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# PRECISION SHOE LASTS MANUFACTURE

IS/IND/75/077

INDIA

TERMINAL REPORT

Prepared for the Government of India by the  
United Nations Industrial Development Organization,  
executing agency for the  
United Nations Development Programme



United Nations Industrial Development Organization

United Nations Development Programme

PRECISION SHOE LASTS MANUFACTURE

IS/IND/75/077

INDIA

Project findings and recommendations

Prepared for the Government of India  
by the United Nations Industrial Development Organization,  
executing agency for the United Nations Development Programme

Based on the work of H.A.J. van der Wegen,  
expert in the production of precision shoe lasts

United Nations Industrial Development Organization  
Vienna, 1977

Explanatory notes

References to dollars (\$) are to United States dollars.

The monetary unit of India is the rupee (Rs). During the period covered by the report, the value of the rupee in relation to the United States dollar was \$1 = Rs 8.60.

PSLF refers to the Precision Shoe Lasts Factory at Agra.

SISI refers to the Small Industries Service Institutes

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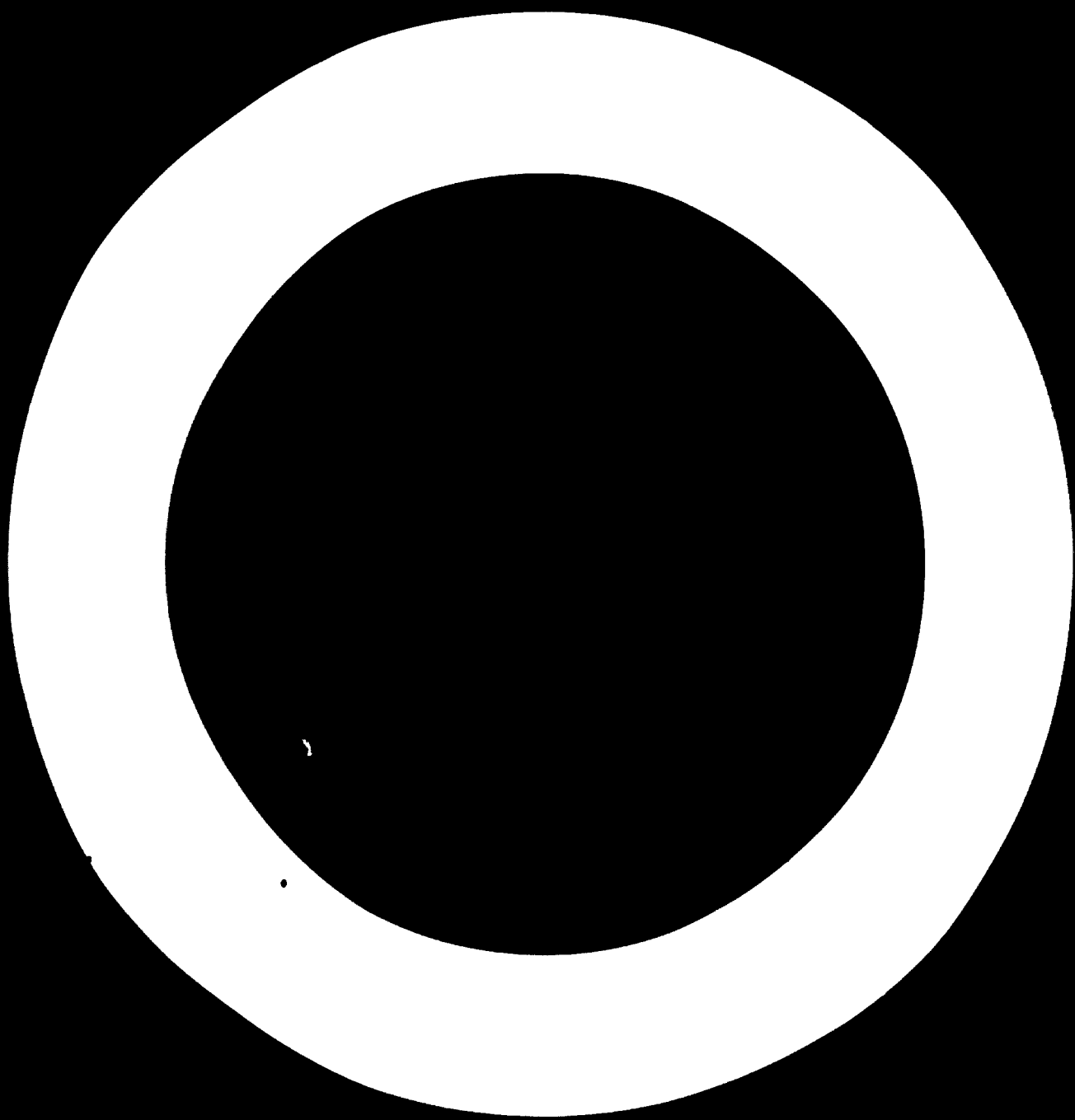
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ABSTRACT

The project "Precision shoe lasts manufacture" (IS/IND/75/077) stems from the request, in November 1975, of the Government of India to the United Nations Development Programme (UNDP) for assistance in the modernization of the Precision Shoe Lasts Factory (PSLF) at Agra. The productivity of this operation was very low, and its products did not meet the requirements of the domestic shoe industry, which in consequence experienced great difficulties as regards times of delivery of shoes in both the domestic and export markets.

As executing agency for this project, the United Nations Industrial Development Organization (UNIDO) assigned an expert in the manufacture of precision shoe lasts to study the problem in September and October 1976. He was attached to the Development Commission (Small Scale Industries) of the Ministry of Industry and Civil Supplies. Specifically, he was to study present work of the factory and suggest measures for its modernization and for increasing the production of shoe lasts of a quality suitable for export markets as well as for quality control. He was also to assess the requirements for appropriate seasoning of the wooden blocks used in shoe lasts manufacture and to provide advice in this area.

