

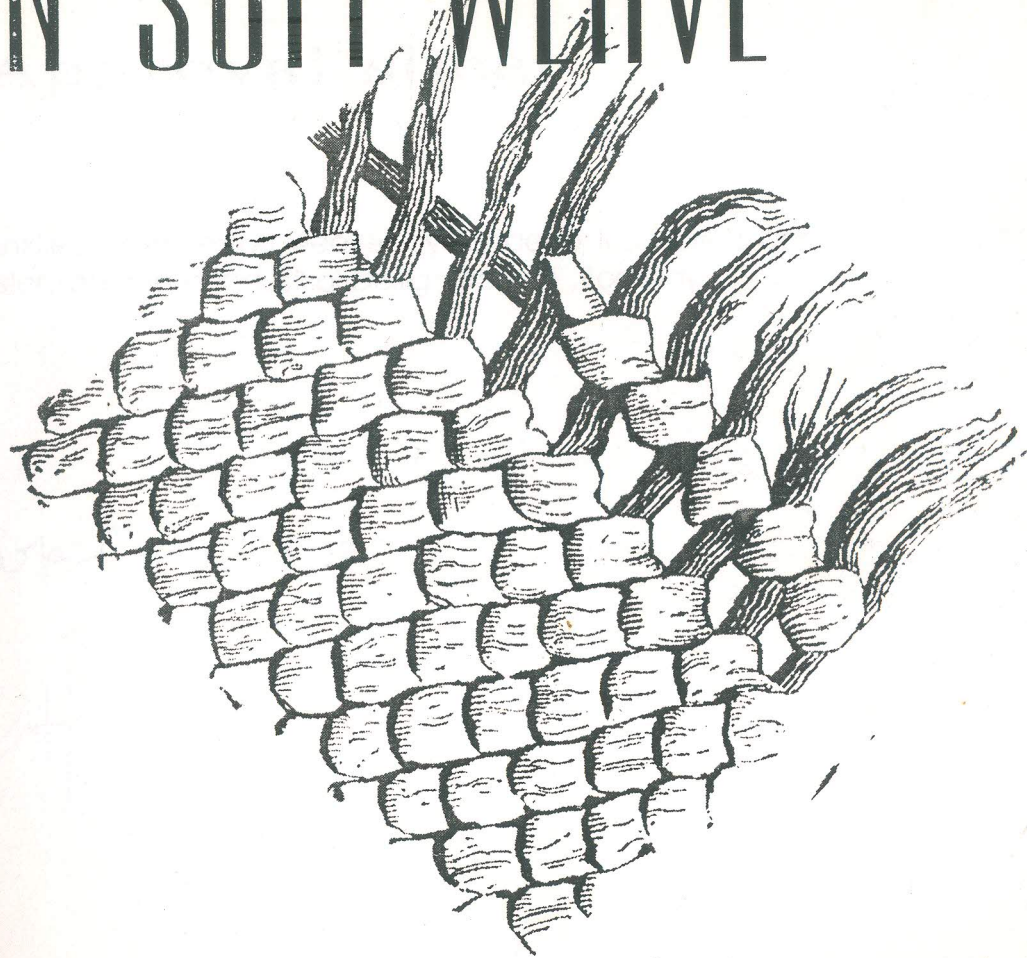
FORMS IN SOFT WEAVE

SPECIAL PROJECT

By
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Guide : Prof A.G.Rao

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Approval sheet

The special project entitled "Form in soft weave" by Sandeep Thombre is approved in partial fulfillment for the masters degree in Industrial Design from IIT ,Bombay .

Guide :

A. P. ... 15.6.98

Examiner :

P. A. ...

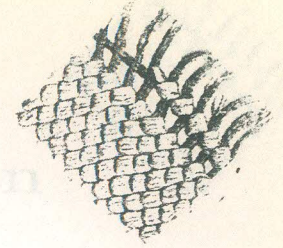
Acknowledgment

I express my sincere gratitude to my guide Prof. A.G. Rao for his guidance and support at every stage of the project and also for providing the rare samples for study.

I also sincerely thank Mr. Alhat , Manager -Sisal Handicraft Ahmednagar , for the valuable information on sisal fibres .

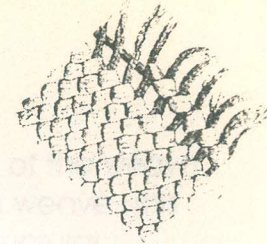
Finally I thank my class mates for encouraging me throughout the course of the project.

Sandeep Thombre



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2. The project
3. Classification of weave structures
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5. Study and analysis of woven forms
6. Documentation of Sisal fibre



1. Introduction

what would it be of a civilized man of today without the art of weaving the soft art that surrounds his home with comforts and lie with luxury.

Weaving is one of the oldest crafts .The best part of weaving craft was it did not required any tool for working .It all started when man started interlacing the twigs of trees besides the river ,which evolved into a weave. The same principal of weaving was developed and explored further with different material taking in to consideration the physical properties of the material which went further to make a woven cloth from fibers.

Initially weaving started by making a flat surface of 2 D form, in form of mats as per the use . But with the influence of pottery coming in some flat weaves were wrapped around the clay form ,which evolved a 3D form through weaving. Then came the evolution of the woven basket . Woven baskets are the best examples of 3D forms through weaving.

2. The Project.

Weaving started with interlacing of linear elements but all the linear elements existed were not suited for weaving ,because for weaving the weaving element should have some flexibility for bending. Depending upon the physical properties ,like bending strength ,stiffness, cross section of the material ,different types of weaves can be made into 2D and 3D forms according to the function of the object to be made. Depending upon the physical properties of the material the weave broadly classified into *Hard weave* and *soft weaves* The scope of the project lies in studying the various woven forms evolved through soft weave .Its form controlling factors .

In a weave the most important factor to be maintained is the structural strength of the weave, which depends upon the binding force between each intersecting point in the weave. This binding force is directly related to the stiffness of the material. To achieve the structural strength in the weave different constructional methods have been evolved, based on the nature of the material to get a desired woven form. On this basis the weave is divided into a hard weave and a soft weave.

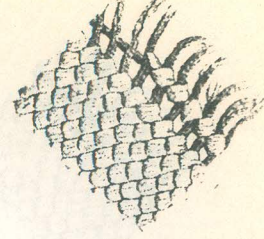
Definition

Hard weave: Hard weave is that weave woven with hard material in which the weave structure is based on the tension between the intersection points due to its stiffness.

Soft weave : Soft weave is that weave woven with soft material in which the weave structure is maintained with fixing the point of intersection to increase the binding force in the weave.

There is a wide range of material used and can be used for weaving. These materials can be categorized according to what type of weave these materials can follow.

| <i>Very hard weave</i> | <i>hard weave</i> | <i>soft weave</i> | <i>very soft weave</i> |
|------------------------|-------------------|-------------------|------------------------|
| wood | bamboo | grass | cotton textile |
| glass | rattan/cane | palm leaf | wool |
| ceramic | metal wire | plastic | silk |
| Iron | | leather | clay |
| horns | | | |



Following chart shows the approach to be adopted depending the nature of material

Each material determines the construction of the weave and the type of weave construction influences the final form to be woven. The type of weave to be selected depends upon the physical properties of the material they are

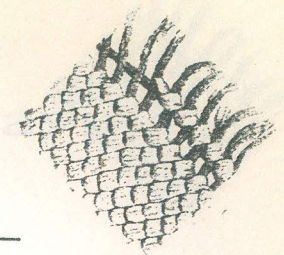
- Stiffness/ Breakability*
- Bendability /flexibility*
- Cross Section of the material.*

All the above properties can be manipulated according to the nature of the material. For e.g., Bamboo being hard and stiff can be split by changing the cross section of the bamboo element and then woven. Also a metal can be made flexible by reducing the cross-section or changing its metallurgical properties.

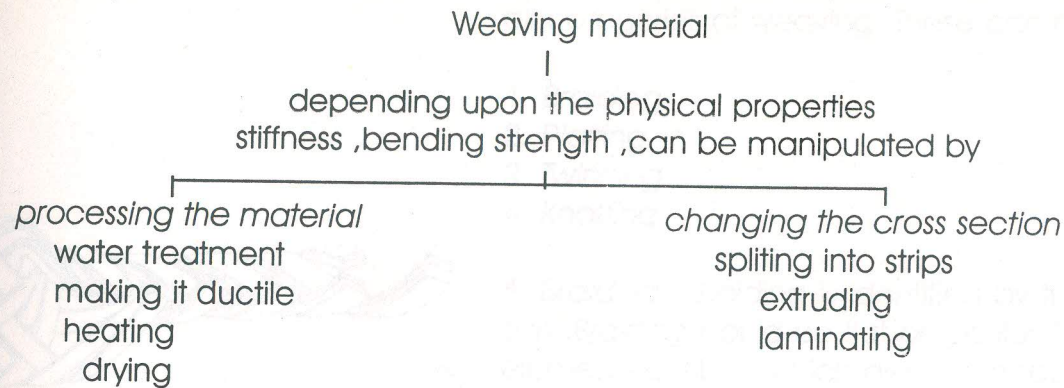
The main focus of the project is on 3D forms achieved by weaving. In short the steps involved in making a 3D form by weaving can be generalized as follows

processing the
water treatm
making / du
heating
drying
depending on
which
Hard weav
On select
Pattern
plating fig(3 2)
knitting fig(3 1)
twining fig(3 3)

On select
construction



Following chart shows the approach for deciding the weave form



depending upon the material selected for the weave ,it is divided into
which weave to be followed

Hard weave

soft weave

On selecting the type of weave, The method of making is decided

Pattern

plating fig(3.2)

knotting fig(3.4)

twining fig(3.3)

construction

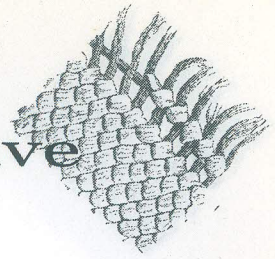
coil forming fig(4.3)

frame filling fig(4.1)

form enclosing fig(4.6)

shaping the warp fig(5.1)

On selecting the pattern and
construction the final woven form is decided



3. Classification of weave structure

Linear elements arranged in variety of interlacing structures are used in all categories of weaving. These can be listed as follows.

