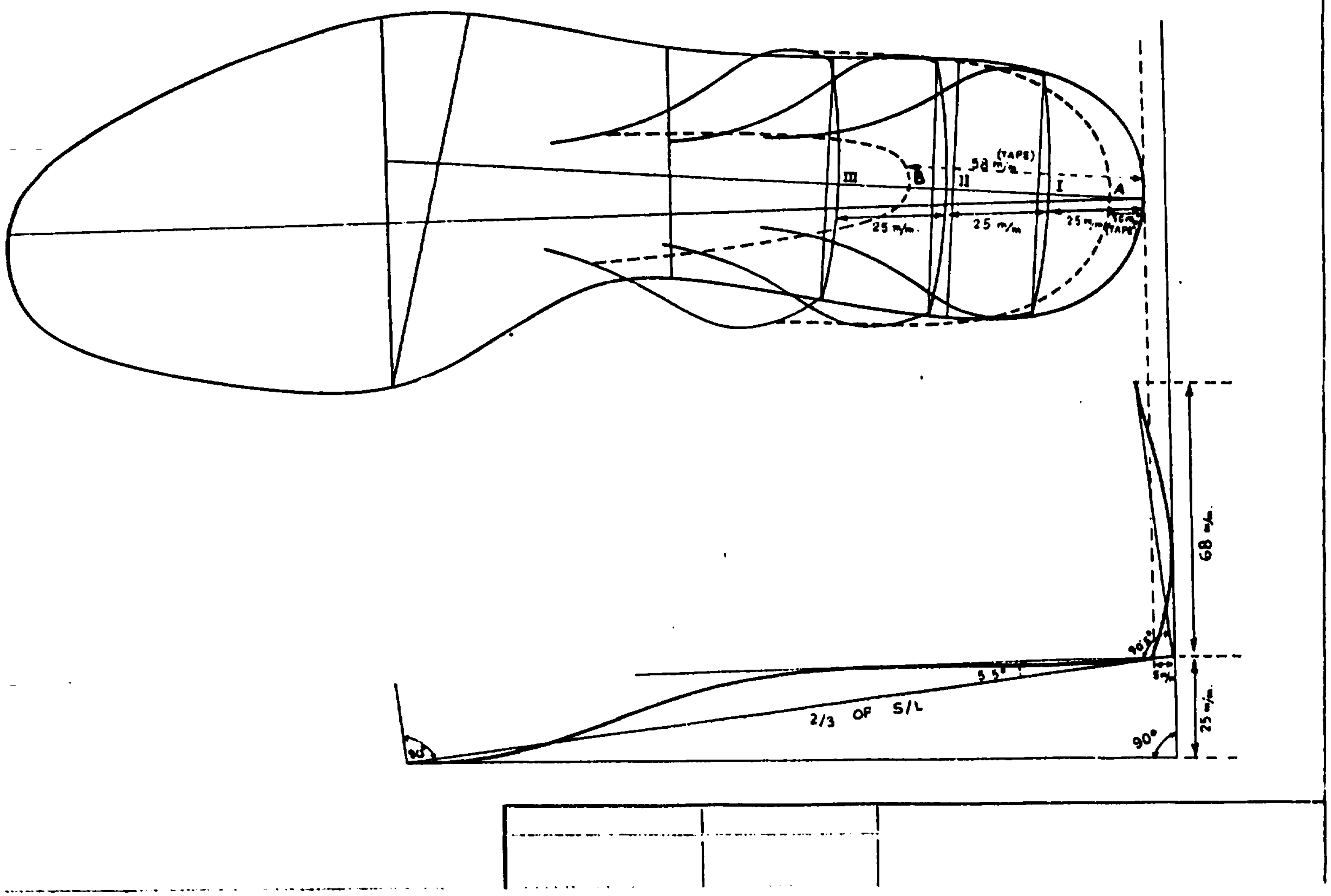
SECTIONAL MEASUREMENT OF LAST.

