Design Of Cobbler Tools

A product design **Project II** report
by

Pravin S. Padale
01613003

Project Guide
Prof. U. A. Athawankar

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Contents

Approval Sheet

The product design project titled
"**Design Of Cobbler Tools**"
by Pravin S. Padale is approved for the partial fulfillment of the requirement for the Post graduate degree in Industrial Design.

Project Guide

Chairperson

Internal examiner

External examiner

Date

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CHAPTER 1

INTRODUCTION

1.1 Why this project ?

Initially, when the project topic was proposed, there was no idea about the nature of the project. Hence few visits were made to the cobblers and general information was collected about their work and their tools. Few initial findings are mentioned below.

- Since long (almost hundreds of years) their tools have not changed.
- The tools are not standardized.
- Safety and ergonomics have not been considered for these tools.

In this project, only the cobblers of Kolhapur district are considered. The chappals they make are beautiful. These will be more beautiful with help of new tools. There is good scope for designers to work in this field. New designs of tools can improve the production and hence the productivity of the cobblers will improve. There is possibility of solving ergonomic issues with the help of new design projects in this area. Though the process of chappal making is interesting, it is quite complicated. This may improve with the help of new designed tools.

These tools are not only used by the cobblers but also by the leather industry which makes other leather products. At present the Kolhapuri chappal industry is slowly shrinking. The leather industry doesn't seem to be following this pattern of shrinking. There are a lot of small shoe and chappal manufacturers other than kolhapuri chappals, who still use the same tools and likely to use it for next few generations because of cost and tradition of craft. Hence, there is a great scope for these tools to be used not only for kolhapuri chappals but also for other applications in the leather industry.

So the data collection was started.The main focus was the cobblers in the Kolhapur district as this city is famous for kolhapuri chappals. These are pure leather chappals. In the first stage of the data collec–tion it was found that there are four types of cobblers. After study of these peoples, user profile was decided. For this class of people the tools were considered. A detailed studywas done about the chappal making process and the tools they use.

1.2 Type of cobblers

a) Roadside Cobblers

The cobbler who repairs and polishes the chappals, shoes comes in this category. Generally, they don't sell the chappals. Their main work is to repair the chappals. Even though some of them sell while repairing, the sales of chappal is not prime focus. They are typically found with tools which are cutting and repair tools. Their meager income comes mainly from repairs and not from the sale of new chappal. Basically, they use sewing tools, specially the tools that are used for sewing with thread. These tools are non-powered hand tools.

Most of the cobblers of this category are over age of 40. The major class of these cobblers is found in all cities around every corner. This class of cobblers is now vanishing rapidly.

Fig. 1.2a

b) Traders and Sales Shops

These peoples were initially having a cobbler shop in the heart of the city but the present generation has shifted from the craft of chappal making into a trading business. Some of them still have cobblers working on back side of their shops. Few of the people purchase the chappals from the cobblers working in the nearby villages. They own highly furnished shops in the town. They are located as a group in the middle of the city. They have a good market in the city for the selling chappals. They even export the chappals. Amazing thing about these peoples is that they have good knowledge of chappal making . This knowledge helps them to sell it at good margins. They act as a mediator between the customer and cobbler. The selling price of chappals are high as compared to the prices in the shops who have their own workshops.

Fig. 1.2b

C) Chappal Manufacturers With Own Shop

These are the cobblers who manufacture all types of chappals and also sell them in their own shop. They also have warranty for their products. They even repair chappals for their customer. Normally they are the individual entrepreneurs and own a small shop located at road sides. They use a good variety of tools. These people are also in good number everywhere. They sometimes use motorized sanders and a few mechanized tools while manufacturing chappals. Basically, they make the cheap chappals with rubber soles com–bined with the leather. Most of the times, the prices are negotiable. Unlike the kolhapuri chappals they have a standardized size of chappals. The leather chappals they sell is also modified version of kolhapuri chappals. They also sell the factory made chappals like slippers and foam chappals.

Fig. 1.2c

d) Pure Leather Chappal Manufacturer

These cobblers use the tools for longest time. Almost all the tools are handmade and very cheap. Cost of their tool ranges from Rs five to Rs 100. They are locally known as kalakaar . These cob–blers live in nearby villages located near Kolhapur city. They can give you the customized chappals based on your own foot size. Ba–sically they have 4–5 styles of chappals. Usually they make one chappal per day, price it between 200 rupees to 350 rupees based on the customer order, style and the decoration needed. Normally they work in own home and the family persons help him in his pro–fession.

Fig. 1.2d

1.3 User Profile

The user is

a) The cobblers who works in small villages

As mentioned in the last few pages these are the peoples who manu–facture the pure leather chappals. They also do occasional chappal repairs. As most of them are uneducated and since from genera–tions they are working in villages, their earning is also limited. They have the customers from the same villages and a few from the neigh–boring villages. Sometimes they get business from traders and sales shops from the city.

b) They manufacture only pure leather chappals

The tradition of their art of chappal making is coming from genera–tions and has not changed. They still keep doing the same pure leather chappals. Few cobblers are changing but still the identity of the chappal is maintained. This is very important because one of the characteristic of the kolhapuri chappals is the fact that it is totally made from leather only. This is what differentiates them from other types of chappals and this is one of the important reasons why they still have business.

c) Generally one person runs the business

For generations, the business is passed on from father to son. They have limited amount of sales volume. They are also mostly treated as service men more than as entrepreneurs. This may be because of his customization of chappals for individuals. Due to this reason, manufacturing setup has limitations. Standardization is almost im–possible.

In some cases they solved the problem by getting a group of cob–blers under one owner. In this case cobbler makes one complete set of chappal. But this is not the picture in village as the volume is low.

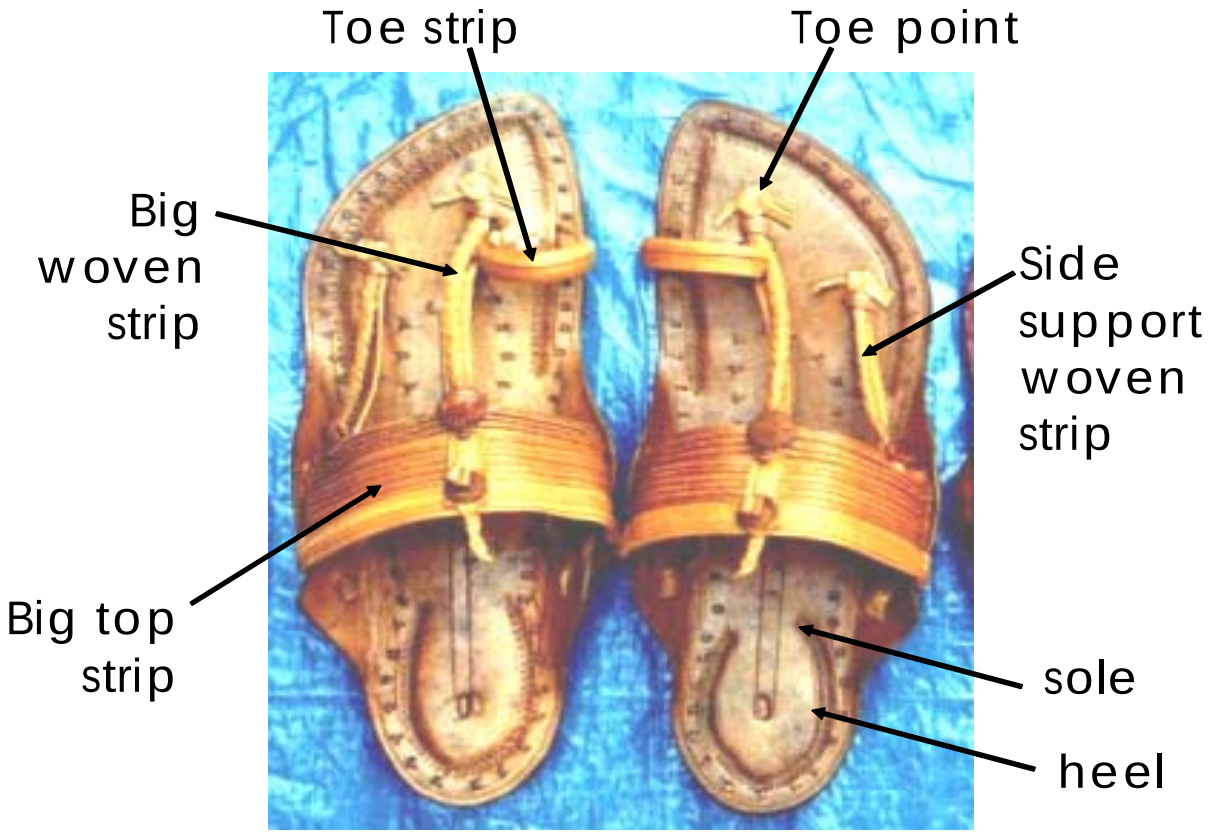
d) They use the cheapest, non–powered tools available in the market

As from generations the design of the chappal has not been changed, the way they make it also not changed. The art of chappal making is passed for generations without much change in it. That is why the tools also have not changed. They are cheap hand powered tools, many times customized for ones own way of working.