1. Braiding
2. Plaiting
3. Twinning
4. Knotting

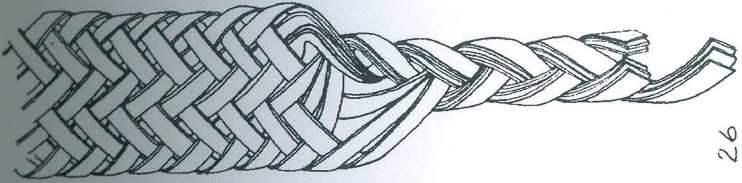


Fig3.1 Braiding

1. **Braiding** : Braiding is identified by the growth of surface along one axis. Braiding could be flat or tubular. These are made up of multiple elements or fibers which are interlaced in two directions each forming a mutually opposite helix. This type of weave is used mostly for soft weave. Fig 3.1

2. **Plaiting** : Two sets of linear elements interlaced diagonally to reference rectangle to generate either two or three dimensional forms. Variation is limited and weave structure is easily deformable. This type of weave can be used for both soft weave and hard weave. Fig 3.2

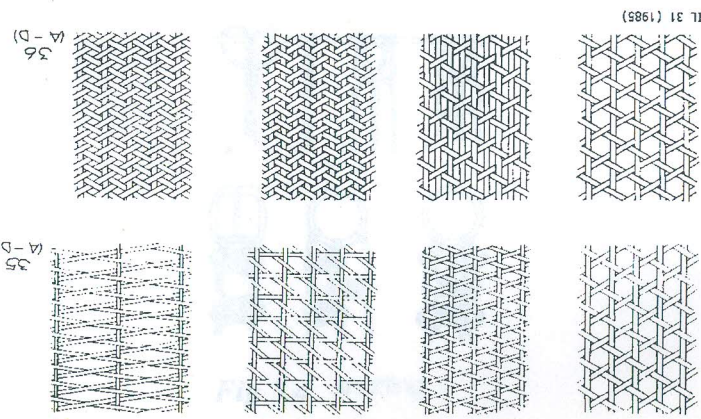
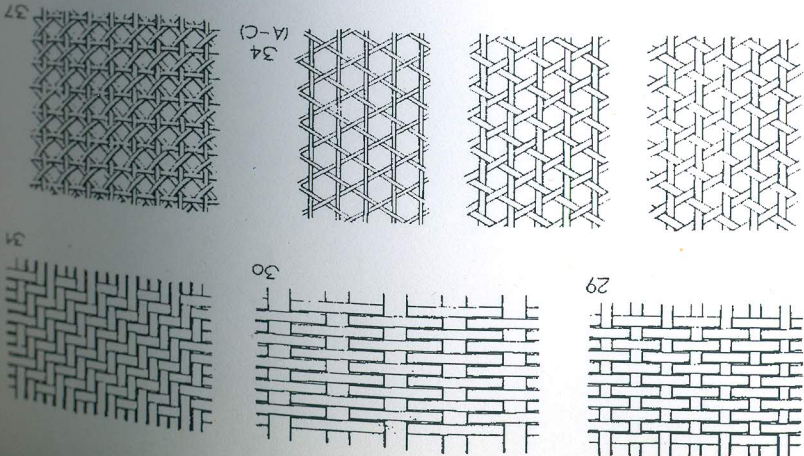
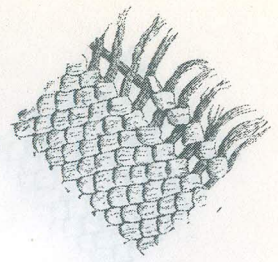


Fig3.2 Plaiting



3. *Twinning* : Twinning is identified by the twisting of a two or more linear elements to arrest a second set of element which are perpendicular or inclined to the first set. Elements of the second set are held between twists of the first set .Twinning is mostly used for soft weaving. *Fig 3.3*

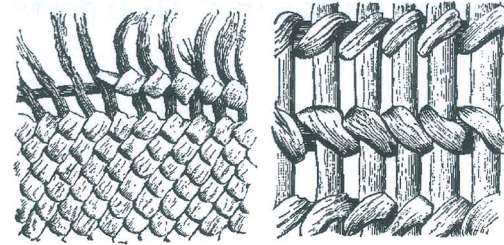


Fig3.3 Twinning

4. *knotting* : is identified by the use of open or closed knots at the point of intersection of two or more sets of mutually inclined elements .This structure is commonly used for surfaces generated by fibres ,ropes cables .Knotting implies the use of extremely flexible elements .best suited for very soft weave. Since hard material breaks when knotted. *Fig 3.4*

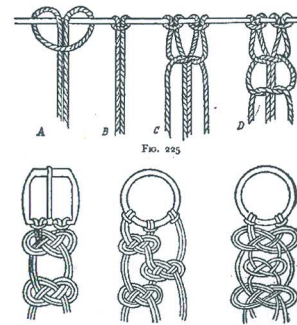
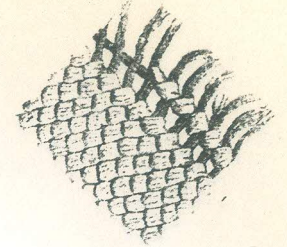


Fig 3.4 knotting



4. Classification of form generation method

These various methods by which a 3D form can be generated by weaving .

4.1 *Forming*

4.2 *Weave moulding*

4.3 *Coil forming*

4.4 *Lattice Forming*

4.5 *Frame filling*

4.6 *Form enclosing*

4.7 *Knot spacing*

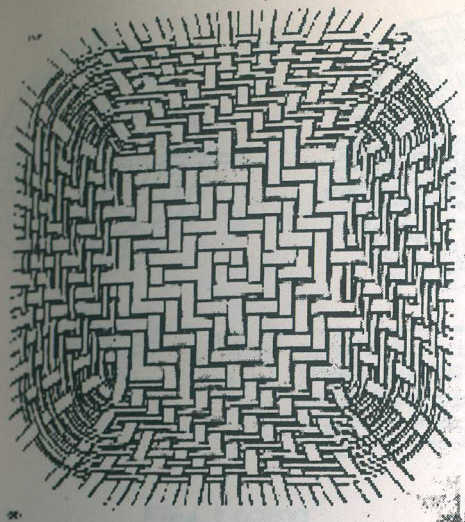
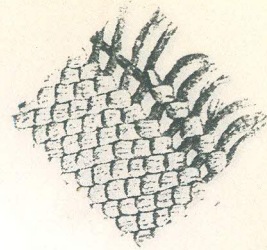


Fig 4.1

4.1 *Weave forming* : Three dimensional forms are evolved by interlacing sets of linear elements .In weave forming a desired size of flat surface is generated by interlacing after which the linear elements are progressively deflected from the horizontal while the process of interlacing continues. Fig (4.1) hence in this process form generation and interlacing are synchronous process .This method is most commonly used for making baskets. Various forms can be created by different type of base ,radial base,square,hexagonal base Tangential base. This method os suited for hard weave.

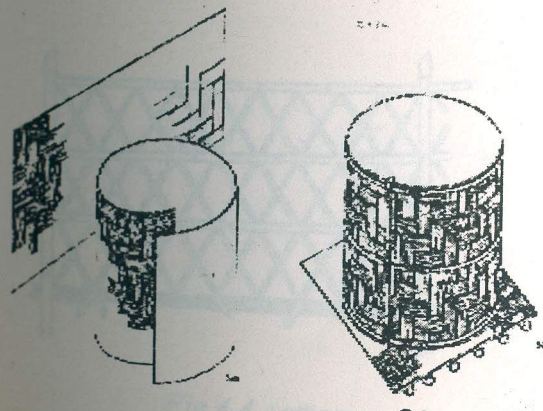
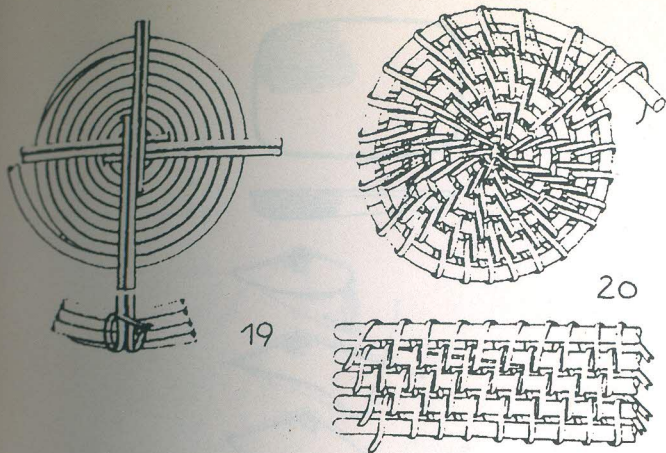


Fig 4.2

4.2 *Weave moulding* : Three dimensional forms are evolved in three stage process . Flat mats are made by interlacing linear elements in a deformable net structure These mats are further deformed either with a mould or freehand .The desired woven form is achieved by anchoring the deformed net to a rigid frame

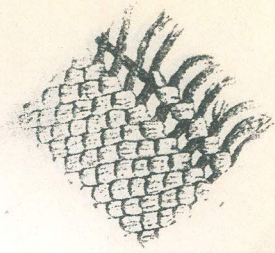
The variation in weave moulding process are identified by the presence or absence of tension in the mat element. Fig. (4.2)



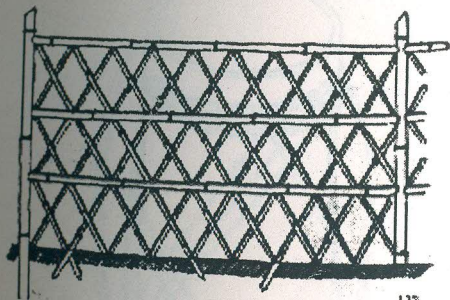
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Fig4.3 colling



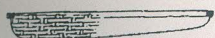
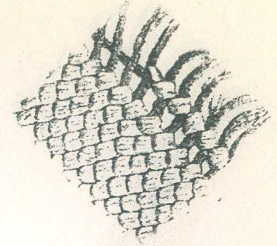
4.3 *Coil forming* : Linear elements bent sequentially to form spiralling coils create two or three dimensional structure. These coils are held together by binding or stitching consecutive turns of the spiral together. Coil forming is commonly used in cane ,palm leave and also is used for soft weave like sisal fiber where the braided element is coiled and stiched. Fig(4.3)



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Fig 4.4 Lattice

4.4 *Lattice forming* : relatively rigid elements forming layers are placed a repetitive and boure together in a lattice to form either two dimensional or three dimensional forms. Fig.(4.4)

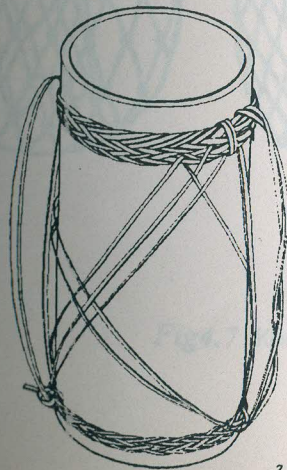


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4.5 *Frame filling* : rigid frames both 2D and 3D are filled in by surface formed by interlacing relatively flexible linear elements .These elements are anchored to rigid frame and are kept in tension .a variety of weave structure can be used to form the surface Fig(4.5)

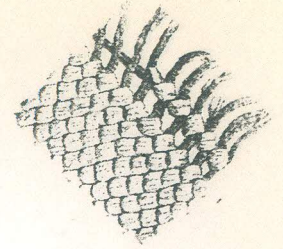
Fig4.5 Frame filling



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Fig4.6 Form enclosing

4.6 *Form enclosing* : form enclosing structure are made of linear element s which are interlaced around a rigid body to form an outer sleeve which is protective or decorative in nature. Woven around bottles or bamboo.Fig (4.6)



4.7 *knot spacing* : This method of forming is particularly used for soft weave ,in which knots are used for structural stability. By spacing the knots at different gaps ,different forms and patterns can be achieved.