LENGTH OF INSOLE	270.94
2/3 OF THE INSOLE	180 mm
TREAD WIDTH	90 mm
SHANK WIDTH	56 mm.
HEEL WIDTH	62 mm
HEIGHT OF HEEL	20 mm.

MEN'S SIZE : 7

2/3 STANDARDISATION OF LAST ; MENS' SIZE 7. 117

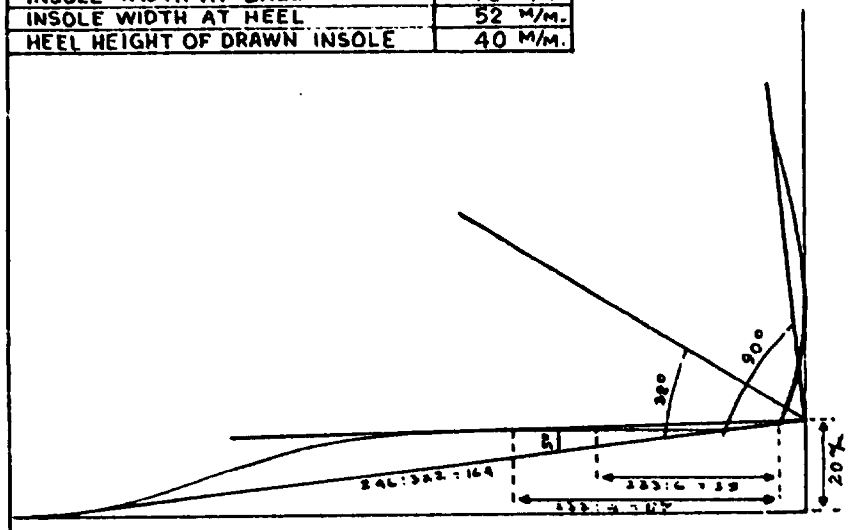
Sketch. No. 22b.

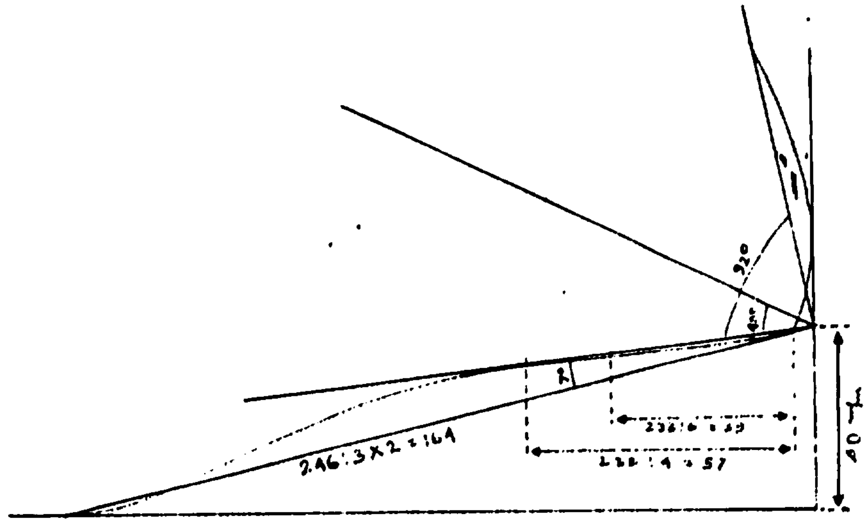


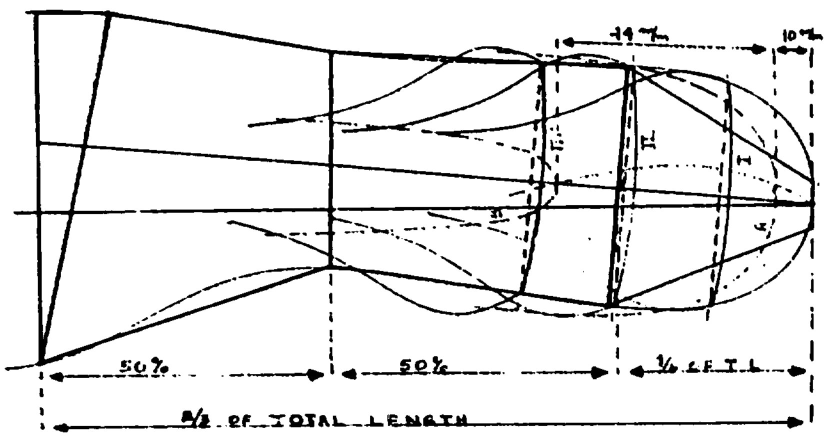
Sketch No. 22c.