All of these objectives were accomplished; suggestions are made for changes in the arrangement, staffing, management and system of remuneration at the factory. This project was financed by a total appropriation of \$9,000 by UNDP.



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## INTRODUCTION

In November 1975, the Government of India requested the United Nations Development Programme (UNDP) to assist in the modernization of the Precision Shoe Lasts Factory (PSLF) at Agra. A study earlier that year had found that this unit, which had been established in 1963 with a planned production of 75 pairs of lasts daily, was producing only about 40 pairs daily. The machines of the factory were old and obsolete or obsolescent, the technical and managerial personnel were not of high calibre and suitable raw materials (wood and plastics) were not available. As a result, production did not meet the requirements of the domestic shoe industry, which therefore experienced great difficulties with delivery schedules, not only on the domestic market but also - and more importantly - on the export market.

Consequently, UNDP set up the project "Precision shoe lasts manufacture" (IS/IND/75/077), with the United Nations Industrial Development Organization (UNIDO) as executing agency. An expert in precision shoe lasts manufacture was assigned to this project during September and October 1976. During this assignment, he was attached to the Development Commission (Small Scale Industries) of the Ministry of Industry and Civil Supplies. The project was financed by UNDP with appropriations that totalled \$9,000

### Objectives of the project

The basic purposes of the project were:

To study the work of PSLF and to suggest measures for its modernization and for increasing its production of shoe lasts of suitable quality to meet export requirements as well as for quality control

To assess the requirements for and to advise on the appropriate seasoning of the wooden blocks used in the manufacture of shoe lasts.

## I. FINDINGS

To familiarize himself with PSLF, the expert examined those facets that affected the output volume in the production department as well as the quality of the final products. The local shoe industry was also visited to obtain an impression of the quality of the lasts after a long period of use and of gauging the opinions of the shoe industry about the products and times of delivery of PSLF.

The findings of the expert follow.

### Organization of the management

PSLF is an establishment of the Small Scale Industries Development Organization of the Ministry of Industry and Civil Supplies and is conducted by a Director who is assisted by a Deputy Director. Neither of these is full-time job. The managers are not stationed in the factory but at the Small Industries Service Institute (SISI) at Agra. The day-to-day management of the factory is exercised by the Assistant Director.

As might be expected, such an organization of management, exercising direction from outside the factory, has led to problems and even to failures of communication, and the decision-making process has been slowed down. Furthermore, this structure has created difficulties for the Assistant Director in fulfilling his duties. As a consequence of such overburdening, many such tasks could be carried out only partially or not at all; control of production and of quality was insufficient, leading to a low productivity and to barely adequate product quality.

### Condition of the buildings

The offices, the production department and the raw materials stores were very dusty and dirty. There seemed to have been no maintenance for years. The production department had a very slovenly appearance; wood waste and old lasts were piled up on the floor everywhere. The raw materials store is completely filled with old lasts; consequently, it could not be used to store wooden blocks, so the wood was mainly stored in the open air.

Because of this lack of maintenance throughout the years, the following defects were observed:

Several leaks in the roof of the production department and the raw materials store

Severe damage to the floor of the production department

The coverings of the walls and ceilings were torn and peeling off.

Equipment: machine tools, hand tools etc.

The machinery and its essential tools, such as saws, fraises, chisels and punches, were in very poor condition, which had led to losses in production and quality.

Small hand tools such as files and hammers showed wear and tear, and the work tables were very poorly constructed. The capacity of the exhaust installation was either insufficient or was not functioning properly; perhaps both were true.

Several machines to produce hinge lasts were unusable because their essential tools were missing and the various machines were not compatible. Also, the purpose of one machine, namely the hydraulic press, was wholly unclear, so it was not being used.

Raw materials

For the production of lasts, shesham wood was used. Because this wood is very hard, it was necessary to perform three consecutive rough turnings before fine turning was started. Also, the hardness of the wood had a negative effect on the productivity of the finishing section. The wear and tear on the tools of the machine - saws, fraises, chisels and the like - was considerable.

Another great disadvantage of shesham wood is that costs for seasoning and transporting it to the factory are relatively high. (These operations are carried out by other firms.) On the other hand, shesham wood lasts have the advantage that they are not easily damaged during manufacture or in use at the shoe factory.

Routing and transport in the production department

The routing in the production department was not very well organized; several machines used to make lasts were not grouped in a rational sequence, which caused much delay in transporting the lasts through the various manufacturing processes.

No transport system was available in the production department, so the lasts had to be placed on the floor during production. They also had to be hand carried from one operation to the next, and had to be sized again and again according to job order and size. Incorrect routing, as well as the absence of a transport system, had a negative effect on the productivity, control and supervision of production were very difficult.

Staffing and remuneration in the production department

Very great losses of production were caused by a shortage of manpower in the finishing section of the factory. As shown in the present manpower schedule (table 1), the production department lacked two skilled workers.

Table 1. Present and planned staffing of the Precision Shoe Lasts Factory at Agra

Job title	Planned staffing	Present staffing
Director	1	1
Deputy Director	1	1
Assistant Director	1	1
Superintendent of Administration	1	1
Modeller	1	1
Investigator Mechanic	2	1
Accounts Clerks	2	2
Steno	1	1
Sales Clerk	1	1
Skilled worker	3	3
Utility man	9	7
Helper	2	2
Messenger	2	2
Watchman	2	2
Totals	29	26

Judged by the operations to be carried out, and adjusted to a production capacity of about 70 pairs of block lasts daily, there was a shortage of five skilled operators in the production department (table 2). This manpower shortage has caused a large backlog of work (about one month's production) between the turning lathe and the finishing section.