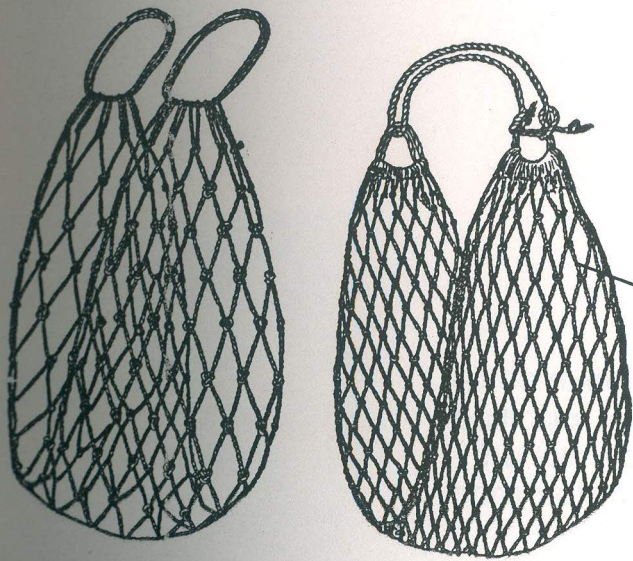


Fig4.7 Knot spacing

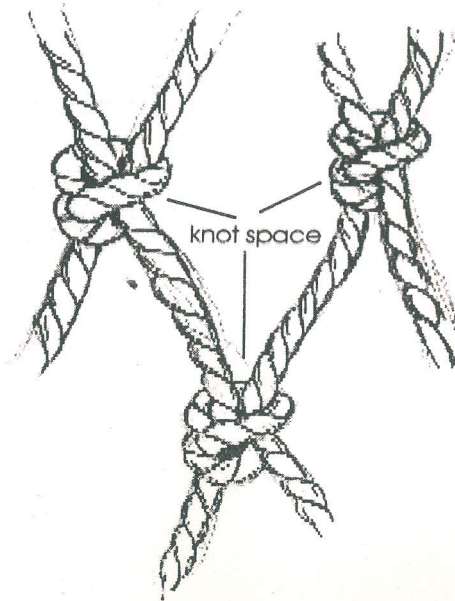
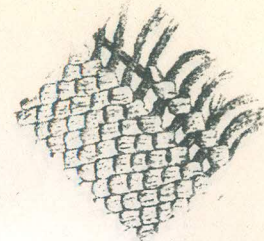


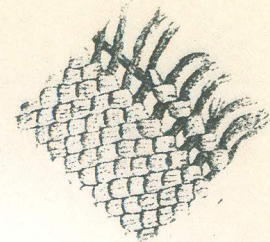
Fig4.7a



5. Analysis of few woven forms

Some selected forms were analyzed on the basis of the weave they adopt to achieve a particular form.

The forms are selected on the basis of material used and the strategy used for construction of the weave for making the form.



Sample 1

This is a simple bamboo basket woven out of bamboo stripes .
The construction procedure is.

A flat square base is constructed by interlacing the flat bamboo stripes .The cross section of the strip is made flat and thin to get the flexibility in the material .These stripes are interlaced close to each other so that maximum number of weaving elements are present for warping .Warp is that weaving element which is vertical and the weaving element which is interlaced around the warp is called as weft. The cross section of the warp and weft may be equal .In the basket the direction of the base elements are further changed from vertical to form the shape of the basket and the warp is further interlaced with a bamboo weaving which is thin in cross-sections . There are different shaped which can be achieved by controlling the shape of the warp of the base element (fig5.1a) .

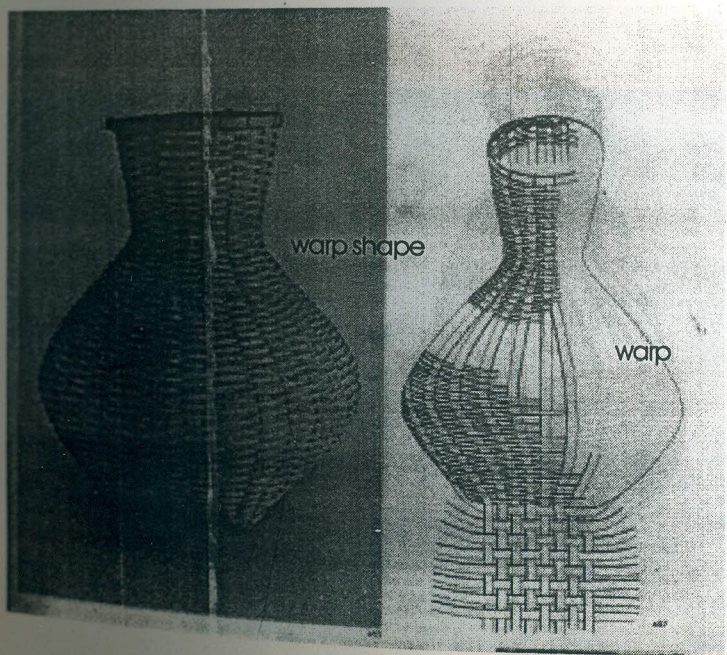


Fig 5.1

base construc-

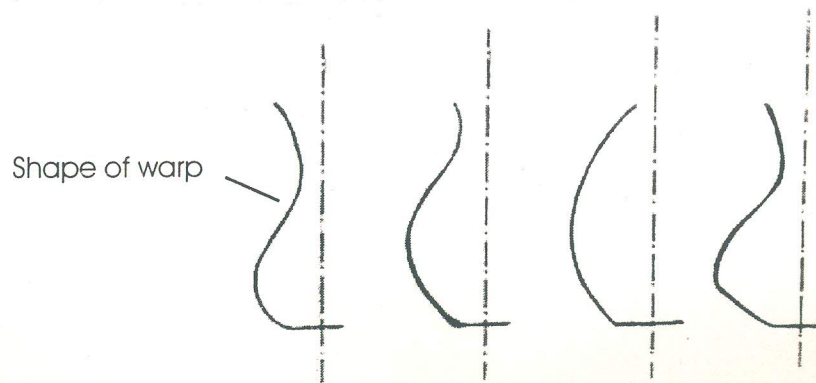
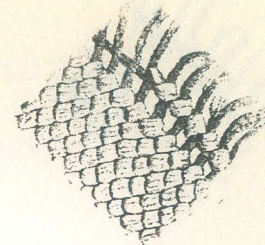


Fig 5.1a



Sample 2

The weaving element here is having equal width and equal cross section cross section

The weave pattern adopted is suryamukhi . In this method the stripes are intersected tangential to an imaginary circle which creates a very interesting pattern .The stripes are woven in opposite direction. These stripes further interlaced forming a flat surface .

The important part of the base is two sets of patterns are placed on each other to get more number of elements interlacing to get a close weave structure.

This is an example of frame fitting .A frame of any desired shape can be fitted to the mould.

This is a example of soft weave .The structural stability is due the stiffness of the strip and the tension maintained by interlacing the element at suitable gaps and intervals of the other element.

Bamboo Woven Tray

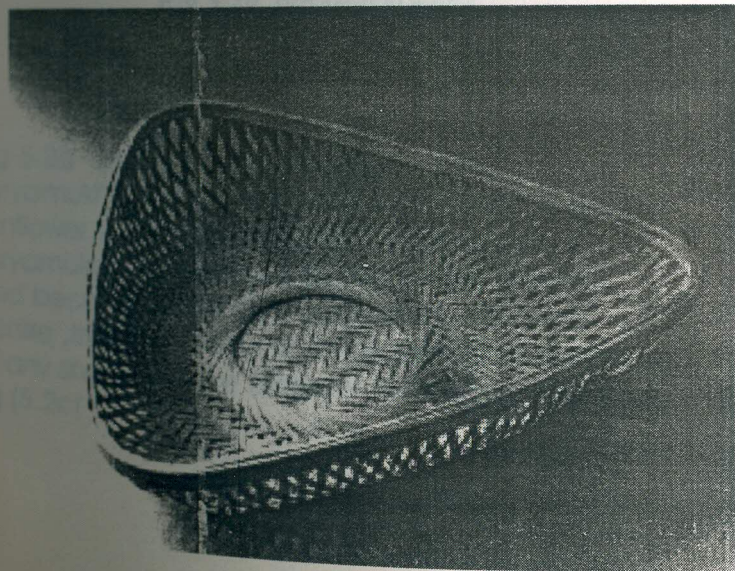


Fig 5.2



Fig 5.2a suryamukhi weave

Fig 5.2a Shows the construction of the Suryamukhi weave. The pattern obtained is like a sunflower so the name given to the weave is suryamukhi. The weave is dense at the centre and become loose as it goes away from the centre, thus the weave can be fixed in a frame of any shape to take different forms as shown in fig (5.2c)