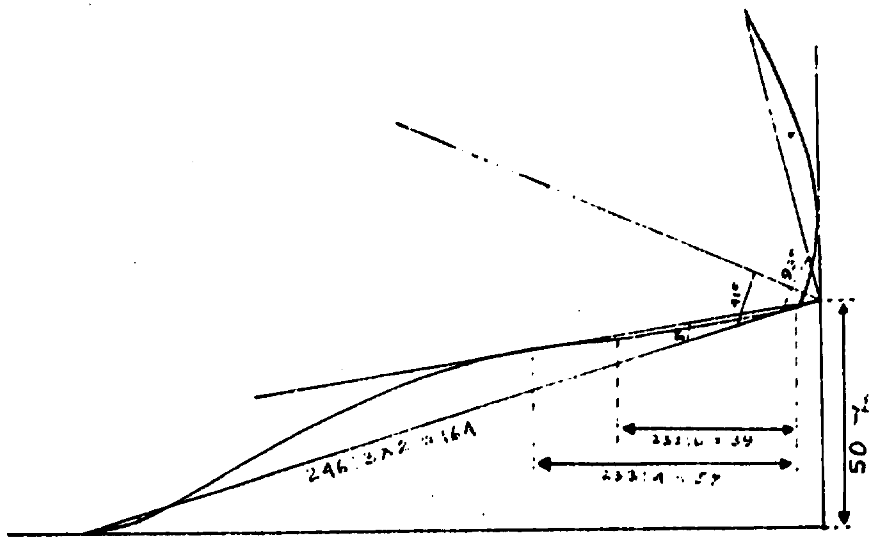
RENGTH OF FOOT	232·5 M/M
RENGTH OF INSOLE	245·5 M/M.
GIRTH OF BALL	215 M/M.
GIRTH OF INSTEP	230 M/M.
GIRTH OF SHORT HEEL	300·6 M/M.
INSOLE WIDTH AT BALL	72 M/M.
INSOLE WIDTH AT HEEL	52 M/M.
HEEL HEIGHT OF DRAWN INSOLE	40 M/M.

