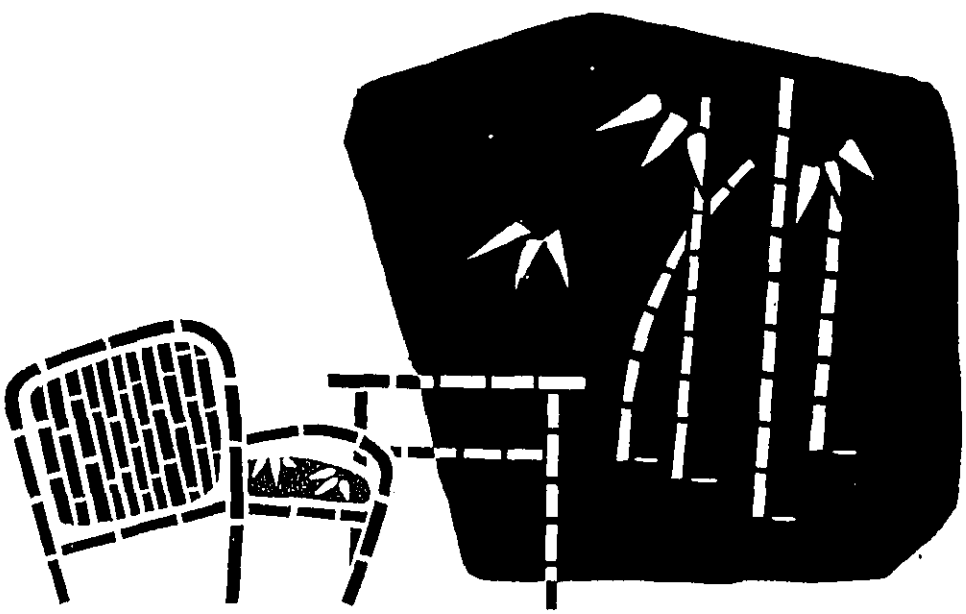
HAND BOOK *for* BAMBOO CULTURE AND PROCESSING



ASIA KYOKAI

TOKYO

Hand Book

for

Bamboo Culture and Processing

1958

ASIA KYOKAI

Tokyo

Foreword

There has been a steady increase recently in the number of people from different countries of Asia who come to Japan under the sponsorship of governmental, United Nations and private institutions to study various phases of industrial arts in this country. In the field of bamboo work, however, the lack of adequate reference material or handbooks in English in this country lays a serious obstacle in the way of training these people from our neighboring countries.

With this situation in view, as well as at the suggestion of the Shimomaruko Institute of Industrial Arts, Ministry of International Trade and Industry, which takes charge of training some of the foreign bamboo-work trainees, barring the earnest wishes on the part of the latter, the Asia Kyokai decided to bring out an English version of "Take no Saibai to Kako" (Culture and Processing of Bamboo), written by Kiyoshi Masaki and published in 1954 by the Taibunkan, Tokyo, upon whose permission the present book has come out.

It is to be noted that this is not a complete translation of the above-mentioned book. As will be so noted in the Table of Contents, Chapter I, Section 4 of Chapter III, Chapter IV and Appendix have been omitted in this translation. The skipps in the numbering of chapters and illustrations therein reflect the omission.

November 1958

Yoshio Iwata
Vice President

HANDBOOK FOR

CULTURE AND PROCESSING OF BAMBOO

- C O N T E N T S -

Chapter II. Bamboo Culture

Section 1. Management of Bamboo Grove

They have recently been much interested in management of bamboo grove, from the standpoint of farm-house management. It is needless to say that the cooperative organization must be established for the purpose of management of bamboo grove, production of superior products, selling or side job of bamboo and finishing enterprise of the farm village industry. However, no cooperative organization has been established, because most of the bamboo groves produce inferior quality of bamboo, moreover they have been neglected, as they are thought to grow naturally. Some farm-houses have cultivated much bamboo of greater demands, and been very much payable, through better management, despite the restriction due to such natural conditions as land and climate. It must be reconsidered that bamboo is cut when it is requested, but is left alone when the price is lower, from the viewpoint of utilization and management of natural resource.

We can considerably save cash payment through utilization of bamboo and bamboo shoot, and in case 20 bundles of bamboo is produced per tan (1 tan = 0.245 acre), and 1 bundle costs ¥200 we can gain ¥4,000 per tan. Besides, most of the bamboo groves are located in convenient place to carry bamboo, so there is not any special difficulty concerning labor. Bamboo culture is much advantageous as subsidiary business, and it should be encouraged to newly plant bamboo in proper land. The unit area of bamboo grove at present is shown in the table below, namely 62% of them is less than 1 tan each, only 4% of them being more than 1 tan each, that is to say, most of them are subsidiary business of farm-houses.

o Rates of Area of Bamboo Groves (November, 1950) %

Area / Kinds	less than 1 tan	1 - 3 tan	3 - 5 tan	5 - 10 tan	more than 1 cho (10 tan)
Bambusa reticulata Rupur	50	22	13	10	5
Species of Bamboo	65	19	8	5	3
Bambusa Simoni	64	25	5	3	3
Phyllospachys, Munro	66	15	8	6	5
Other Bamboo	60	16	9	4	11
Average	62	19	9	6	4

o Excellent Bamboo Groves with Higher Economic Utilization (Broad Bamboo)

Chiba Prefecture ..... Maraida Village, Kimitsu District; Takataki Village, Ichikawa District
Shizuoka Prefecture .. Minaminaka Village, Kamo District; Ryokochi Village, Anbara District
Hyogo Prefecture ..... Hioki Village, Taki District; Sugiharadani Village, Taka District
Shimane Prefecture.... Kobu Village, Yatsuka District; Yagumo Village, Yatsuka District
Yamaguchi Prefecture.. Yonekawa Village, Tono District; Tawarayama Village, Otsu District
Tokushima Prefecture.. Mino Village, Miyoshi District; Kamoya Village, Kaga District
Fukuoka Prefecture ... Haki Town, Asakura District; Heharu Village, Yame District
Kumamoto Prefecture... Moto Village, Amakusa District; Nakajima Village, Kamimasuki District
Oita Prefecture ..... Imaichi Village, Ono District

o Change of Bamboo Quotation for these 3 years
Wholesale Price of Bamboo Wholesaler
(unit: Yen per bundle) Investigation by the Forestry Agency

Kinds / Markets (Prefecture) / Months	Bambusa reticulata Rupur (Appr. 1 ft.)			Species of Bamboo (Appr. 5-6 inch)		Bambusa Simoni		
	Chiba	Mie	Yamaguchi	Chiba	Mie	Chiba	Mie	Yamaguchi
Apr. 1951	,180	165	90	80	60	100	90	75
Oct. 1951	280	180	100	80	65	130	100	110
Apr. 1952	230	180	-	85	65	130	100	-
Oct. 1952	290	210	120	135	65	130	120	90
Apr. 1953	300	200	130	100	75	150	140	120
Oct. 1953	320	240	130	90	80	165	140	120
Mar. 1954	310	240	130	80	80	150	140	130

o By-products of Bamboo Grove (utilized for miscellaneous purposes)

1. Bamboo Shoot (Species of bamboo shoot is sold, other kinds are consumed by farm-houses.)

2. Bamboo-sheath (Sheath of white-sheath bamboo, Bambusa reticulata Rupur, Bambusa henonis Hort, and species of bamboo); Yearly production per tan - 50 kg. - 100 kg.

3. Bamboo Branches (Branches of species of bamboo, Bambusa reticulata Rupur, Bambusa henonis Hort and Phyllospachys Munro.

Yearly output per tan - 150 kg. - 300 kg.

4. Bamboo Leaves (Compost for bamboo grove)

5. Subterranean stem - root-stock of Bambusa reticulata Rupur, Bambusa henonis Hort and Bambusa aurea Hort

o Output of Bamboo Sheath

1952	912,432 kan	
1953	526,661 kan	(1 kan = 3.75 kg.)

Section II. Breeding of Bamboo Grove

There are two kinds of reproduction of bamboo, one of them is sexual reproduction and the other is asexual reproduction.

Sexual reproduction - reproduction by seeds asexual reproduction

(1) by sprouting of subterranean stems

(2) by growth of sprout from joints

You should select proper land for bamboo breeding, because it is influenced by climate and weather.

Bamboo with the largest output in Japan are such kinds as Bambusa reticulata Rupur, Bambusa henonis Hort and species of bamboo, all of which belong to long-jointed bamboo, and the breeding methods are almost the same, so we will explain culture and improvement of bamboo groves, chiefly with regard to Bambusa reticulata Rupur which has the largest output.

I. Proper Land

The best cenditions for bamboo culture are mild climate, better drainage, sandy, fertile and soft soil and less windy.

Bamboo is reproduced by the subterranean stems, and quality and quantity of reproduced bamboo chiefly depend on their size and growing state, besides owing to shallow root, in case of strong wind, the subterranean stems do not grow well, due to movement of bamboo. The land with too much dampness is not suitable, and easy grade at the foot of a mountain or a hill which faces south or south-east is suitable. Especially species of bamboo should be cultivated on the sunny grade where there is no north or north-east wind, but it can be cultivated except on rocky, stony, sandy or damp land, besides, Bambusa henonis Hort is more resistible to the wind and snow than Bambusa reticulata Rupur and species of bamboo, therefore it grows in case the conditions of climate and land is a little worse. In case you breed Bambusa reticulata Rupur and species of bamboo chiefly for the purpose of getting bamboo materials, a sunny land facing north is more suitable. However, in case of a grade, the cold northern area differs from the warm southern area, to some extent, and it is thought that the land facing south is suitable in the northern area, while the land facing north is suitable in the southern area. Dry land is suitable to growth of Bambusa reticulata Rupur, but not suitable to Bambusa reticulata Rupur and species of bamboo.

II. Plantation of Bamboo

1. Transplantation of Mother Bamboo

You should plant annual or biennial mother young bamboo with good shape. You should select mother bamboo from broad subterranean stems with many lively sprouts. Cut the upper edge of the mother bamboo, leaving the branches grown on the fourth or fifth joints from the lower limb, and dig it up, with fifty or sixty cm. length of subterranean stems around the root. In digging up the bamboo, you should vertically dig the ground on about 70 cm. of radius, and when you strike against the subterranean stems, confirm the direction of the stems, take away soil in the direction where there is no subterranean stems, and dig up the bamboo ovally. You had better select shallow root bamboo for mother bamboo, from those grown around the bamboo grove, because inside of the bamboo grove, you would damage other subterranean stems, in digging up some of them, besides you would seldom get bamboo with suitable size to handle.

The mother bamboo selected should be transplanted in the soil which has already been cultivated and softened. According to so-called "water transplantation", put sufficient water into the transplanting hole, put the soil upon the stems, in order to keep the subterranean stems horizontal, by the muddy water. In this case, a slight leaning of the bamboo does not matter. In cultivating the soil, you should sufficiently soften the soil, in order that the subterranean stems may grow well, so when the soil is poor, apply compost and barnyard manure, to grow the subterranean stems and stimulate the bamboo to be broad. Keep the similar depth of the soil to that of the mother bamboo, and tread them under the soil, and stand a support to prevent it from being moved by the mind. After transplantation, be careful to keep the soil wet, and if the soil becomes too dry, lay grass, chaff and straw etc. on the soil and sprinkle them from time to time. It is ideal to transplant bamboo on a cloudy day or before the rain.

Quantity of bamboo transplanted:

As a general rule, about 50 - 100 stems of Bambusa reticulata Rupur, Bambusa henonis Hort and species of bamboo are transplanted per tan. In fertile soil, bamboo grows faster, and you had better transplant less stems, whil transplant more stems in case you want earlier growth.

Transplanting time:

Spring is the best season for transplantation of bamboo, namely the from February to April (from February to March in the southern warm area, and from March to April in the northern cold area) when the bud which is to be the bamboo-sprout grows or in April or May when bamboo-sprout is already been dug is the best for transplantation. If transplantation in spring is impossible, you should do it in autumn, namely by the middle of October or Novenber, and in case it is cold, lay grass and straw on the root to protect the bamboo transplanted.

2. Transplantation of Bamboo Root

It is not easy to transplant broad mother bamboo, because we need much trouble for its conveyance and support. However, if we cut the mother bamboo stem at about 20 cm. from the ground, it is easier to transplant the stump. The stump can be transplanted according to the same way as the mother bamboo, but it must especially be careful to transplant it before growth of bamboo-sprout, and to select young and broad subterranean stems with buds.

3. Extension of Bamboo Grove

In case you extend the bamboo grove to the neighborhood, bamboo should be planted in the soil which has already been cultivated, softened, and provided with compost to promote growth of subterranean stems, as well as transplantation.

4. Care and Manuring after Plantation

After plantation, prevent from being too dry, manure night soil, plant and grass ash and compost to grow subterranean stems, and endeavor to weed. Manure immediately effective fertilizer in the time from June to July, to make it effective in summer when bamboo grows the most. Quantity of manure differs in accordance with fertility of the soil, kind of bamboo, purpose of plantation, that is to say purpose of getting whether bamboo or bamboo-sprout, and in case manure is too much, bamboo becomes soft, namely quality of material becomes inferior.

Manuring: night manure 200 - 500 kan, or
fowls droppings 60 - 80 kan

Gradually increase the quantity of manure every year after plantation until completion of the bamboo grove, and then keep a certain amount of manuring. At the end of autumn, bury subterranean stem near the surface of the ground into an adequate depth of soil, or in winter, (from October to February next year) earthen up them. Earthening up has often been carried out in the Kansai District, and is necessary especially for sticky soil, and it is said that it is desirable to earthen up the laid straw and grass. As a general rule, they seldom manure the bamboo grove which produce bamboo material, and earthening up and weeding cannot be executed, neglecting profits. Dr. Ueda, professor of the Kyoto University recommends to manage bamboo grove as subsidiary business according to the forestry system, in order to gain as much profits as possible with less expense, that is to say to utilize the shade living chamaephyte which are effective for maintenance and increase of fertility. He says it is much more advantageous not to earthen up or weed the bamboo grove for bamboo materials at a grade, according to forestry management.

III. Kinds and Quantity of Fertilizer

We do not put so much importance on manuring of the bamboo grove which produces bamboo material as that produces bamboo

sprout. Generally quality of natural bamboo is superior to that of cultivated bamboo, moreover bamboo grown in a grove together with Japan cedar or Japanese cypress is straight, long, having flat joint, thinner and superior quality, so bamboo dealers call such one mountain bamboo, the superior material. Thus, in case of bamboo chiefly used for bamboo material, no manuring can be supplemented with natural nourishment, and bamboo can be produced in accordance with fertility of the soil, unless it is excessively cut. Therefore necessity of manuring occurs, with regard to increase of production per unit area, and improvement of inferior bamboo grove. Quantity of fertilizer varies according to the kinds of bamboo grove, and it is sure that the yearly fall closely relates with the yearly manuring quantity. Dr. Ueda explains that if we want to raise fertility of poor soil and middle class soil to upper grade each, namely to increase by 15 bundles of natural output per tan, we should calculate inorganic composition such as nitrogen, phosphoric acid, pottassium contained in the amount of bamboo, and apply fertilizer equivalent to the same amount of composition to the soil, and the quantity is as follows.

1. Chemical fertilizer (per tan)
   Utilization rate means the rate of effective fertilizer absorbed in the plant.
   ammonium sulphate ..... appr. 10 kan
   (in case utilization rate is 50%)
   superphosphate of lime ..... appr. 7 kan
   (in case utilization rate is 25%)
   pottassium sulfate ..... appr. 4 kan
   (in case utilization rate is 50%)

2. Organic fertilizer (per tan)

a. human manure	300 - 500 kan
b. compost	200 - 1,000 kan
c. barnyard manure	400 - 600 kan

Bamboo leaves contain much silicic acid, one of the inorganic composition of bamboo, and much nitrogen, phosphoric acid and pottassium, so they are valuable as fertilizer, and they are desirable to be resolved into the elements and manured to the bamboo grove.

Moreover, the organic fertilizers generally utilized are wood ash, fowls droppings, oil cake, bean cake, fish manure, straw and garbage.

IV. Manuring

It is the best manuring period when the subterranean stems grow, namely immadiately effective manure should be applied in about from March to April before growth of bamboo sprout, or in about from June to July after growth of bamboo sprout and in September small quantity of it should be applied. Late effective manure should be applied in late autumn, from September to October, and in winter next year, from February to March. Twice diluted well rotted human manure and fowls droppings and diluted well rotted oil cake and bean cake should be manured. Ordinary liquid fertilizer should be poured into two or three shallow holes per 1 tsubo (= 3.305 m^2) and covered with earth. Straw, garbage etc. should be cultivated into the soil or buried in the soil.

V. Improvement of Bamboo Grove

Considering from the economic viewpoint of farmhouse, management of bamboo grove is very profitable, because of cash income due to selling of bamboo material, utilization of bamboo material for farm-house, besides side job of bamboo handicrafts. Moreover, it is the advantageous characteristic of bamboo grove that we need not plant after cutting, and it grows very fast. Nevertheless most of such profitable resource has been neglected, and poorly managed, consequently left inferior grove and less profitable.

There are two kinds of inferior bamboo grove, one of them is (1) It has been long since the grove was cultivated and produced less bamboo-sprout and narrow bamboo. (2) The bamboo grove has been producing narrow bamboo and less bamboo-sprout since its original culture. The former is commonly called "declining bamboo grove", and most of them have been left to take its own course, and it is said that a bamboo grove changes into "declining bamboo grove" for twenty years. The reasons are thought to be as follows.

1. negligence and excessive cut

2. decrease of bamboo-sprout due to intricacy of subterranean stems

3. Mixture of pine trees and miscellaneous trees with bamboo grove in mountainous district.

The following measures should be taken to improve the reasons of inferior bamboo grove.

(1) In case miscellaneous trees are mixed with the bamboo grove, cut them adequately, and leave some of them so that they may prevent bamboo from being fallen by the wind and snow.

(2) Cut such inferior bamboo as old bamboo with more than several years, broken bamboo, light bamboo with less branches, bamboo with hanging branches, and bamboo damaged by blight and noxious insects. In case there is too much inferior bamboo, gradually cut it for a few years. After cutting, remove harmful weed and apply manure.

(3) In case the bamboo has been less productive narrow since plantation, change the kind of bamboo or execute new transplantation.

(4) In case fertility of the soil and geographical features are inadequate, positively improve the defects. However it is impossible to do so, if improvement expense is too expensive to be payable.

(5) If the reasons have resulted from negligence and excessive cut, it is easy to improve them by means of cut of imferior bamboo, weeding and applying manure.