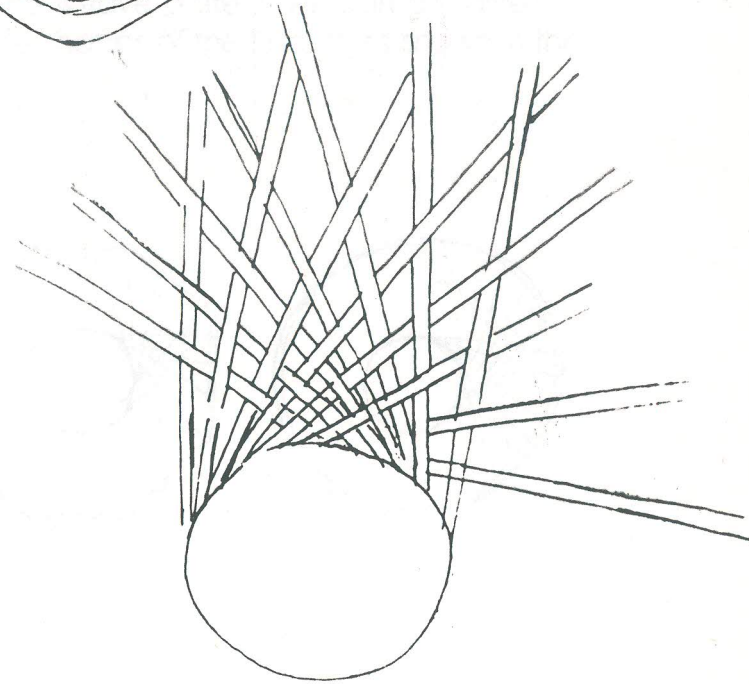
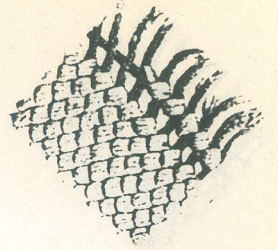
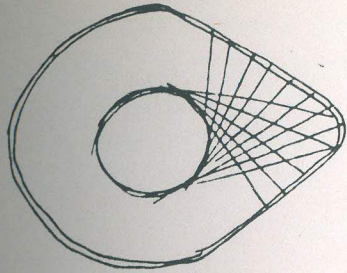
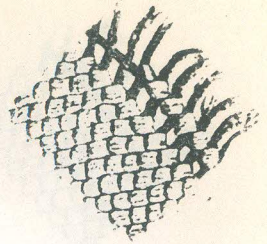


Fig 5.2b





Sample no 2 is an example of frame filling type of construction .Keeping the same weave pattern ,we can get different forms by changing the shapes of the frames as shown in the Fig .5.2c

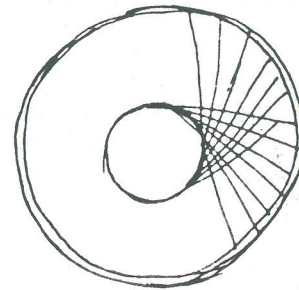
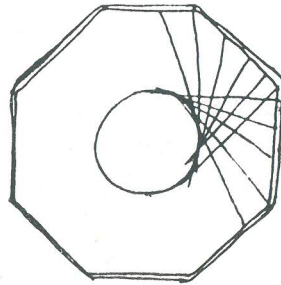
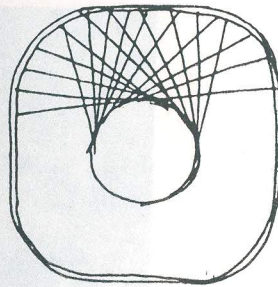
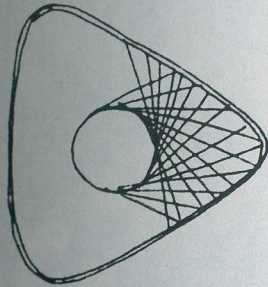
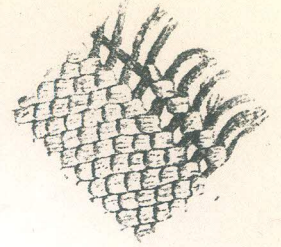


Fig 5.2c



Sample 3

Examples in soft weave

Soft weave being made of soft material like Palm leaf ,sikki grass ,plastic strands,sisal fibre .cotton thread.

Palm leaf , being a soft material is weaved very interestingly to achieve the stability of the weave structure .The leaf is available in thin cross section with a width of either 10mm and 7mm. .It is flexible and can be twisted and turned.

Sample 3 is a simple box woven in palm leaf .

Method of construction is interlacing

The leaf being a soft material so to increase the strength two layers of leaves are used .

The base is developed by interlacing closely for structural stability .Then four corners are developed by turning two intersecting stripes at right angles at four corners . This

Corner adds to the strength of the box.

The form controlling factor is the turning of the elements at right angles,forming the corner.

Palm leaf woven box

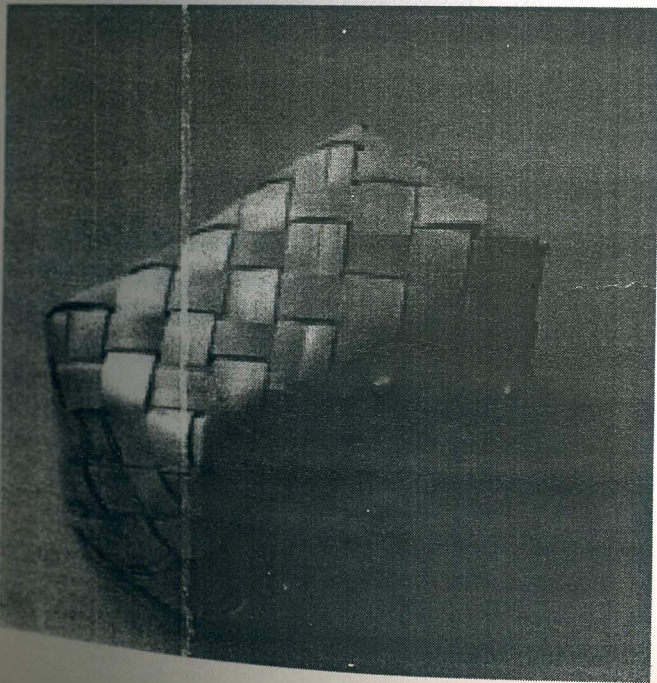


Fig5.3

Fig.5.3a shows how the corner is constructed in a weave. This corner is responsible for generating the sides of the box within the weave. Thus a corner is the form generating factor in this case.

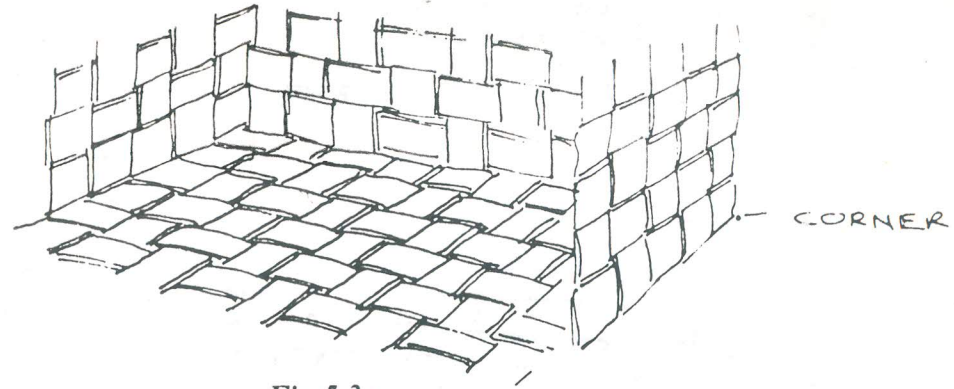


Fig 5.3a

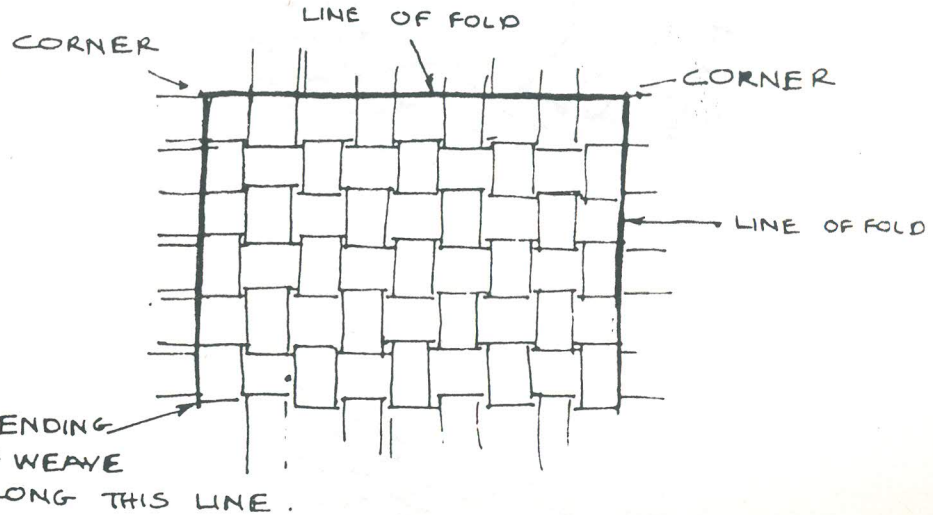


Fig 5.3b

Fig.5.3b shows if the line of fold between two corners is parallel or in line with the weave pattern, the form achieved is a flat sur-

Fig 5.3c shows a weave woven from palm leaf .In this particular example the line of fold is along 45degree of the weave pattern .After folding the weaving elements along the line of fold as shown in fig5.3c, and further interlacing these elements after the fold a curved surface is developed fig 5.3d. So to get a curved surface the interlacing, should be at 45degree to the line of fold Fig. 5.3e