e) They have limited variety of chappal styles

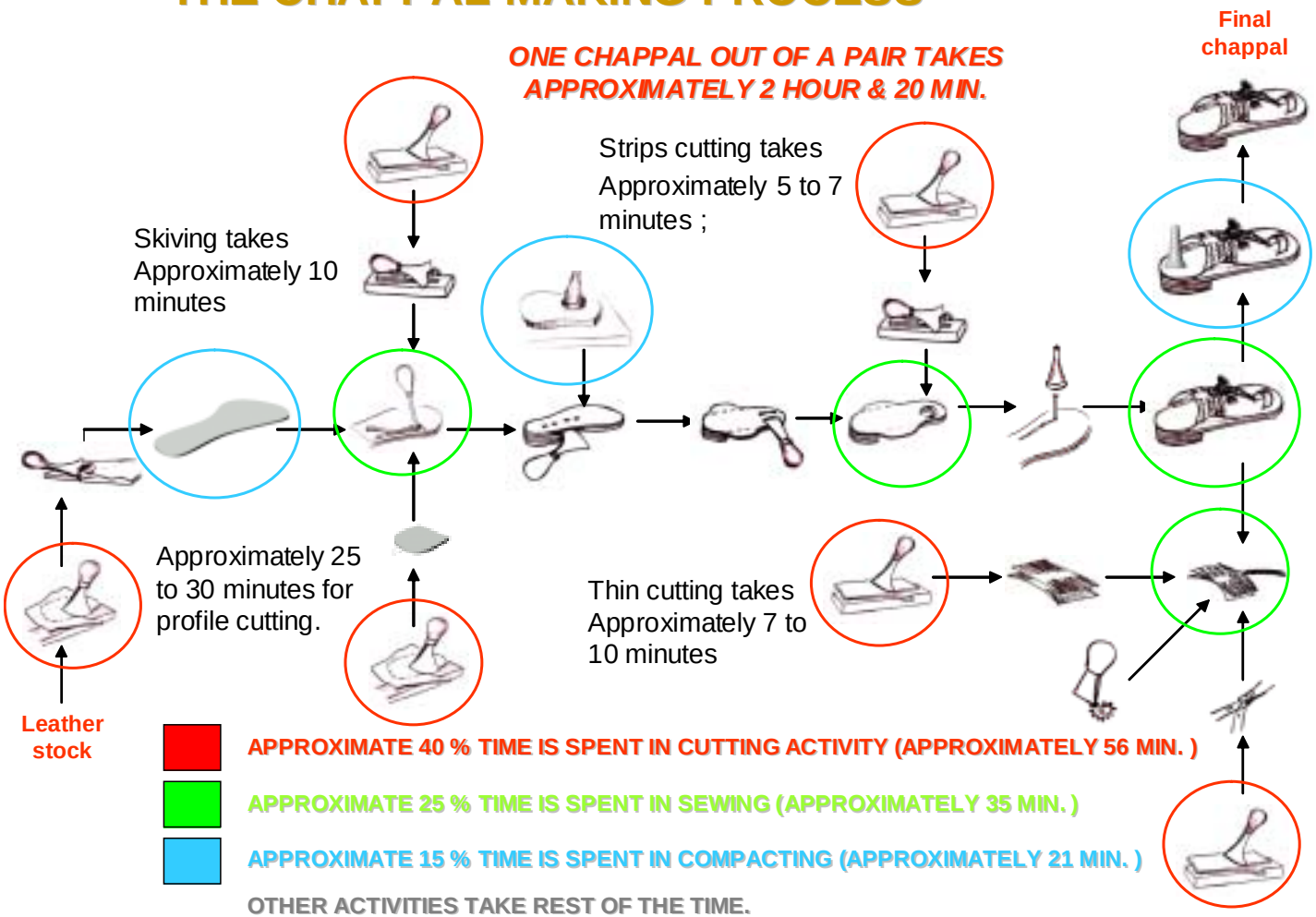
One person manages the complete business therefore maintaining fewer styles is more convenient. Also, if he has to maintain three styles then it becomes six varieties as he makes for both male and female. Based on particular style he customizes further for customer likeness and usage of the chappal.

1.4 Anatomy Of Kolhapuri Chappal



THE CHAPPAL MAKING PROCESS

ONE CHAPPAL OUT OF A PAIR TAKES APPROXIMATELY 2 HOUR & 20 MIN.



APPROXIMATE 40 % TIME IS SPENT IN CUTTING ACTIVITY (APPROXIMATELY 56 MIN.)

APPROXIMATE 25 % TIME IS SPENT IN SEWING (APPROXIMATELY 35 MIN.)

APPROXIMATE 15 % TIME IS SPENT IN COMPACTING (APPROXIMATELY 21 MIN.)

OTHER ACTIVITIES TAKE REST OF THE TIME.

1.5 The Chappal Making Process

1. Preparation Of The Sole.

a) Taking the profile of the foot.

For the purpose of making exact sized footware for a particular person, they ask the person to put a foot on the paper and then mark the outer line of foot profile by pen. After this they compare the best fit of the profile with the foot profile template they have with them. Then they decide the clearances to be kept along with the best fitted foot profile.(Fig. 1.5a)

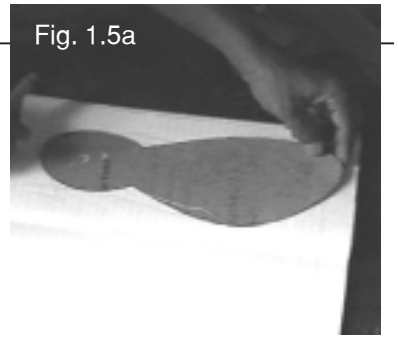


Fig. 1.5a

b) Selecting the proper leather piece for cutting and skiving.

Initially, they cut a particular part of the whole leather depending on which part of the animal it is. For example the part of leg is good for strength and wear so it will go for the *sole profile* of the chappal. Then for uniform thickness of leather they skive with the same cutting tool called `rapi `. (Fig. 1.5b)


Fig. 1.5b

c) Cutting the foot profiles.

Now after the selection of appropriate part of the leather piece, they prepare for the cutting. They mark this profile on the leather piece with all the margins as noted previously. They start by sharpening the cutting tool called Rapi. They dig its sharp end on a wood base and very skillfully start cutting the profile. They cut the leather in small part with each stroke of the tool. They have to follow the profile accurately.(Fig. 5c)


Fig. 1.5c

d) Pasting the foot profiles with mud.

Now after cutting the foot profile they paste all these pieces with mud. Then add small profile pieces near the hill, so that the back end of chappal has more height. These are again pasted by the mud along with the big profiles near the hill. The mud they use is from the river basin. After the pasting, they hammer it with a hammer called `hasti`.(Fig. 1.5d)

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Fig. 1.5d

e) Cutting the leather strips for sewing.

After this they cut the leather strips for sewing the above pasted stock of leather profiles. One end of the strip is smaller and thinner. This helps them to push it through the hole while sewing. This strip is made by the same cutting tool `rapi`.(Fig. 1.5e)

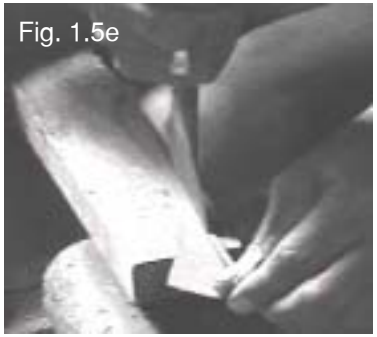


Fig. 1.5e

f) Sewing the stock & making design on it.

Then they start sewing the stock. First they make a hole in the *leather stock* with a pointed tip tool at an angle. Then they push the leather strip through this hole. Now they start the second hole from the end of the first hole so that a V–type of alignment between these two holes is made. They repeat the same along the periphery(Fig. 1.5f and 1.5g). After this they make a fine design by hitting metal em–bossing punch called `pogar` with metal hammer.

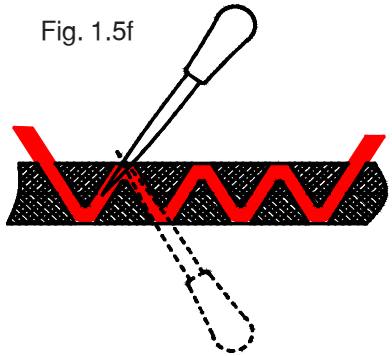


Fig. 1.5f


Fig. 1.5g

2. Preparation Of Toe and Top Strip.

g) Fixing the toe.

Now they prepare for fixing of the *toe strip*. They first start with cutting of a small rectangular piece of leather. They beautifully carve its end as well as chamfer it and also make its ends chamfered or skived so that the fixing is easy. They also make the design on the strip. Then they make the slits in the upper leather layer of the sewed leather stock. Then they insert the strip and both its ends are sewed from the top. After this they just turn this sewed toe ring such that the sewed part goes below the top leather slit made.(Fig. 1.5h and 1.5i – 1.5n)


Fig. 1.5i


Fig. 1.5j

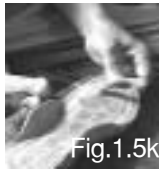


Fig.1.5k


Fig. 1.5l


Fig. 1.5m


Fig. 1.5n

h) Preparation of the top strips

After this they start preparing for the top half of the chappal. They first make the rectangular piece which has a very fine weave of leather strips from a two single rectangular pieces. These are made from the sheep leather. Then they sew this with other thick rectangular piece of the cow leather. Now they make the strip which connects this *big strip* with the *toe point*. This is also a big weave made from a leather strip. (Fig. 1.5o)

i) Making designed element and assembling the top strips

Now they make few additional elements from the leather pieces for the good look of the chappal. After making this, all the pieces are riveted by aluminum rivets and then it is fixed to the chappal. To attach the big chappal with the base stock, they sew the strip with the flap coming out of the base profile. Now they fix woven strip end to the inner corner of the toe ring on chappal.(Fig. 1.5p)