(6) In case of decrease of bamboo-sprout due to intricacy of subterranean stems, divide the bamboo grove into square sections with the length and width of about 4 m. from south to north (in the horizontal direction in a grade), then cut bamboo in every other sections, cultivate them and apply manure to them. When new subterranean stems grow, then the bamboo grove is matured, after two or three years, cut and cultivate the rest of the sections.

With regard to (2) and (5), 5 - 10 kan of ammonium sulphate should be applied per tan. Take care of the bamboo grove after improvement and manuring, as well as its culture.

VI. Protection of Bamboo Grove

Sometimes production of bamboo and bamboo-sprout decrease, because of devastation of the bamboo grove and wither of bamboo

stems, due damage by blight and noxious insects, wind, snow, blood, blight of bamboo stems, so we must protect them from these damages.

1. Disease of Bamboo:

Frequent diseases are natural wither of vine, red blight of bamboo, wither of blades, black wither of bamboo, smut disease and moire wither of leaves. Prevent them according to the followings.

(a) Old bamboo and light bamboo with less branches apt to be damaged by the diseases, so cut them to make better bamboo grow well.

(b) Cut damaged branches and leaves, and burn them.

(c) Application of chemicals: Generally, sulfurated lime, petroleum, bordean mixture and solution of corrosive sublimate are applied, and it is said that P.C.P. (pentachlorophenol) is also effective.

(d) Damages often occur in too damp soil, so in case of wither of leaves and red blight of bamboo, pay special attention to drainage.

2. Damage by Noxious Insects:

Oligia vulgaris Butler (Noctuidae; larva), the larva of "Gastrophilus intestinalis de Geer" (injury of eating bamboo shoot),
Idiococcus bambusae (Pseudococcidae; parastic on bamboo at branches and blades),
Harmolita phyllostachitis Gahan (live at bamboo branches; injury of eating bamboo shoot),
Aiolomorphus rhopaloides Walker (parastic blades of species of bamboo),
Minois dryas bipunctatus Motschulsky (Satyridae; injury of eating bamboo blades),
Cosmotriche albomaculata Bremer (Lasiocampidae; injury of eating bamboo blades),
Elater canalicollis Lewis (Elateridae; injury of eating bamboo shoot),
The larva of elateridae (injury of eating bamboo shoot),
Myzocallis arundicalens Clark and Pseudococcidae; (They damage growth of bamboo.)

To protect bamboo from these noxious insects, catch and kill them or kill them with insectifuge.

There are noxious insects of bamboo stalks such as Chlorophorus japonicus Chevrolat (Cerambycidae), Dinoderus minutus Fabricius and Lyctus brunneus Stephens (Lyctidae), which are explained in process of bamboo", Chapter V.

3. Natural Damages:

(a) Wind Damage:

Plant a windbreak toward the wind of the bamboo grove, in accordance with the area and geographical features of the grove, or plant bamboo stems densely at the part of the grove toward the wind. At a grade in a mountain, a grove mixed with wood and bamboo is recommended.

(b) Snow Damage:

Dense plantation of bamboo per tsubo, of snow-break and mixed grove of wood and bamboo are effective against snow damage. In some districts they bundle the tops of several bamboo stems with rope, but it is much effective only to drop the snow on the bamboo, except the districts with much snow.

VII. Culture of Other Useful and Special Bamboo

1. Phyllospachys Munro

Phyllospachys Munro has been widely used and demanded as well as Bambusa reticulata Rupur, Bambusa henonis Hort and Species of bamboo, but produced little.

(a) Suitable Land:

It is the suitable land for black bamboo that is sunny, well drained and ventilated, and sandy, and a grade is much suitable to black bamboo than a level land, and a bertile level land produces broad bamboo, while a poor dry land produces narrow bamboo. But, sunny land produces narrow dark black bamboo with superior quality, and there are brisk demands for narrow bamboo with about 2 - 3 bu

(1 bu = 3.03 mm.) of diameter for export fishing rods, so poor land does not matter.

(b) Plantation:

The character of mother black bamboo is imherited to its offsprings, so you should select annual or biennial good colored Bambusa reticulata Rupur, dig them with 10 - 15 cm. of subterranean stems, and transplant them, having cut the edge of twigs. The soil to be transplanted should previously be cultivated into the depth of about 50 cm., and be leveled. About from 300 to 500 bamboo stems should be shallowly transplanted per tan, so they should be supported to prevent them from moving. In order to get many seedlings at a time, it is convenient to dig up the subterranean stems with their roots, cut them into adequate length, transplant them in the soil to grow seedlings, and then finally transplant them to grow a bamboo grove.

(c) Transplantation Period:

The best season is spring (February - March), and autumn (September - October), but it does not matter to plant them, except mid-summer and mid-winter.

(d) Manuring:

Some manuring is necessary to increase output. You should apply bean cake, bone manure, and weed every year for four or five years till their maturity. With regard to black bamboo, it is considered that the color of the bamboo stem is closely connected to the soil, so it is necessary to earthen up them from 2 to 5 times until maturity since transplantation. Manure should be applied once a year in winter or spring, namely about 20 kan of bean cake should be applied per tan. Compost, barnyard manure, oil cake and straw are also be applied. In case narrow bamboo for fishing rods is produced, less earthening up and manuring should be done.

2. Artificial Variety of Bamboo

Some times the end of subterranean stems of Bambusa reticulata Rupur appears above the land, and grows upward due to special reasons, and at last grows to a bamboo stem. The phenomenon naturally appears. If we want to artificially grow a bamboo stem to such a shape, we find out the edge of Bambusa reticulata Rupur appeared above the ground, we support it with a bamboo stem or a

board, to gradually make it grow upward and stand vertically. (The example is seen at the Matsushima Island in Miyagi prefecture.) On the other hand, the method using a right-angled unglazed cylindrical pottery is also popular. If we put the edge of the subterranean stems into the pottery whose one end is in the soil and the other end is kept vertically stand on the ground, into which previously earth has been put, then the subterranean stem will grow to vertical bamboo stem in accordance with its maturity.

3. How to increase subterranean stems:

Subterranean stems grow with Bambusa henonis Hort, Bambusa reticulata Rupur, Bambusa aurea Hort and species of bamboo, and the subterranean stems of Bambusa henonis Hort and Bambusa aurea Hort are the best, and those of Bambusa reticulata Rupur bamboo are next to the best. The groves of Bambusa henonis Hert and Bambusa reticulata Rupur which have much superior quality of broad bamboo are thought to produce better subterranean stems. We should apply manure to the land where we want to collect subterranean stems, in about October, to promote growth of subterranean stems. We dig ditches with about 2 ft. of width and about 4 ft. of depth at the interval of about 8 - 10 m. in the bamboo grove in May or June next year. The subterranean hang into the ditches, according to their growth. In about October or November, they stop growing and become hard, when we should collect them. The better subterranean stem is long and the length between upper joints should be longer than that between lower ones on a superior subterranean stem. Growth of the subterranean stems is generally very much influenced by dryness or dampness of the land namely in case of extreme dryness, the length between joints apt to be shorter and withered, on the contrary in case of extreme dampness, the length between joints apt to be longer and be rotted, so we should adjust dryness and dampness, covering the ditches with straw-mats etc. It is thought that a subterranean stem whose diameter is more than 2.1 cm. and length between joints is shorter, and length is more than 106 cm. and with more than 30 joints belongs to superior one.

4. Moire Bamboo

This kind of bamboo has moire spots on the surface and used for ornament materials. In the first year, it is green bamboo, and in the second year, brown and purple spots appear, and in the third year, they become clear moire spots.

(a) Suitable Land:

On moderately fertile sandy or pebbly level land or grade with sufficient sunshine and good drainage, bamboo with much more lusterous and clear moire can be produced, or the contrary on damp, fertile land in the shade, moire become too dark and luster is dull.

(b) Transplantation:

As mother bamboo, select sound young bamboo of about 7 - 8 cm. of diameter with lower branches at lower position, cut the end of twigs, leaving three or four lower branches, having kept the subterranean stems of about 45 cm. long previously cultivate the land well, and take away roots of shrubs, bamboo grass and weeds. Pour earth and water into the transplantation holes. The subterranean stems should be transplanted paralleled with the surface of the ground, and covered with earth and straw, and stand supports, if necessarh. About 70 - 100 bamboo stems are transplanted per tan.

(c) Manuring:

Compost, barnyard manure and human manure can be applied, and simple or excessive application of nitrogenous fertilizer damages the quality of the bamboo and moire, so adequate amount of phospheric acid and pottassium should be mixed without fail. Moreover, about 20 - 30 kan of lime should be applied once every three or four years. Apply manure twice in spring and autumn each. Please see 4 in the Section II, with regard to weeding, laying grass, earthening up and protection.

5. Bambusa aurea Hort

(a) Suitable Land:

Poor land is suitable to production of Bambusa aurea Hort, and in fertile land, the material becomes weak, and the characteristic of short length between joints of bamboo disappears. This bamboo can grow well even in a dry land and a mountain.

(b) Transplantation:

Select sound annual bamboo stems with 1.5 - 1.8 cm of diameter at their base as the mother bamboo, and transplant

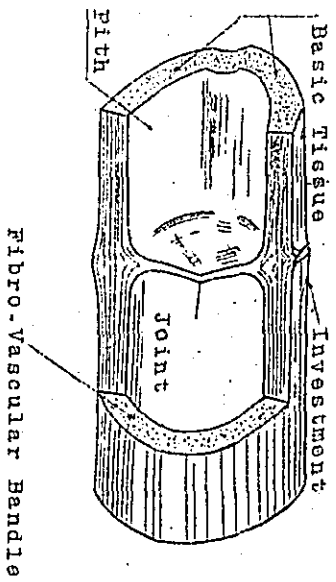
about 600 - 1,200 stems per tan into a well cultivated land. They can be cut after two years since their transplantation as well as Phyllospachys Munro.

Section III. Nature of Bamboo

1. Composition of Bamboo

We have explained before that bamboo belongs to a perennial plant Graminae of Monocotyledoneae which changes to extremely woody, but is extremely different from wood, namely about forty or fifty days after growth of bamboo-sprout, length and thickness of the stem is already matured, then no growth of the stem can be seen, and cellular tissue is organized inside of the bamboo and becomes dense. The bamboo stem is an almost hollow cylinder, consisting of joints and the parts among joints, whose length us different according to the kinds of bamboo and state of growth, and as a general rule the length between joints is longer at the center of the stem, while shorter at its both ends, and consists of the outside thin investment, the cylindrical part under the investment (basic tissue), the inside thin pith and the hollow.

Fig. 1 Cellular Tissue of Bamboo



Composition of Bamboo

(1) Investment (Cells are put in sequence of (1) (2) and (3) described below from investment of bamboo.)

(i) Investment Cells

(a) Long Cells (Stoma and auricle exist between the cells (a) and (b).)

(b) Rectangular Cells — Silicic Acid Cells, Cork Cells

(ii) Hypoderma (Thick Film of (1) and (2))

(iii) Cortial Cells (Thin Film of (2) and (3))

(2) Interior Cylinder

(i) Basic Tissue (Soft Cells) - generally put in the shape of long cylinder in the direction of the bamboo stem.

(ii) Fibro-vascular Bundle (scattered in the basic tissue.)

Phloem (consisting of two reticular vessels and one Spiral vessel)

Woody part (many sieve cells)

(iii) Sheath of Fibro-vascular Bundle (Phloem fiber) - wraps the fibro-vascular bundle.

(3) Pith

2. Fibro-vascular Bundle and Sheath of Fibro-vascular Bundle

The fibro-vascular bundles scattered in the basic tissue consists of many sieve cells to pass nourishment and three vessels to pass water. Outside of the fibro-vascular bundle, there is the sheath of the fibro-vascular bundle which consists of phloem fiber of thick film. Quality and quantity of the group of fiber greatly influences upon physical character of the bamboo stem. Density of the fibro-vascular bundle varies according to the kinds of bamboo, and there are several kinds of arrangement of fibro-vascular bundles. The bamboo whose density of the fibro-vascular bundle is high has strong flexibility, and it is said that Bambusa reticulata Rupur has extraordinarily high density. The size of the fibros cells composing the sheath of the fibro-vascular bundle differs from the lower stem, middle stem and the upper end of the stem of the bamboo, and even in the same part of the stem, it differs from outside, center and inside. Dr. Uno researched this from the viewpoint of the relation between length and thickness of the fiber, namely the rate between length and thickness is significant for utilization of physical character and for the material of paper, that is to say, bamboo which

is strong and esasily split and suitable for the paper material must have high rate between the length and thickness, on the contrary, flexible bamboo must have low rate. (The rates between length and thickness are 110.1 regarding Bambusa henonis Hort, 125.5 regarding Bambusa reticulata Rupur and 130.2 regarding species of bamboo.)

3. Repletion of Bamboo Stem

Nourishment absorbed from the subterranean stems is changed into effective nourishment for the plant through metabolism of carbon and distributed to every part of bamboo to grow and replete it to strong bamboo stem. It is thought that the quantity of sunshine absorbed by the bamboo during its growth influences upon growth and repletion of the cells in the bamboo. Therefore we must keep adequate number of banboo stems and adequate quantity of sunshine in the bamboo grove, to replete the bamboo cells, but excessively small number of bamboo stems in the grove results in growth of needs, waste of fertilizer and labor, consequently not only in decrease of productivity, but also too much direct direct sunlight leads to damage of luster of the bamboo and quick fading. Adequate density of growth bamboo stems and branches varies in accordance with the kinds of bamboo, climate, glographical features and degree of growth of the branches, but generally speaking, about 800 - 1,000 Bambusa reticulata Rupur, a little more Bambusa henonis Hort and a little less species of bamboo are planted per tan.

4. Length between joints

As a general rule, the length between the joints of bamboo is shorter at the lower part of the stem, and longer at the upper part of it, and after a certain maturity, it becomes shorter on the contrary, but some times it does not vary so regularly as this. Long length between joints is often seen on straight and long bamboo stem, in this case joints are flat and length of the stem under branches is generally long. Such bamboo stems are generally produced in a bamboo grove located in a mountain district where adequate sunshine, moderate mind, sandy land are available. Especially bamboo stems produced from the mixed grove with Japan ceder and Japanese cypress are thin and superior and very valuable for technical utilization. The longest bamboo among the broad bamboo is Bambusa reticulata Rupur, Bambusa henonis Hort and species of bamboo are next to the longest.

5. Composition of Bamboo Stem

In utilizing bamboo stems for various purposes, we consider its toughness, flexibility and split, in this case, adequacy must be decided, after chemical character has sufficiently been understood, as well as such physical character as contractibility, compressibility, tensile strength and tensile elasticity. With regard to the chemical composition of bamboo, many results have been published. In accordance with active export of technical bamboo products, it is expected that dyeing, bleaching, insect and mold controling, binding and new forming technics of bamboo will be developed, besides problems concerning new resource of bamboo pulp are closely connected with the composition of bamboo. Composition of bamboo is different in accordance with each part of the bamboo stem, namely investment, interior tissue, lower, middle and end of the twig have their own characteristic of chemical composition, moreover composition varies according to the kind and age of bamboo.

o Composition of Calcium in Bamboo
(by Yuzuru Tsuchiya & Setsuo Fukuhara)

Kinds / Composition	Bambusa reticulata Rupur	Species of Bamboo
Silicic Acid	12.21 (%)	14.02 (%)
Sulphuric Acid	1.70	2.24
Lime	1.78	2.80
Magnecium	0.97	3.82
Pottassium	12.71	27.52
Iron	4.86	8.53
Phosphoric Acid	1.62	2.47
Mangan	1.94	1.46
Soda	56.27	33.91

. o Chemical Composition of Bamboo Stem from
Dr. Masaichi Uno, "Character & Utilization of Bamboo"

Kind / Composition	Bambusa reticulata Rupur		Bambusa henonis Hort		Species of bamboo	
Interior & exterior	interior	exterior	interior	exterior	interior	exterior
Coarse fiber (%)	36.95	47.44	41.59	45.45	32.61	37.90
Average	42.30		43.52		35.26	
Lignin (%)	26.97	29.62	27.33	30.52	25.06	25.20
Average	28.30		28.93		30.13	
Pentosan (%)	23.12	21.42	27.73	25.88	27.62	25.38
Average	22.27		26.81		26.50	
Alcohol extraction (%)	5.55	5.38	7.24	6.45	4.24	4.29
Average	5.47		6.85		4.27	
Coarse albumen(%)	9.76	8.43	8.96	7.77	9.32	8.88
Average	9.05		8.36		9.10	
Calcium (%)	1.09	1.06	2.22	1.83	1.57	1.48
Average	1.07		2.03		1.53	

Chapter III. Bamboo

Section 1. Utilization of Bamboo

Bamboo has been utilized for practical and ornamental purposes for a long time since old times. Bamboo shows special external appearance as a pipe, and its investment is smooth and elegant, so there are many uses utilizing not only these characteristics of external appearance, but also the physical and chemical characteristics. The uses are roughly classified as follows, and it is expected that the utilization of bamboo will be much more developed in future, in accordance with development of physical and chemical application and industrial technics.

1. Utilization of characteristics of external appearance of bamboo:

(a) Utilization of beauty and characteristics of investment:

Outer skin of Bambusa reticulata Rupur and Bambusa henonis Hort which is strong, hard and have bright green luster, and special moire of black bamboo and moire bamboo.

(b) Utilization of the shape of bamboo stem:

Mystery of the shape of hollow, joints, partition between joints and part between joints:

2. Utilization of special physical characteristics:

(a) Utilization of toughness:

Stalk of Bambusa reticulata Rupur with repleted cells:

(b) Utilization of flexibility:

Annual and biennial Bambusa reticulata Rupur, Sasamorpha, Bambusa simoni, bent root bamboo all of which have no thick cells of bamboo stem.

(c) Utilization of elasticity:

Bambusa reticulata Rupur, Bambusa henonis Hort and Bambusa aurea Hort with higher coefficient of elasticity.

(d) Utilization of split:

Bambusa reticulata Rupur and Bambusa henonis Hort with narrow and long fiber.

(e) Utilization of solidity and less expansion and contraction, especially thin Bambusa reticulata Rupur bamboo with less growth due to sunshine.

(f) Utilization of hardness:

Matured and repleted Bambusa reticulata Rupur of five or six years old.

3. Utilization of Chemical Characteristics:

(a) Pulp of bamboo fiber:

(b) Utilization of comparatively high durability:

Bambusa reticulata Rupur and species of bamboo with less albumen (water pipe, bamboo-reinforced concrete)

In utilizing bamboo, characteristics of bamboo have been synthetically applied, but it is very difficult to judge and classify adequate bamboo for each purpose, and even the same kind of bamboo often becomes inadequate due to the climate, geographical features and fertility of the land where bamboo were produced, moreover according to years since transplantation, composition and characteristics are different. The kinds of bamboo which has been produced and utilized are as follows.