Table 2. Present and planned staffing of the production department of the Precision Shoe Lasts Factory at Agra

Operations	Planned staffing (table 1)	Present production capacity (40 pairs daily)	Planned staffing to achieve maximum capacity (70 pairs daily)
Sawing rough blocks	1	± 40	3
Sawing last blocks			
Drilling and milling the hole for the block fastener pin			
Repairing damaged lasts	1		
Rough and fine turning	2	± 70	2
Toe- and heel-curve cutting and milling	1	± 70	1
Toe- and heel-curve filing	1	± 70	1
Nibbling the iron bottom and punching tack and fastener holes (full iron bottom)	1	± 30	2
Shaping and fixing the full iron bottom	1	± 30	2
Manufacturing top pieces, fixing top pieces and drilling the hole in back part for the last-removing string	1	± 40	2
Finishing: inspection, marking, polishing, waxing etc.	<u>5</u>	± 50	<u>6</u>
Totals	14		19

The workers in the production department received fixed wages, independent of their productivity. The output of the department was low, especially in the finishing section (about 40 to 50 pairs/day).

### The model section and the modeller

The model section was too small and was poorly lit. A number of essential apparatuses were missing, as were several tools of at least one apparatus for measuring heel height, so that it could not be used. In the model section, auxiliary materials such as paper and nails were used that were almost or totally unsuitable for their purposes. The storage of the turning models as well as the storage of the insole patterns and toe and back curve profiles was very poorly organized.

Despite the conditions under which the modeller had to work, and the expedients he had to use, the turning models were of fairly good quality. However, he was insufficiently oriented to the fashion requirements of the western export market and totally unfamiliar with developments in western methods of making lasts and machines for making them.

He performed activities that could have been done at much less cost by assistants. He had also to perform control activities in the production department regularly, which is quite inappropriate.

### Selling policy

PSLF worked without a collection of samples from which the selling could be done. As a consequence, shoe factories, large and small, created their own models and ordered PSLF to make them up. Consequently, the modeller had to make many turning models, even for orders of only about 10 to 15 pairs. This way of working caused much loss of time in preparing the turning models, resulting, in turn, to long delivery times; this way of handling small orders is patently uneconomic.

### Quality of the lasts

During the visits to PSLF, the following findings were assessed with regard to the quality of the lasts:

In general the iron bottom plates were badly cut, so many of them were attached inside the feather line of the last bottom. Consequently, filing the plates was not possible, leading to sharp edges and an irregular feather line of the last bottom

During the hand shaping of the full iron bottom plates, they acquired a rather irregular surface, which can cause problems during insole attachment in shoe manufacturing. During visits to the local shoe industry at Agra it was observed that the fastener and the fastener pin of the block lasts were worn out, causing an incorrect fit of the block on the last. Therefore, according to the local shoe manufacturers the use of hinge lasts would be advantageous.

### Conclusions

Generally speaking, the conclusion seems to be justified that the low productivity of PSLF at Agra results mainly from the following factors:

Poor organization of management, causing important tasks such as production control to be performed inadequately

Bad condition and insufficient maintenance of the factory buildings

Bad condition and insufficient maintenance of the machines, hand tools, working tables etc.

The raw material used (shesham wood) is too hard to be manufactured in an economic way with the present facilities and staff

Non-rational routing and the lack of a transport system in the production department

Inadequate manpower in the finishing section and a rewards system that provides little motivation for good work

An unfavourable selling policy.

Although several faults in the lasts were assessed, it can be said that the quality of the final product is reasonably high. The present margin of the tolerance between the last blocks and the lasts themselves is unavoidable, at least over long term.

## II. RECOMMENDATIONS

It is possible to increase both the productivity and the quality in the shoe lasts factory at Agra. In order to realize such increases, the following recommendations are given:

### Reorganization of the management

In order to establish clear-cut lines of authority and responsibility, the management of PSLF should be reorganized in the manner shown in figure I. It is important that the general management be brought in from outside, where it now is, and installed at the factory at Agra. The Director should be given high decision-making competence. The advantages of such a reorganization would include reduction of problems of communication and decision-making and the clear delineation of responsibilities. Such a reorganization would have a positive effect, not only at the administrative level, but also on the productivity of the factory and the quality of its output.

### Rehabilitation of the buildings

It is already the policy of the Government to create facilities for the primary maintenance of the buildings. It should also consider the possibilities of extending or rebuilding some of them, or perhaps both. The following changes, improvements or both should be carried out:

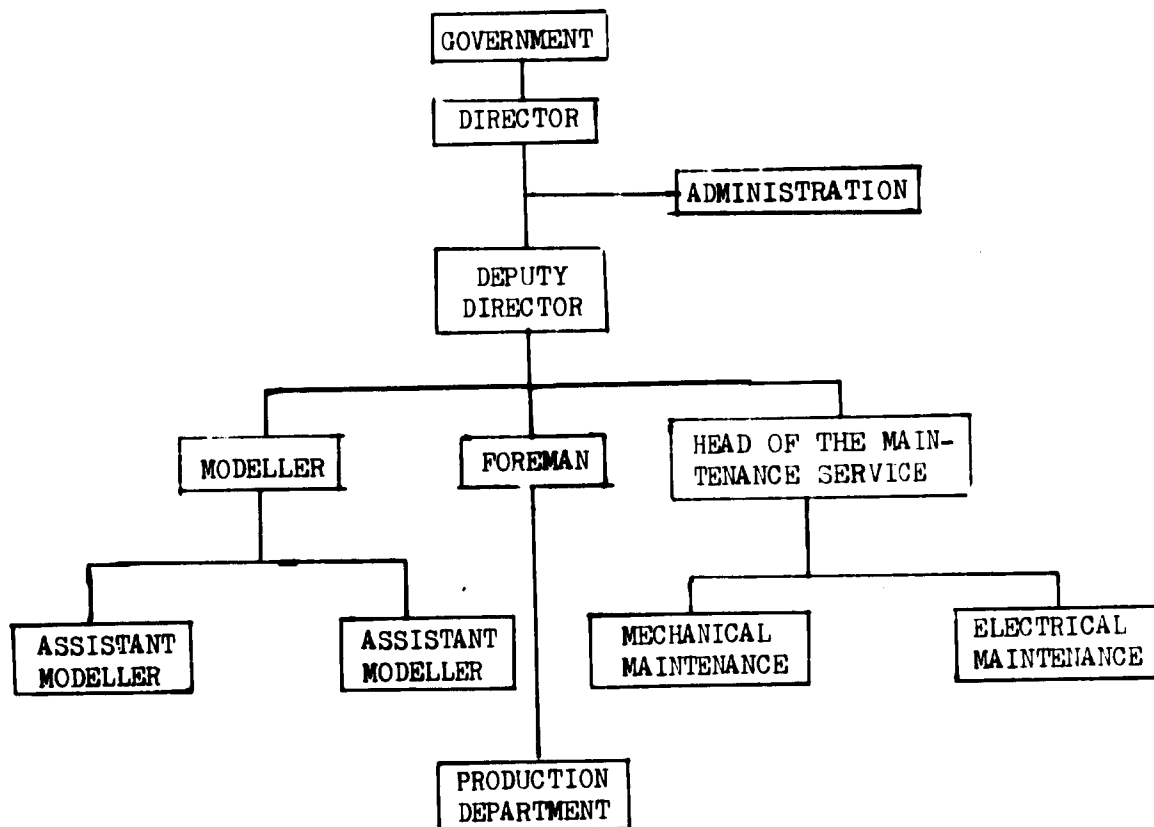
Repair of the roof and floor

Repair and painting of the walls and ceilings of the production department and offices

Furnishing the raw materials store with ample storage space for the wooden blocks. This can be done by building two-level racks along the walls of the raw materials store.

The minor maintenance of the buildings should be done once a week, perhaps during the last hour of the work week. Such maintenance could be restricted to clearing away the waste and dust in the production department. The principal maintenance of the buildings is incidental and can be done when necessary.





Titles and job descriptions of the management personnel:

Director	Shoes and/or lasts technician. General management of the factory; liaison with the Government. Specialized tasks: personnel management, purchasing, sales, administration.
Deputy Director	Shoe and/or lasts technician. General management of the production department; planning; quality control.
Modeller	Lasts technician and designer. General management of the model section, responsibility for the designs.
Foreman	Shoe and/or lasts technician. Assistant to the Deputy Director; day-to-day control of production and quality.
Head of the Maintenance Service	Mechanical Engineer. General management of the maintenance section.

Figure I. Planned organization of the management of the Precision Shoe Factory at Agr.

Equipment: machine tools, hand tools etc.

The production personnel must undertake the maintenance of the machines immediately. It should be done simultaneously with the weekly maintenance of the production department. For the primary maintenance of the machines, a maintenance schedule must be drawn up in which it is set down just when the essential tools of the machines and the small hand tools must be overhauled or replaced. Machines and working tables that are not in use must be removed from the production department.

The productivity of the factory would be very favourably affected if the preparation of full iron bottoms for the lasts were to be done on the hydraulic press. This press must therefore be rebuilt in a way that would make it possible to shape the iron bottoms on the lasts. Such rebuilding could be performed easily by a mechanical engineer. The acquisition of a special guillotine-type machine to cut the iron bottoms into rough shape should also increase production.

If the maximum capacity of the turning lathe is ever attained, especially in view of the mechanization of the shoe industry, the following machines will have to be acquired:

A new fine-turning lathe that could turn two pairs of lasts simultaneously. The existing machine can be converted into a rough-turning lathe

A special machine for sawing the hinge in hinged lasts

A two-headed chain-cutter to cut the hinge slot in hinge lasts

A special machine for boring standardized thimbles in the back part of hinge lasts

Raw materials

The use of shesham wood should be abandoned. Plastic (high-density polyethylene) should be used for production lasts and a wood more easily worked than shesham for the turning models. The help of the plastics industry will be essential here. The change to plastic as a raw material offers great advantages for the production of lasts, as well as for the shoe manufacturer for the following reasons:

Plastic lasts need rough-turning only once

Polishing and waxing, which must be done with wooden lasts, is unnecessary with plastic ones

Fitting the top pieces on the back cone top plane is not necessary with plastic lasts

Plastic lasts are insensitive to humidity and therefore have more stability

Wastes in the production department and discarded plastic lasts can be recycled by grinding and melting them together with a new granulate

There would be less wear of machine parts and small hand tools in production

Operations such as filing the toe and heel curves could be done more quickly

There would be little or no air pollution, and therefore cleaner operation

Plastic lasts do not need powder on the toe and back part in the shoe factory to prevent the sticking of toe and stiffener materials to them

When using plastic for lasts, the problems of drying the wood and the plan to organize a wood-seasoning department in the factory in Agra would be unnecessary.