Palm leaf woven article

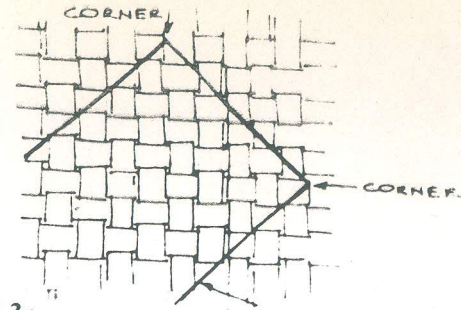


Fig 5.3c

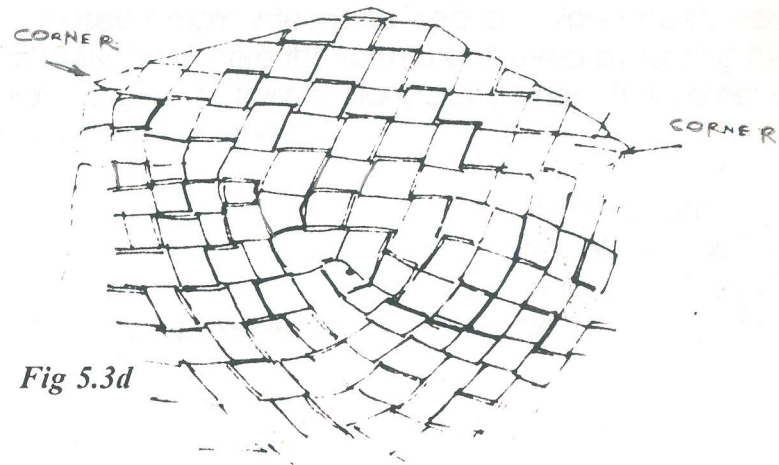


Fig 5.3d

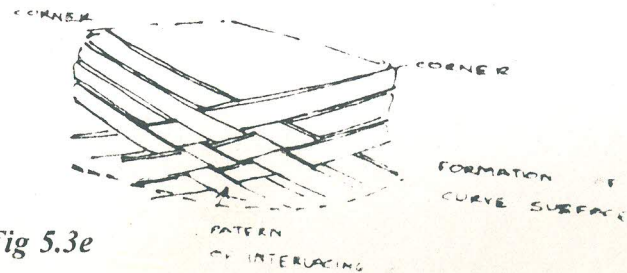
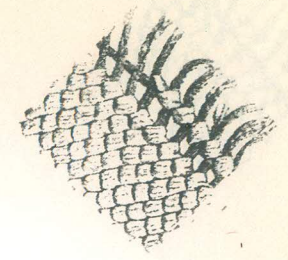


Fig 5.3e



Sample 4

This form is woven from palm leaf of width 7mm being flexible the weave is a closed simple interlaced weave .It very closely woven for structural stability .Even here the form is achieved by turning the elements at right angles to form a triangular corner . This corner also gives a dimensional stability to the form.

Comparing both the forms Interesting thing to note is, to get a box form ,four corners can leads to a box form . Where as the number of corners increases the form start taking a round form .These many number of corners is possible only with this type of soft weave.

Palm leaf woven article

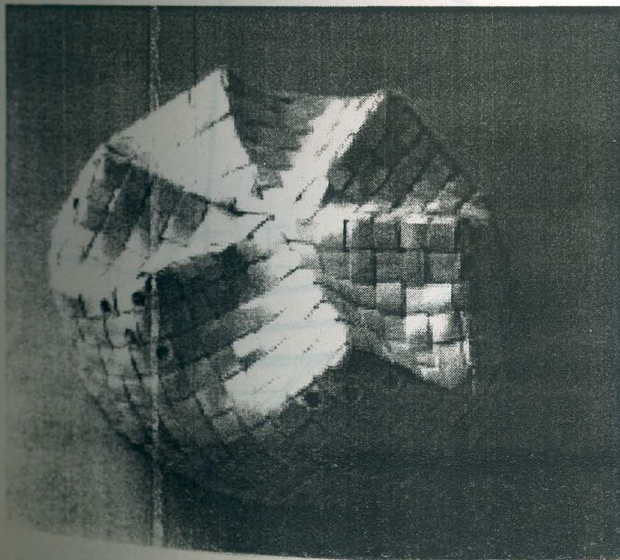


Fig 5.4

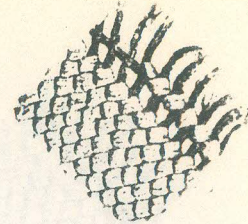


Fig 5.4a shows ,there are only two lines of fold perpendicular to each other, creating three corners .When the weave is continued to be woven by interlacing linear elements coming from corner 1 and corner 2 (fig 5.4b),a curved surface is formed out of the weave as shown in fig.5.4c .This curved surface is responsible for getting a round shape of the form in the sample.

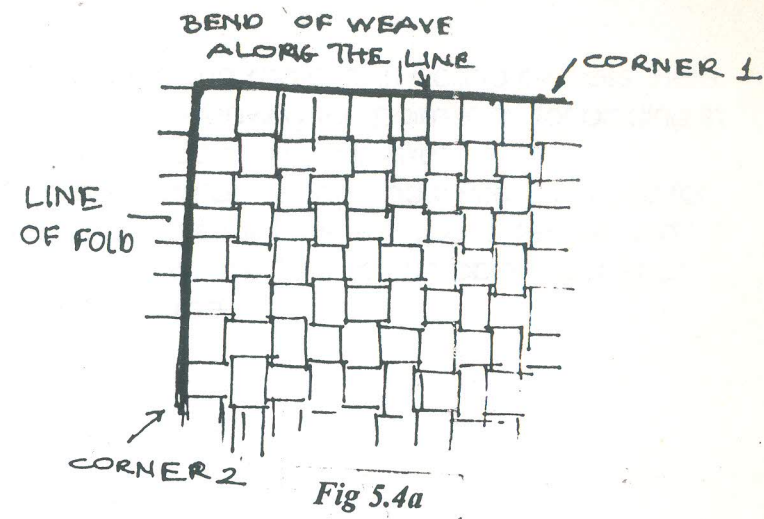


Fig 5.4a

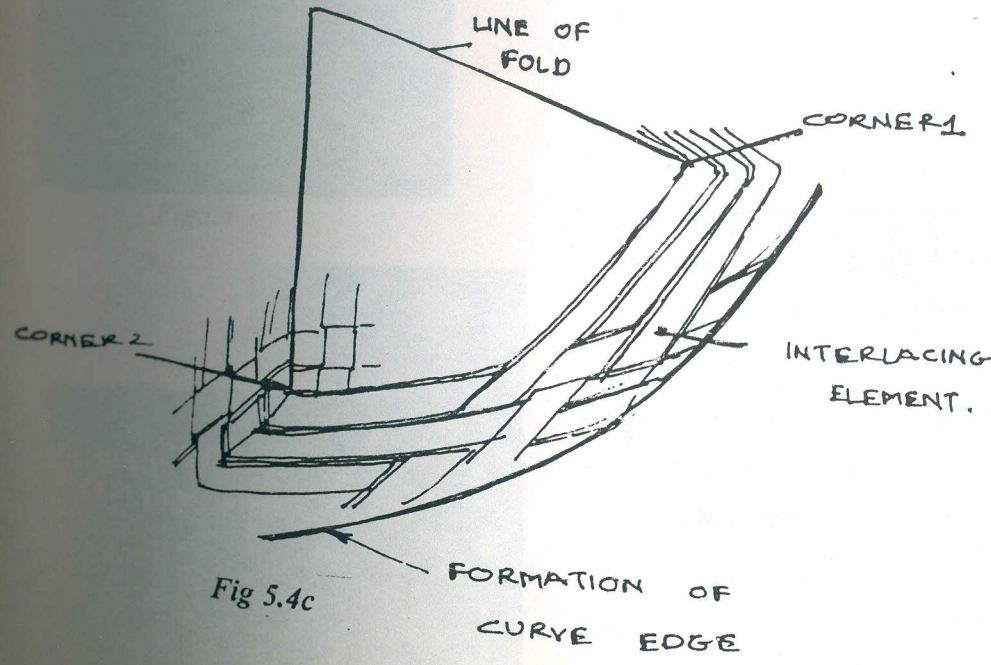


Fig 5.4c

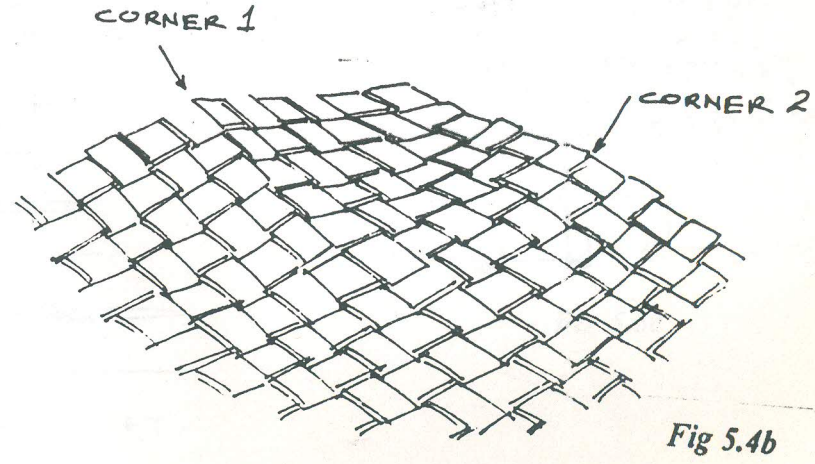
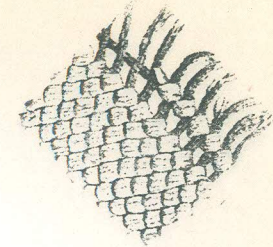


Fig 5.4b



Sample 5

Palm leaves are also used as a binding material in coiling process .Here the aesthetic quality achieved by weaving the palm leaf for binding in coiling is highlighted .Fig.5.5 and 5.5a shows a basket. The material being supple and can be turned and twisted. ,is used for binding the coils of some hard material. Different type of texture and pattern can be achieved as shown .The form of the object depends upon the shape of the coiling element.