Various kinds of bamboo products and kinds of bamboo utilized

(i) Knitted goods:

flower basket	species of bamboo, Bambusa reticulata Rupur
weeding basket	species of bamboo, Bambusa reticulata Rupur
rice basket	species of bamboo, bambusa simoni
silkworm breeding basket	species of bamboo, bamboo
fruits basket	Bambusa reticulata Rupur,

shopping basket	Bambusa henonis Hort, bambusa simoni
open-work basket	bambusa simoni, bent root bamboo
vegetable distributing basket	Bambusa reticulata Rupur and bambusa simoni
rice drying basket	Sasamorpha
waste-paper basket	Bambusa reticulata Rupur, bambusa simoni, bent root bamboo and Hakone bamboo
hand basket	Sasamorpha and bambusa simoni
bamboo trunk	Sasamorpha, bambusa simoni, Bambusa reticulata Rupur and Bambusa henonis Hort
fish basket	Bambusa reticulata Rupur and bambusa simoni
knitted bamboo used for the bottom of steam basket	Bambusa reticulata Rupur
delivery basket	Bambusa reticulata Rupur
cup basket	Bambusa reticulata Rupur and Bambusa Simoni
towel basket	Bambusa simoni, spotted bamboo, and Bambusa reticulata Rupur
book case	Bambusa reticulata Rupur, Bambusa henonis Hort, bambusa simoni and Hakone bamboo
garbage basket	Hakone bamboo
gift basket	Bambusa reticulata Rupur, okame bamboo
tray for lacquerware	Bambusa reticulata Rupur, Okame bamboo
rattan blind	Bambusa reticulata Rupur, Bambusa henonis Hort, Bambusa simoni, Iyo bamboo, Hakone bamboo & Bambusa marmorea

Bambusa reticulata Rupur is utilized for the picture frame, frame of shikishi (square card with Japanese poetry and/or picture), frame for photograph, wickerwork tray of split bamboo and bamboo hat.

(ii) Bamboo stem products:

chair, table, screen, book shelf, tea shelf Bambusa henonis Hort and display shelves.. Bambusa reticulata Rupur, white skin bamboo, species of bamboo,

	Phyllospachys nigra Munro F Nakai Punctata, moire bamboo, spotted bamboo, Phyllospachys Munro, smoked bamboo and other bamboo for products
flower vase	species of bamboo, smoked bamboo and Phyllospachys Pubeseens Var Hekerocycla Carr.
handle of umbrella	Bambusa reticulata Rupur, Bambusa henonis Hort, Sasa Senanensis Rehd neliulase Rehd, Bambusa aurea Hort and Phyllospachys Munro
writing bruch holder ..	arrow bamboo and Bambusa simoni
scroll hanger	bambusa simoni and arrow bamboo
stick	species of bamboo, Bambusa reticulata Rupur, Sasa Senanensis Rehd neliulase Rehd, Phyllospachys Munro, Phyllospachys Pubeseens Var Hekerocycla Carr and Bambusa aurea Hort
jumping pole	Bambusa reticulata Rupur
writing brush stand ...	species of bamboo and Bambusa reticulata Rupur
bamboo-pipe stem	Hakone bamboo, tiger's stripes and Sasa Senanensis Pubeseens Var Hekerocycla Carr.
duster stick	Hakone bamboo
case of rolled writing paper	Phyllospachys nigra Munro F Nakai Punctata
arrow	Bambusa reticulata Rupur and arrow bamboo
fishing-rod for Cyprinus auratus	Bambusa henonis Hort Phyllospachys Munro and arrow bamboo.
fishing-rod	Bambusa henonis Hort Phyllospachys Munro and arrow bamboo
fishing-rod for Sillago japonica	Bambusa aurea Hort
fishing-rod for ayu (sweetfish)	Bambusa henonis Hort, Phyllospachys nigra Munro F Nakai Punctata Phyllospachys Munro, and arrow bamboo
fishing-rod for goby...	Bambusa henonis Hort, and arrow bamboo, black bamboo
flower stand	Phyllospachys Munro, spotted bamboo, Kure bamboo and smoked bamboo

umbrella stand	Bambusa henonis Hort, and Phyllos-pachys Munro
legs of table	spotted bamboo, Phyllospachys Munro and Phyllospachys nigra Munro F Nakai Punctata.
book stand	Bambusa reticulata Rupur
towel hanger	Phyllospachys Munro, Spotted bamboo, arrow bamboo and Bambusa marmorea
folding screen	Bambusa reticulata Rupur Bambusa henonis Hort, smoked bamboo and spotted bamboo
hanger of shikishi (square card with Japanese poetry and/or picture)..	Phyllospachys Munro, spotted bamboo and Bambusa reticulata Rupur
bench	Bambusa reticulata Rupur and Bambusa henonis Hort
exported chair set	bent root bamboo (substitute for rattan)
Chinese whistle	Bambusa simoni, spotted bamboo
other whistle	Bambusa simoni and arrow bamboo
dress hanger	Bambusa simoni, Phyllospachys Munro, Bambusa marmorea and arrow bamboo
clothes rack	Phyllospachys nigra Munro F Nakai Punctata, smoked bamboo
frag staff	Bambusa reticulata Rupur, Bambusa henonis Hort Bambusa simoni and arrow bamboo
ladder	Bambusa reticulata Rupur
ski-sticks	Bambusa reticulata Rupur, Bambusa henonis Hort and hoo (Chinese phoenix) bamboo (the best quality)
child's bed	Phyllospachys nigra Munro F Nakai Punctata and Bambusa reticulata Rupur
bamboo ash-pot	Bambusa reticulata Rupur (or smoked bamboo)
pot-hanger	Bambusa reticulata Rupur
portable ink and pen case	moire bamboo, spotted bamboo, smoked bamboo and white skin bamboo
broomstick	Bambusa henonis Hort, Bambusa reticulata Rupur and black bamboo
clothes drying rod	Bambusa reticulata Rupur, Bambusa henonis Hort

bow	Bambusa reticulata Rupur
alcove post	Bambusa reticulata Rupur, species of bamboo, phyllospachys nigra Munro F Nakai Punctata, Bambusa aurea Hort, Simonobambusa qurdriangularis Makino and Phyllospachgs pubeseens Var Hekerocycla Carr
pent roof	Bambusa reticulata Rupur, species of bamboo, phyllospachys nigra Munro F Nakai Punctata and Simonobambusa gurdriangularies Makino
gableboard	Bambusa henonis Hort smoked bamboo, Phyllospachys Munro, Chimonobambusa qurdriangularis Makino and Phyllospachys nigra Munro F Nakai Punctata
open verandah and ceiling coffer	Bambusa henonis Hort, smoked bamboo, phyllospachys Munro and Phyllospachys nigra Munro F Nakai Punctata
latticework and transom window	phyllospachys Munro, phyllospachys nigra Munro F Nakai Punctata, spotted bamboo and Bambusa marmorea
aqueduct and water pipe	Bambusa henonis Hort
tub	Bambusa henonis Hort and species of bamboo
incense case	moire bamboo, smoked bamboo and phyllospachys nigra Munro F Nakai Punctata

(iii) Bamboo products

tray for scroll	Bambusa henonis Hort and species of bamboo
picture frame	phyllospachys nigra Munro F Nakai Punctata, spotted bamboo, Bambusa henonis Hort and moire bamboo
tea chest, tea spoon, tea ladle, tea-cup holder, tea-urn and tea-whisk..	Bambusa henonis Hort, Bambusa reticulata Rupur, smoked bamboo and phyllospachys Munro
tea-napkin case	smoked bamboo, Bambusa reticulata Rupur and Bambusa henonis Hort
teaspoon	Bambusa reticulata Rupur and species of bamboo

cake chopsticks	smoked bamboo, Phyllospachys nigra Munro F Nakai Punctata and Bambusa reticulata Rupur
bamboo chopsticks and splittable chopsticks	Bambusa reticulata Rupur, species of bamboo and Bambusa Henonis Hort
lunch box	species of bamboo and Bambusa reticulata Rupur
exported knives, forks and spoons	species of bamboo and Bambusa reticulata Rupur
cake bowl	species of bamboo
cake tray	species of bamboo, Bambusa reticulata Rupur and Phyllospachys nigra Munro F Nakai Punctata
toothpick case	Phyllospachys nigra Munro F Nakai punctata, Bambusa reticulata Rupur and smoked bamboo
tobacco-tray	Bambusa reticulata Rupur and Phyllospachys nigra Munro F Nakai Punctata
cigarret case	Bambusa reticulata Rupur and species of bamboo
pipe	Hakone bamboo
paper knife	Bambusa reticulata Rupur and species of bamboo
letter-box	species of bamboo
pen tray	Bambusa reticulata Rupur and species of bamboo
writing brush hanger	Bambusa reticulata Rupur, spotted bamboo, Bambusa henonis Hort and arrow bamboo
curved rule, measure and slide-rule	Bambusa reticulata Rupur (scarecely species of bamboo)
rake and pine-needle broom	Bambusa reticulata Rupur and specie of bamboo
inner sole	outer skin of Bambusa reticulata Rupur and Bambusa henonis Hort
bamboo skewer	Bambusa reticulata Rupur, species of bamboo and Bambusa henonis Hort
clasp of bag	Bambusa reticulata Rupur
coat hanger	species of bamboo
clothespin	Bambusa reticulata Rupur and species of bamboo

bamboo whisk	Bambusa reticulata Rupur
bamboo beads bag	Bambusa simoni
fine-toothed comb	Bambusa reticulata Rupur Phyllos-panchys Munro, white skin bamboo and arrow bamboo
earpick	Bambusa reticulata Rupur
back scratcher	Bambusa reticulata Rupur
dandruff comb	Bambusa reticulata Rupur
compact	species of bamboo
bamboo spatula	Bambusa reticulata Rupur and species of bamboo
bamboo pincette	Bambusa reticulata Pupur
letter rack	Bambusa reticulata Rupur, species of bamboo and Phyllospachys Munro
bamboo nail	Bambusa reticulata Rupur (Bambusa simoni for roof nail)
bamboo button	Bambusa reticulata Rupur and species of bamboo
bamboo toys	Bambusa henonis Hort, species of bamboo and Bambusa reticulata Rupur

(iv) Products of split bamboo, bamboo stick, shaved bamboo etc.

bamboo hoop	Bambusa reticulata Rupur
skelton of paper lantern.	Bambusa reticulata Rupur, Bambusa henonis, Hort, Hakone bamboo, Bambusa simoni and Iyo bamboo (species bamboo for bow)
shaved bamboo of abucus..	smoked bamboo (or Bambusa reticulata Rupur) and white skin bamboo
skelton of round fan	Bambusa simoni, Daimyo (feudal lord) bamboo, Hakone bamboo, Bambusa reticulata Rupur and moire bamboo (Various kinds of narrow bamboo are used for the handle of the round fan.)
fan	Bambusa henonis Hort and Bambusa reticulata Rupur (Main frame is made of smoked bamboo, moire bamboo and Bambusa reticulata Rupur)
skelton of umbrella	Bambusa reticulata Rupur and species of bamboo
bamboo sward	Bambusa reticulata Rupur and Bambusa henonis Hort
bamboo plastron	species of bamboo
arrow	Bambusa reticulata Rupur

knitting needle	Bambusa reticulata Rupur
divining rods	Bambusa reticulata Rupur
skelton of hood	species of bamboo
wall foundation	Bambusa reticulata Rupur and Bambusa henonis Hort Bambusa simoni and arrow bamboo
bench	Bambusa reticulata Rupur and Bambusa henonis Hort and species of bamboo

(v) Other special industrial products:

bamboo pulp	species of bamboo, Bambusa reticulata Rupur, bent root bamboo and Sasa albo-marginata
hexagonal fishing-rod ...	Bambusa reticulata Rupur
bamboo ply wood	Bambusa reticulata Rupur and species of bamboo
Synthetic Resin bamboo board	species of bamboo and Bambusa reticulata Rupur
bamboo veneer tray	species of bamboo and Bambusa reticulata Rupur (for ply-bamboo)

(vi) Products of joint, subterranean stem and bamboo stem

teapot mat	subterranean stem of species of bamboo and bamboo root
insense burner	varied root of species of bamboo and Bambusa reticulata Rupur
insense tray	joint and root of Bambusa reticulata Rupur
handle	joint of smoked bamboo
teapot	root of species of bamboo and Bambusa reticulata Rupur
kettle-rest	root and joint of species of bamboo and Bambusa reticulata Rupur
slop basin	root of species of bamboo
wine-cup rest	root and joint of Bambusa reticulata Rupur
lid-rest	bent root of Bambusa reticulata Rupur
sake-cup	root of Bambusa reticulata Rupur
bottle-holder	joint of Bambusa reticulata Rupur, Phyllospachys nigra Munro F Nakai Punctata and white skin bamboo

bowl and cup	joint of Bambusa reticulata Rupur and species of bamboo
buckle	root of Bambusa reticulata Rupur and species of bamboo
ornamental hairpin	joint of species of bamboo and Bambusa reticulata Rupur
bamboo whip	lower stem of Bambusa henonis Hort
five-holed bamboo flute	lower stem of Bambusa reticulata Rupur and Bambusa henonis Hort

Section II. Utilization of By-products of Bamboo Grove

In cutting bamboo, we get such by-products as branches, subterranean stems and sheath, and subterranean stems are main products, because bamboo groves have been cultivated and managed in order to get subterranean stems, besides bamboo sheath has also recently been exported much more than ever, so we have taken up the bamboo sheath together with bamboo in this chapter.

1. Utilization of Branches:

There are not so wide utilization of bamboo branches as bamboo stem, and branches of species of bamboo, Bambusa reticulata Rupur, Bambusa henonis Hort and black bamboo are only used.

broom, baggot of sea-weed and hedge of bamboo branch.....	species of bamboo
hedge of bamboo branch, broom and fuel	Bambusa reticulata Rupur and Bambusa henonis Hort
lamp shade, toy material	Phyllospachys Munro

2. Utilization of Subterranean Stems:

Subterranean stems of bamboo are produced in Kyoto, Wakayama, Miyazaki, Kagoshima, Oita and Fukuoka, and 90% of them are finished in Otsu, Shiga prefecture, and the rest are finished in Wakayama prefecture . Such bamboo as Bambusa reticulata Rupur, Bambusa hanonis Hort Bambusa aurea Hort and species of bamboo have been utilized, Bambusa henonis Hort have most widely been utilized.

Products of subterranean stems and kinds of bamboo utilized:

stamp material	Bambusa reticulata Rupur
handle of umbrella	Bambusa reticulata Rupur
bamboo whip	Bambusa henonis Hort, Bambusa reticulata Rupur and species of bamboo
pen-holder and pipe	Bambusa aurea Hort
toys	Bambusa reticulata Rupur and Bambusa aurea Hort
towel hanger	Bambusa aurea Hort
chopsticks-rest	Bambusa aurea Hort

3. Utilization of Bamboo Sheath:

Only Bambusa reticulata Rupur and Bambusa henonis Hort, white skin bamboo and long-jointed bamboo produce bamboo sheath to be utilized. Sheath of species of bamboo is large, but has much coarre fluff, black spots and rough quality, being inadequate to product and rarely utilized. Bamboo sheath drops on the ground one sheet after another, in accordance with growth of bamboo sprout in May or June, at this time we collect and preserue them immediately after their fall, being careful not to make them wet with rain or dew. The size, shape and quality of sheath varies, according to the position where each sheath grows, and there are several names. Some times they are called branch sheath (grown at the twig) and stem sheath (grown at lower stem), but usually called as follows.

In the sequence from the upper edge of a bamboo stem, the sheath is called twig sheath, rolled sheath, stem sheath and tortoise shell sheath, and some times the sheath at the upper edge of the stem is called unmatured sheath, while the sheath of the middle of the stem is called stem sheath. Quality of sheath is better at the upper edge, and worse at the bottom, because it is hard there. Sheath of white sheath bamboo is the best, because it has no black spot on the surface, so is often used for the face of clogs, straw sandals and sheath work. Sheath of Bambusa henonis Hort is also often used, because it has no spot, and sheath of Bambusa reticulata Rupur is used for wrapping sheath, because of its flexibility. Sheath is further utilized for padding of footware, inner sole, applier of wood-block print and sheath lamp shade, while inferior quality of sheath such as lower stem sheath and tortoise shell sheath is used for wrapping sheath of bean paste, pickles, fish and meat.

Sheath utilized for sheath face and sheath work must be superior in quality as follows.

(1) White sheath without spots ..... If theath is left in bamboo grove after its fall for a few days, mold will appear on the surface and luster will disappear, so it must be collected as soon as possible.

(2) Sheath with unrolled joint ..... If it is rolled, open it with hands or knees when it is being dried.

(3) Fresh and strong sheath

(4) Long sheath ..... 1.2 - 1.5 ft.

(5) Well dried to be preserved ..... yield rate is usually about 50% in case of ordinary dryness. If fire drying is applied, dry it at the temperature of 50° - 55° C, for 8 or 9 hours.

4. Utilization of Other By-products:

Bamboo leaves are used for manure, fuel and feed of domestic animals, and bamboo sprout is a kind of important food. Sprout of species of bamboo, Bambusa reticulata Rupur and Bambusa henonis Hort are eaten, but those of species of bamboo are sold at the market. Bamboo grove of species of bamboo is cultivated mainly for the purpose of production of sprouts, but some times is managed to produce bamboo as subsidiary business. Quantity of sheath of bamboo sprout is about a half or the same of the quantity to be eaten, and used for manure and feed of domestic animals, but it is desirable to be applied to the bamboo grove as manure, because of its chemical composition. Bamboo seeds are also utilized.

Section III. Bamboo Cutting

1. Cutting age:

It is clear that cutting age of bamboo is different according to kinds and uses of bamboo, even if the kind is the same, considering repletion of cells and chemical composition of bamboo. That is to say,

(1) In case bamboo is slenderly split, to be used for handicraft, it must be elastic and glutinous and the stalk of Bambusa simoni and bent root bamboo of one year of age

and some times one or two years of age of Bambusa reticulata Rupur is used.

(2) In case outer skin is used after being bleached into white, comparatively young bamboo of two or three years of age is used.

(3) In case we need tough bamboo, full maturity of bamboo from four to six years of age is adequate.