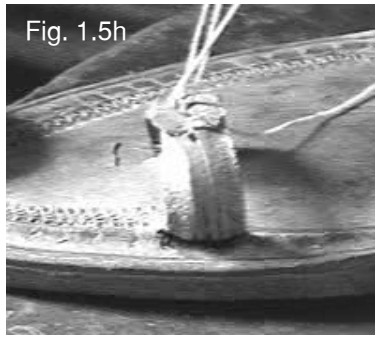


Fig. 1.5h

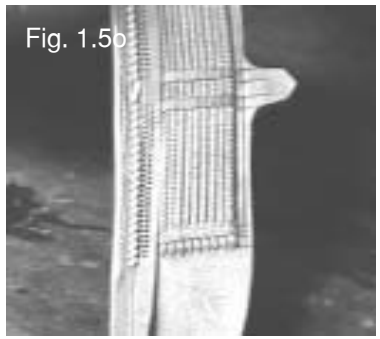


Fig. 1.5o

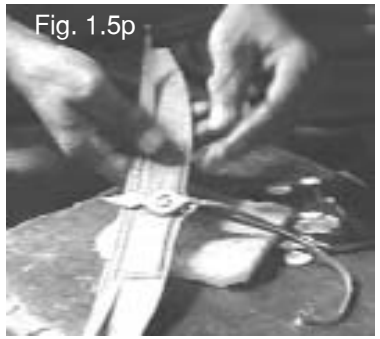


Fig. 1.5p

j) Making chappal ready for customer and delivery of chappal

After doing this chappal is ready for the final stage. For the good strength and to give stiffness they compact the chappal by a special hammer called `hasti `. Now before delivering them to the customer, they ask customer to try the chappal and if there is slight misfit. Adjustments are made before giving it to the customer. They also apply a coat of vegetable oil over the chappal before final delivery for making chappals soft. (Fig. 1.5q)

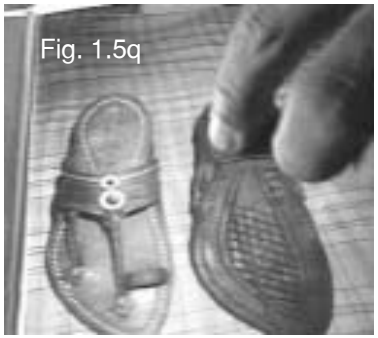


Fig. 1.5q

1.6 Design Focus

The cutting and sewing activity are the major activities involved in chappal making. These are the basic activities involved. Approxi–mately 75 % of the activities are cutting and sewing while making the chappals. If we see the process chart of the chappal making then this fact is clear. Hence these activities take more energy and time in chappal making. Tools concerned with these activities are of primitive stages and have not changed yet. So the focus for de–sign is on the tools related to these processes.

Therefore, work will be done on the following

- Leather cutting process and tool related to it.
- Chappal sewing process and tools related to it.

CHAPTER 2

STUDY AND ANALYSIS OF EXISTING TOOLS

2.1 Problems In Leather Cutting

When observed closely, lots of problems were revealed. While cutting the thick leather the whole tool acts as like a big L type lever. This is how they get a good cutting force. The tool they use has two ends. Each end is very sharp and pointed. They always keep the ends sharp. This is the sharp point with which they dig into the wood base and start cutting the profile. The middle part of the blade remain unutilized in cutting but is used for cutting thin leather as well as for skiving the leather pieces. The whole shape of the tool thus has operational significance. The grip is kept symmetrical as the tool is used in both orientations. The problems were studied by following methods,

– Direct observation while cobblers working and performing various tasks.

– Video recording of the whole process, which could be analysed in detail.

THE PROBLEMS

There are two problems currently with this system of cutting process. First is the frequent sharpening required for the cutting tool. While cutting, they take a wooden base to make a tool point to act as pivot and then they cut leather little more deeper so that the tool digs into wood base below. Because of this, the sharpness of the tip is lost immediately. Second problem is that while cutting they have to maintain a pivot point for the tool on wooden base, they have to exert a lot of vertical component of force. This force is only required for maintaining this sharp point on the wooden base.

Also the same tool is used for other applications such as skiving. As the tool looses its sharpness rapidly the tool has almost symmetrical geometry so that the other side of the pointed end can be used for the same purpose. As a result the wooden grip is symmetrically made resulting in heavy surface contact stress on the palms and fingers.

EXISTING TOOL
RAPI

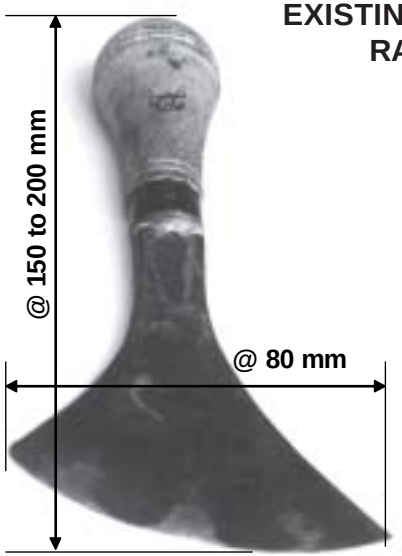


Fig. 2.1a

ABOUT RAPI

This tool is available in the market for Rupees 25 to 50 depending on the size, type and quality of the tool. This tool has wooden grip at the top which is common for all the tools. The blade is made up of spring steel which is hardened after it is shaped by hand forging. Tool makers purchase the scrap of automobile leaf spring to make the tools.

2.2 Activity Analysis Of The Cutting Process

TASKS	TASKS ANALYSIS
1) Cutting a base profile. (Fig. 2.2a and b)	1) Clean the stone base. 2) Take the user foot print and after comparing take out apropriate template. 3) Take a wooden base over the stone. 4) Bring the big piece over this wooden surface. 5) Cut the leather. 6)For uniform thickness, skive the leather. 7) Take the matched profile of customer foot and mark it over the leather. 8) Take marked piece over the wood surface. 10) Take the rapi lying at right side and grip it appropriate. 11) Place rapi at appropriate starting point with tilted position so that front end is nearly flat over the leather.(Fig. 2.2b) 12) Press rapi downwards to shear the leather. then after touching/ rocking of sharp edge below the wood surface pull it back like a lever. 13) Without lifting, pull the rapi along the last end and repeat the ptocess.
2) Making a leather strip for sewing.(Fig. 2.2c)	1) Take a wooden base over the stone. 2) Search the big leather piece around his work area. 3) Take piece over the wood surface. 4) Take the rapi lying at right side and grip it appropriately. 5) Place rapi at appropriate starting point with tilted position so that the front end is nearly flat over the leather. 6) Press rapi downwards to shear the leather.Then after touching/ rocking of sharp edge below the wood surface pull it back like a lever.


Fig. 2.2a


Fig. 2.2b


Fig. 2.2c

7) Without lifting displace rapi in the newly made cut .Again main–tain the same downword force and then pull rapi back like a lever.
6) While cutting take care that the tapered strip is achieved
9) Repeat the same steps as 6 and 7 till the entire stripe is cut.
10) Then change the grip of the rapi, and start shaving at one end i.e. the small end of the strip and make it thin as required.

3) skiving the leather strip.
(Fig. 2.2d)

1)Take a wooden base over the stone.
2) Take leather strip lying by the side and pull it over the wood sur–face.
3) Hold and press the leather strip by left hand.
4) Take the rapi lying on the right side and grip it appropriatly so that the blade is held horizontal in hand.
5)Then start cutting with little pressure so that slight chipping is started and then increase the pressure slightly the deep so that the end is thinned. Repeat it till the required thin end is achieved.

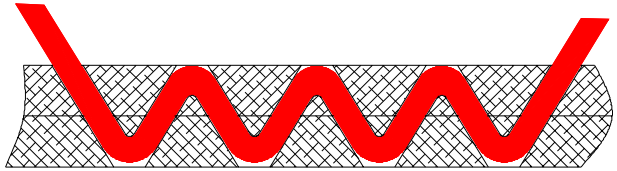

Fig. 2.2d

2.3 Sole Sewing Problems

The sewing is done by the two types of tools that are shown in the Fig. 2.3a and b. First, they start with tool with pointed end . Then they make a hole in the chappal slightly at an angle to the vertical of the surface of the leather. Second, they keep leather strip over the hole and using the tool with flat end push leather through the hole.

Again with the pointed tool they make a hole but now starting with the end of first hole. This automatically makes a V type of cross section between each two consecutive holes.(Fig. 2.3c) In short a zigzag type of stitch is made by the cobbler. This is typical with kolhapuri leather chappal. Because of this the life of the chappal is increased.

Fig. 2.3c



THE PROBLEMS

They use two tools for sewing. While using first tool heavy force comes on the palm. This is because the resistance offered by the thickness of the leather stock they handle. They stitch the leather stock thickness of around 10 mm to 30 mm normally. The force re–quired makes this process of sewing very exhausting and painful.

Once the hole is made then its comparatively easy for them to push a leather strip through by second tool. Besides the way cobbler handles the chappal while sewing can also be responsible for small accidental injuries. As the surface of the tool grip is also hard, the heavy contact stresses are developed.

SAL AARI

Fig. 2.3a

SHIVNACHI AARI

Fig. 2.3b

ABOUT AARI

This tool is available in the market for Rupees seven to 15 depend–ing on the type and quality of the tool. This tool has wooden grip at the top. The tool is made from medium carbon steel which are first forged and then hardened.Normally these tools are water quenched so that they become hard.

2.4 Activity Analysis Of Sewing Process

TASK	TASK ANALYSIS
1) To cut hole into the leather stock for sewing.(Fig. 2.4a)	1) Grip the tool in hand. 2) Grip the sole in between two legs and by left hand. 3) Then hold the tool in vertical position so that the pressure from the top can be applied. 4) Apply the pressure and pierce the leather and then change orien–tation to slightly angular direction in the leather. 5) Pierce to the depth so that a sufficient hole size is achieved.
2) To push the leather strip into the holes while stitching. (Fig. 2.4b)	1) The chappal is held inbetween the legs and there will be already a hole done by another aari. 2) Take a leather strip in left hand and place its thin end over the top of the hole by the first finger of the left hand. 3) Hold tool as close as to the hole and then push the thin end of leather into the hole by the tool so that the tool comes out of the leather stock from other end. 4)Then pull the leather strip from other end while aari is in hand. 5) Withdraw the tool by pulling it out.