#### Rationalization of routing and transport in the production department

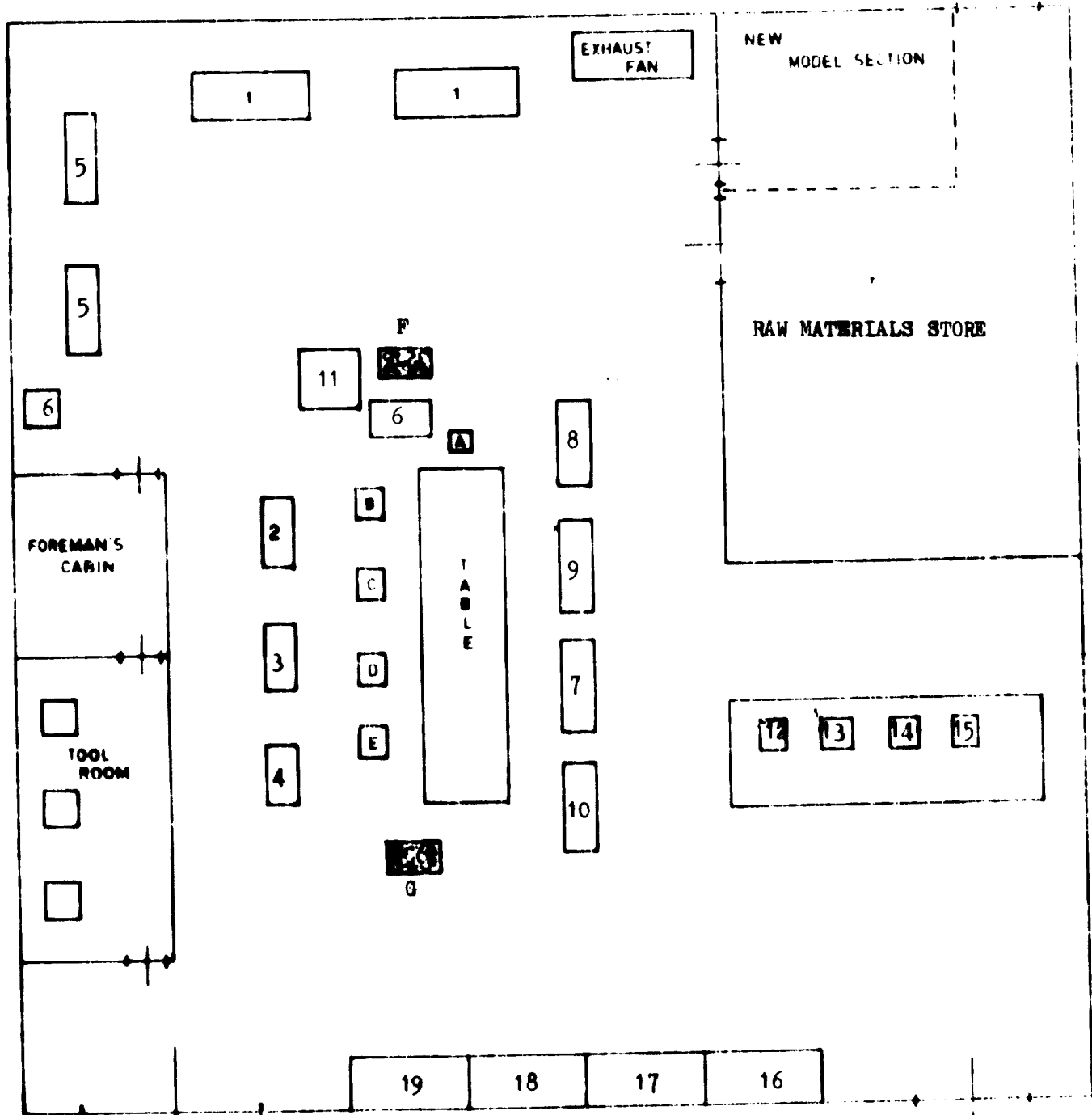
A number of machines will have to be removed in order to make possible faster operations and thus a shorter process time in the factory. On the drawing attached (figure II), a rational grouping of operations is shown.

The form of the plant in this drawing corresponds to the existing ground-plan of PSLF, which was drawn by SISI.

A transport system must be installed in the production department. The most efficient and also the most widely used system in a lasts factory is the use of movable racks closed on three sides, as shown in figure III, B.

The lasts can be placed on these racks by order and grouped by size and be transported from one operation to the next. It is also recommended to use hand trucks to convey the raw blocks from the raw materials store to the band saw machine (figure III, A).

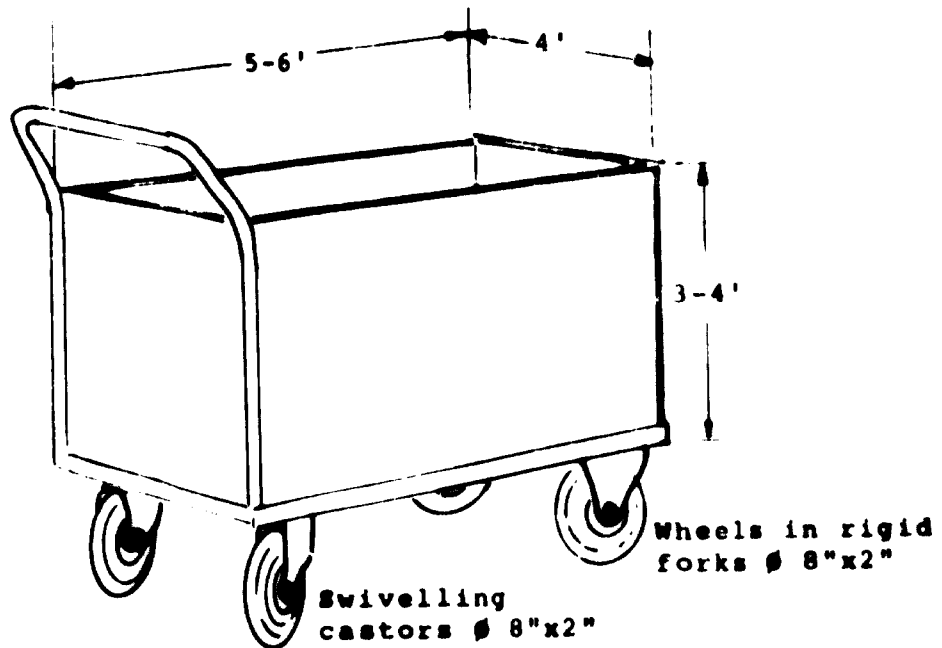
For the present production volume, about 30 movable racks and 5 to 7 hand trucks will be needed. In addition to higher productivity, the installation of a transport system would provide the advantages of simple process control in the factory and will affect the quality of the products favourably.