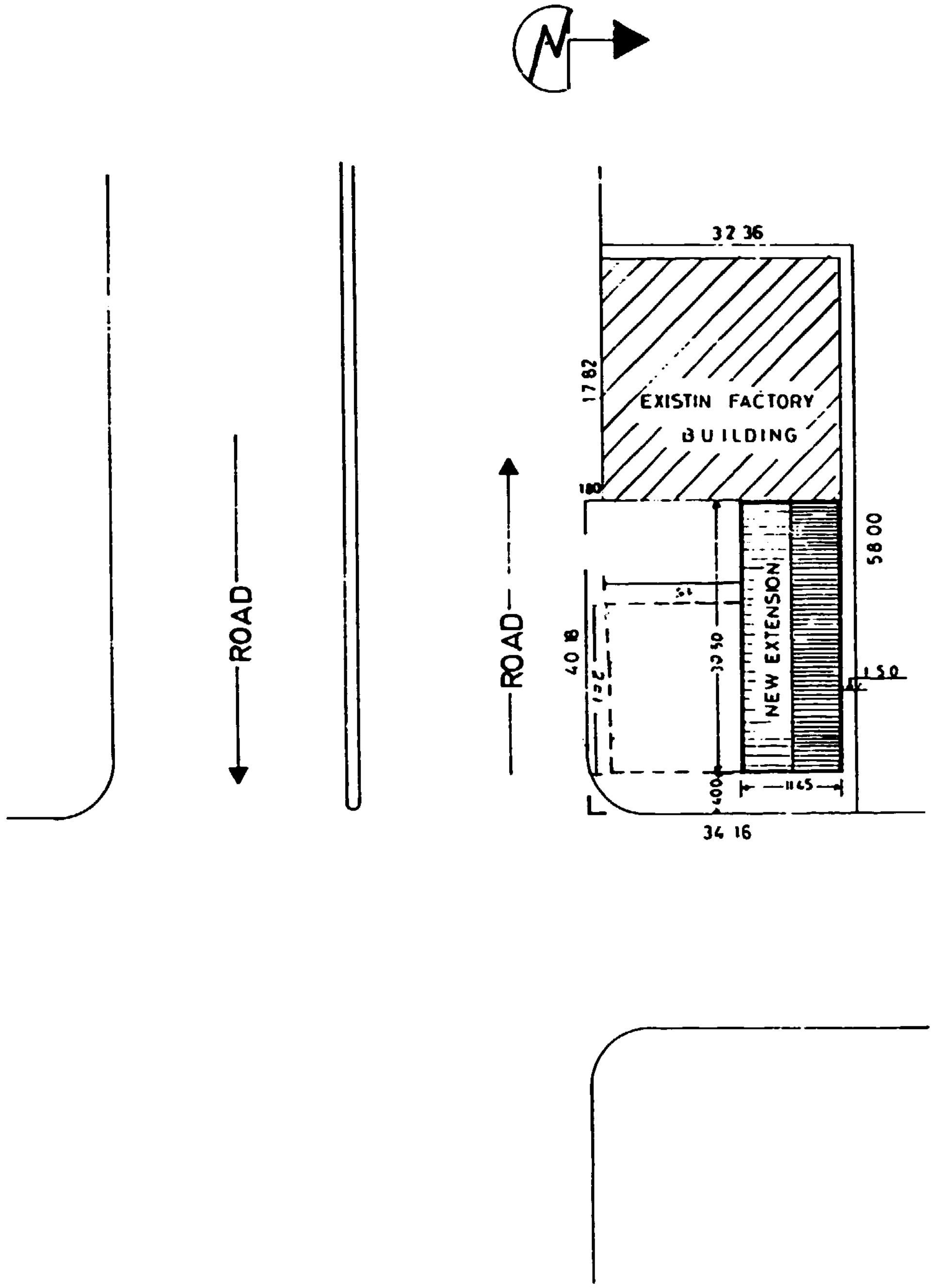
Article	Design	Size	Fitting	Designer
RANGE·5,6&7		4	F	