Fig. 2.4a

Fig. 2.4b

CHAPTER 3

DESIGN BRIEF

The Design Brief

Design the tools for the following mentioned needs of chappal mak–ing for the processes as below.

– Leather cutting process

– Chappal sewing process

As mentioned in `Design Focus` these two processes takes almost 70 to 75 % of total time and are most exausting.

Cutting Activity

- **Accuracy in foot profile cutting.**

  Right now they cut the profile by hand and after sewing they again skive so that the level on side face is uniform. By in–creasing the accuracy of the profile, there is quality improve–ment in the chappals.

- **Reduced downward force application.**

  After watching the way they cut in to thick leather, it is obvi–ous that the extra added force is needed to just maintain the pivot. This again creates a stress on the hand as well as needs greater skill to operate the tool.

- **Fast cutting.**

  As cutting with existing tool is a skilled activity and needs an extra force to cut the leather the cutting speed dependant on the cobbler‘s skill. If the skill required is reduced by some means, then the fast cutting can be achieved– increasing their production capabilities.

Sewing Activity

- **Less application of force on the tool.**

  As the force while making hole for sewing is very large, there are possibilities of the development of physiological disor–ders or injuries after few years of working. So, it very impor–tant that it is taken care that the new design eliminates or solve this problem.

- **Consistency in the quality of the stitching.**

  This has a straight concern with the product quality. The qual–ity of chappal may be judged by the consistence of the work–manship in chappal making. This way by quality improve–ment a value addition to the chappals can be made. This is a major concern with the sewing and cutting, which are the main activities in chappal making.

- **Reduction in actions.**

  This will save the time and obviously increase the productiv–ity. Another issue is that same can be achieved by reducing the number of tools required, so the cost and time both can be saved.

Ergonomic Requirements

- **proper grips**

  As the tools are meant to exert the forces through the wood grips, there be contact stresses acting on the palm. The grips should be designed to take care of that. Also the proper angle of the wrist and proper hand and body postures should be adopted by the user with new tools.

- **safety**

  As the tools are very sharp, some means to protect from the sharp edges are necessary.

CHAPTER 4

IDEA GENERATION AND CONCEPT FOCUS

4.1 The Ideas For Cutting tool

Idea 1. (Fig. 4.1a andb)

This is a modification of the old rapi itself. Existing tool has not been changed for years. From ancient days they use a forge steel to make a tool. Then while the tool is red hot, they shape it. After shaping it in red hot condition by hammering them, water quenches it for harden–ing of the tool. After this, the tool is handed to the cobblers. Then they further sharp the tool. This is a cumbersome process, as the sharpening on oilstone takes hours. Besides this the cutting curve below is also not maintained so accurately. This certainly has great impact on the functionality of the tool.

This idea focuses on the same issues here. The cutting blade can be a part of the spring steel sheet metal of good thickness like 3mm. The cutting edge can be such that for the depth of largest thick leather piece can be cut but thin cutting knife edge. This can be sharpened on the special grinder which runs on single phase power supply. This way, lot of energy wasted in grinding of the tools on the oilstone is saved. Besides this, the strength of the tool will be good due to the thicker part above the cutting edge. Also, the grip will be such that it has tough body but the surface is soft like foam. This will be done to avoid the contact stress coming while exerting force through the tool.

In case of maximum wear, the blade can be removed from the handle part. This is necessary because both the parts here are a little costly. So either blade or handle, any one of them can be changed. Also the blade can be used in sets. If the sharpness of the one blade reduces then you can attach the second blade. This way all together all the blades can be sharpened on weekends or during free time.

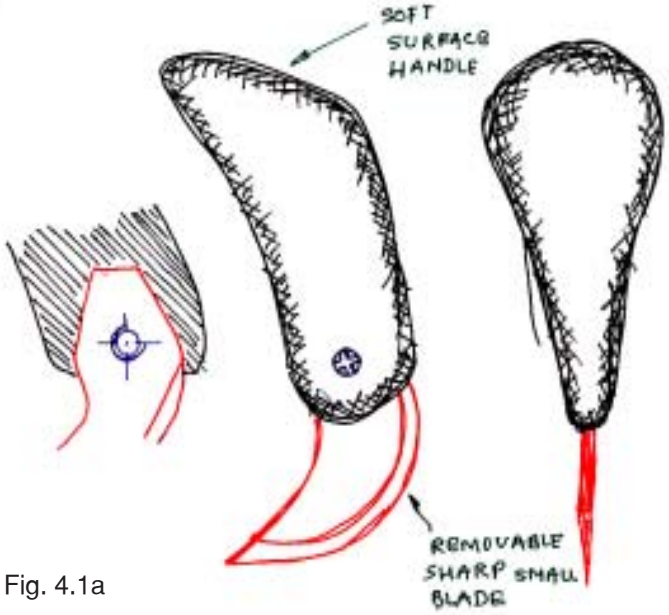


Fig. 4.1a

Fig. 4.1b

Idea 2. (Fig. 4.1c and d)

This is another idea close to idea1. But the major difference is the way blade is attached to the tool and other benefits associated with it. In this concept the blade is a thin spring steel piece or a special cutting alloy such as the shaving blade. This can be screwed to the top metallic body. The upper metallic part holding the blade can be made from other cheap steel for the reduction of cost. Strength of the tool also is increased due to the thicker section at the top side. Now after the wearing out, only the blade needs to be changed. Also, if further flexibility is needed then the steel piece holding the blade can be changed like in the previous concept. This will facili–tate the change of cutting blade profile.

The major advantage comes from the fact that no additional special purpose accessories are needed; such as the grinding arrangement in previous concept. The blade can be ground on ordinary oil stone what they normally use. As the blade thickness is less and already has a sufficient amount of sharpness, no extra efforts are necessary to sharp the tool on oilstone. Besides there is flexibility that any other shape of blade can be mounted as per the requirement. This also helps standardizing these tools because in India there are numer–ous shapes of this tool.They vary in different regions based on dif–ferent styles of working. Also it has most of the advantages that was mentioned for the first idea.

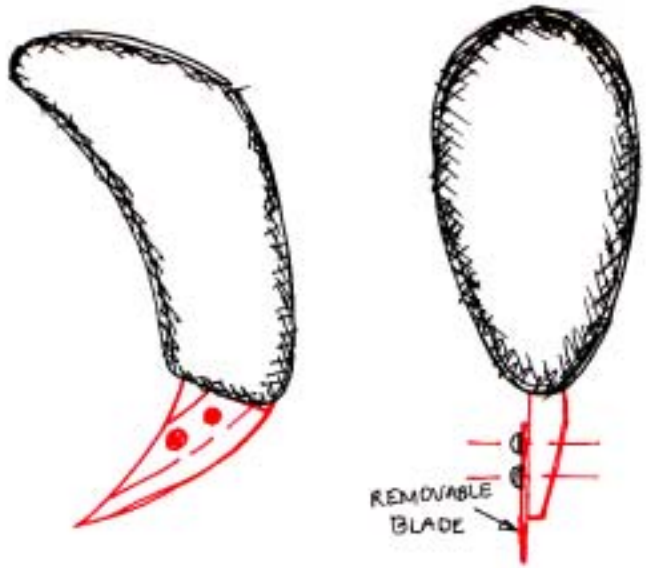


Fig. 4.1c

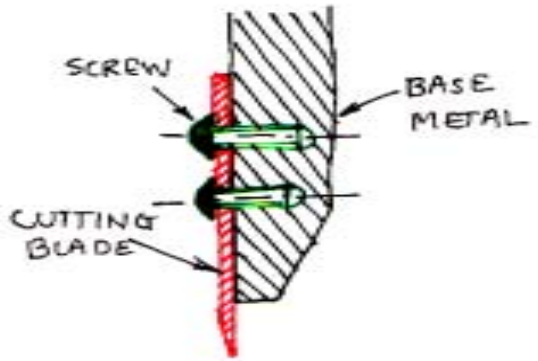


Fig. 4.1d

Idea 3 (Fig. 4.1e to f)

This is a completly new concept. After careful study of how they use their cutting tool, it is found that they anchor one sharp end in the wooden base and then they start cutting. This particular point acts as an instantaneous pivot and the whole body acts as L–type lever. The place where the short end is the cutting edge measures only 8 to 10 mm and big end is the length of the tool. Two things happen here which takes a lot of energy. First, anchoring into the wood and again further maintaining the same point takes a lot of vertical force. Second, for getting a clean cut they have to cut a little below the surface into the wood. Hence every time this energy to cut into the wood at the base is wasted.

This concept exactly avoids these two efforts by arrangement shown here. Rapi used traditionally is not changed much, except an addi–tional hole at one end. In this arrangement, there is one point at the end, around which a rapi can be pivoted and at the wooden base there are two steel strips attached with the exact gap matching the blade width. Below these plates, there is blank space or a slot. This slot avoids the cutting into the base for the clean cut. As it is pivoted mechanically, it avoids the vertical force needed.

The operation is also easy. Whenever one has to cut thick leather then this arrangement can used. One just has to pivot the rapi, which can be done quickly as its one end is free and the tool is removable. Once it is turned to go slightly below the steel strips, it can cut the thick leather easily as the force required is no less. Also, cost wise it is cheaper and variations can be made combined with the previous ideas.