Generally speaking, bamboo of one year of age is so soft and immatured that it is imadequate to common handicraft because of lack of the characteristics of bamboo, except usage of rim. On the other hand, luster and color of outer skin of the bamboo of more than seven or eight years of age is inferior, and tissue of further old bamboo becomes rough and hard, simultaneously less fat and elastic, and only the surface of stalk is so hard that it is not suitable to be worked, moreover, joints change to black, and it is liable to be damaged by blight and noxious insects, consequently growth of subterranean stems is unfavorably influenced and production decreases. Therefore the cutting age of bamboo is thought to be as follows, and in order to increase production of bamboo, considering not only utilization of bamboo, but also growth of subterranean stems and bamboo sprout, it is said that the most adequate cutting age of such broad bamboo as species of bamboo and Bambusa reticulata Rupur is three or four years of age.

Bambusa reticulata Rupur and Bambusa henonis Hort	4 - 5 years of age
species of bamboo	5 - 6 years of age
Phyllospachys Munro and Bambusa aurea Hort	2 years of age
Bambusa simoni	1 - 2 years of age

2. Cutting Period

It is said that cutting period of bamboo should be in autumn and spring, namely the most adequate cutting period of bamboo is from the middle of October to the middle of November. If it is impossible to carry out cutting in autumn, due to the busiest farming season, cutting must be finished at the latest

until from December to February, and it is said that quality of bamboo cut after the beginning of the natural year according to the old calendar is inferior. Bamboo grows most vigorously from spring to summer, and contains most starch and coarse albumen and other nourishment in its stalk, so bamboo cut in this period apts to be damaged by harmful insects and generate mold, on the contrary in winter, it stops growing and liable to be hard and fragile, therefore it is considered that the most adequate cutting period of bamboo is the period when growth stops.

3. Cutting Volume

With regard to yearly cutting volume of bamboo, you should calculate the number of bamboo stalks which exceeds the standard preserving volume of bamboo grove, and cut the amount of bamboo stalks in the regular cutting period, but as a matter of fact, the cutting volume is often decided according to actual production and the economic conditions of demands and supply of the year. At the same time, if inferior bamboo is cut as soon as possible from the view point of protection of bamboo grove, and well grown bamboo with expected thickness is preserued, the grove will naturally become better. The number of standard preserving bamboo stalks has been explained in the former chapter, namely density of plantation influences upon thickness of bamboo, that is to say, bamboo grown in a high density of grove becomes narrow, while bamboo grown in a low density of grove becomes broad, so you should decide the kind of bamboo, and stimulate to grow subterranean stems, keeping the grove in adequate temperature and humidity, making use of adequate radiant heat of the sun. The yearly cutting volume of bamboo must be settled about 10 - 20% of the preserving volume of bamboo before cutting, in accordance with the conditions of each bamboo grove.

4. Cutting Method

When we cut bamboo, according to physiology of the bamboo grove, the result is successful every year, namely density of bamboo grove can always be preserved regular, therefore even if you must adjust cutting on account of economic conditions, it is thought to be much more profitable to adequately cut bamboo, from the synthetic viewpoint of management of bamboo grove. In subsidiary management of bamboo grove, it is needless to cut bamboo regularly every three or four years, and in case it is inevitable to cut bamboo, you may execute cutting every other year, but in this case, the cutting volume should be settled, increasing by about 10% than the former case, considering the number of newly

grown bamboo stalks.

(1) Cutting Method:

As a general rule, bamboo is cut near its root by a hatchet, and a bamboo stalk of about 7 inches round is cut with a hatchet, while a broader bamboo stalk of more than 8 inches is sawed at first and cut with a hatchet. It is recommended to cut bamboo only with a hatchet and leave the kerf slivers, in order to make root quickly rotted. When you cut bamboo grown in the bamboo grove at a grade, you should cut the side facing lower ground at first, then cut the both sides, at last the side facing the higher.

(2) Lopping off Branches:

In lopping off bamboo branches, you must be careful not to strip off or hurt the outer skin. Begin lopping off branches from the base of bamboo, and at first slightly check under the joint of a branch with a hatchet, then strike it down considerably strongly with the back of a hatchet. If you check it from above at first, some times the outer skin is stripped off at the same time with the branch, and the bamboo becomes less valuable. Some times broad bamboo is sawed, you should slightly check under the joint of a branch with a saw, then strike it down with the back of the saw, quite similarly to lopping with a hatchet.

In cutting bamboo stalks, put their bases toward the way out of the bamboo grove, so that they may easily be carried, moreover it is recommended not to lop off branches immadiately after cutting, and leave them alone for a while, to make the branches withered, because it will be able to protect them from being damaged by harmful insects, due to decrease of atarch in the bamboo stalks to some extent.

5. Storage of Bamboo

Bamboo cut in the most adequate period can be kept green for about a year, if it is well stored, and be used as if new bamboo at a time. Bamboo must be stored with great care, from the viewpoint of protection from noxious insects and mold.

In storing bamboo, build a stand about one foot high in the shade, lay bamboo stalks on the stand, to prevent moisture on the ground, wind and rain, and keep them well ventilated.

In case they are temporarily stored at the place they have been cut, they must be kept free from excessive dryness due to sunlight and moisture, making the most of a valley or the shade of trees. When they are preserved in a warehouse or a factory, prevent them from absorption of moisture and being stuffy due to dense pile, putting them at the place facing morth and well ventilated. When you store bamboo as half-finished goods, (Bambusa simoni is often stored after being dried as split bamboo for a year), you had better build earth floor in the warehouse, and make a space between the wall and the bamboo leaned against the wall and in case they are piled, pile them on the stand more than one feet above the ground, and it is recommended to change piling once or twice from spring to summer. Leaning is better than pile, and in both cases, it is most important to prevent bamboo stalks being close together, and to keep them better ventilated. Bamboo is often dried by sunshine before storage, but excessive dryness in a warehouse or a factory, as well as sudden change of temperature and humidity and worse ventilation result in inferior quality of bamboo, so these must strictly be avoided.

Chapter V. Processing

Bamboo products are roughly classified into three kinds according to the process such as whole bamboo products, cylindrical products or roughly split products, and finished goods of slenderly split bamboo. Further such new products as a new knitted bamboo board applied with sticky and clear synthetic resion and formed through compression, bamboo veneer and bamboo block have been mass-produced and stabilized as an industry. In this chapter, we will explain general preparatory treatment of bamboo materials which are common to all the products, and additionally explain treatment of finished goods, with regard to dyeing, coating, painting, mold control method and insect control method.

Section 1. Preservation of Bamboo

We have explained how to preserve bamboo after cutting in the former chapter, and it is one of the greatest difficulties in handling and preserving bamboo and bamboo goods how to prevent bamboo from being damaged by noxious insects and mold. It is said that there is almost no damage by noxious insects when bamboo is cut in the most adequate period, but when the composition of the bamboo is liable to be damaged by noxious insects and facteria, especially it contains much water, it is often damaged. It must especially be carful that in case large quantity of bamboo or bamboo products are stored at a place, all the bamboo stored will be damaged, if the inferior bamboo cut off the season should unexpectedly be damaged. Under normal well dried storing condition, very little damage is seen, and bamboo products well dried after being boiled in hot water for about ten minutes will be several times durable.

In accordance with recent development of export of bamboo products, every research institute has studied insects control and mold control, and new methods have been published. As a matter of fact, various methods have been carried out in every place, but each one has its own merits and defects, so you must select an adequate method for the finishing purpose, considering the economic effect and circumstances.

1. Insect Control Method:

Practical insect control methods are as follows.

(a) Use of poison or special chemicals,

(b) Exclusion or fixation of starch and albumen which cause damage by noxious insects,

(c) Lasting or temporary effect of gas,

(d) Control of damage by means of interception of moisture and bacteria in the air.

Noxious insects of bamboo are as follows.

Chlorophorus japonicus Chevrolat (Cerambycidae), Lyctus brunneous Stephens and Dinoderus minutus Fabricius (Lyctidae)

(1) Coating Method:

Bamboo is generally extremely hygroscopic, and the outer skin which has dense tissue and is hard is seldom damaged by harmful insects and mold, namely the inner skin which is coarse and soft is usually damaged at first, so you must completely coat chiefly interior and kerf of bamboo stalks. Damp-proofing coating is used for the purpose of the effect of mold control at the same time. Before coating, oil of bamboo must previously be removed. The outer skin is seldom damaged by noxious insects, and it is not usually coated except the case where it is especially necessary to coat it, from the standpoint of utilization of particular beauty of the outer skin.

(2) Application and soak of chemicals:

Insects control chemicals are capper sulfate, zinc sulfate, carbonic acid, lead acetate, borax, fluorid soda, alum, solution of corrosive sublimate, camphor oil, naphtaline chloride and pentachlorophenol, and they are applied on bamboo or bamboo is soaked in the chemicals above. These methods have been traditionally practised and researched and recommended by public and private research institutes as well as the mold control method explained in the following.

Examples of Practice:

(a) Bamboo is dried, after being soaked in 2 - 2.5% solution of fluorid soda for about 10 minutes.

(b) Bamboo is washed and dried, after being boiled in 1% solution of borax for about 30 minutes.

(c) Bamboo is washed and dried, after being boiled in 0.5% solution of sodium carbonate for about 60 minutes.

(d) Bamboo is washed and dried, after being boiled in 5 - 10% solution of copper sulfate for about 20 - 30 minutes.

(e) Bamboo is washed and dried, after being boiled in 0.5 - 1.0% solution of caustic soda for about 5 - 30 minutes.

(f) Heat 65% of sulfur and 35% of naphtaline chloride at the temperature of 120° - 125°C, and soak bamboo in the compound solution, to make the chemicals well penetrate into bamboo tissue, then take bamboo away from the solution to leave and cool it. Naphtaline chloride is more effective for insects and mold control, but sulfur is cheaper and harder, so effective for strengthenment of bamboo and economical. (Patent No. 18,145)

(g) Soak bamboo is 1 - 3% solution of water soluble pentachlorophenol (P.C.P.Na) for about 40 - 60 minutes, or apply the solution about three times, with the interval of 24 hours. In case bamboo oil has previously been removed, for the purpose of good penetration of the chemical in to tissue of bamboo, the result is more successful. In case, bamboo is soaked in 0.5% solution of acetate, after being boiled in 0.5 - 1.0% the former solution and dried, the chemicals becomes insoluble, and the effect lasts. The chemicals can be mixed with dye or coating, when bamboo is dyed or coated. (See (4) in 2 of this section.)

(h) In case dried bamboo is soaked in compound solution of 2% copper sulfate, 2% Rhot oil and 1% teremen oil for 24 hours, the chemicals sufficiently penetrate into bamboo.

When bamboo is treated with chemicals, bamboo will change the color of the outer skin as follows, namely blue with copper sulfate, slight yellow with borax and yellow brown with caustic soda or sodium carbonate, so when these chemicals are applied, conparatimely weak ones should be applied. It is rational to treat bamboo with cheoric bleaching powder together with smaller quantity of caustic soda and sodium carbonate.

(3) Other Methods:

(a) Soak bamboo in water. Ordinary split bamboo should be soaked in water for 7 - 10 days, and whole bamboo stalk should be soaked for much more days, and prevent from rottenness by means of soaking in running water.

(b) In case bamboo products are stored in a tightly sealed case with such insecticide as naphtaline etc.

(c) Sulfur funigation is also effective.

2. Mould Prevention Method

Mould prevention as well as insecticide of bamboo products have been serious problem, in accordance with development of export, especially damage due to mould of bamboo in the rainy season and on board is fatal. Mould prevention is one of the most important problems of processing bamboo, and an adequate method must be adopted considering practical and economical effects. On the other hand, mould prevention is connected to oil extraction, bleaching, drying and dyeing, so it is possible to effectively keep bamboo from getting mouldy, through these process. Insect control and mould prevention process are usually executed as one process.

(1) Coating Method

Moisture proof coating is used as well as insecticidal coating. It is necessary only for bamboo products, and the process has scarcely been applied to bamboo stalks.

(2) Drying Method

Mould of bamboo and bamboo products is Aspergillus and Penicillium, and Penicillium is influential. Usually the mould generating temperature is 28° - 30°C, the relative humidity being above 80%, and when the humidity becomes 100%, mould is generated after 3 days, while it is below 80%, mould is seldom generated. Therefore it is necessary to keep the warehouse and reserving place dry in preservation of bamboo and its products, and to keep the place well ventilated, and put such hygroscopic chemicals as raw lime etc. packed in bags to suitable spots of the warehouse. It is necessary to keep bamboo well before preservation, but only by means of drying, complete mould prevention would not be expected.

(3) Germ-killing process and mould prevention method by chemicals:

(a) Turpentine-oil mixed with 1% solution of mustard oil, turpentive-oil mixed with gromwell oil or turpentine oil, turpentine salicylic acid etc. are applied.

(b) Bamboo is boiled in boracic acid solution.

(c) Powder of paraformaldehyde (formaline chemicals) equivalent to about 1/3,000 of the volume of the package of the products is put into the package.

(d) Process by sodium carbonate, naphtaline chloride, sulfur, and pentachlorophenol (P.C.P.) explained in the insect control method is also effective for mould prevention.

(e) Bamboo is boiled in 0.1 - 1.0% solution of "Marsel Soap" or "Soapless Soap"

(f) Bamboo is boiled in solution of 0.1% caustic soda and 0.2% "Soapless Soap" for 50 - 60 minutes.

Process of caustic soda some times changes the color of the outer skin of some kinds of bamboo into brown-yellow, even if solution is 0.3%, so comparatively low concentration of solution must be applied. From this viewpoint, the method (f) is thought to be much more practical. Importance of pentachlorophenol (P.C.P.) as mould preventive chemicals for bamboo and its products have recently greatly been recognized by various fields and the experimental results have been reported, so we will explain the chemicals in the following.

(4) Pentachlorophenol

Climate in Japan is rainy, moist and moderate, bamboo fiber is less durable and less valuable, due to decoying bacteria and filamentous fungus, and to prevent bamboo from being damaged by them, various kinds of chemicals are used, but each of them has merits and defects, so it seems that very little complete effect can be expected. However P.C.P. is very effective.

(1) General Character of P.C.D.

Pure P.C.P. is needle-shaped clear crystal, with 190°C of melting point, very little smell, and industrial product is white or light brown needle-shaped crystal or powder, and according to the American standard, it is regulated that this chemical should have more than 174°C of melting point. This chemical has very little smell and stabilized, but when what is not pure or containing water is heated with high temperature, it will be somewhat resolued and colored. It is very little soluble in water.

- o P.C.P. is soluble with caustic soda and sodium carbonate and changes into P.C.A. Na. (Pentachloronatrium)
- o P.C.P. is not soluble with ammonia solution.

(2) Character of Pentachlorophenol natrium

Pure P.C.P. is needle-shaped crystal, and the industrial product is clear or light brown and has no smell. It is not resolved, if it is heated at less than 300°C. It is very much soluble with water.

The solubility is as follows.

Temperature (C)	4°	25°	35°
Solubility (%)	20.8	26.1	28.0

Examples of solubility to organic soluent

ethyl alcohol	32-33%	(25°C)
aceton	32-33%	(25°C)
benzol	0.1%	(25°C)

o Examples of Solubility to Organic Solvent

Temperature / Solvent	0°C	10°	20°C	30°C	40°C	50°C	60°C
Methanol	40.5	48.0	27.0	65.5	72.0	75.5	77.5
ethyl alcohol (absolute)	46.0	49.5	53.0	56.5	60.0	63.5	67.0
ethyl alcohol (95%)	39.0	43.0	47.5	52.0	56.5	61.0	65.5
pine oil	24.540	28.0	32.0	35.5	39.9	43.0	46.0

Japanese Industrial Standard (P.C.P. - Na.) J.I.S; K1552

Kind of Products	No.1 Product		No.2 Product	
	Alkali Product	Neutral Product	Alkaki Product	Neutral Product
Water	below 9%	below 9%	below 10%	below 10%
Insolubility in water	below 1%	below 1%	below 3%	below 3%
Free alkali (NaOH)	2-4%	below 2%	2-4%	below 2%
Melting point (P.C.P.)	above 175°C	above 175°C	above 165°C	above 165°C
Purity	above 86%	above 86%	above 85%	above 85%

o Reaction to Metallic Salts:

When solution of metallic salts (except alkali metal such as sodium, kalium etc.) is added to solution of sodium salts, they change into each insoluble metallic salts and settle. These salts have mould preventive power. Solubability of copper salt (purple), Zinc salt (white), mercury salt (yellow) and aluminium salt (white) in water is low, and making use of the character, it is possible to prevent solution and flow out of the chemicals due to rain, through the process to repeatedly treat the material which has been treated with the solution of P.C.P.-Na with suitable solution of metallic salt.

o Influence of P.C.P.-Na upon dyestuff:

(1) It is impossible to mix this with solution of basic dyestuff. If this is done, insoluble mixture appears in solution and settle.

(2) It can be used as solution with acid dyestuff.

(3) Acid dyestaff can either be treated with P.C.P.-Na after dyeing, or be dyed after treatment with P.C.P.-Na.

(4) In case of basic dyestuff is used, it is recommended to use dyestuff at first, and treat with solution of P.C.P-Na, after complete dry and stabilization.

o Poisonous Character of P.C.P.

Both minute powder of P.C.P. and P.C.P.-Na stimulates the nose and cause sneeze. The solution some times stimulate weak part of one's skin and red boils appear, but in case the rate of solution is below 0.1%, it is not so seriously poisonous. Some of persons of diathesis are seriously poisoned by the chemical.

o How to deal with:

You should wear mask in handling the powder of P.C.P-Na. In case one's skin is kept touched solid P.C.P. or solution of P.C.P. of the rate of above 1%, for about 5 - 10 minutes, one feels pain on his skin. (In case of solution of below 0.1%, no pain is felt.) When you deal with solid or strong solution of P.C.P., you must put on the outer garment and rubber gloves, and wash your hands and face well with warm soap after completion of the operation. DCD emulsion soluble in water is recommended for the purpose.

o How to treat Bamboo with P.C.P.-Na

Many research institutes have researched the methods of treatment of bamboo and its products with P.C.P., and published the results. Rate of absorption differs according to the difference of nourishments contained due to the difference of cutting period, kinds of bamboo, degree of dryness and the size of material to be treated, and consumption of chemicals is different in accordance with the rate of absorption. Moreover, it is thought that boiling treatment is more effective than soaking one, and the quantity of chemicals used is connected with the continuation of the effect.

(a) Slenderly Split Bamboo:

Soak it in 1.0% solution of P.C.P.-Na. for 40 - 60 minutes, or boil it in 0.7 - 1.0% solution of the same above for 30 - 40 minutes.