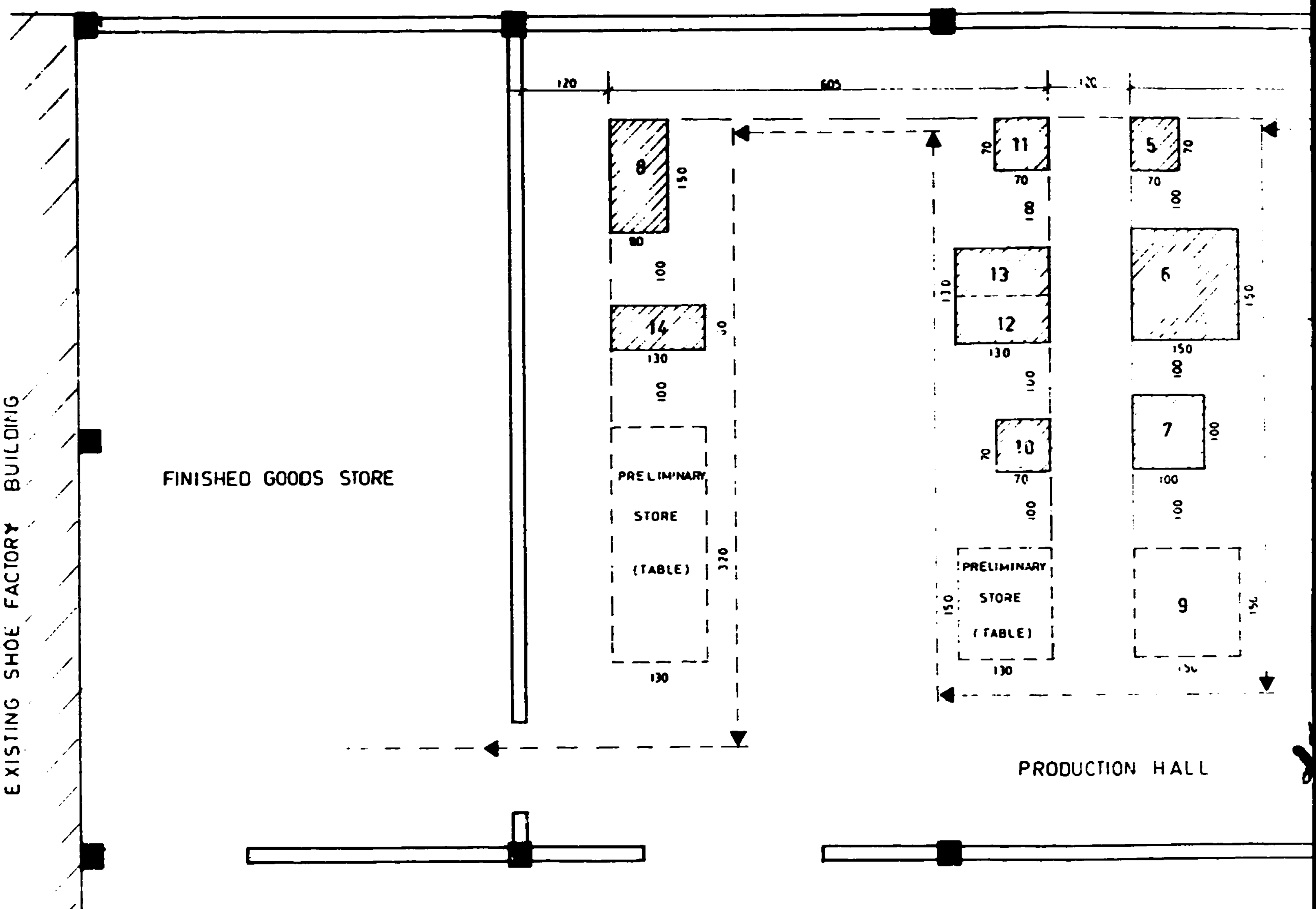






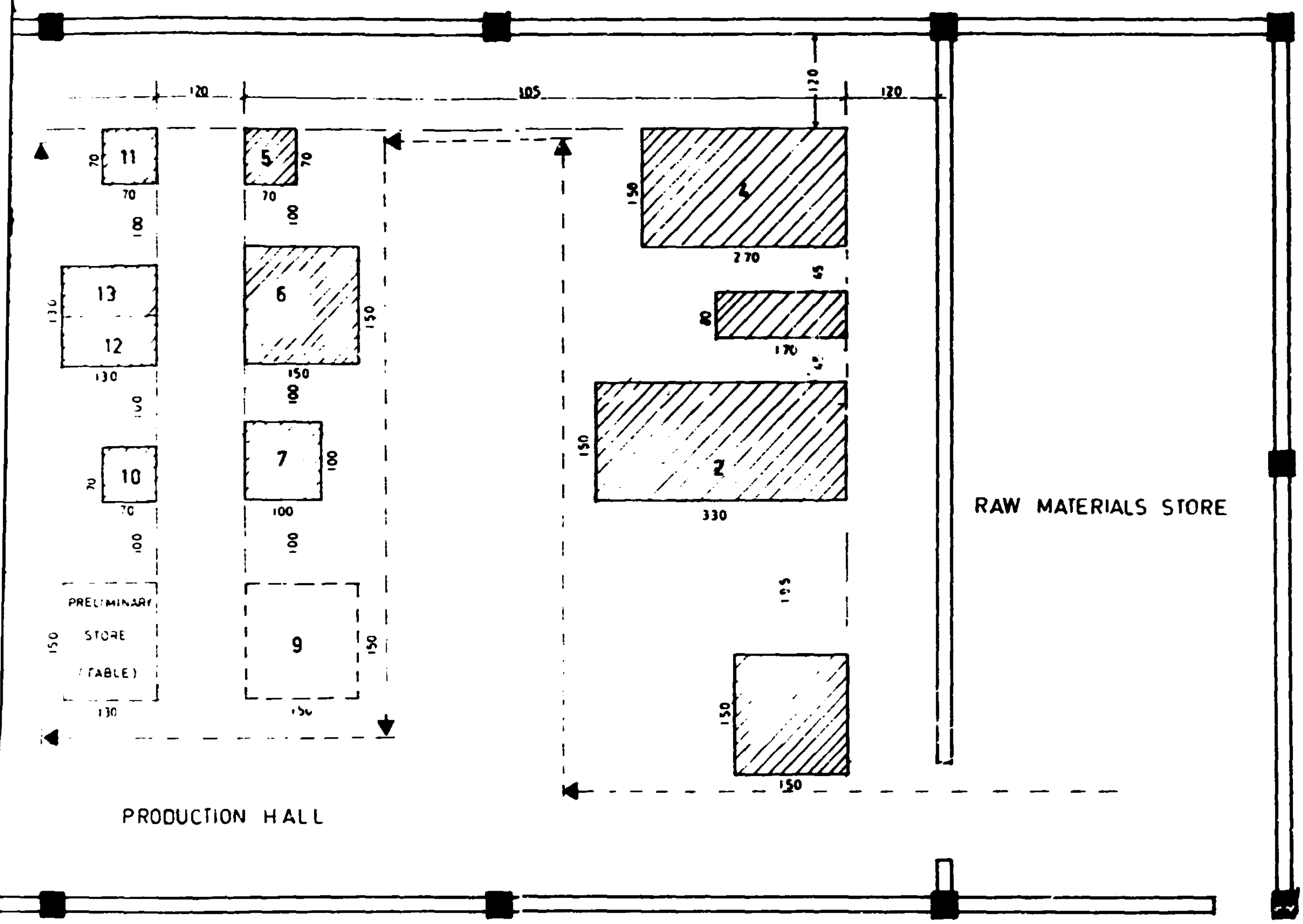
SITE PLAN

MINISTRY OF INDUSTRY NATIONAL LEATHER & SHOE CORPORATION	DR TITLE ELEVATIONS & SECTION
JOB TITLE LAST PLANT MANPO	DES DRN Barhom Abdul Bap CHKD APPD SCALE 1:50, 1:500 DR Nº DATE 21-5-1977



1 BAND SAW CUTTING m/c
2 ROUGH TURNING m/c
3 CHIPS EXHAUSTER
4 FINE TURNING m/c
5 DRILLING m/c
6 BAND SAW CUTTING m/c
7 CHAIN SLOTTING m/c
8 BAND SCOURING m/c
9 HINGE ASSEMBLY TABLE
10 DRILLING m/c
11 SHOULDER PLATE MILL
12 PNEUMATIC VICE
13 PNEUMATIC HAMMER
14 POLISHING m/c

SECTION 1



1 BAND SAW CUTTING m/c
2 ROUGH TURNING m/c
3 CHIPS EXHAUSTER
4 FINE TURNING m/c
5 DRILLING m/c
6 BAND SAW CUTTING m/c
7 CHAIN SLOTTING m/c
8 BAND SCOURING m/c
9 HINGE ASSEMBLY TABLE
10 DRILLING m/c
11 SHOULDER PLATE MILLING m/c
12 PNEUMATIC VICE
13 PNEUMATIC HAMMER
14 POLISHING m/c

MINISTRY OF INDUSTRY NATIONAL LEATHER & SHOE CORPORATION	DR TITLE MACHINERY INSTALATION
JOB TITLE LAST PLANT	DES.
	DRN Benhanu Chekol
	CHKD
	APRD.
MANPO	SCALE 1:50 · DR No
	DATE 17-5-1977

SECTION 2