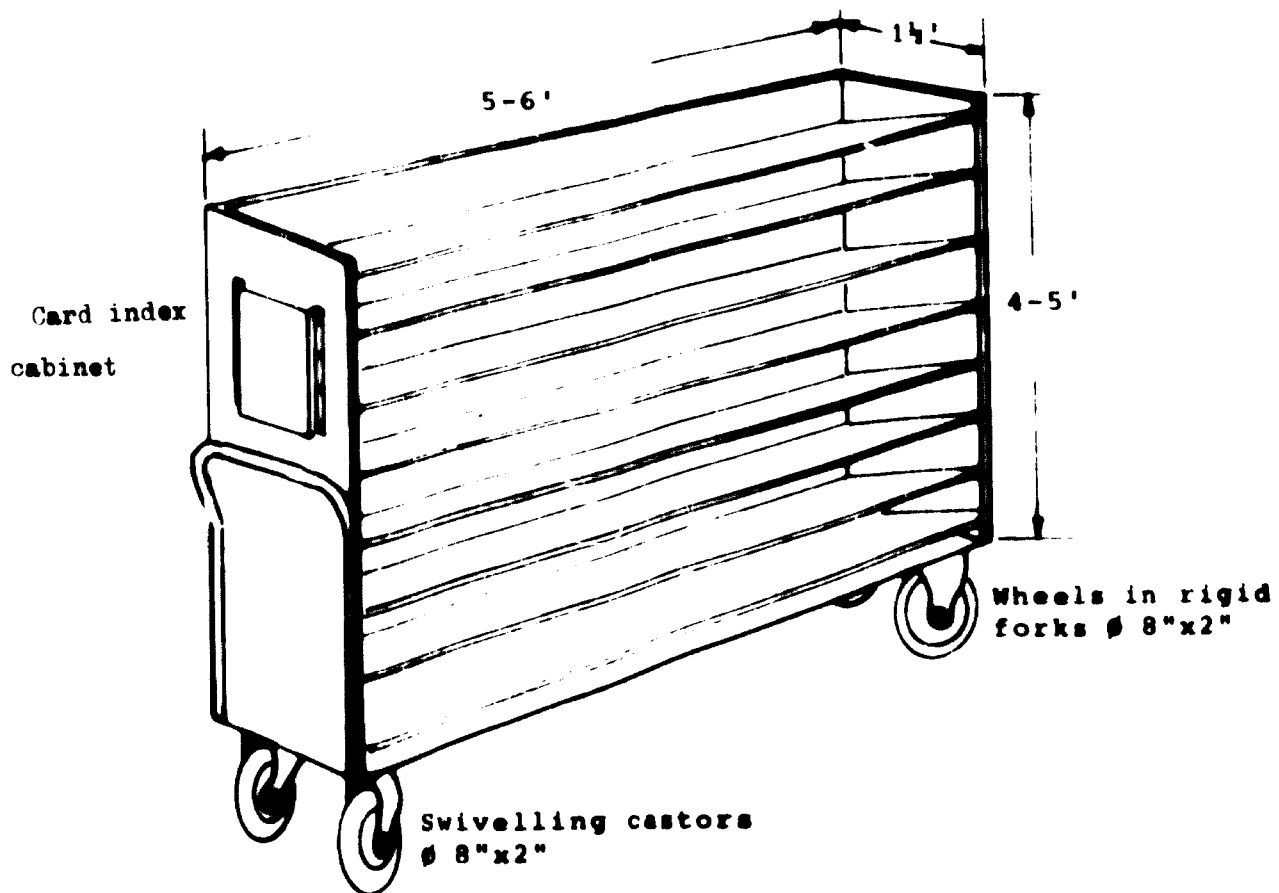
- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. Copying lathe                   | 12-15. Grinding and polishing jacks |
| 2. Spindle drilling machine        | 16. Hydraulic press                 |
| 3. Gap saw                         | 17. Punching machine                |
| 4. Chain cutter                    | 18. Nibbling machine                |
| 5. Band saw                        | 19. Cutting machine (guillotine)    |
| 6. Electric motor with drill chuck | A - E. Working tables:              |
| 7. Tip milling machine             | A. Top piece fixing                 |
| 8. Heel cutting machine            | B. Toe filing                       |
| 9. Heel shaver                     | C. Heel filing                      |
| 10. Top saw                        | D. Plate fixing                     |
| 11. Pillar drilling machine        | E. Plate filing                     |
|                                    | FG. Hand carts                      |

Figure II. Planned rearrangement of the Precision Shoe Lasts Factory at Agra

- (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.