(b) Small Pieces of Bamboo:

Boil them in 1.0 - 3.0% solution of P.C.P.-Na for 15 - 60 minutes.

(c) Boil bamboo in 0.5 - 1.0% solution of P.C.P.-Na for 60 minutes, and after dry up, boil it again in 3% solution of aluminium chloride for 60 minutes. Other metallic salts can be used, and especially take care for drying after the first treatment.

Section II. Oil Extraction of Bamboo

Oil of bamboo is extracted before the treatments of insect proof, mould proof, bleaching and dyeing, to make the treatment effective. In addition to the original purpose of extraction of excessive oil in bamboo to strengthen bamboo and to make the outer skin beautiful, it is also expect from oil extraction to prevent from damage of insects and stimulate dryness, through extraction or neutralization of the fermentative composition of bemboo. In executing oil extraction of oil, it is recommended that to lean bamboo stalks keeping their bottoms upward in the shake where the air is well ventilated or pile them on a bench in the shade, to prevent them from sudden wither, for about a month after cutting, and then treat them, for the purpose of getting rid of appearance of spots on the outer skin.

Extraction of oil is carried out through two kinds of methods, namely heating with fire and boiling. These methods are also called exposure with fire and that with hot water, or dry or moist method. The bamboo treated is called exposed bamboo, which is used for materials of building and industrial arts. With regard to influence upon the material by the treatments, heating method makes it strong and hard, while boiling one makes it soft, therefore the adequate method ought to be selected, in accordance with the quality, purpose for use and production scale of the material.

1. Fire-heating Method

According to this method, they dry bamboo in the furnace using charcoal or cokes at high temperature and keeping it not being burnt, for a short time, completely wiping oozing oil successively with dry cloth to finish the outer skin beautifully. Temperature and time of heating vary in accordance with the kind and thickness of bamboo, and it is about 20 minutes at about 120° - 130°C. Some times heating is carried out after penetration

of joints, because bamboo some times happens to burst away by heating.

2. Boiling Method

Some times bamboo is boiled in only water, to extract oil, but it take about one or two hours to attain the object, because the temperature is lower than that of fire-heating method, besides satisfactory effect cannot be expected, so chemical is often used. That is to say, bamboo is put into boiling solution of caustic soda or sodium carbonate, and the temperature temporarily falls, then the solution becomes boiling again, at this time take bamboo out from the kettle, and quickly wipe off oozing oil and dirt with dry cloth. At first, boil bamboo stalks for about 5 - 6 minutes, and take them out one by one and finish it while the outer skin remains green. It must be careful and skilful to wipe of oil and dirt at one time, not to remain adhesive materials on the surface, due to coolness. Immediately after oil extraction, sufficiently wash them, to extract alkali, and dry them. Immediately after being boild, bamboo usually, looks dark green, but in case bamboo is boiled for too long time or too much chemicals are applied, the color changes to yellow, so be careful to this in practice.

Bamboo is dried through fire-heating and natural dry. According to the latter method, surface of bamboo become brilliant and no drying spot appears. Usually bamboo is dried by sunshine, being kept turned. The surface naturally is bleached into white. It takes usually about 5 - 10 days in summer, and 10 - 20 days in winter, although it may be somehow long. Too long exposure in the sunshine some times results in cracks, so bamboo is some times dried at the place where is well ventilated in the shade, after being comparatively dried.

It is the principle of extraction of bamboo oil to take it away through saponification with alkali, so any alkali chemicals can be used.

There are some examples as follows.

(1) Usually, 3 monme (1 monme = 3.759 g.) of caustic soda or 4 monme of sodium carbonate is applied in 1 to (= 18.05 l.) of water, in this case it is boild for about 15 minutes.

(2) After soaking bamboo in clean stream, keeping the bottom of bamboo upstream, for about 5 - 12 days, polish it with chaff, wood ash or straw ash.

(3) In case bamboo is treated according to (2), then to (1), the quantity of soda is reduced to a half.

(4) Boil bamboo in the solution of 2.5 monme of caustic soda and 2 monme of powder soap.

Section III Bleaching

The exposed bamboo after treatment of oil extraction has still kept yellow, so when white surface or beautiful dying is required, bleaching process is practised.

(1) Boil bamboo in solution consisting of 1 to of water and 5 - 10 monme of bleaching powder, for about 20 - 40 minutes, then take it out to wash and dry.

(2) Soak bamboo in clean water for one day, then fumigate it with sulfur in tightly closed funigation room for about six hours, and leave it in a room for one day, wash it with water and dry.

(3) Soak bamboo deep in bleaching solution (1 koku = 10 to = 180.5 l. of water and 40 monme of bleaching powder) in the concrete or wooden tub, and add minute quantity of sulfuric acid (about 10 drops), leave it for about 10 hours, until it is washed in water and dried.

Peroxides soda, sodium thiosulphate are also used for bleaching. Sufficient penetration of chemicals and complete dryness result in not only bleaching effect but also insects and mould prevention.

Section IV Polishing of Outer Skin

Bamboo is polished in order to take away the dirt on the surface of the outer skin of bamboo, to make it lusterous, sufficiently making the most of natural luster of bamboo stalk. Select the adequate polishing method in accordance with the kinds and purpose of the bamboo.

1. Chaff Polishing

(1) Bamboo is polished with chaff soaked in water.

This method is adopted when the best Bambusa reticulata Rupur and Bambusa simoni is finished.

(2) Bamboo is polished with the wet chaff mixed with the double quantity of wet sand. Sand hurts the surface of bamboo, so this method is adopted in finishing common grade of Bambusa henonis Hort and species of bamboo.

2. Sand Polishing

Bambusa henonis Hort has spots on its surface of the outer skin, and less lusterous surface, so cheap one is polished with sand.

3. Rope Polishing

Bamboo is polished with rice straw rope being soaked in a stream etc. This method is adopted, when special bamboo, such as Bambusa marmorea whose natural beauty and luster of the green surface must be kept.

In other cases, in order to make the surface smooth and lusterous, bamboo is polished with pottery, tusk and horn, in making main ribs of a fan. Some times, sandpaper and horretail are used for polishing bamboo.

Section V. Bamboo Drying

Bamboo must be well dried, in order to preserve it. Usually bamboo stalks are naturally dried, and some times they are dried after being split.

1. Natural Drying

Bamboo stalks are leaned at the place well ventilated in the shade, keeping the bottoms upward. They are dried for three or four months. Split bamboo is arranged on a board with spaces, and dried for about 10 - 20 days. With regard to Bambusa simoni, each bundle containing 500 - 600 split pieces is dried, being kept hung or stood with one end of the bundle opened. This method is called "midwinter exposure", which dries bamboo for about 15 days, exposing it in shunshine and cold and strong wind. However, when it is wet by the rain on the way, change the position of the bundle up and down, and stand it keeping the bottom upward. Rain after April gives the worst influence upon

the bamboo, so bamboo must always be protected from it.

2. Artificial Drying

Natural drying is widely practised, but this cannot control the rate of water contained, and bamboo is unable to be exposed to the sun for a long time, so in case of mass-production, artificial drying is superior to natural drying. Some times artificial drying is rather indispensable, according to the uses of bamboo.

Artificial drying, however, needs facilities and is expensive so the method is not adopted except when it is profitable, prompt drying in a short time or absolutely dried material is required. Artificial drying is practised in such ways as shown below.

(1) Hot Air Drying:

Bamboo is dried by heating the air in a drying chamber with heated source of steam, electric heater or flame, or by sending heated air into the drying chamber as an hot air current.

(2) Other Methods:

High frequency drying method and reducing air pressure and vacuume drying method are available.

Section VI. Dyeing and Painting of Bamboo

When we use bamboo as the material of industrial arts and decorative material for building, we color it into various sorts of colors. There are such coloring ways as that of dyestuffs, paints or pigments and chemicals. We should adopt the most adequate way, considering the purpose, use and economical effect.

I. Dyeing of Bamboo

(1) Dyestuff:

Dyestuffs used for bamboo are classified into three kinds, namely basic dyestuff and direct dyestuff and azo dyestuff. Acid dyestuff is scarece in affinity for bamboo and difficult to dye, but once dyed it is very durable. On the contrary, basic dyestuff is abundant in affinity for bamboo, and brightness of

colors and tinting power is superior. So it is most widely used, but it is not so durable. Direct dyestuff has the moderate character to the other two kinds above.

Dyestuffs used for Bamboo

Kind / Color	Acid Dyestuff	Basic Dyestuff	Direct Dyestuff
Red	Rocelline, acids of Eosine, Red P.G.	Magenta, Kinds of Rhodamine	Diamine Scarlet, Fast Red BB Conc
Orange	Orange II, German Orange	Chrysoidine, acridine Orange NS Conc	Direct Fast Orange, Direct Orange, R Conc
Yellow	Metanil Yellow	Auramine	Chrysophenine., Cotton Yellow
Green	Brilliant Milling Green B	Malachite Green, (Green bamboo) Brilliant Green GX	
Dark Green		Malachite Green, Auramine	
Blue	Water Blue	Janus Blue, Methylene Blue Conc	Diamine Sky Blue
Violet	Acid Violet 5B	Methyl Violet, Saframine, Rhodamine	
Brown (Golden Red)		Extra Brown	
Red Brown (Light Brown)	Resorcine Brown G	Bismark Brown B.G.R.	Direct Brown KGG Direct Brown 3G
Black	Nigrosine	Janus Black	Direct Black

The part of the crust and the inner crust of bamboo has different dyeing degree. The part of the crust is difficult to dye, and some acid dyestuff and direct dyestuffs are less effective for the part of the crust of bamboo.

(2) Method of Dyeing:

When we dye bamboo, we must take out oil from it previously, to make it well tinted and colored. If necessary, bleaching of the material results in bright color. As for bamboo products to be exported and required to be dyed, it is most desirable to bleach them previously. In this case, extraction of oil is processed through boiling bamboo in the solution of 0.2% caustic soda or sodium carborate for 3 - 5 minutes. After extraction of oil, bamboo must be washed fully with water and dried completely, to make dying effective. It is the key for good coloring to choose bamboo without any scratches on the surface of the crust, and to shane its crust thinly and make the surface as smooth as possible, before dyeing.

Usually iron kettle, a zinced iron kettle or an enamelled pot is used for dyeing bamboo. If possible, it is recommended to use a separate kettle for each color, for the purpose of saving of dyestuff and good coloring effect. In case the same kettle is used for several colors, you must be careful not to mix colors with one another.

(a) Pour cold water into the kettle, and put dyestuff which has been fully dissolved in a small quantity of hot water beforehand in the water and stir the mixture well.

(b) After heating and boiling the dyestuff solution, put material into it and boil again. Though the time and temperature for boiling is various in accordance with the materials (meat of bamboo, crust of bamboo, round bar bamboo), dyestuff and eyeing concentration, usually it is thought to be about 20 - 60 minutes and at 90°C. As the color of black and blue lines apt to fade somewhat after being dried up, so the time should be put off a little for them.

(c) When dying is finished, take out the colored material and wash it with weak solution of acetic acid, so as to make the color fast, then dry it completely, to protect it from being moldy.

(d) Dyestuffs are different in characters, so you must well be careful in dyeing.

(I) Basic Dyestuff:

(1) Hard water which contains much calcium, magnesium and others must not be used for dyeing, for dyestuffs and the salts combine with each other and become insoluble precipitate.

(2) If the material bamboo keeps alkali, it will produce precipitate.

(3) Acid dyestuff must not be mixed with direct dyestuff. In this case, you may apply another dyestuff solution for the material which has once been dyed and dried up.

(4) Auramine is less durable to heat, so the temperature must be kept below 80°C.

(5) When dyestuff is difficult to dissolve, make dyeing solution after the dyestuff has been dissolued with equal quantity of acetic acid.

(6) Dyestuff which is not soluble in water e.g. Victeria Blue may be made into solution after being dissolved with some kinds of alcohol.

(7) Co-chemical is not especially required. (On certain occasion turkey-red oil is used for a quarter of dyeing solution.) Acetic acid is used to make the color fast, but it must be noticed that it is soluble and color may be occasionally faded.

(8) When previous process of dipping the material in 4 - 6% solution of tannic acid for 3 hours, or 1 - 2% solution of tatar emetic for 30 minutes has been practised, it will be colored up better. When the process is carried out after dyeing, the resisting power to water of the material increases.

(9) Time for dyeing should be 10 - 20 minutes. The rate of dyestuff for solution should be 0.05 - 1.00%

(II) Acid Dyestuff:

(1) Hard water must not be used.

(2) Acetic acid and sulphuric acid is used for co-chemical.

Example (1,000 cc of water)

(a) 2-15g of dyestuff; 3-5 cc of acetic acid
(b) 2-15g of dyestuff; 2g of sodium acetate and 1g of sulphuric acid

(3) This kind of dystuff is more difficult to dye than basic dyestuff, so about 30 minutes of boiling is necessary.

(4) As for brown, orange and blue colors, acetic acid must always be used.

(5) It is recommended to use hydrochloric acid or formic acid at about 1% for silk-scarlet (red) and orange II.

(III) Direct Azo Dyestuff

(1) It is recommended to use salt as co-chemical. Some times sodium sulphate or sodium carbonate is also used for co-chemical.

Example (1,000 cc of water)

2-15 g of dyestuff; 5g of salt

(2) Material should be boiled for about 30 minutes.

(e) Special Colors and Mixing Dyestuff:

Single color is seldom used for industrial arts. As a general rule, dyestuffs are mixed before use.

(1) Smoked-bamboo color

(a) Dye with (1 - 1.2 g. of Bismark Brown (1,000 cc of water) and after drying up, dye again with 0.6 g. of malachite green. (Otherwise 0.4 g. of methyl violet and 0.2 g. of malachite green)

(b) Dye with the mixture of 1.2 g. of Bismark Brown and 0.6 g. of methyl violet.

(2) Dark Brown:

Mixing rate is 1 Janus Black to 2 Bismark Brown.

(3) Hot Chocolate Color:

Add adequate quantity of Malachite Green and auramine to Bismark Brown.

II. Painting of Bamboo

Painting is practised to protect the bamboo or its products from moisture and noxious insects and to add beauty to the material, by means of coating the surface of bamboo and its products with paints or pigments.

1. Painting Materials:

Japanese lacquer, paint, enamel, varnish, lacquer, vinyl paint, perssimmon's shibu and logwood are used for the painting materials on bamboo. It if difficult to stick fast paint or pigment on the surface of the crust of bamboo, so the crust of bamboo must be shaved off or ruffed away with sandpaper before hand. Recently vinyl paints and other new paints made of synthetic resin have been invented, and they have been widely applied for bamboo.

o Kinds of Paints

(i) Varnish

A. Volatile Varnish:

This is made through the process of dissolving resin or synthetic resin with solvent, which is usually alcohol. Therefore this is called, in other words, alcoholic paints or resin varnish.

(1) Shellac Varnish:

Of all volatile varnish, this is most frequently used. The coat made of this varnish colors yellow or orance-red, while that is made by solution of bleached shellac varnish is clear, so is called white shellac varnish.

(2) There are copal rosin (solvent is alcohol), phenol resin (solvent is alcohol), dammar gum (solvent is benzine or turpentine oil) and other paints which are made of other resin or synthetic resin through dissolving them with solvent.

(3) Clear Lacquer:

Paints made by dissolving nitrified fibrin (nitrocellulose) with solvent (aceton, methyl cetate, ethyl acetate and others). This paint is called nitrified fibrin varnish in other words.

(4) High Solid Laquer:

Paints made by mixing melanine resin or alkyd resins to nitrified fibrin. This paint is superior to clear lacquer with regard to brilliance, elasiticity, resisting power to dissolution and durability.

B. Oily Varnish:

This paint is made the process of heating and melting of resin or synthetic resin and drying oil, and dissolution with solvent, after desiccant is added. According to the rate of drying oil added, it is classified into short drying, middle drying and long drying varnish.

(1)	Short Drying Varnish	Gold Size
(2)	Middle Drying Varnish	Capal Varnish
(3)	Long Drying Varnish	Body Varnish and
(4)	Black Varnish	Main compositions of this varnish are asphalt and pitch.

ii) Enamel

A. Volatile Enamel:

This is the compound of volatile varnish and pigment.

(1) Resin Enamel:
(2) Synthetic Resin Enamel:
(3) Lacquer Enamel:

This is the compound of pigment and nitrified fibrine varnish, and is called colored lacquer in other words.

B. Oily Enamel:

This is the compound of pigment of oily varnish. Oily varnish belonging to synthetic resin is chiefly used for the material of this enamel.

(1) Outside Coating Enamel:
(2) Frosted Enamel:
(3) Aluminium Enamel:
Mixing rate of aluminium powder is about 15-20%.
(4) Special Enamel:
This is applied for special use.

(iii) Paint

A. Oily Paint:

This is the compound of drying oil, pigment and solvent.

(1) Hard Kneaded Paint:

This is used after being dissolved with voil oil or mixture of voil oil and turpentine oil.

(2) Mixed Paint:

This is usually composed of the rate of 55-65% of pigment and 45 - 35% of oil. Some times, oily varnish is mixed in addition to drying oil.

B. Water Paint:

This is made of gluey chemicals (glue, casein, arabian gum etc.) and pigment, and used for coating wall or veneer board.

C. Emulsion Paint:

Some kinds of alkali, emulsifying agent are mixed with gluey chemical solution, to which drying oil or oily varnish are added, then to the second solution carbonic acid is added.

(iv) Japanese Lacquer:

There are many kinds of Japanese lacquer, according to its quality and uses. For instance, Japanese lacquor which requires

luster and what does not do it, and what needs dryness, transparency and solidity, on the other hand what does not require them so much are found, besides the character required is various in accordance with the materials on which loquer is to be applied.

A. Raw Lacquer:

(1) Kishomi Urushi (Unmixed Raw Lacquer)
(2) Sejime Urushi (Sejime Lacquer)
(3) Gensai Urushi (Gensai Lacquer)
Sejime lacquer is used for the undercoating.

B. Refined Lacquer:

Raw lacquer is kneaded to make its quality even, and heated at about the temperature of 45 - 50°C to make surplus water evaporate out, then crystal lacquer without oil is obtained. After adding vegetable drying oil and coloring agent to this, it is used for various purposes.

(1) Black Lacquer:

Compound of raw lacquer and iron powder or oxidized iron.