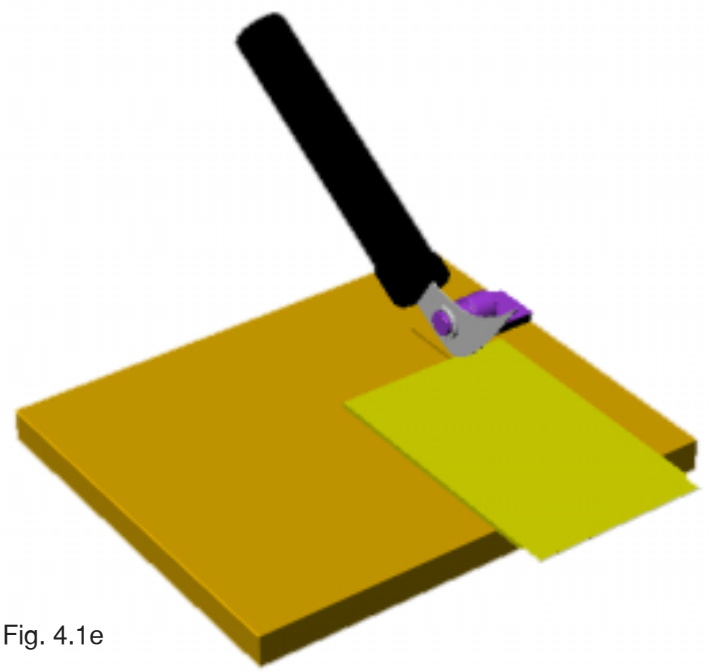
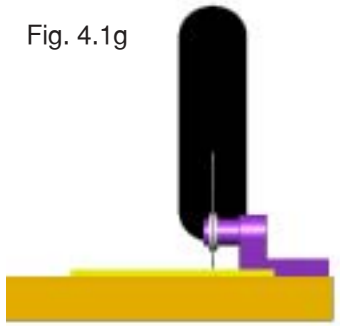


Fig. 4.1e

Fig. 4.1f

Fig. 4.1g



Idea 4 (Fig. 4.1h to l)

This concept is based on a very important observation of handling these tools. It is observed that the leather can also be best cut when the tool is applied like a knife. That is when we apply the tool like we are cutting the bread. In this concept the blade reciprocates and leather is fed to the blade. Now the reciprocating action is provided by the 0.5 kW single phase electrical motor. The shape of the blade is also important as the feed and cutting speed also depends on that.

One advantage of this idea is that user`s both hands remain free. So there is a good control over the profile cutting. Besides, as it is motorized the good production rate is also achieved. But consider–ing the context, one problem may be there. The electrical power in the neighboring villages of Kolhapur is not consistent. Infact most of the time electricity is not available constantly and the area has power cuts. It may not be wise to depend on it completely.

Fig. 4.1h

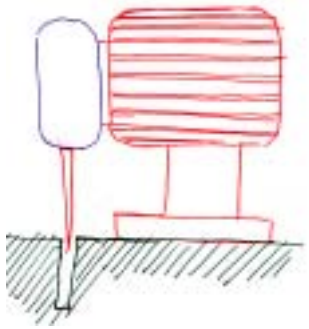


Fig. 4.1i

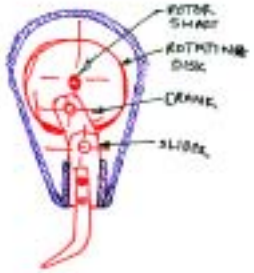


Fig. 4.1j

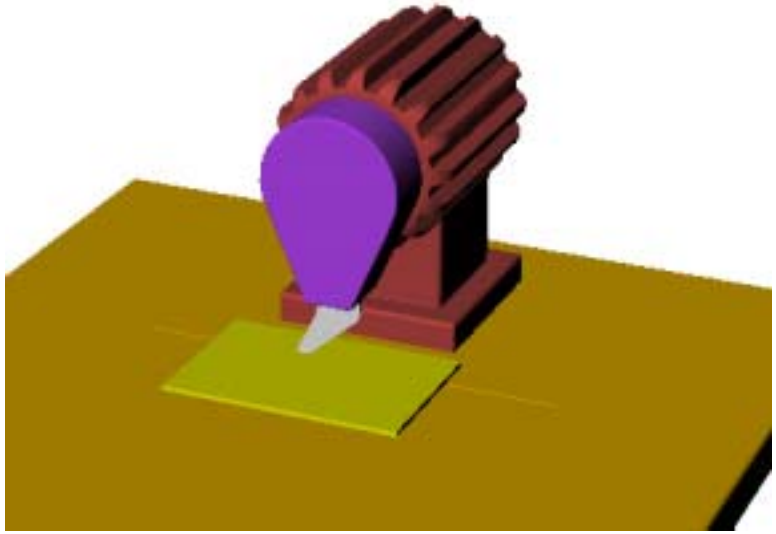
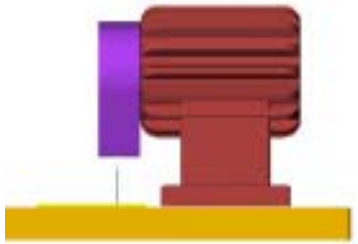


Fig. 4.1k

Fig. 4.1l



Idea 5 (Fig. 5a to 5d)

Actually this type of machines is already available in the market, but for industrial applications such as small leather gift items. The idea can be borrowed and transformed for the chappal manufacturing. This idea explores one of such possibility. In this machine a linkage system transfers all the force applied by a hand over a cutting pro–file. Now the cutting profile is knife edged and backed by some soft material such as rubber. In a single stroke, one profile can be cut. The cutting profile is very important, as it has to have a knife edge for cutting.

If this idea is to be adopted then there are certain issues that need to be understood. Actually, cobblers have a set of standard profiles. They may be as many as 50 in numbers. But it is very rare that they use them directly. Infact, they vary the sizes manually by adding or reducing the standard size of the profile as per the customer fit. As the customization is the one of the USP of their product, the stan–dardization that this idea demands, may not work. Besides the cut–ting edge sharpening and all other maintenance have to be very simple, so that they can do it themselves.

Fig. 4.1n

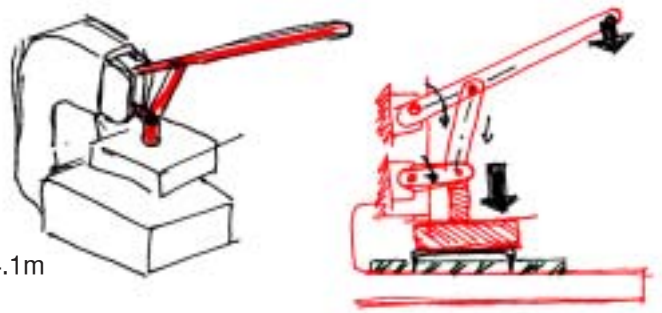


Fig. 4.1m

Fig. 4.1o

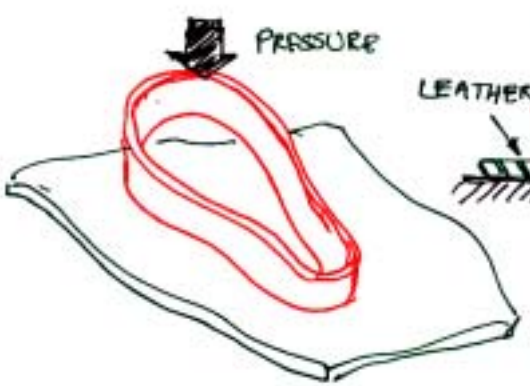


Fig. 4.1p

4.2 Testing Of Cutting Tool ideas (R

First trial

The first trial based on one of the quick concept. This was for the testing of the grip orientation and the shape, maneuverability of the tool. Cobblers who tried this tool gave interesting feedback. he was satisfied by the grip orientation but did not like the shape of the tool. In addition, he needed a sharp point at least at one end to start a cut. This sharp point helps them to rock the tool, so that he can use it for heavy cutting.

Fig. 4.2a

Second trial

The second trial also gave some important feedback from the cob–blers. In this case also, he liked the grip orientation. He was not confident for the cutting abilities of the tool due to the small size of the blade. In both trials, one amazing observation found. The cob–blers were not ready to accept the fact that this is a version of their old cutting tool due to the shape of the tools. But he readily adapted the grip and its orientation.

Fig. 4.2b

4.3 The Testing Of Idea 3 For Cutting Process

Test Model 1 (Fig. 4.3a)

The idea 3 looks promising amongst all other concepts for leather cutting. So it was decided to work further on this idea. To test the idea a simple arrangement was made. the existing tool was used for this purpose. A small piece of the rod was welded at one end of the blade. A bushing was provided in which this rod fits. This bush–ing was welded on a m.s. sheet metal piece. On a piece of wood two metal strips were screwed. One strip had welded bush on it. The gap between the strips is exactly equal to the thickness of the blade. Below the gap between the strips there was a slit so that the blade of tool can easily pass through slit. This idea worked but there was a problem. The bush at the side obstructs the leather while cutting. Also the rod on the tool obstructs while sharpening the tool.

Test Model 2 (Fig. 4.3b)

Considering above problems second test model was made. In this concept the bush was eliminated. The rod on the tool was also re–moved. In this model also the existing tool was modified and used. The tool used was having a open hole on one side. Because of this arrangement the tool can be made quick change type. The rod was welded at the bottom of the metal strips. Other things were same as like in previous model. This also worked but again had problems. As the tool is pivoted below the strips blade width at the cutting level was more. This made the curve cutting difficult. Second problem was frequent loosing of the pivot. When there is no force on the tool to rock against the rod this happens. Also it is good idea to have a pivot at the top side of strips or at surface level.