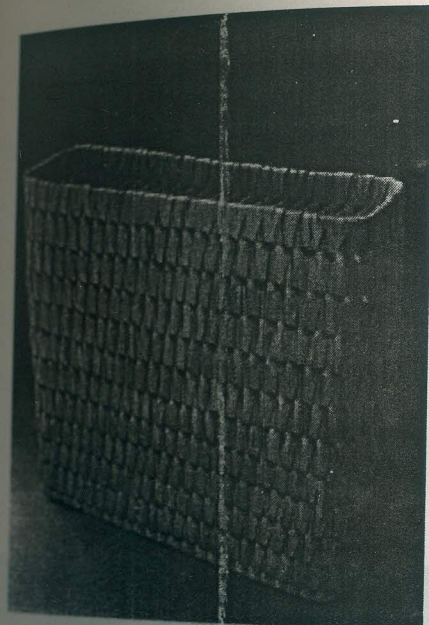


Fig5.5

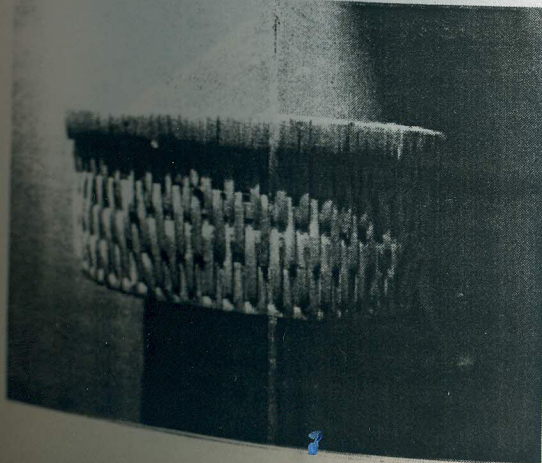


Fig 5.5a

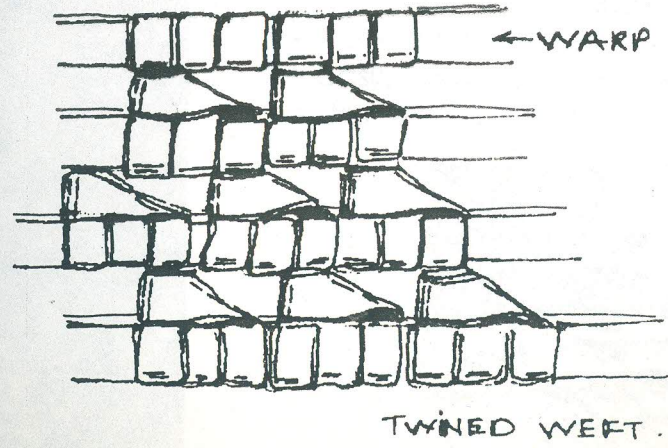


Fig 5.5b

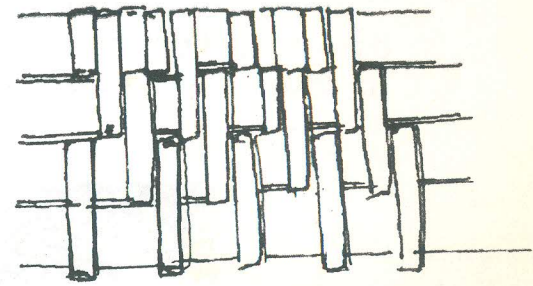


Fig 5.5c

Sample 6

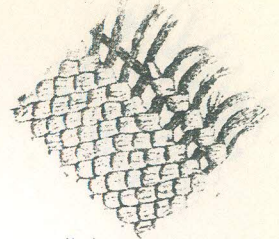


Fig 5.6 shows a woven chapple. The material used here is a wild grass called willo, with round cross section. This grass is flexible and thus the weave generated through this weave is a soft weave. Since the material is flexible the weaving elements are locked at the point of intersection of the weaving elements. The weave used here is called as twining (fig 5.6a) where the weaving element is twisted around the warp which gets locked around the warp forming a beautiful pattern.

This pattern of weave was used only weaving baskets and mats, But this form of a slipper can be achieved by controlling the warp shape i.e.. The element around which the weave is twined. The whole of the slipper is woven out of a single weave with no stitches and joints.

The steps involved in constructing the slipper is
The upper base is woven first and a border is set of the shape of the foot print then a templet of the form to be created is placed on the woven base and the warp is wrapped around the templet and a border weave is placed at the edge of desired form. Following the template the basic form structure is developed and further weave is woven in the structure developed.

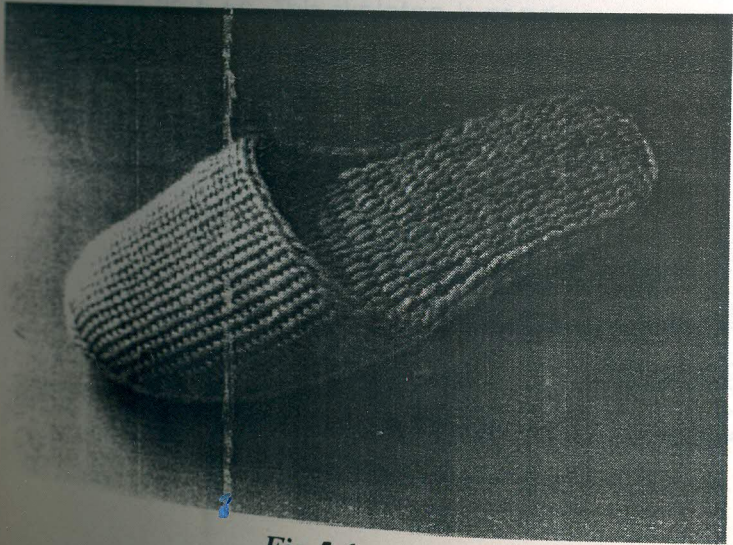


Fig 5.6

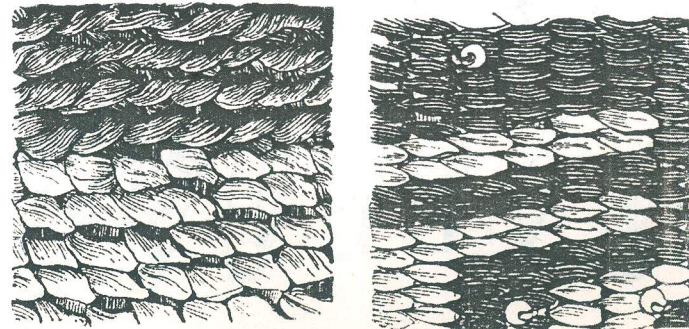


Fig 5.6a

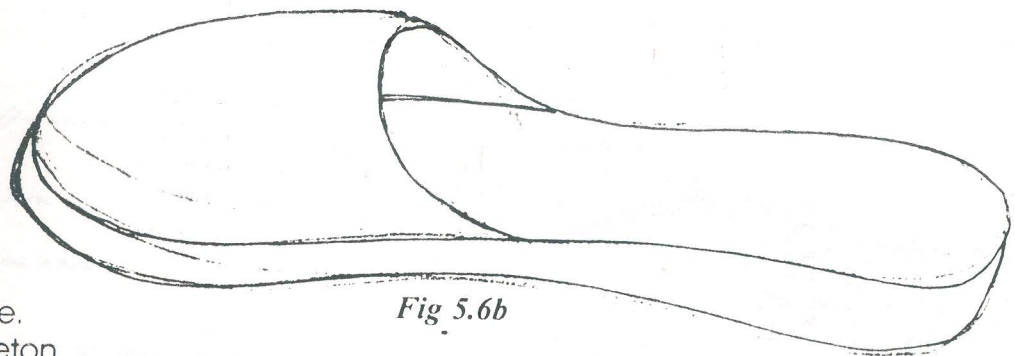
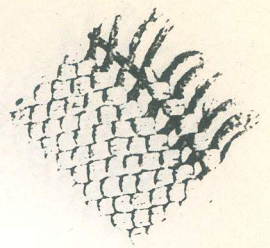


Fig 5.6b

Fig. 5.6b shows the form of the chapple. To weave a shape like this a basic skeleton of the desired form is to be made as shown in fig.5.6c. This skeleton is made from the grass itself and the weaving element is woven or wrapped around the skeleton.

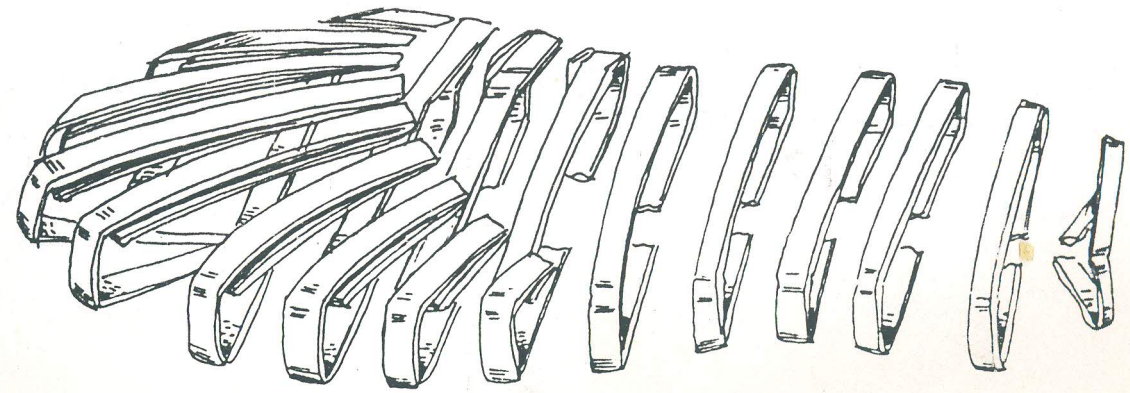
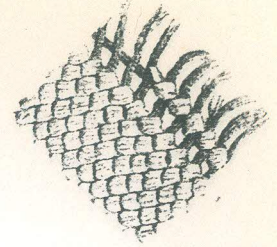
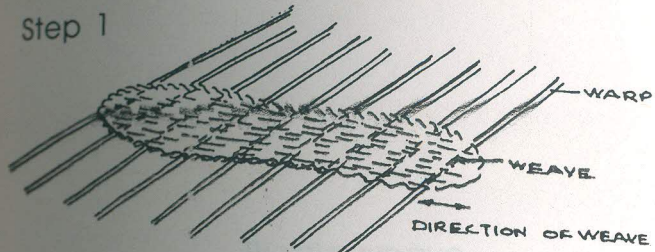


Fig 5.6c



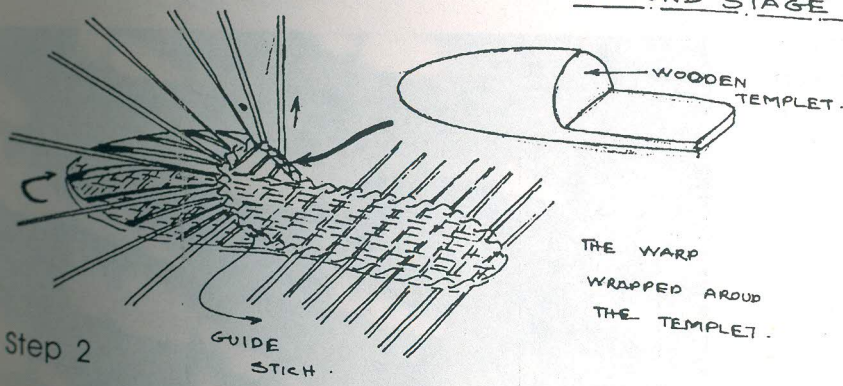
Steps for weaving the chapple

Step 1



1st STAGE
A FOOT PRINT IS WOVEN.