Figure III. Hand trucks for transporting materials in the production department

Staffing and remuneration in the production department

The finishing section of the factory is where all operations after fine turning are done. Its staff should be expanded by at least seven labourers, in order to bring production to the maximum capacity of the turning lathes. For the principal maintenance of the building and the machines, specialized manpower will have to be employed. In the model room, two assistants will be needed. Every operation should be able to be done by at least two people, so that no production stagnation would result in case of illness or holiday periods.

One of the most efficient ways to increase the productivity in a factory is to adopt a bonus system for the production personnel. There are two principal methods of doing so:

An individual bonus system, calculating for each employee a tariff that is oriented towards over-production, with maintenance of quality

A group bonus system, whereby a bonus is given to a group of employees when a specified level of production has been attained.

The latter system can be set up relatively simply, and it is, especially in the initial period, a satisfactory system for a shoe lasts factory. The present Assistant Director is able to design and introduce such a system for the factory.

The model section and modeller

A new model section must be built, sooner or later. This might be done in a relatively simple and inexpensive way by separating part of the present raw materials store shown in figure II.

In this model section (figure IV) racks could be built to store the turning models and to put away the insole patterns and the toe and heel curve profiles. At the upper side of the model section a working table could be built, provided with at least three special vices to facilitate the work of the modeller and his assistants. A drawing of this special vice is available in the factory. In addition two new apparatuses will have to be constructed by SISI, namely:

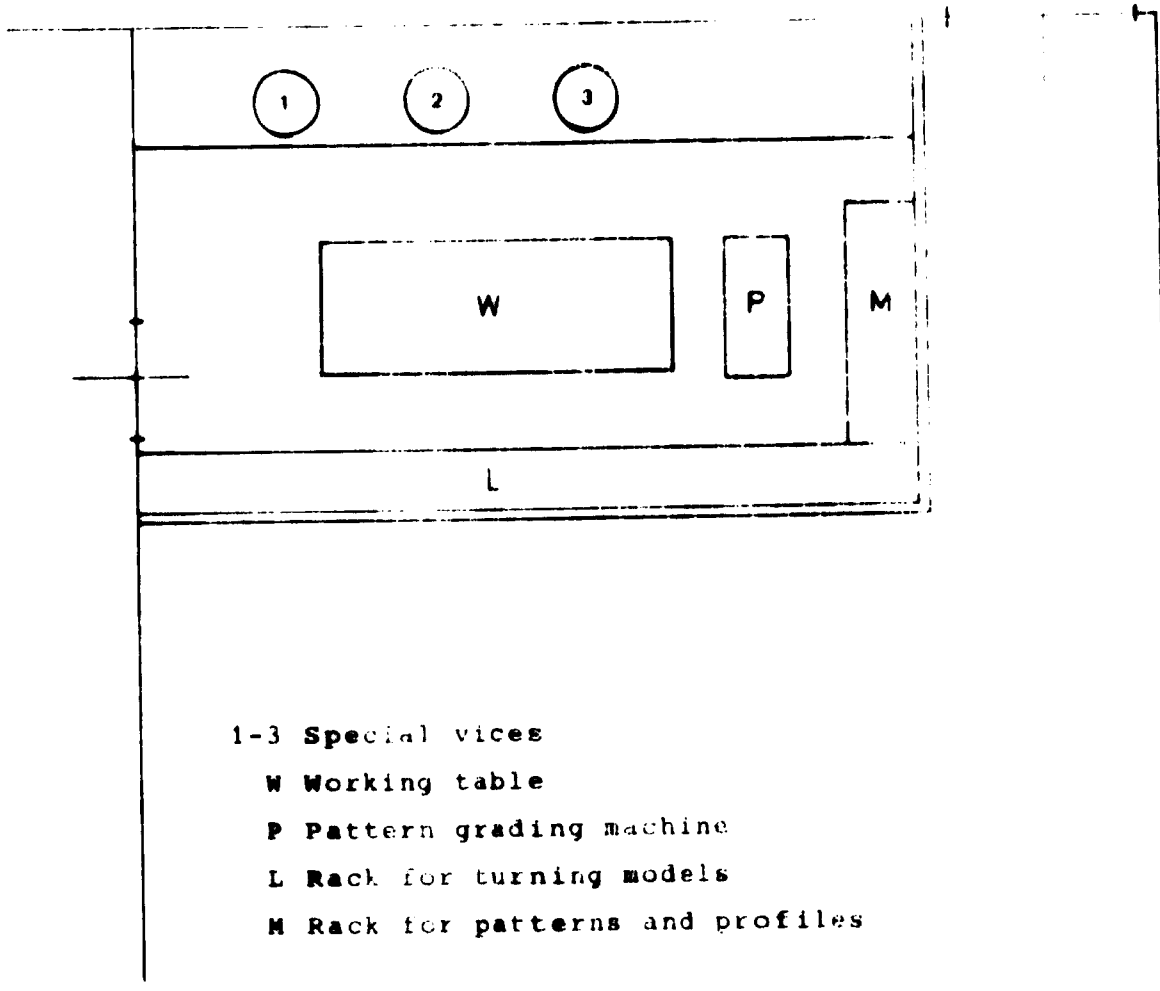


Figure IV. Planned layout of the new model section (See figure II.)

An apparatus to identify the centre line of the lasts and to mark it with the aid of a scratching device

An apparatus on which the ball girth of the lasts can be pointed out in a simple way, also with the aid of a scratching device.

Rough designs of both apparatuses are on hand in the factory.