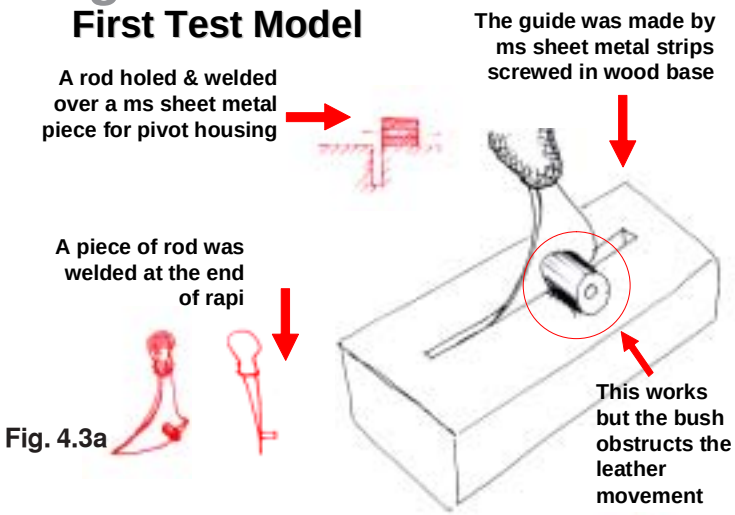


Fig. 4.3a

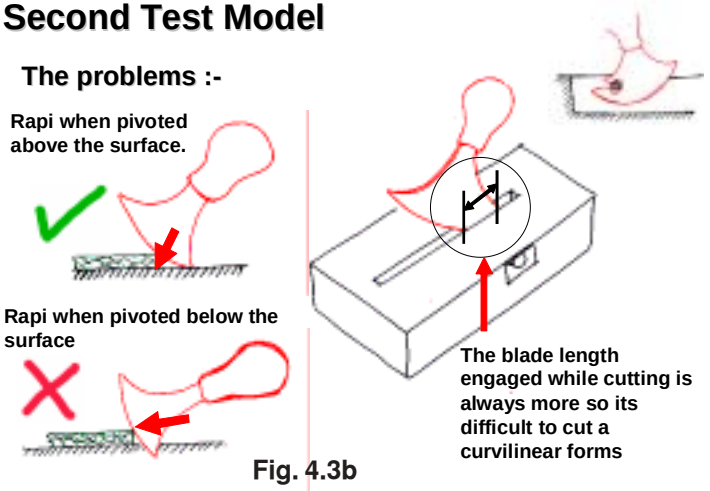


Fig. 4.3b

4.4 Ideas For Sewing Tool

Idea 1. (Fig. 4.4a to 4.4c)

This is the modification of the old tool called `aari`. All existing tools have the wooden handle. The tools are also super sharp. For sew–ing he has to first make a hole by a tool which has a pointed end. Then he pushes a leather strip from that hole to bring it out on the other side with another tool which has flat sharp end. So, sewing operation needs two tools. The initial tool to make a hole requires lot of force. As the cobbler has to push this tool through a leather stock, which on the heel side may be around 30 MM. Tremendous forces is required to push this tool through this leather stock. Sec–ond tool compared to first does not need much force.

These factors were considered for idea generation. The first approach was to improve the old tools. What happens when large force is applied over the tool by the palm is that it produces contact stress resulting in pressure on the skin. This is avoided by a soft surface over a tough grip shape. Here tools are shortened so that it will be easy to handle easier to locate, but the optimum length of the tool is necessary so that the force required to push this tool should not increase. The shape of the grip was also manipulated in such a manner that it will be easy to handle as well as help to push the needle more effectively. Also the contact area was increased so that the contact stress is further reduced. The tool grip is asymmetri–cal. This is because, most of the time cobblers turn the tool while pushing in. the spherical grip provide less torque than is proposed in this concept.

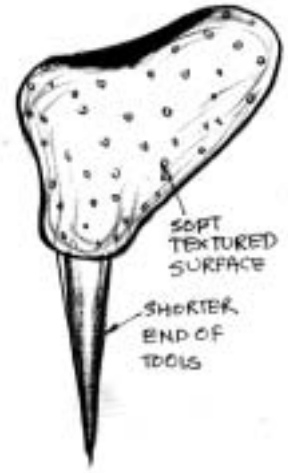


Fig.4.4a

Fig. 4.4b

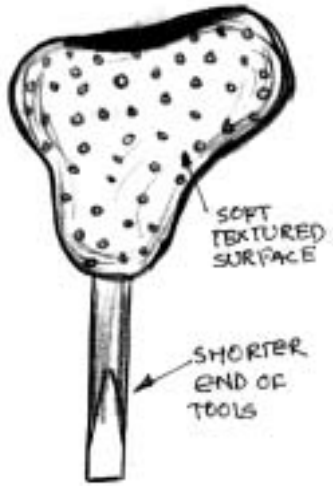


Fig. 4.4c

Idea 2. (Fig. 4.4d)

As cobbler has to use the two or sometimes more tools in one task, every time he has to search, then pick the tools and keep it away after use. Many times the tools are spread around or lying in the leather waste and he has to search for it. So why not to combine the related tools? This is what was tried.

This can be made from a spring steel rod which can be hardened. The tools can be weld at centre and then insert plastic moulded. There are good possibilities of mass manufacturing for this tool as all cobblers need this tools, no matter whether he seats on road or he has a shop. Besides it will be cheap.

The cost is likely to come down from the traditional tools. But there are certain issues. The tools orientation is such that each tool tip is located 120 degrees from each other, sometimes its possible that it might hurt. Though the chances are less, it is better to avoid this if possible. As these tools are very sharp the care has to take about the usage.

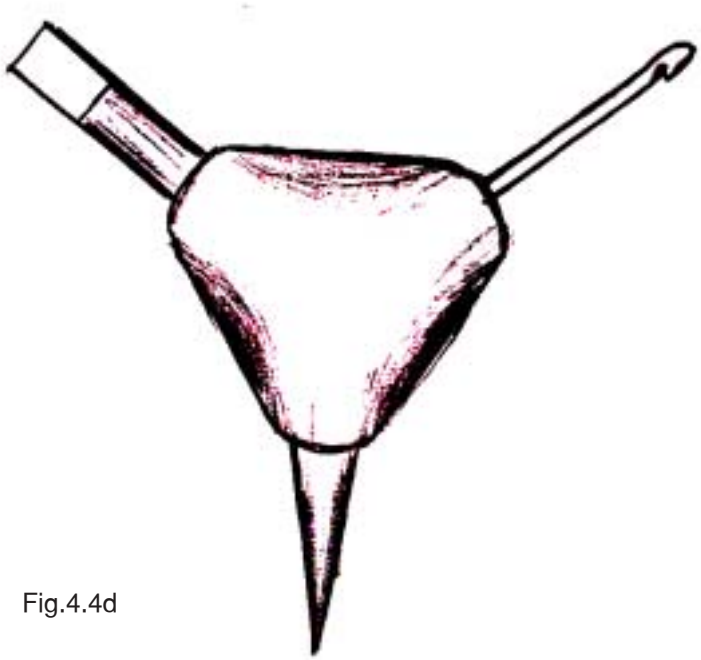


Fig.4.4d

Idea 3. **(Fig.4.4e)**

This idea also emerged from the same line of thinking, that is to reduce the activities so that the speed of work can be increased. But the problem that was discussed in last idea is solved here. The sharp end of the tools if kept bare may raise the possibility of acci–dental hurt. This is avoided in this idea. It has soft grip with tough gut inside. The shape of the grip is also similar to the first idea.

There are other functional issues. First, the problem of hinges and close tolerances. The mechanisms suggested here may not be ef–fective without very close tolerances. Lot of loose elements are there such as the latch. So slightly loose tool also can give rise to uncer–tain push over the tool. There is also a danger of buckling or acci–dental slipping due to tolerence in the parts. There is a possibility for building a good tool based on this concept, with lot of innovative details and changes. There should be proper consideration for the length and width of the tool or needle itself. Operation wise, it sug–gests that two hands should be used unless an automatic turn–re–turn arrangement is provided.

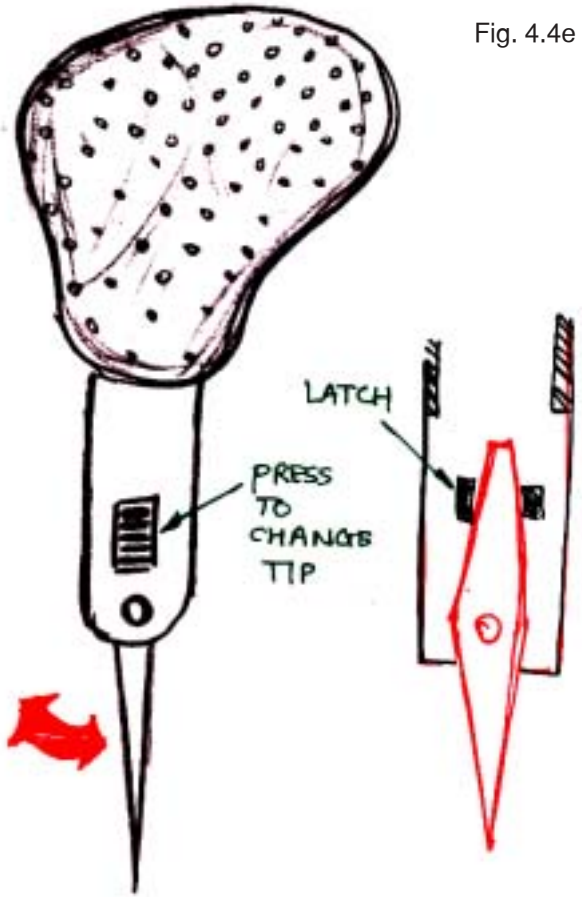


Fig. 4.4e

Idea 4. (Fig. 4.4f)

This is also based on the idea for combining the tools. But again as discussed earlier, attempt is made to remove the possible problems that may rise with this type of tools. it does not have any more sharp ends spread out, neither it has any loose hinges. This way it is a safer tool to use. The grip has been borrowed from the idea 1 to take care of the contact forces coming over the tool. Besides, it is much faster than previous ideas that previously discussed for sewing tools.