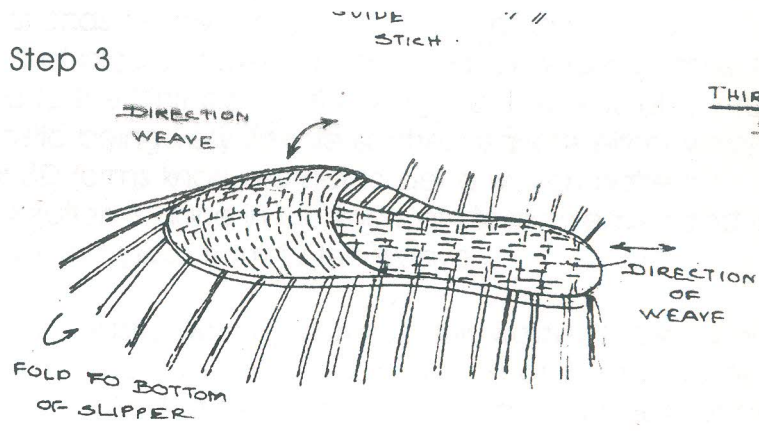
SECOND STAGE



THE WARP WRAPPED AROUND THE TEMPLET.

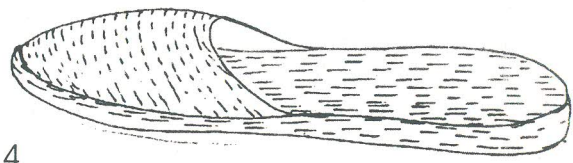
THIRD

Step 3

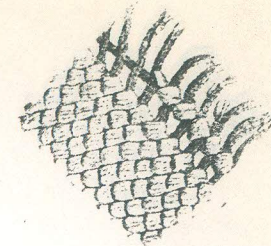


THIRD STAGE

Step 4



FINAL FORM



Sample

Plastic is one of the man-made materials used for weaving 3D forms. Plastic in extruded form is used for weaving. Plastic is flexible with good bending strength, it can be extruded into continuous strands of any cross-section and of any colour.

The need of plastic material to be used for weaving must have evolved due to the limitation of the length of the natural accruing material. Plastic being very flexible so the weave is either woven in a frame or for 3D forms knots are put to get a woven pattern.

Exploration is done in the knots of plastic weaves and a significant knot gives a typical form to the weave.

Plastic weave

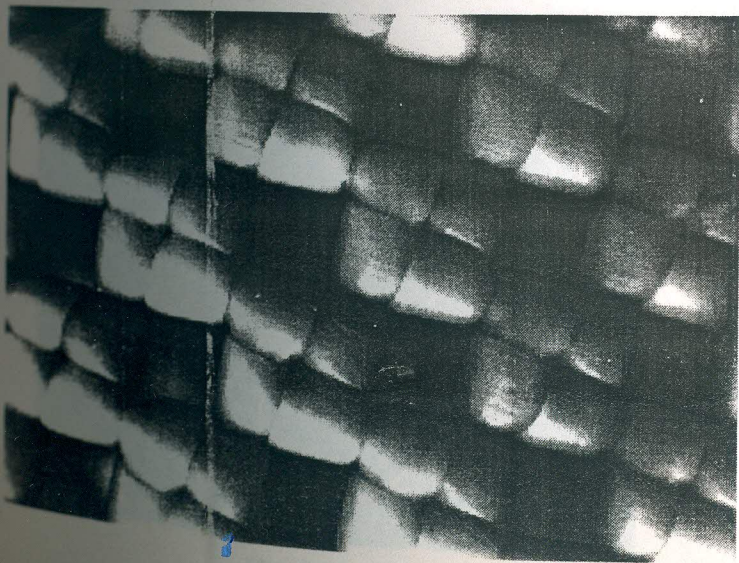


Fig 5.7

Fig 5.7 shows a plastic woven weave. In this weave shown a plastic strand of 5mm is used. It is called as square knot. It is made by interlocking of four folded strands ends to form a square knot and the strands coming out are continued to tie with other knot continuing to form a single weave. This type of knot gives a good structural strength to the weave when placed close to each other. This square type of knot is best suited for a flat weave. But still variations can be made to create a form by changing the inter knot spacing like 3 knots tied together or 5 knots tied close to each other, which significantly takes up a form.

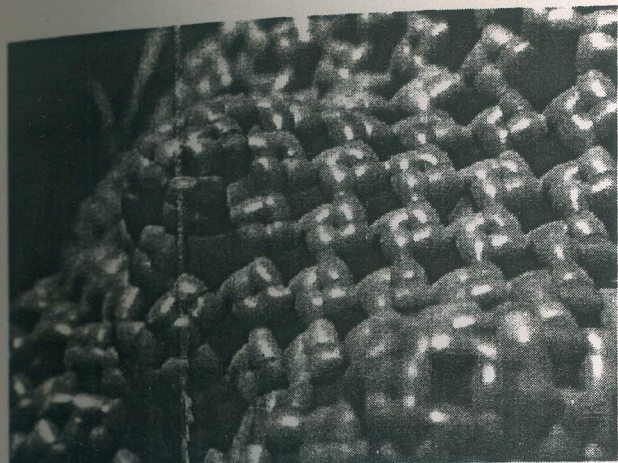
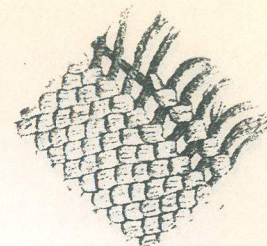


Fig 5.7a

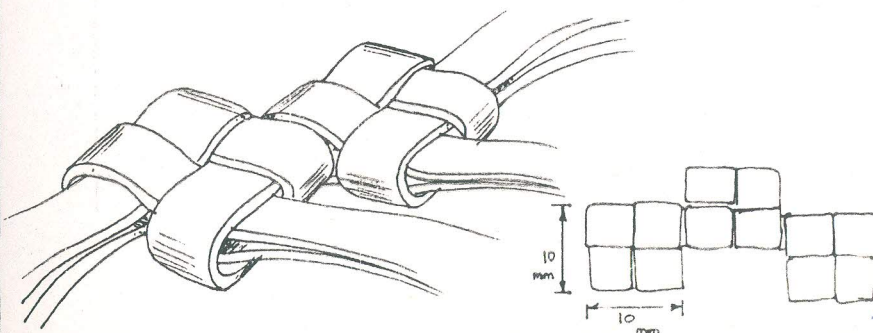
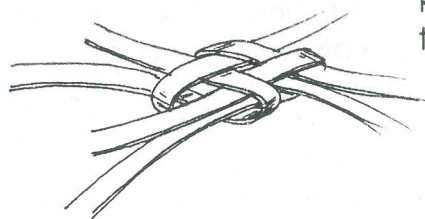
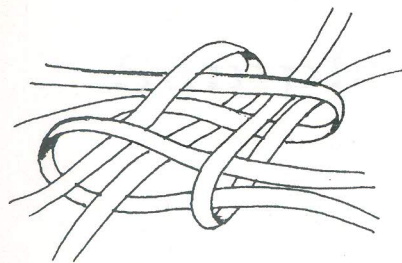


Fig 5.7c

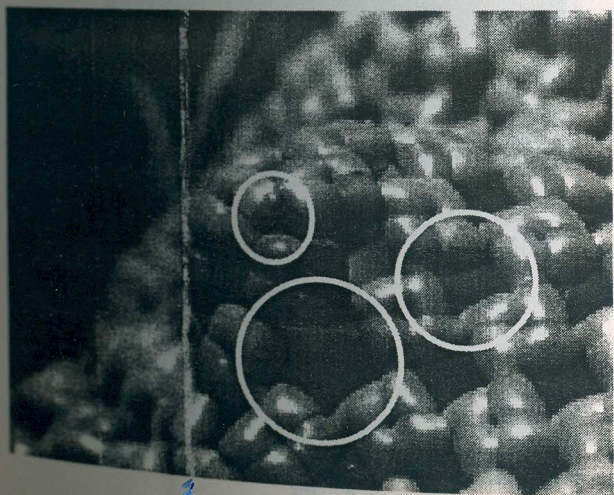
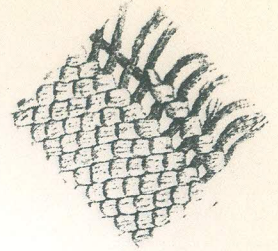


Fig 5.7b

Fig 5.7a shows a 3D form evolved out of the weave. The construction of the knot is shown in fig 5.7c. Taking a closer look at the 3D form of the weave, the factors governing the form generation process are the geometric shape between the group of knots. As shown in fig 5.7b in circles there is a formation of a pentagon with 5 knots, a square with 4 knots and a triangle with 3 knots. These arrangement of knots brings the variation in the form of the weave.



Sample 8

Enclosed woven form

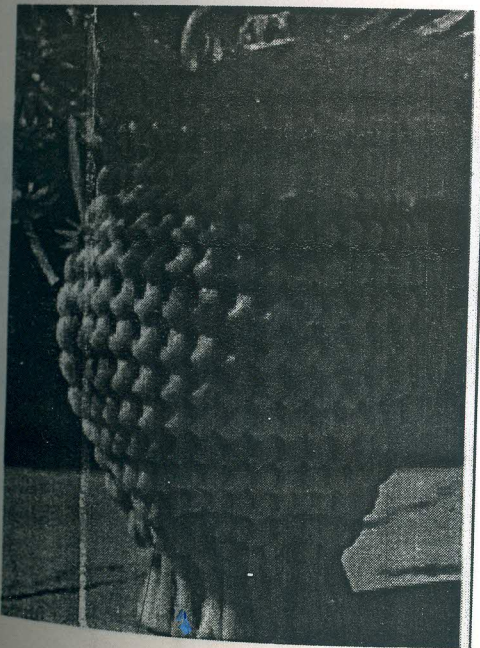


Fig 5.8

In this Example the knot put for weaving is different and is called as turn knot .In this weave material used is 5mm plastic extruded shread . The most interesting part of the weave is ,at each knot the weaving element is turned around the warp element.

If watched closely the weave has two conical shapes getting intersected with each other. Due to this conical element in the knot , when such knots are woven close to each other ,the weave takes a curved surface .This weave is best used for creating curved objects ,or wrapping around a circular object.

fig 5.8 shows a weave woven out of plastic strands. In this type of weave the knot is conical in shape (fig 5.8 c). The pattern formed by these knots are shown in fig5.8d .Due to the conical shape of the knots the weave when woven flat ,gives a curved surface.Thus this type of weave is best used for constructing spherical forms.The knot shape (fig 5.8b) creates a beautiful pattern when woven.