(2) Clear Japanese Lacquer:

Compound of raw lacquer and arsenic crange or the ground sap of Cape jasmine. (Gardenia florida)

(3) Colored Lacquer:

Compound of clear Japanese lacquer and pigment

(v) Cashew Lacquer Paint

This paint is made through the process of adding phenol resin to non-drying oil which is extracted from nutshell of cashew-tree grown in the tropical zone and processed as the material of this cashew oily lacquer. This paint has the similar character to Japanese lacquer, but refined cashew lacquer is not poisonous for us as lacquer, and when it is used for the purpose of application to be naturally dried, it can be

dealt as well as oily varnish or oily enamel, and has strong resisting power against changeable climate the sunshine, water, alkali and acid, besides being much more cohesive and elastic.

According to the progress of the chemical industry, many new products of synthetic resin paints have lately been produced, and they have been used to many purposes such as heat-proof, chemical-proof, water-proof and moisture-proof etc.

2. Paints for Bamboo and its Products

The following paints for bamboo are popular.

(i) Transparent Paint:

(1) Shellac Varnish
(2) Nitrified fibrin Varnish (Clear Lacquer)
(3) High Solid Lacquer

(ii) Color Paint

(1) Enamel Lacquer belonging to Nitrified fibrin
(2) Colored Japanese Lacquer

(iii) Cashew Lacquer Paint (Clear and Colored)

It must be noticed that the kinds of paints must be changed, in accordance with the purposes of application, because each of them has different character. That is to say, each paint being sold at present in the market has so distinctive characteristic that it would satisfactorily be suitable to one purpose, on the centrary be apposite to another, and result in worse effect.

3. Painting Method

The following methods are used for painting.

(1) Brush Painting
(2) Dip Painting
(3) Roller Painting
(4) Spray Painting

Brush painting is the most popular method among them. Spray painting by means of spary painting machine is necessary

for mass production, and even for the smaller industry, hand operated sprayer is very effective.

(1) Brush Painting:

Most of paints can be applied with a brush, but lacquer enamel which dries especially in a short time is exceptionally difficult to be applied with a brush, and even lacquer enamel can be painted with a brush, provided that the drying time has been prolonged by means of application of especially chosen solvent.

(2) Spray Painting:

The size and capacity of painting sprayer are decided according to the scale of the factory. The sprayer is classified to two kinds, such as increasing pressure type and decreasing pressure type, both of which spray paint to the objects by compressed air. Characteristics of the sprayer are

1. evenness of painting,
2. high working efficiency,
3. no bubble,
4. adequacy for quick drying paint which cannot be applied by a brush.

The defects of this method is that paint must be thinner and much more solvent is necessary than the case of brush painting. Consequently hot spray which sprays heated paint is adopted, and this method can same solvent and raise working efficiency.

Examples of Painting:

(A) Shellac Varnish Painting:

(1) Smoothening of Foundation:
Shave off thin crust with a knife, polish the material with sand-paper (No. 0 - No.00) to make it smooth.

(2) Coloring:
Color the foundation into aimed color.

(3) Filling up Dents and Cracks:

This process may be omitted, as the quality of bamboo is rather dense, but as a general rule it is desirable to fill them up completely, and then wipe the surface before it dries up. It takes about five hours for it to dries up. The liquid filling material is made by adding glue or paste to clay powder or polishing powder.

(4) Undercoating:

Clean the surface with a dust brush, and paint clear lacquer two or three times. When the material dries up after painting, polish the it with sand paper and polish again with cloth after application of wax.

(5) Finishing:

At last, painting is finished with application of clean lacquer and polishing. At the finishing process, bamboo is polished with cloth which contarns a little shellac varnish, or after polishing with polishing compound, (compound of punice-stone powder, turpentine oil and yellow wax) and with flannel which contains non-drying oil.

Paints should be weakened with alcohol. The paints usually dry up promptly, so the brush must be quickly moved in the same direction.

(B) Lacquer Enamel Painting:

(1) Foundation:

Paint lacquer primer on the surface smoothened with sand paper or water-proof paper. (Lacquer primer is a paint to make the foundation coat thick, for lacquer enamel coating is very thin.)

(2) Undercoating:

After the foundation paint dries up, apply properly weakened lacquer suffuser (undercoating) two or three times. When the surfacer dries up, polish the material with the water-proof paper (No. 240-280) to make the surface smooth.

(3) Finishing:

Paint weakened lacquer enamel. In case the foundation is

seen through the coating painted once, and the color does not seem to be good, apply white lacquer once, and then after its dry, paint the lacquer of the color wanted. When some patches remain, repeat painting additionally two or three times. Then adjust the surface with the water proof paper of No.320 and finish the process with polishing. Lacquer thinner is used for weakening agent.

(C) Simple Painting of Lacquer Enamel:

(1) Foundation:

The same process as above is practised.

(2) Undercoating:

Undercoat two times with compound of the rate of 7 gluey solution (2 glue and 10 water) and 3 clay powder.

(3) Finishing:

After the foundation of clay powder dries up, polish the material with sandpaper, and then finish with painting of lacquer enamel. In order to give water-tight character and durability to gluey solution, suffuse formaline solution after dry up of the foundation.

(D) Cashew Paint (Transparent Painting):

(1) Foundation:

Make the surface smooth.

(2) Filling up:

The material is filled up with the mixture of the rate of 90 clay powder and 10 gluey solution.

(3) Base:

The base consists of the compound of cashew clear paint and clay powder.

(4) Undercoating:

Apply cashew transparent paint once.

(5) Finishing:

Apply cashew transparent paint once or twice. Some times, undercoating and finishing coating is practised once each, but it is recommended to suffuse thin paint several times. It usually takes for about 6 - 10 hours to dry, and cashew thinner or 10 - 20% of turpentine oil is used for solvent, but any solvent can be used, except alcohol.

Cashew transparent and less transparent are dealt with as well as varnish, and regarding colored cashew paints, they are dealt as well as enamel. Polishing is practised with water-polishing using water-tight paper (No.320), after the coat dries up and is hardened. The process is finished with oil clay powder polishing.

(E) High Solid Lacquer Painting:

This painting method is almost the same as those of another lacquer. When light colors are demanded, the material is filled up with clay powder, talc, titanium white and others, then the undercoating paint which is used for lacquer (the finishing paint) is applied two or three times, and finished with application of transparent high solid laquer. In case high solid lacquer is applied, we can finish the material, without wax and polishing.

(F) Grading Painting: (An Example in the Industrial and Technological Laboratory)

(1) Foundation:

Shave off the crust with a lathe or a knife to polish up the foundation brilliant. Sandpaper-polishing is also adopted.

(2) Filling up:

The material is filled up with the compound of clay powder and 10% of glue.

(3) Undercoating:

Apply the paint belonging to urea on the material with a bru brush, and with sand paper twice.

(4) Intermediate Painting:

Spray-painting of transparent lacquer is applied, and after dry up, practise grading paint with a sprayer, and after dry up again, polish with water-tight paper. The grading paint is at first made through the process of adding dyestuff to pure alcohol, and this is added to the transparent lacquer paint or the paint of urea being stirred. The paint belonging to urea is soluble in water and alcohol, so it is very easy to mix dyestuff with it. In grading painting, unevenness of color is adjusted in accordance with the way of spraying and polishing with water-tight paper after it dries up.

(5) Finishing Coating:

Spray transparent lacquer and polish with watertight paper of No.320 - 400, and paint transparent lacquer with sprayer.

(6) Finishing:

The material is finished with polishing compound, polishing wax, and thoroughly cleaned to make the painted surface smooth and brilliant, but if the painting process is completely done, this finishing process is not considered to be absolutely necessary.

Examples of polishing compound are as follows.

Polishing Compound:

45% of wax, 45% of turpentine oil and 10% of punice stone powder

Polishing Wax:

48% of wax, 50% of turpentine oil and 2% of olive oil.

(G) Painting of Flower-basket:

(1) Dyeing:

Dye it into brown with basic dyestuff.

(2) Polishing:

When it dries up, polish it with polishing powder.

(3) Painting:

Raw Japanese lacquer is applied. It is used after its dissolution with the same quantity of camphor oil.

(4) Rust Attaching:

After it dries up, make "dust" which is made by mixing at the rate of 5 white clay powder, 2 red clay powder, 1 soot and 2 dusting powder, and polish it several times with this "dust" in a way of beating at the object with the dust. Then wipe off the dust from the part which must be brilliant.

(5) Satining:

Polish it with tree wax, pareffin or white wax.

III. Other Coloring Method than with Dyestuff

1. Coloring with Nitric Acid or Sulphuric Acid

After the outer skin or crust has previously been shaved off or polished off by sandpaper, and then apply dilute nitric acid or dilute sulphuric acid on the surface of the bamboo and immediately heat it evenly with the charcoal fire or in the cokes furnace, then apply ammonia solution on it, successively wash it in dilute soda solution to make it neutralize, and at last wash it with water. Otherwise, after heating bamboo with fire, it is some times soaked in the solution at the rate of 1,000 cc of water and 20 g. of ammonia for about an hour.

With regard to color, nitric acid treatment makes it brown or red-brown, while sulphuric acid treatment makes it black or dark-brown. In this case, dilute sulphuric acid (weakened to about 9 - 10 times with water) is applied on the original surface of bamboo stalk, numerous and various sizes of spots and lines appears on the surface, because of bamboo oil chemically acted by sulphuric acid, and when it is centinued to be heated, the spots and lines are fixed on the surface, consequently artificial sesame bamboo is obtained. In case the bamboo to be treated contains less oil, especially is old, oil should previously applied on the surface.

The coloring process utilizing dilute nitric acid, namely repeat of the series of process, such as (1) application of

dilute nitric acid on the surface, (2) drying (3) application of ammonia for the purpose of netralization, which changes the color from light brown to dark brown, that is to say, the process of manufacture of artificial smoked bamboo is often practised.

2. Coloring with Silver Nitrate

After oil extraction (water treatment is better) of bamboo, polishing with clay powder, and apply silver nitrate solution on it, then expose it in the sun, after drying. According to this method colors can be available from the first light red-brown to dark-brown at last, through repeated process. Otherwise, you may apply bichromate solution, after application with silver nitrate solution and drying, and then after leaving the material alone for a while, and wash it with water and finish it through drying.

3. Roasted Bamboo

The color of smoked bamboo is available through the process of applying animal oil or vegetable oil on the surface of bamboo and roast it with charcoal fire, and according to this process, different kinds of oil result in a little different colors.

Section VII Glueing of Bamboo Materials

I. Glueing Conditions

Bamboo materials have porous surfaces, which are still rugged even when evenly grinded. Glueing agent penetrates into the surface and, as rooted in the materials, effects mechanical binding, glueing the materials by adhesive force between molecules of glueing materials. Consequently, the following are the conditions necessary for glueing:

(1) The surfaces to be glued shall be as even and smooth as possible.

(2) Glueing agent shall be in such viscosity that it can penetrate into the materials.

(3) The materials to be glued shall be same in quality of the materials and in moisture contents so that glueing agent may act evenly.

The surfaces to be glued should always be clean, because the presence of dusts, oils and fats, waxes, etc. will affect the adhesive effect of the agent.

The glueing agents are usually used in solution in order to permeate and penetrate into the materials evenly. The thinner the membrane is, the more adhesive is the agent.

The outer surface of the bamboo is of very fine quality and covered with waxy substance, which hinders the penetration of glueing agent into the materials and makes the glueing impossible.

II. Classification of Glueing Agents

By the current social demands, various types and varieties of bamboo wares are required, and glueing works are most frequently needed. The glueing agents also varies from vegetable pastes like rice, starch, etc. to the more adhesive agents like synthetic resins.

a. Animal glues (1) Japanese glue. (2) Gelatin.

b. Protein glues (1) Soy bean glue. (2) Lactic bean glue. (3) Milk casein

c. Carbon hydrate glues (1) Starch pastes (fu - Japanese cracknel -, Various kinds of rice paste, wheat paste) (2) Dextrine (3) Cellulose xanthogenic soda (viscose) glue.

d. Rubber glues (with natural and synthetic rubbers as main components) (1) Sulfurized rubber glue.

e. Synthetic resin glues (1) Phenolic acid resin glue. (2) Urea resin glue. (3) Vinyl synthetic resin glue. (4) Melamin resin glue.

Let us deal with more details about these glues.

1. Starch Paste

Various kinds of starch pastes have been used since the earlier times. They are easy in making and applying but weak in adhesive power. To cover this point, glutinous rice glue, persimon juice are mixed (Shibusen powder), or lacquer is mixed with flour (Bakushitzu). These glues are more resistant to moisture than starch paste itself.

2. Animal Glues

Animal glues consist of Japanese glue and gelatin. Gelatin is less adhesive, and Japanese glue is widely used.

The glues vary in quality as plate glue, bleached glue, Sanzen-bon, Sen-bon, etc. Plate glue is the best in adhesive power, while bleached glue is better in colour tone and transparency. Glue is very quick in drying time after glueing, and pressing for a long time is not required. This causes the simple using and small-scale equipments for glueing. But, glue is less resistant to moisture and less adhesive than casein or synthetic resin.

(Applying method)

(1) Solving. The glue is crushed into fine pieces and dipped in clean water for 8 - 12 hours. The glue is, then, boiled in a kettle, stirring and mixing well. If insufficiently mixed and incompletely solved, some defects in quality may occur. The heating temperature should be 80 - 85°C, not to heat to scorching. After 5 - 6 hours of heating, dissolving concentration will be in such degree that dipping and lifting of a brush may result in continuous flowing down of melted glue. If left too long after dissolving, the glue becomes less adhesive and sometimes putrid.

(2) Glueing. The glue is applied thinly and evenly all over the surface to be glued. The materials to be glued, then, shall be applied each other and closely pressed by clamps, and be left untouched until completely dried up. (About 4 hours). Once become cold, the glue will be too hard to handle, and room temperature must be constant. If the temperature of glues is low. The materials to be glued shall be applied with heat and, then, with glues. After being applied against each other, the materials shall be bound

with more heating. Formalin is often applied to increase moisture-resistancy, hardening the glues after drying up.

3. Milk Casein Glues

Protein casein as made from cow milk is the main component, to which slaked lime and alkali salts (sodium fluoride or sodium carbonate) are added. Making and applying methods are simple, and applying time is longer and adhesive power is stronger than glues. The disadvantageous points are that this kind of glues is less resistant to moisture and longer in pressing time than synthetic resin glues.

(Applying Method)

(1) Preparation. The required quantity of glue shall be added bit by bit into water of 1.5 times in volume, by stirring and mixing. Concentration shall be in such a degree that scooping up by wooden spatula may result continuous flowing down of glue from spatula and slight rising above the liquid surface. The time required for preparation is 20 - 30 minutes, well dissolved by use of stirrer. The glue shall be applied within 30 minutes to 3 hours after preparation, and no water shall be added while applying. Metal container must be avoided because of alkalinity of the glue.

(2) Glueing. Glue shall be applied, evenly by wooden spatula, on the surfaces of the materials to be glued. If the materials can be applied against each other, glue amy be applied on one surface only. Standard pressing time is 24 hours. The degree of the pressure differs by the size of bamboo materials, concentration of glueing agent, but usually 5 - 7 kg/cm^2 are required.

4. Soy Bean Glues

De-fatted soy bean powder is the principal constituent, to which slaked lime and alkaline salts are added. Moisture resistancy and adhesive power of soy bean glues are better than animal glues but worse than milk casein. Preparation and application are same as in the case of milk casein glues.

5. Lactic Bean Glues

No.1 and No.2 are generally sold. No.1 consists of 7 parts

of milk casein and 3 parts of de-fatted soy bean powder. No.2 is a mixture of 3 parts milk casein and 3 parts of de-fatted soy bean powder, to which slaked lime and alkaline salts are added. This kinds of glue are between milk casein glues and soy bean glues in moisture resistancy and adhesive power. The mixing ratio of milk casein determines the property of the glues.

6. Synthetic Resin Glues

Synthetic resin glues are the best qualified in adhesive power, moisture resistancy, and the shortest in drying time, causing simple applying method. With the recent chemical developments, there came into being many types of well-qualified glueing agents, while they largely differ in their chemical properties, which should be carefully noted when applying. Generally, synthetic resin glues slightly change their hardness by moisture. They differ in hardness of applying, acidity and alkalinity, applying conditions (viscosity, concentration, quantity applied, drying time, pressure applied, etc.), sizes of glues molecules, etc.

Efficiency of Synthetic Resin Glues (General Normal Temperature glues)

Classification Subject	Urea Resin Glues	Phenolic Resin Glues	Vinyl Resin Glues	Melamin Resin Glues
Adhesive Power: Normal state In Water	70 50	80 50 or above	80 50 or above	more adhesive than urea
Water Resistancy	when drying up, returns to normal	high	high	better than urea
Preparation	simple; hardening agent used	simple; hardening agent used	simple	simple; hardening agent used
Applying method	Mixing method: separating method	simple	weak in heat resistancy	can be with urea in solution
Pressure kg/cm2	8 - 12	comparatively low	5	5
Applying Time	30°C 25min. 10°C 8 hrs.	10°C 7 hrs. 20°C 2 hrs.	a little longer	longer than urea

Pressing time	16 - 24 hours	5 - 6 times of applying time	30°C 24 hrs. 100°C 72 hrs.	30°C 2-3 hrs.
Chemical property	Acidity	strong acidity	solved in acetone, esters	Acidity

(Applying method) - in case of urea resin glues.

(1) Composition of glueing agent. Composed from binding agent and hardening agent. Hardening agent is divided into normal temperature hardening agent and heating hardening agent, and normal temperature hardening the agent is further divided into quick effective agent and slow effective agent.

(2) Glueing. Normal temperature hardening agent is applied on the surface of the material by means of soft brush, evenly and thinly, and dried for 20 minutes. On the surface of another material to be glued, binding agent is applied with hard brush or spatula, and both materials are pressed against each other. Or, the mixture of 1 part normal temperature hardening agent and 10 parts binding agent is applied on the surface of one material only. In this case, the agent 30 minutes after mixing shall not be used.

CHAPTER VI. BAMBOO MANUFACTURING

Section I Classification of Bamboo Goods

Bamboo goods made of bamboo material for various purposes may be classified by the form of materials or processing methods as follows:

(1) Circular Bamboo Manufacturing. To use bamboo trunk.

(2) Bamboo Ware Manufacturing. To make bamboo wares from bamboo trunks or other bamboo materials

(3) Interweaving manufacturing. To cut and reel bamboo materials, and interweave them. Finer bamboo may be used.

(4) Bamboo Plywood. To glue thin bamboo plates or pieces into (a) bamboo veneer or (b) bamboo block.

(5) Bamboo Packet. To cut bamboo materials vertically and glue them.