This is may be one of the good ideas that were previously proposed. There are certain facts that have to be considered for any further work on this idea. First is about the length of the tool. Its not a good idea to have too long tool or too short a tool. An optimum has to be considered. Second is the shape and profile of the tool. This is im–portant because the tool should be as easy to pierce and push the thread through. One greater advantage is that there is no `tool switch–ing` or `tool change` operation here. This is what makes it easy and fast to use.

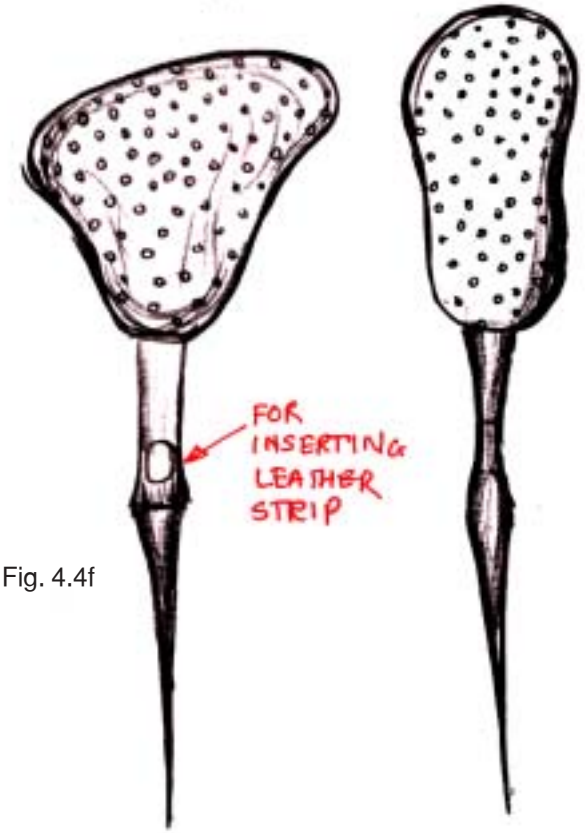


Fig. 4.4f

Idea 5. (Fig. 4.4g and 4.4h)

The biggest challenge for devising a hole making system is because of angle of cut and creating a zigzag type pattern. This is the solution driven by the fact that need to use such tremendous force should be eliminated or reduced to the ergonomic standards. As this excessive demand of force application from the human body can have serious physiological problems after few years of work. Infact, this is the one of the major reason peoples are leaving this profession of chappal making in Kolhapur region. This drove one to come with an idea that the force used is reduced to as much as possible to an acceptible limit.

The idea is simple. Make a power needle that enters at an angle. The development of total concept is very challenging. In this arrangement a lever is used such that the force is then converted to moment and moment at other end is converted to force on needle with multiple of lever ratio. One big challenge in this is the way conversion of the forces is conceived. For smooth and painless operation the mechanism inside should provide a uniform application of a force over the needle as well as on human body. It should follow the standard limits for minimal forces that human body can exert. The mechanism should be simple and should cost less. This also should have easy operation and least maintenance.

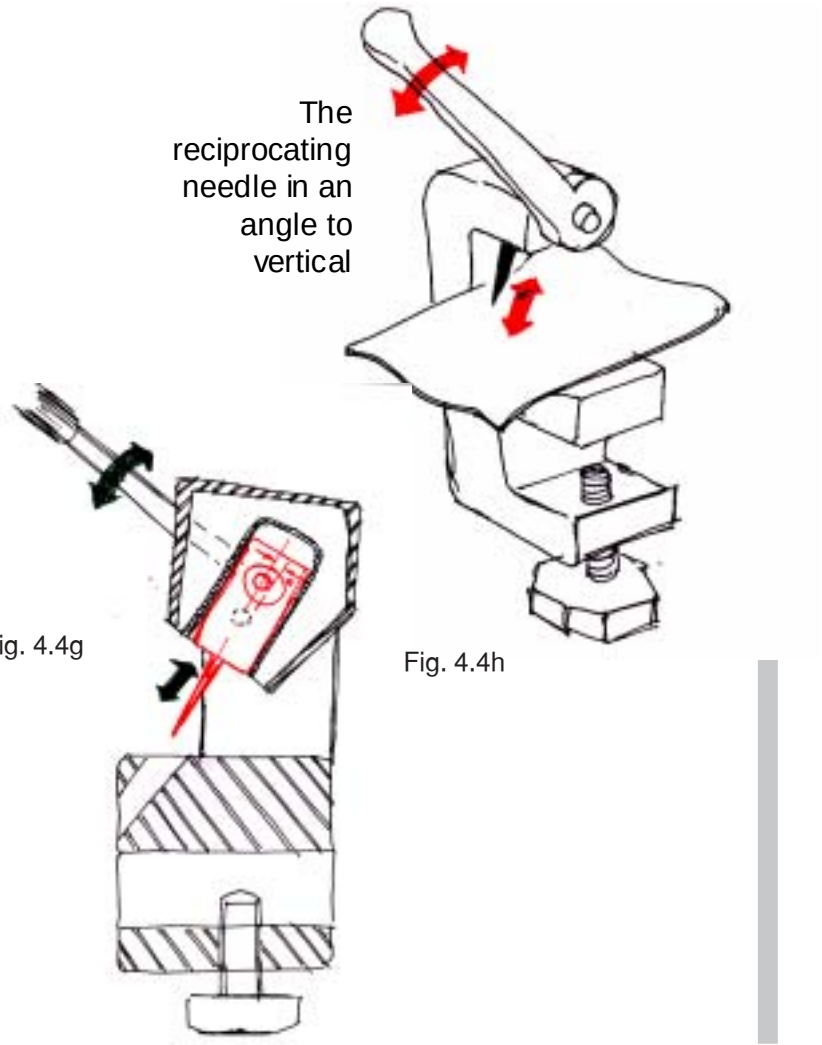


Fig. 4.4g

Fig. 4.4h

4.5 The Mechanism Exploration For Idea–5 For Sewing Tools

The slider–crank mechanism. (Fig. 4.5a)

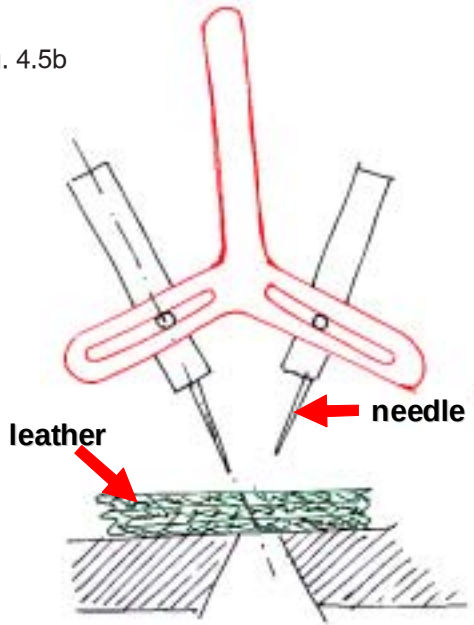
The first mechanism considered was slider crank mechanism. The reciprocating motion of piston helped in cutting the hole. However, there are few problems with this mechanism. First is that force act–ing on the needle is not uniform. Second problem is that the detail–ing of the concept can be complicated when compared with other mechanisms possible. In addition, this mechanism is a good choice for motorized applications.

Sliding block and slotted lever mechanism. (fig. 4.5b)

This simple mechanism consists of a slotted lever and a sliding block in it. The block can reciprocate by lever action. The needle attached to the block end, cut a hole. If two needles used then two holes at an angle can be made make simultaneously. This mechanism has one serious drawback. When the needle goes at the extreme end, it needs a lot of force to bring it back. However, in actual situation, the needle might fit tight in leather stock so the force required is more.

Fig. 4.5a

Fig. 4.5b



Rack And Pinion Mechanisms

The greatest advantage of this mechanism is that it gives uniform force output. This mechanism is also simple. There are two impor–tant elements in this mechanism. The input force applied to pinion. The output force acts on the needle through rack. There are two possible mechanisms as shown in fig 4.5c and 4.5d. The first mecha–nism consists of two racks and a pinion. These two racks are placed at a particular angle. They make V type holes without clashing with each other. In the second mechanism, only one rack and pinion is used. The force required is less in second mechanism due to use of one rack. This reduced the stroke of the needle to the half com–pared to the first mechanism.

Based on this mechanism, one concept was developed. (Fig.4.5e and 4.5f) The feasibility of the mechanism was tested with the drill–ing machine, as it has similar mechanism. Instead of drill, needle was used to test the idea. The mechanism with single rack was used to develop this idea.

However, concept had a problem because of the load required for the needle to pierce. The ergonomic standard load on lever should be 3kg. In this concept, it was more than the 3kg. When reverse calculated based on the 3kg load then the travel for grip end was not within the ergonomic standards. Simply there is no mechanism possible, which will fit into these values. Explanation for this is as follows.

By law of energy conservation,

Input work = output work.

Standard ergonomic lever length × ergonomic standard load = travel of the needle × force needed for making hole into the leather.

The calculations based on above equations shows that there cannot be a mechanism for this idea.