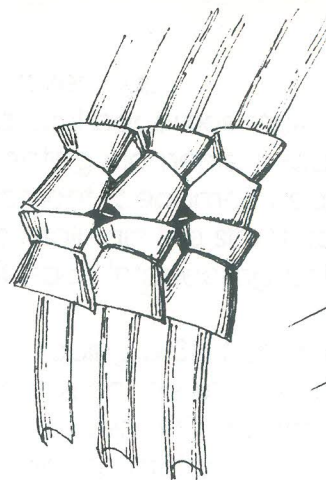
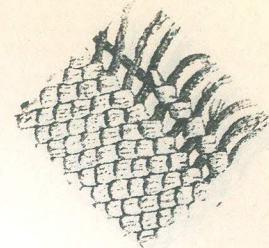


Fig 5.8d

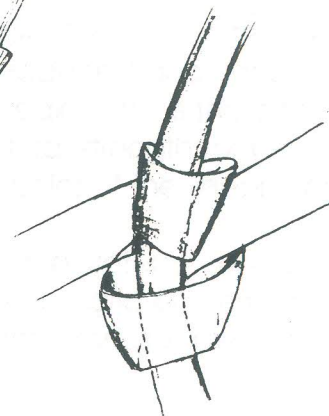


Fig 5.8c

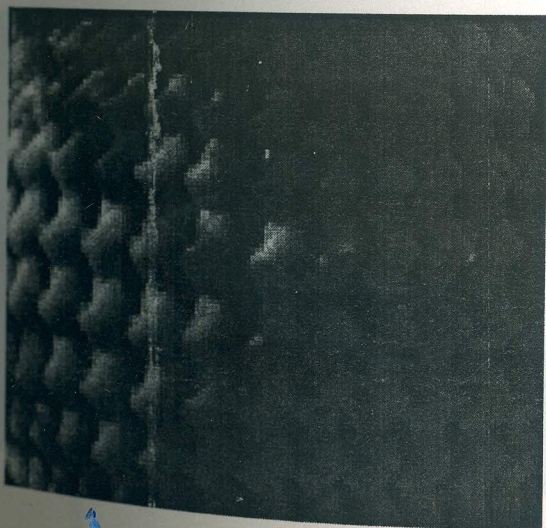


Fig 5.8a

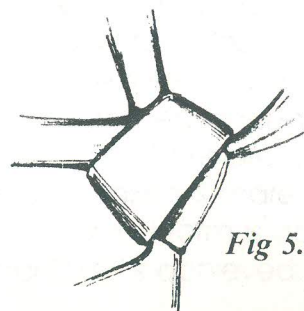
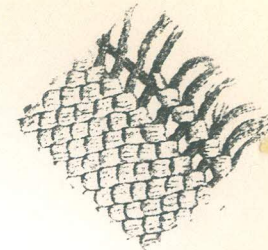


Fig 5.8b



Sample 9

A cotton woven cap.

As the material becomes more flexible, the tension within the two woven intersecting elements is reduced and hence the structure of the woven element becomes weak. This is the case of a very soft weave. To maintain the structural strength for very soft material, knots are put at each intersecting point of the linear element.

For developing a 3D form the strategy used is manipulating the distance between the knots in the grid of the weave.

This cap is woven with a cotton thread. The form achieved, depends on two governing factors.

- 1 Structural strength
- 2 Control of the form

Thread being a very soft material, to get the structural stability, knots are put at each point of intersection of the weaving element (fig 5.9a). In this case the knot selected is such that it increases the thickness of the knot thus increasing the overall thickness of the weave. The knots are placed very closely leaving no gaps. The pattern followed is concentric progression the knot around the concentric. The form is controlled by the rate of increase of knots in the center. If the each knot circle is expanded at a greater rate i.e., in 5th circle there are 25 knots in 7th there are 29 and in the 10th circle there are 32 knots, the form taken is more flat. But if the rate of increase of knot is less a more curved form is achieved, and if the rate is kept constant a cylindrical form is achieved. (fig 5.9b)

A cotton woven cap



Fig 5.9

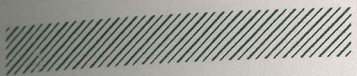


Fig 5.9a

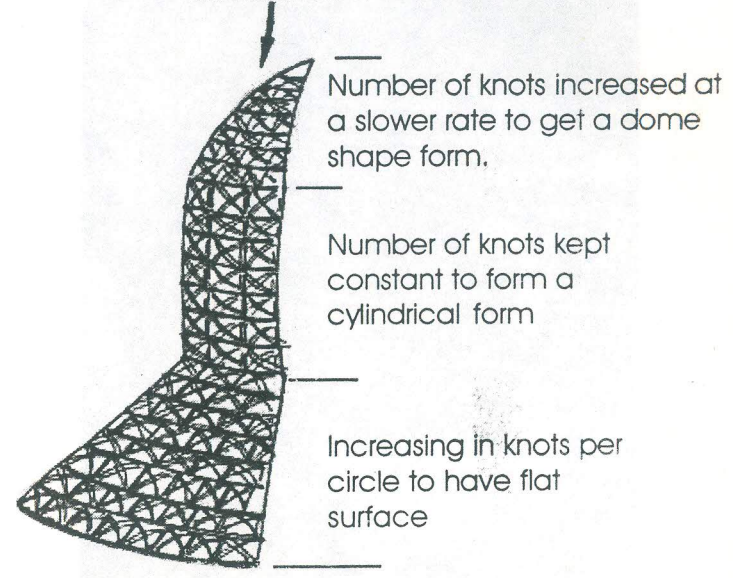
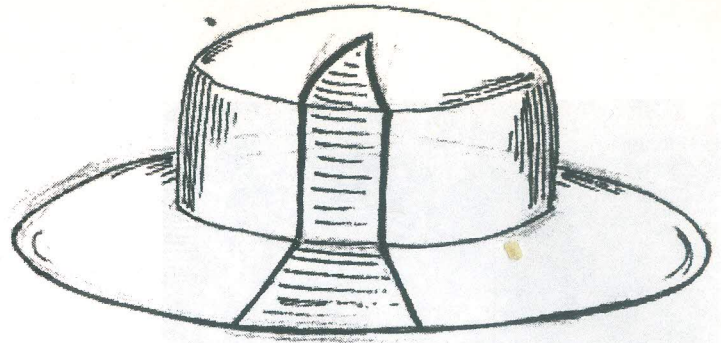
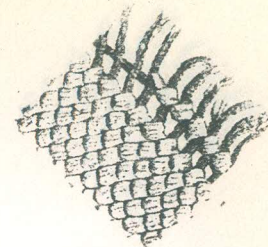
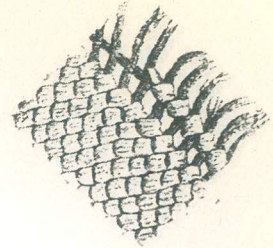


Fig 5.9b



6 Documentation on Sisal fibre



Name of the fibre: Sisal

Made out of a cactus

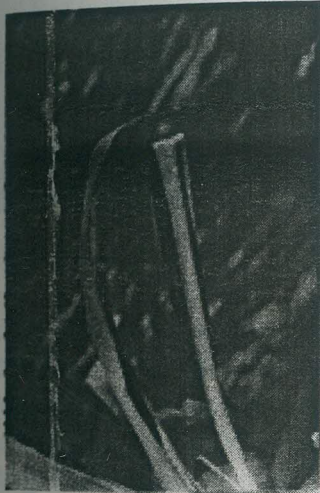
Description of the Cactus : The cactus has leaves of about 4-5 feet long, max length of growth . It is green in colour when fresh

The cactus is usually planted along the fencing of the fields.

As they require very little of water

The leaves are thorny and tergid and pointed at the ends.

If the leaf is cut from the present plant then it again grows with a new set of leaves in a period of one to 1 1/2 year



The plant



Making fibres out of the plant

The process of Makijng fibres :

The cactus leaves are cut from tthe present plant. Then bundles of these leaves are tied with ropes. These bundles are then soaked into water, usually at river banks or even same time in the drange and dirty water.

These bundles are kept in the water for 8-10 days

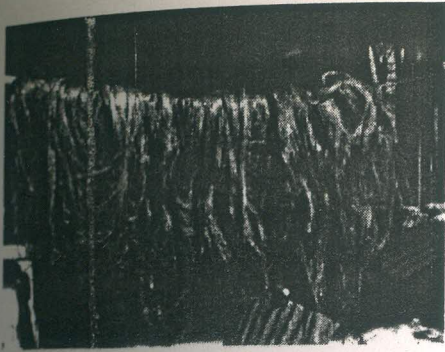
During this soaking period the leaf gets decayed and only the fibres inside the leaf one left behind.

These fibres are then dried for 2-3 days in hard sun light

The fibre we get after drying is dry golden yellow shining medium soft fibre.

Then these bundles are tied and sold in the market for 15 rupees per kilogram

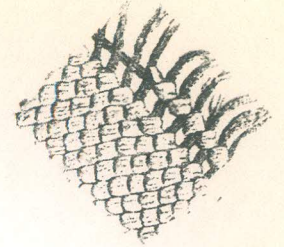
The fibres are bought to the centre, where the fibres are cleaned and with a comb and only soft fibres are taken out making the budle loose.



The weaving process

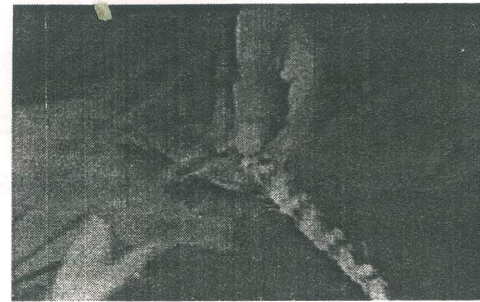
The fibres are now ready for weaving

The fibre are cleaned and fine fibres are made loose and seperate and small bundles of such fibres are taken out
The only process they do on the fibre is they weave into pleates. and further coiling it to form a flat surface.

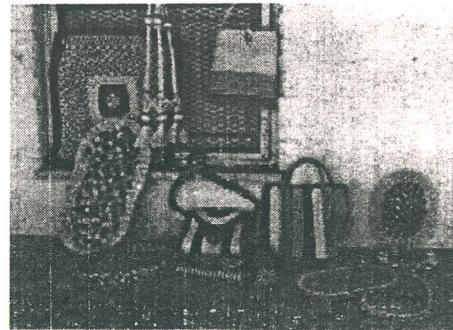


Dying process

The fibres are dyed with different colours.
The colours used are cotton fibric colours. The fibres are dipped in the boiling water with colour mixed in the water. The fibres are soaked for 1 hour and then dried for 5-6 hours in sun light.



Objects like mats bagsand wall hangings are made out of this craft



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