(6) Bamboo netting plate. To reel out the outer surfaces of interwoven bamboo materials, and paint bakelite or other materials over them and press them into plates. They are used as materials for further manufacturing or moulded into various forms by heating and pressing.

(7) Developed bamboo plate. To cut a designate length of bamboo trunk, split it vertically, cut off the joints, or to cut bamboo trunk spirally, softening them and roll them into plates.

There are some other new bamboo products with bamboo plate and wooden plate glued together, lacquered and engraved. In the recent bamboo manufacturing field, mechanical process is now in common. Splitting process is performed by circular saw, and planer is used for finishing. Bamboo netting plate is also mechanically processed.

Section II .General Works on Bamboo

I. Bending of Bamboo and Correction

When working on raw bamboo, some bent bamboo trunks should be corrected, or, on the contrary, straight trunks must be bent. Processing is the same or similar in each case, and we shall deal here, first, with bending process and, then, with other special processing and bending of split bamboos.

1. General processing. When heated, bamboo loses its elasticity, softens and can be bent freely. Sudden cooling at this stage will determine the form of products. To correct bending, like oil removing process as mentioned already, the bent part shall be heated, and corrected on correcting bar or plate when oils come out, and cooled. Bar is used for fine bamboo, while for bigger bamboo, correcting plate is applied.

To bend circular bamboo of about 1 centimetre in diameter, the bamboo is heated gradually by rotating above charcoal fire or alcohol lamp. When bent to proper angle and oils come out upon the surface, the material shall be cooled in water or cooled by applying wet cloth on the bent part. In case of circular bamboo of up to 2 centimetre in diameter, fat is applied on the part to be bent, and when oils begin to boil, the material shall be bent by means of correcting bar or correcting iron. To bend circular bamboo to sharp angle, the material shall once be cooled during the bending process, shall be bent again to the angle desired. To bend thin bamboo or bamboo with joints cut off, heated sand shall be put into the part to be bent before heating. The heated sand will convey the heat well to the bamboo trunk and also prevent the flattening of the bent part, making the part still circular. If circular bamboo is heated violently, the trunk sometimes blows up. Joints must be cut off in this case.

The correcting iron is used to clamp bamboo trunk and to bend or correct it by pressing another end of the trunk by hand. The correcting plate is used for bending or correcting bigger bamboo by clamping the trunk on the plate.

For heating, fire is generally used, while the temperature appropriate for bending bamboo materials is 90 - 140°C, and hot water or vapour heating may be used depending on the operational process or scale of production. In selecting the processing method, production capacity, kind of production and

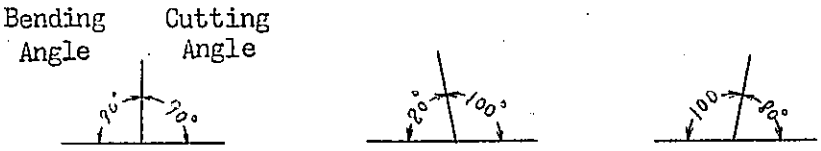
financial conditions must be considered. It is also clear that bamboo trunk must be bent between joints.

2. Special Processing

Although it is impossible to bend circular bamboo nearer to right angle, the following processing is common in the manufacture of bamboo furnitures:

(1) To cut the inner side of the part to be bent in right angle, and to heat the remaining part. If cutting were effected wider than right angle, the material can be bent sharper, and if cut narrower, bending will be obtuse. (See Fig. 25)

Fig. 25 Bending Angle and Cutting Angle



(2) If wood or bamboo support is to be put in the part to be bent, the material shall be cut deeper by the size of such support. (See Fig. 26)

Fig. 26 Circular Cutting of Circular Bamboo

(3) To effect some cutting in the part to be bent, and apply strong glueing agent like urea resin glue. Press and fix the material.

3. Bending of Split Bamboo

To bend split bamboo, heat outer part of the material until oils come out. Then, heat inner part, bend to the desired angle and cool by putting into cold water. If to be bent at sharp angle or bending thick bamboo, cut the inner side of the part to be bent by chisel, and the bending operation will be

effected much easier.

To bend at right angle, smoothing iron or electric iron shall be applied. The iron must be heated in such degree that the bamboo becomes light brown. Iron must be applied firmly upon the part to be bent, and material is bent on this point. When bent to desired angle, fix it. In case bending many bamboo materials at the same time like bamboo rake, or bending a number of same material, heat iron bar and use this as an applier. The length and diameter of the bar vary by the products to be made.

II. Circular Bamboo Manufacturing

1. Selection of Materials

In recent times, circular bamboo began to be utilized for manufacturing of various types of shelves and other furnitures, while the bamboos with harder skin are often apt to be cracked (especially long-jointed bamboo and moso bamboo), and the following precautions will be necessary in selecting materials:

(1) In long-jointed bamboo (madake) or moso bamboo, young bamboo of 2 - 3 years shall be used.

(2) Drying shall be executed by natural drying. After a considerable period of drying in shade, drying may be performed in sunny place.

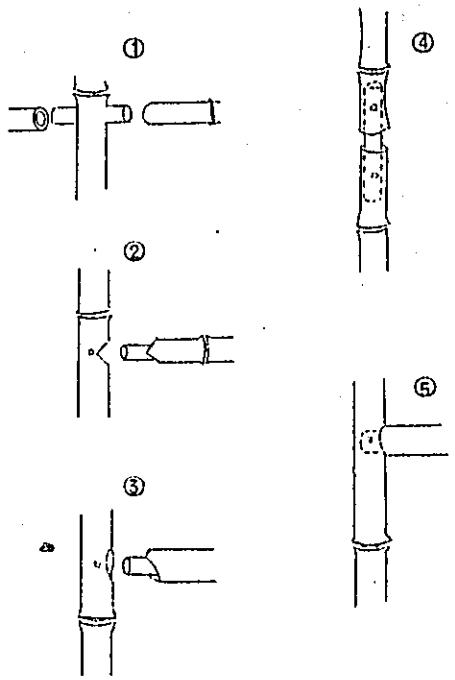
2. Joining of Circular Bamboos

Circular bamboos are usually joined by ravel-joining, while circular bamboo ware should be strong, and joining shall be executed not only by cutting and inserting other bamboos but wooden supporters shall be inserted in the part to be joined and bound by glueing agent or bamboo nails.

Bamboo nails shall be made of well-dried materials. When driving nails, a small hole shall be drilled out. The size of drilling holes shall be determined in proportion of the width of bamboo trunk and almost same size as bamboo nails to be droven.

Measurement shall be doubled, and care must be taken when joining bent bamboos.

Fig. 27 Joining of Circular Bamboo



(1) (2) (3) Inserting

(4) Straight joining

(5) Joining of finer bamboos

3. Holing

When making a hole, bamboo materials are often apt to be split because of its special fibre system, and operation must be performed with much care upon this point. As the fibre is running vertically, the material is easy to be split in this direction, and knife must be applied perpendicular or diagonally to this direction. First, make small holes to cover the part to be holed and, then, cut the whole part out. Gimlet must be applied as lightly and quickly as possible not to make pressure on the materials.

In some case, rectangular hole is made on circular bamboo. In this case, small hole shall be made on each corner of the rectangular part, and, then, chisel must be applied to cut out the part.

III. Cutting of Circular Bamboo

Bamboo skin is hard and slippy. The saw must be applied perpendicularly to the material and be used very slowly at first. When some cutting was made, rotate the bamboo with left hand to the sawer so that the saw teeth are applied on ward. If applied to opposite direction, skin is reeled and irregular cutting may be resulted. If not cut perpendicularly, the materials would be inconvenient for further manufacturing.

IV. Cutting of Joint Ridges

When cutting off joint ridges, hold circular bamboo in left side with root onward, apply bamboo cutter on ridge by right hand and cut off the ridge by rotating bamboo foward cutter edge by left hand. Skin is hard and slippy, and care must be taken not to hurt left hand by cutter. Or, small plane shall be applied in opposite direction or plate plane shall be applied in ordinary direction to cut off joint ridges. Joints are cut to even the material surface. Don't cut off too deep or don't hurt bamboo skin. In case of high ridges (e.g. long-jointed bamboo), cutting shall be excuted twice, not in one time. (In second time, with root to the sawer). The degree of cutting shall be determined by economical effects, operational needs or artistic points of view. If cut too deep, the material fibres are cut in case of reeling.

V. Paving of Skin

In case colouring bamboo materials or wares, skin must be paved. Small knives or glass pieces may be used for small bamboo materials, but skin parer or chisel are generally used. To pare, hold the bamboo trunk by foots and pare. Apply your force equally on any part of the material, and finish the material without spots. Especially, spots are apt to come out on joint parts. If unevenly pared, spots become more apparent when dyed or coloured. Sand paper of No. 0 shall be applied to finish the pared materials.

VI. Splitting of Bamboo

Splitting of bamboo, together with reeling, is said to be the hardest work in fundamental bamboo manufacturing. The split bamboo is sharp on each side, and care must be taken not to hurt your hands.

1. Larger Splitting

Bamboo is easier to be split from top to root. To split shorter trunk by cutter, let the material stand on a block, hit

the back of the cutter by left hand and press the cutter by right hand. In case of longer bamboo, pick up the top of the bamboo by left hand, apply the cutter vertically, press the back of cutter and split forth. Bamboo trunk must be split along the line of twig buds. Split it in such manner that twig buds come on the edge of split bamboos. Fibres are very close at twig buds, and reeling cannot be executed at these points. Don't split trunk with twig buds on the middle of split bamboos. The split bamboos are first cut off of twig buds and, then, splitted further. Splitting is generally executed bisecting.

When jointed bamboo is divided into four equal parts, inner joints must be scraped by cutter. Then, splitting must be continued to have equal parts on both sides. One side is always apt to get bigger, and the other smaller, and the loss of material is often resulted. To prevent this, hold the material with smaller part to your body, and push the bigger side by hand and turn the cutter edge toward the bigger.

To split seven equal parts for instance, first divide into 4 and 3, and, then, split 3 into 2 and 1. As mentioned above, adjust the width of the split materials by turning cutter edge toward bigger side. Also same is the case of scraping twig buds of split bamboos.

One of the hardest work in splitting bamboo is the splitting of joint parts. By centering the cutter edge on the splitting line, and moving the edge right and left, joint parts must be split. If technically advanced, return the cutter before the joint part and press stronger toward joint. Joint splitting is very important, especially to have equal split parts.

2. Splitting by Bamboo Splitting Implements

"Kumode" is usually used to divide long bamboo trunk into four parts. To execute this, first cut in four cuttings on the top of trunk by cutter, and with cutters still in the trunk, insert kumode into cuttings, draw the cutters out and split forth by hitting kumode with back of the cutter. In this case, too, care must be taken to divide into equal parts, and turn the bigger side down so that top and root of the trunk are bent down. Or, set a piece of thin, circular iron bar or crossed bar on a block and put this into the cuttings of the trunk to be split. Thinner bamboo will be easily split by this method. If stopped before joint, push the trunk before iron bar and pat the joint part so that the splitting may be easier.

To divide by bamboo splitter, apply the edge of splitter on the center of horizontally sawed top of the trunk and start to split just like splitting the trunk by cutter. The precau-

tion should be taken to split joint part as in the case of hand splitting. In case of thinner bamboo splitter, just insert the splitter as designated and split by opposite side. In would be better to fix the splitter on a block and split by two men. Mechanical splitting is less accurate in split width but more effective in producing a mass of products in shorter time.

Splitting of bamboo is executed not by cutting with cutter but by splitting along the line of bamboo fibre. Fibres, therefore, must not be cut. The edge of cutter is used only when cut into the top of trunk and cut in the joint part. Elsewhere, the edge is not used. For this sake, bamboo cutter is mostly not very sharpened.

To hold the cutter, set middle finger between cutter body and haft, hold firmly the cutter between thumb root and middle finger with other fingers set along the middle fingers. Thumb top and index finger are used to adjust thickness or width of the bamboo trunk or to prevent the hurting of left hand by cutter.

3. Fine Splitting

To make fine bamboo line, circular bamboo is first divided into four and, then, split finer by measuring. To make higo (fine bamboo line) of 5 rin (rin=1/100 sun; 1 sun=100/33 c.m.). bamboo is split into 2 bu or 4 bu (bu = 1/10 sun) and, then, pared down to the proper thickness. In fine splitting, too, equal dividing is common. The detailed procedure depends upon each case.

(1) 4 bu bamboo: (a) Paring inner skin, (b) split into 2 bu (c) split into 1 bu (d) Paring inner side (e) split into 5 rin

(2) 2 bu bamboo: (a) Paring inner skin (b) Split into 1 bu (c) paring inner side (d) split into 5 rin.

The split higo is pared into 2 or 3 to become materials for further manufacturing. The part already pared is too crude in fibre and is not used for manufacturing.

VII. Reeling of Bamboo

To reel bamboo thinly, reel from top to root as in the case of splitting. Make cuttings in the same procedure as splitting, and apply cutter at the point 2 to skin and 3 to flesh. Bamboo fibre is thicker and harder on skin side, and force is balanced to have equal two parts. Further, reeling may be executed by two equal dividing. The detailed procedure differs by the kinds of bamboo, but reeling will be executed thinner when skilled,

because bamboo fibres are so fine. At joint part, reeling is often apt to be executed thicker, while after joints reeling may become thinner. Do try to have equal and even reeling. To reel joint parts, apply left thumb on the skin, put it and squeeze joint with index finger on lower side. Push the cutter bit by bit between these finger and thumb. When reeling started, put bamboo on left palm, pick up the reeled bamboo by thumb and index finger, squeeze the bamboo with left thumb and cutter edge and reel, raising the edge upward. To reel extremely thin bamboo like materials for industrial arts, mouth reeling is used. When reeling started, hold the upper reeled bamboo in mouth, hold another reeled bamboo by right thumb and cutter, and adjust the bamboo by left hand, with care on the thickness of the bamboo to be reeled. To reel wide, long and thick bamboo, hold lower reeled bamboo between right tees, hold another reeled bamboo by cutter and right thumb and reel on.

VIII. Straight Splitting (Masa-wari)

Straight splitting is the method used from earlier times to make special kind of fine bamboo lines with skin on one side of the line. If curving is made on inner side of split bamboo and straight splitting is effected, line with varied width may be produced. Thus made bamboo line has no front or rear sides, furnish good materials for industrial arts. Straight splitting becomes practical when this method is applied on the part near inner skin. This also will furnish economical way of producing materials. If straight splitting work is applied for broaches and accessaries for summer lady suits, new field of bamboo work may be open.

IX. Width Determination and Corner Planning

The bamboo materials split and reeled in this way are further to be finished with equal width and thickness.

1. Bamboo line drawing

The simpler way is to unfold thick cotton cloth on kneels, place bamboo line on it, apply knife with edge perpendicular to line and draw the bamboo by left hand. When repeated several times, the surface will be smooth and polished. If wooden block is used, place reeled bamboo on block, apply knife and draw by left hand. The edge of knife shall be sharpened in such manner that it will not cut in bamboo fibres.

2. Width Determination

The width shall be equal in any part, especially materials for industrial arts such as flower baskets must have equal width. Erect a set of knives on work block with designated distance

(same as desired width), push bamboo line against the edges of knives, prossing the line with long bamboo piece before knives not to raise line before being cut. Equal width will be obtained by drawing the line with right hand. If operation need more accuracy, width determiner may be used. The plane edges of width determiner are inserted at 45° angle, and the distance between them is adjusted by turning screw. The angle of plane edges is also adjusted to make the cutting easier.

3. Corner Planing

Width-determined bamboo has angular corners and must be made round with corners cut off. This is the so-called corner planing. Place bamboo line on your laps, apply corner planing cutter at right angle and draw line by left hand. Or, place bamboo line on "corner plane", press line by left hand and draw to plane corner by right hand.

4. Bamboo Line Rounding

To plane corners and make circular bamboo, bamboo lines a little thicker than the desired bamboos are made by fine splitting and bamboo line rounder is applied. If more accurate roundness is needed, draw lines throw smaller holes for a few times. Sand paper shall be applied on the materials for industrial arts.

5. Use of Sen

In bamboo manufacturing, various efforts have been concentrated on hand dexterity which necessarily limits the use and improvement of manufacturing implements to personal scope. Sen is generally used for paring of bamboo skins, and very rarely used in finishing of materials for bamboo netting wares. In preparing extremely fine bamboo lines, corner planing and bamboo line drawing are easily performed by use of sen with smooth and polished finish.

Sen, as shown in Fig. 4 - 18.1, is the one used in Bamboo Manufacturing Research Laboratory of Industrial Arts Experimental Institute of the Ministry of International Trade and Industry. For reference, we shall see here some detailed descriptions on its structure and applying method:

Finishing Process of Bamboo Netting Materials by Use of Sen

(1) Structure

(a) Stabilizing Plate. Wooden flat plate of 215 x 95 x 5(bu) for stabilizing of installing block for sen.

(b) Installing Block for sen. Rectangular lumber of 95 x 55 x 35 (bu).

(c) Foothold for Sen Holder. Hard wood of 42 x 15 x 27(bu) with upper corners planed off.

(d) Sen Holder. U-shaped rectangular iron bar to be installed upside down to the foothold and secured by wooden screw on one side. Reclining angle of about 45° with sen secured by one screw on the holder, one on rear center of holder, 2 on up and downside of front plane. Sen is allowed to remove freely.

(e) Sen. Usually used type with total length of 120, edge length of 85, width of 15 (bu.) Side helves are not necessarily required but convenient for polishing and other purposes.

(f) Seatmetal and Seatmetal Hold. Seatmetal hold is composed of flat plate and seatmetal installing block with 45° reclining angle to the front and two steps cutlings on the rear side. Seatmetal is made of steel to prevent defacement by bamboo line drawing. The size of hold should be made in proportion to the dimensions of a.c. and e.

(2) Applying Method

(a) Sen is horizontally secured with front edge to rear by screws on holder. The height is determined by desired thickness of bamboo lines adjusted by the screws up.

(b) When sen is secured as mentioned above, draw bamboo lines to see thickness. If not proper, adjust screws on front and more edge back and forth to have proper thickness. To increase thickness, turn edge to front, and to decrease, turn to rear and sharpen the angle. For finer adjustment, adjust the angle of bamboo lines when drawing.

(3) Special features

(a) The thickness is determined by three adjusting steps of moving of sen, edge angle and drawing angle. Once acquired

the procedure, you can easily proceed your operations with a speed 2 - 3 times faster than hand drawing by skilled workmen.

(b) The finished surface is as smooth and polished as by plane finishing, and far better than bamboo line drawing with perpendicular knife - especially in straight splitting.