Missing parts of the Fagus heel-height apparatus must be acquired, if it is to be used to determine the heel height of the lasts. More suitable sources auxiliary materials such as paper, fibreboard and nails should be sought. In order to simplify the work of the modeller and to direct it more towards the exact designing of lasts, two assistants will have to be trained. After the training period, it is recommended that the modeller be sent for at least three months to a shoe lasts factory, perhaps in the Netherlands, so that he can study modern production and design techniques. Furthermore, the modeller will have to orient himself towards western fashions, with a view to promoting the export of footwear to western countries. This can be realized by the regular purchase of fashion publications and by visiting the fashion fairs that are organised regularly in Paris, Milan and Pirmasens (Federal Republic of Germany).

#### Selling policy

In order to work more efficiently in the model section, to limit the quantity of turning models and to speed up delivery, one must design a collection of last samples, preparing the turning models at the same time. The size of the collection and the number of changes each year (in Europe, summer and winter collections are usual) will have to be attuned in practice to the requirements of the market. If special turning models must be made to the specifications of a shoe manufacturer, their costs would have to be charged separately. Such costs would be related to the salary of the principal modeller, plus materials and overhead.

The advantages of such a combined system, that is, a sample collection and calculation of costs of manufacturing to special order can be summarized as follows:

The smaller shoe factories tend to choose from the sample collection because of the high cost of manufacturing to order

Delivery can be faster to both the larger the smaller shoe factories

Planning and process control are much simpler.



Quality of the lasts

The overall quality of the product supplied can be improved in the following areas:

More attention must be paid to quality control during production

The production staff should work more accurately by the frequent use of control aids such as insole patterns and toe- and back-curve profiles

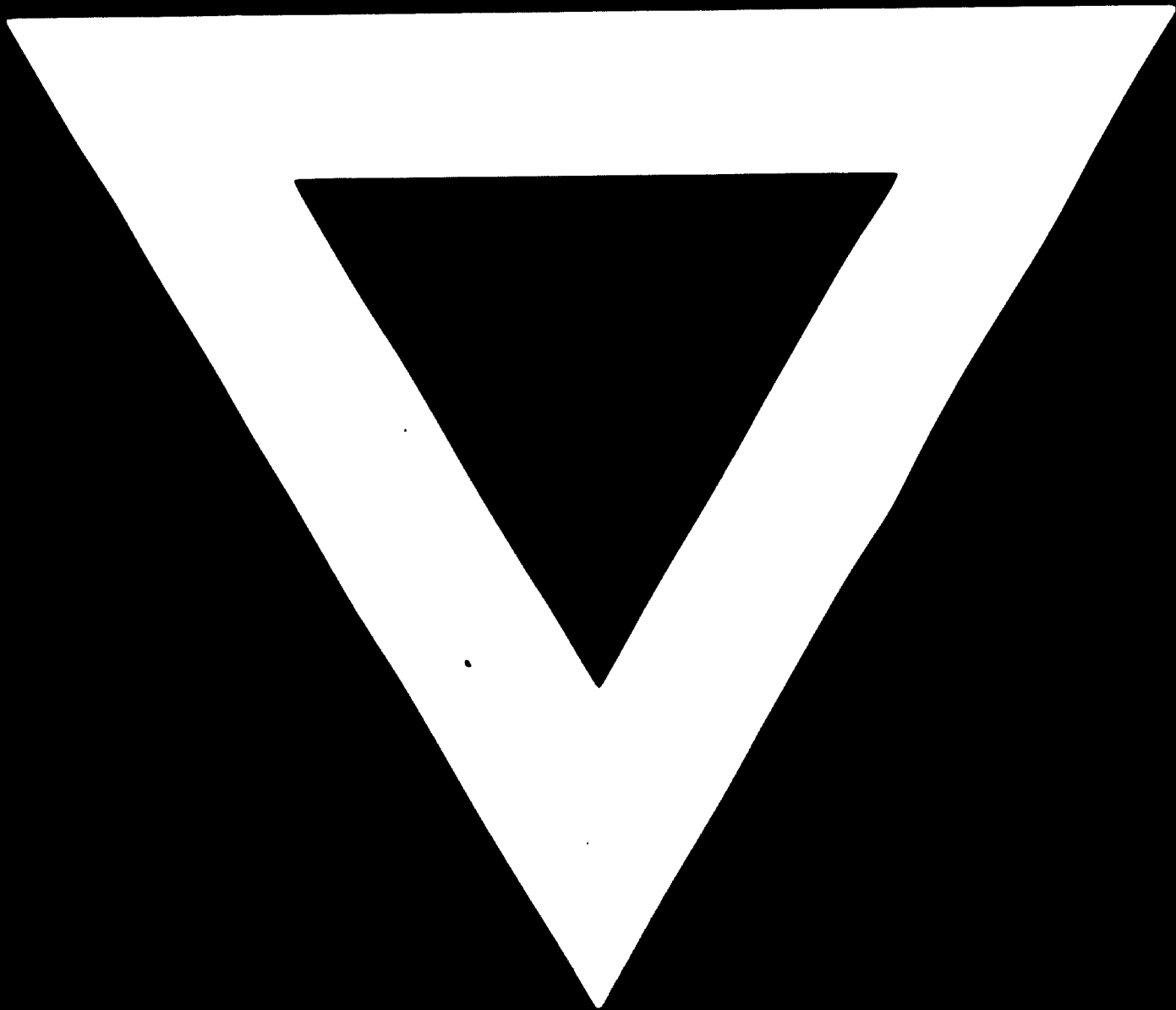
Care must be taken to maintain the tools in the machines and the hand tools in good condition

If the mechanization of the shoe industry in India is to continue, there must be a complete change from block lasts to hinge lasts with a thimble.

In the long run, the hinge lasts will certainly be qualitatively better than block lasts. Furthermore, hinge lasts are more suitable for shoe production as far as their removal from shoes, and especially from boots, is concerned.



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