Fig. 4.5c

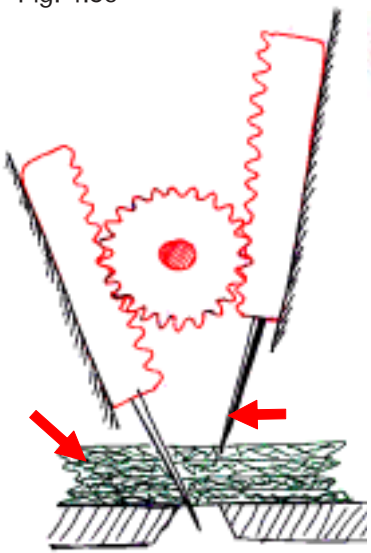


Fig. 4.5d

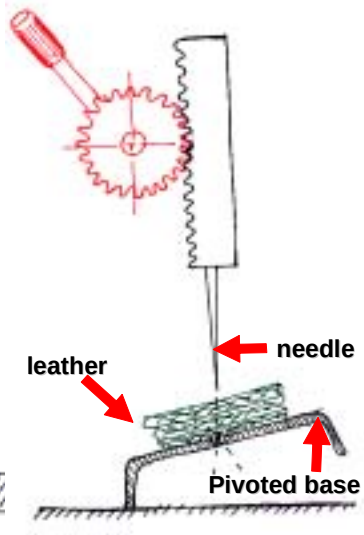


Fig. 4.5e

Fig. 4.5f

CHAPTER 5

FINAL DESIGN CONCEPT

5.1 Final Design For Cutting tool

Form exploration for the final cutting concept

After the testing of idea 3(refer 4.1) , it was observed that it is not possible to develop a tool, which will have the same maneuverability as old tool or more than that. Therefore, the design now focused on idea 1 and 2 (refer 4.1). After finalizing the idea, it needed to develop further to take product form. Various sketches (fig. 5.1a to 5.1d) show the exploration for the grip. The grips was actually tested by modeling it in Styrofoam and plaster. The figures 5.1e to 5.1k shows this explorations and gradual development of final form.

Fig. 5.1a

Fig. 5.1b

Fig.5.1c

Fig. 5.1d

Fig. 5.1e

Fig. 5.1f

Fig.5.1g

Fig. 5.1h

Fig. 5.1i

Fig. 5.1j

Final concept details

This is a development of the combined concept of concept no. 1 and 2 (refer 4.1). The blade has a slot so that when it wears then one can loosen the screw and bring part of blade out for further use. The screws fit on a 3 mm thick metal plate. This metal plate is insert–molded in one component of the body. The body has vertical part–ing line. These two bodies are screwed to each other and covered by a rubber clad. This rubber clad is pasted to the plastic body. The blades are pre–sharpened. The material for the blade is spring steel, specially the spring steel that is used in heavy automobile leaf springs. As the blades are removable, pre–sharpened, and pointed, it does not have to be both sided and symmetrical. In addition, the customization is possible by change of blade with different shapes.(Fig 5.1k to 5.1n)

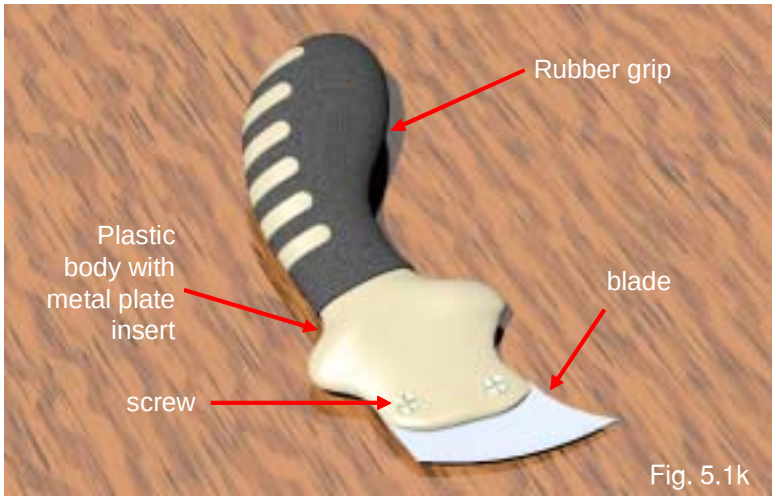


Fig. 5.1k

Fig. 5.1l

ig. 5.1m

ig. 5.1n

5.2 Final Design For sewing tool

Development process of the sewing tool

The development of this tool was treated as a part of a total system. This system includes the worktable for cobbler along with a cutting and compacting surface. The first model was devel–oped to test the overall size and ergonomic valuation of the concepts. The load needed to oper–ate the mechanism was beyond standard ergonomic value. Therefore, the needle stroke wasw reduced, as well as by that time one observation came out. The change of needle material could significantly improve the performance. Besides this, already there was reduction of force by five times(refer 4.5). Therefore, it was decided to develope this solution further. (fig. 5.2a)


Fig. 5.2a

With above changes in mind, the next version of the tool was developed. At this stage, the space around the tool and layout of the worktable became the issue. Besides this there was need to work on the form of the tool. In this case, initial concept was for a tapered surface over which a cobbler keeps a chappal for sewing. However, when it was tried, it was realised that to detail out this thing was very complex. There was a need for a radical change in the physical arrangement of the tool. Also when worked out, it was clear that a lot of space is necessary around the needle for easy handling of chappal. (fig. 5.2b)


Fig. 5.2b

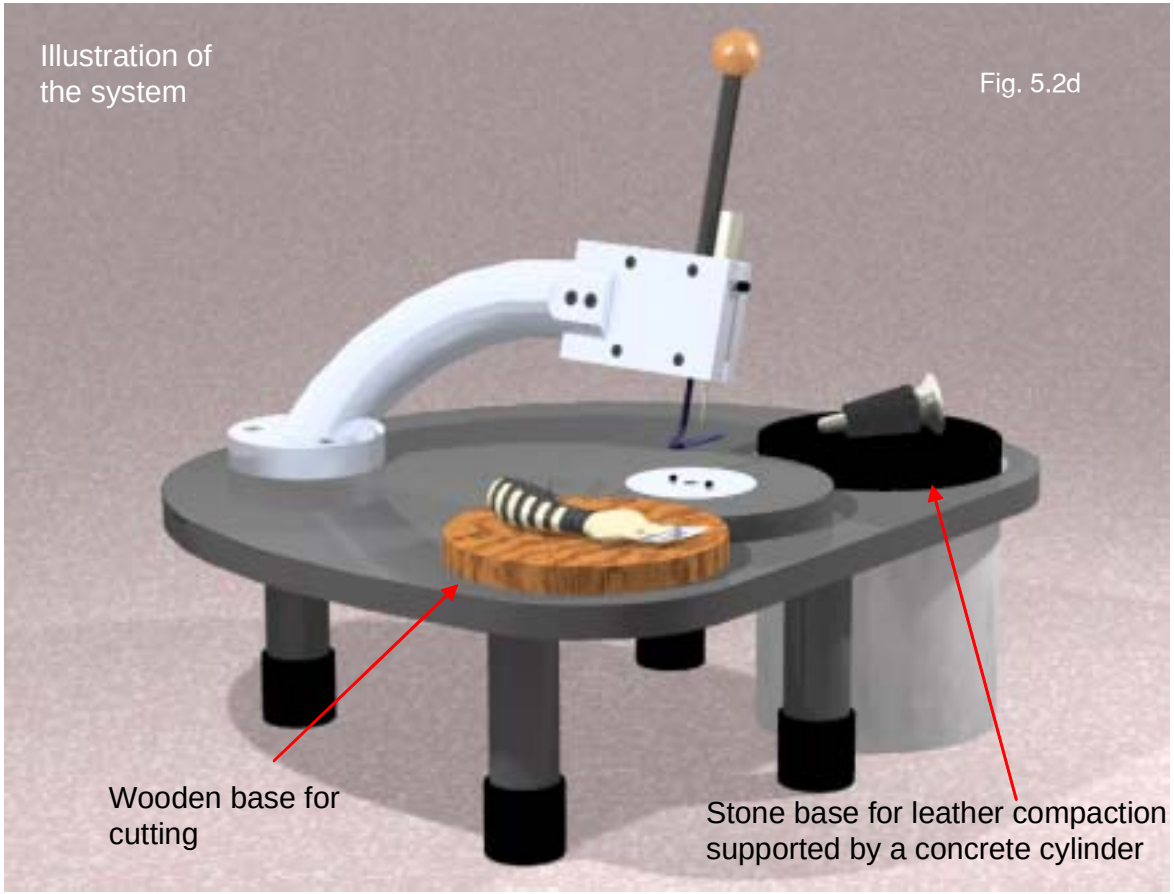
With all the facts in mind the third version was developed. In this concept, instead of giving tapered base for sewing, the head was tilted by a required degrees(refer 1.5, step f). This also removed the necessity of a separate working base as such for sewing only. Another issue was about the space needed around the needle. In order to resolve that issue, a long bent pipe, turned at an angle was used to hold the rack and pinion assembly. In addition, the work areas were brought close to each other sharing the spaces. Dimensions also finalized at this stage while developing the form. (fig. 5.2c)


Fig. 5.2c

The Final Design Details

This tool developed along with the worktable of the cobbler as an integrated unit. This helps to make hole for sewing. Also the needle can be removed, giving possibility to attach other tool such as for embossing

The work surface for cutting is very close with the sewing as these two activities takes place one after another through out the chappal making. The total work–place is raised by 200mm so that the cobbler can view his actions. This also improves the working posture (Fig.5.2d)



The Final Mock – Up Model

Mock – up model
from top

Mock – up model
from side

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