Section III. Special Glueing Bamboo Manufacturing

All of bamboo plywood, bamboo packet, bamboo netting plate are process by mechanical manufacturing, and the handling of materials and manufacturing process are almost same, glueing processing is the most important stage in this manufacturing. They differ only in form and assembling method of original materials. In the present section, we shall see general manufacturing process for bamboo plywood. Bamboo manufacturing in agrarian districts will develop in this field in future.

I. Classification of Bamboo Plywood

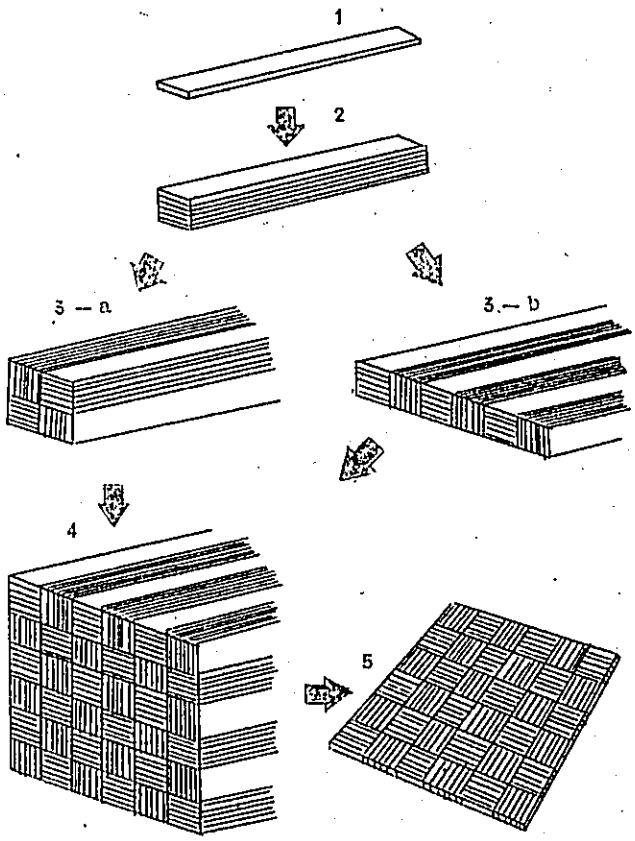
Bamboo plywood is classified into the following three categories:

(1) To cut designated length of bamboo trunk, reel it by circular reeling as in wooden plywood and glue it as extremely thin plate.

(2) To prepare thin plates of 2 cm wide x 1 mm thick x 1 ft. log, join them into 1 square ft. plates and make one plywood plate by glueing three such plates.

(3) To prepare 5 - 6 bamboo plates of 1 m x 3 cm x 7 mm, join them into 1 piece. Then, glue 4 pieces of them into 1 block or glue them horizontally into 1 ft. long plate, and finally make bigger block of 1 square ft. In making block, each plate must be glued with their fibre directions alternatively changed, and the blocks finally prepared are cut as in Figure 29 to be materials for further bamboo manufacturing.

Fig. 29 Manufacturing Process of Bamboo Flooring Block



II. Manufacturing of Bamboo Flooring Block

The manufacturing process of bamboo block varies in each manufacturer, but is generally as follows:

1. Bamboo Materials

3 - 5 years old big bamboo with circumference of 1 - 1.5 Shaku (1 shaku = 10/33 meter) cut in best season. Moso bamboo is mostly used.

2. Original Manufacturing in Place of Production

(1) Cutting. Material is cut in designated measures by circular saw (650 bu). As diameter and thickness of bamboo trunk vary according to the distance from ground, trunks of same dimensions are assorted. The top parts are exempted.

(2) Splitting. Split by bamboo splitter in larger pieces.

(3) Circular Saw Cutting. Cut into (2 bu width by circular saw with two circular sawteeth.

(4) Circular Saw Joint Cutting. Inner and outer joints are cut off as in (3).

3. Operation Process in Factory

The materials prepared in place of production are transported to factory.

(1) Rough cutting. The materials carried into factory are roughly cut by planer to have joint parts even.

(2) Preparatory Processing. Oil pressing, anti-insect and anti-bacteria measures as well as drying are executed. Drying is performed by steam drying or high frequency drying.

(3) Finish Cutting. Both sides are cut by automatic planer to have equal thickness.

(4) First Glueing. The materials are joined with back to back and inner side to inner side. Milk casein or urea synthetic resin glueing agents are applied, pressed by pressing implements.

(5) Side Processing. The pieces glued in this way are, then, planed of their sides by automatic planer, making rectangular materials.

(6) Second glueing. Rectangular materials are assembled and glued as shown in 3a or 3b of Fig. 29.

(7) Surface Processing. To cut and adjust the surfaces of materials glued in (6).

(8) Third Glueing. The blocks as shown in 4 of Fig. 29 are completed in rectangular materials with 1 square ft. section.

(9) Section Cutting. The finished materials are cut into desired dimension by band saw to become materials for flooring or other bamboo wares. Such as cake container, fruit container, service tray, tobacco set, compact, bob-bon container, inkstand, etc.

The export of bamboo plywood is now gradually increasing and mass production is required, while this is more costly than wooden plywood, and more advanced technics in glueing are expected to develop.

Export Flooring Dimensions: 1 ft x 1 ft x $\frac{1}{2}$ in.

Chapter VII. Interweaving Manufacturing

Section I. Fundamental Interweaving Method of Bamboo Wares

Many varied types of daily necessaries and accessaries are made from split and reeled bamboo materials by interweaving them. Industrial arts objects and higher industrial products with synthetic resin glueing processing are also produced by interweaving bamboo materials. In each of interweaving methods, there are a number of varieties, and if their applications are included, the varieties are almost limitless. In the present chapter, we shall deal with general fundamental interweaving methods for reference of further studies. The interweaving of bamboo wares generally starts from bottom interweaving, then to waist interweaving and body interweaving and finally to edge preparation. Various kinds of materials are required for each process by the classification of materials, purpose of bamboo wares, size, design, etc. In general practical goods, the kinds are rather determined from long customs. Interweaving methods are roughly classified into basket pattern, netting pattern, cross pattern and random pattern, and various artistic patterns are invented from these fundamental interweaving. But in products for daily use, not so complicated patterns are required. The interweaving patterns generally used are as follows:

I. Fundamental Interweaving Patterns of Bamboo Wares

1. Basket Pattern

(1) Hexagonal pattern, double hexagonal pattern
(2) Variant hexagonal pattern, (Variant hemp leaf pattern)
(3) Hemp leaf pattern.
(4) Cobweb pattern
(5) Octagonal cobweb pattern
(6) Octagonal pattern (octagonal basket pattern)
(7) Bull's eye pattern (Single moon pattern, double moon pattern)
(8) Triangle pattern
(9) Collecting pattern
(10) Tying pattern
(11) Cornflower pattern

2. Netting pattern

(1) Two skipping netting pattern

(2) Three skipping netting pattern
(3) Square netting pattern
(4) Simpler square netting pattern
(5) Lattice netting pattern
(6) Flower netting pattern

3. Cross pattern

(1) Cross pattern (check pattern, check netting)
(2) Diamond pattern (Double diamond pattern, horizontal diamond pattern, vertical diamond pattern)
(3) Two-one pattern, Three-one pattern
(4) Mat pattern
(5) Chrysanthemum pattern, chrysanthemum bottom pattern (Single chrysanthemum bottom, double chrysanthemum bottom)
(6) Raft pattern
(7) Pine needle pattern, reverse pine needle pattern
(8) Wave pattern
(9) Brick-laying pattern
(10) Dykes pattern
(11) X pattern
(12) Simple lattice pattern

4. Random pattern

5. Rope pattern - Two rope, Three rope, Four rope

II. Fundamental Interweaving

1. Hexagonal pattern

Hexagonal pattern, together with cross pattern, is called basket pattern, and is one of the easiest and the unexpensive way of interweaving. Six bamboos are interwoven as to become hexagonal. The pattern is divided into right hexagonal and left hexagonal patterns by weaving order, but right hexagonal pattern is generally used. It is important that the corresponding two bamboos run parallel with equal distance. The hexagon shall be made accurate to be fundamental tone to the whole. To each side of hexagon, each one of bamboo materials shall be added to develop the pattern. In interweaving, be careful to form accurate right or left hexagonal pattern.

This pattern is used for packing basket, carrying basket, bird cage, kitch basket, waste paper baskot, fruit basket, etc.

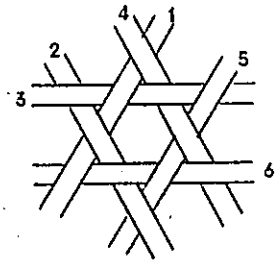
(Procedure)

For right hexagonal pattern, put 2 upon 1 and set 3 upon 2 and under 1, accurately forming triangle of 1, 2 and 3. Put 4 parallelly to 2 upon 1 and under 3. 5 must run parallel to one under 4 and upon 3. Under 5 and 1 and upon 4 and 2 comes 6. Finally, weave 5 and 2 adjust the hexagonal form made up in the center.

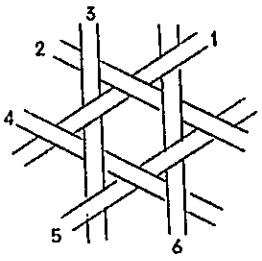
For left hexagonal pattern, the position of 2 is in the position of 3 in right pattern, and 3,4,5,6 are woven in left pattern.

To continue the interweaving, set each bamboo parallel and in equal distance to each side of hexagon as shown in (3) of Fig. 30 in right (or left) pattern. The first triangle made by 1, 2 and 3 is on one side of hexagon, and with 4 and further sequence more triangles are formed in right turn in right pattern and in left turn in left pattern. In these triangles, the bamboo running to left upper comes over in right pattern, and in left pattern the one running to right upper comes over the other. The hexagon is composed of 3 two parallel lines, and as the pattern develops, there come out four parallel lines, six parallel lines and eight parallel lines.

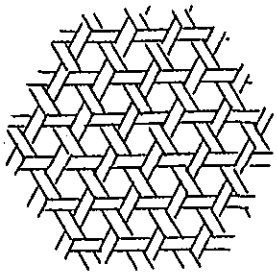
Fig. 30 Hexagonal Pattern



(1) Right Hexagonal Pattern



(2) Left Hexagonal Pattern



(3)

2. Blinded Hexagonal Pattern

To cover interstices of hexagonal pattern, another bamboo materials are inserted to blind the pattern as shown in Fig. 31 a, b and c are applied for hexagonal bottom interweaving, inserting blinding bamboo covering the bottom.

a. Insert another bamboo material across the center of hexagon. The blinding bamboo go over and under every other crossing.

b. Insert the blinding bamboo between the crossed lines. This is generaly called hemp-type" insertion.

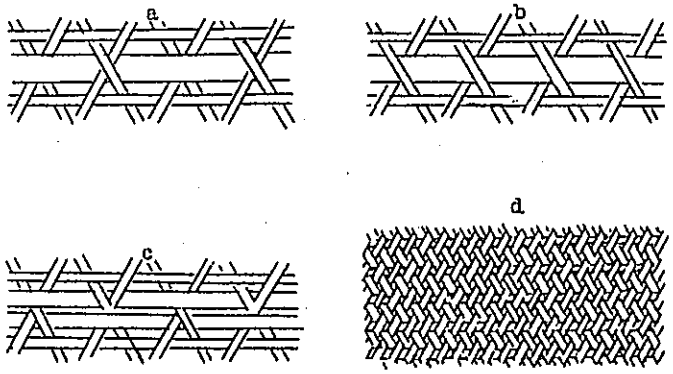
c. Insert two narrower split bamboos alternatively over and under every other crossing.

d. Insert diagonally crossing blinding bamboos at the center of hexagon and make pattern like hemp-type interweaving. This is called hemp-type blinding.

(1) As shown in Figure, insert the bamboo running left upper under and the one running right upper over the hexagon.

(2) Insert bamboo A and bamboo B alternetively over and under, and interweave these two each other.

Fig. 31 Blinded Hexagonal Pattern

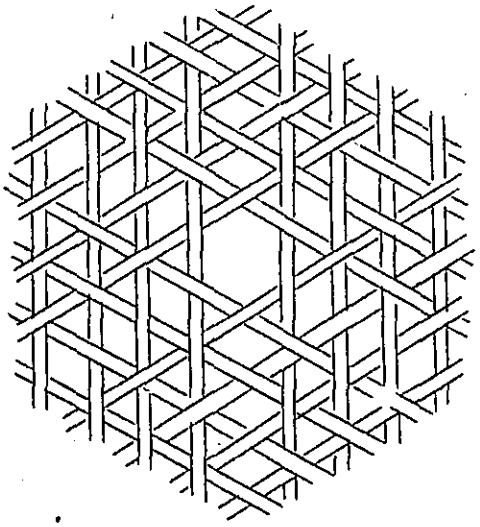


3. Variant hexagonal pattern (variant hemp leaf pattern)

This pattern is a variant of hexagonal pattern. To the central right (or left) hexagon, left pattern (right pattern to the case of left hexagon) is added outside the hexagon, and, further, right and left patterns develop outward alternatively. If three more bamboos are added in the center, this becomes hemp leaf patterns. So, this is also called "variant hemp leaf pattern".

This pattern is applied for bottom pattern of waste paper basket, fruit basket, banana basket, etc. and also for more artistic use like flower basket.

Fig. 32 Variant Hexagonal Pattern
(Variant Hamp Leaf Pattern)



(Interweaving Method)

First, make right hexagon in the center, and, then, form left pattern second hexagon outside the central hexagon, and change 2 crossirgs outside the second hexagon to left pattern (the bamboo running upper right to the above).

Next, form the third hexagon in right pattern, by inserting bamboos to these two crossings, and change three crossings made up to right pattern (the bamboo running upper left to the above).

In short, change crossings (which increases by one every time) to the opposite pattern. The pattern of central hexagon is determined by each case.

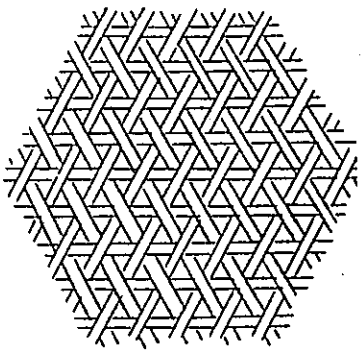
4. Hemp Leaf Pattern

This pattern is formed by inserting three bamboos in hemp type into the central hexagon of variant hexagonal pattern. This is generally known as "true hemp pattern" and rarely used for baskets. Its applications are for table mats, bamboo chair seat, etc.

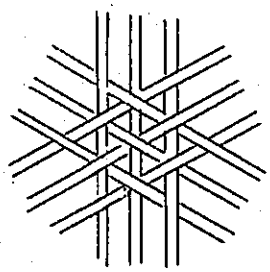
(Interweaving Method)

Insert three bamboos into central hexagon in hemp type, and continue variant hexagonal pattern as mentioned above. But, works are sometimes too complicated, and variant hexagonal pattern is generally used for this.

Fig. 33 Hemp Leaf Pattern



Fundamental Interweaving of Hemp Leaf Pattern



5. Cobweb Pattern

To the central hexagon of hexagonal pattern, fit closely bamboos parallel to each side of the hexagon, continue to interweave hexagonal pattern like cobweb, leaving star-like pattern. If the central hexagon is in right pattern, continue to weave right pattern in right turn, and if left pattern, weave left pattern in left turn. The interwoven products are thick, and this pattern is used for artistic baskets, especially for bottom of them.

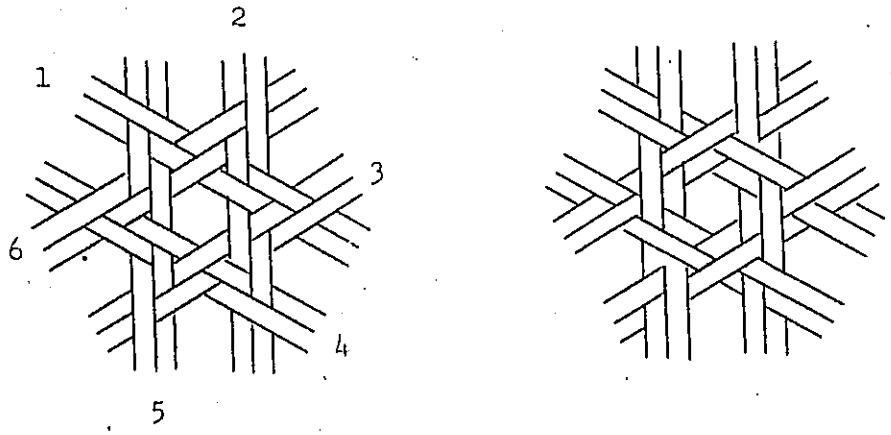
(Interweaving Method)

First, make the central hexagon in right hexagonal pattern, and with the second series of bamboos 1, 2, 3, 4, 5 and 6, form right hexagonal pattern closely fit and parallel to the first bamboos. These second bamboos shall be inserted in such way that 6 triangles on each side of hexagon rise to the surface. Insert 1 under triangle and over the other two sides, insert 2 under 1 and the neighbouring triangle and over the other. 3 is interwoven under 2 and the next triangle and over the others. Continue to insert 4, 5 and 6 in exactly same way, and, next, re-arrange 5 and 1, 6 and 2, adjusting right hexagonal pattern. Continue to weave third and fourth rounds in the same way under triangles, and you will have a developing pattern as shown in (3) of Fig. 34. There is a variant pattern of cobweb netting pattern.

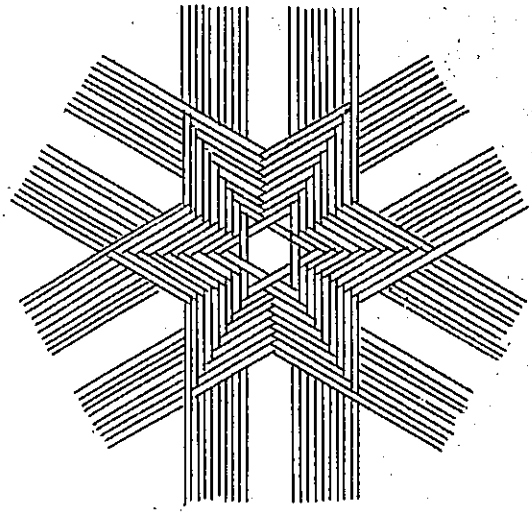
The rear pattern of comweb pattern has a very characteristic feature with parallel hexagonal lines, and is applied for various bamboo wares.

Fig. 34 Cobweb Pattern

(1) Fundamental Pattern (2) Fundamental Rear Pattern



(3)

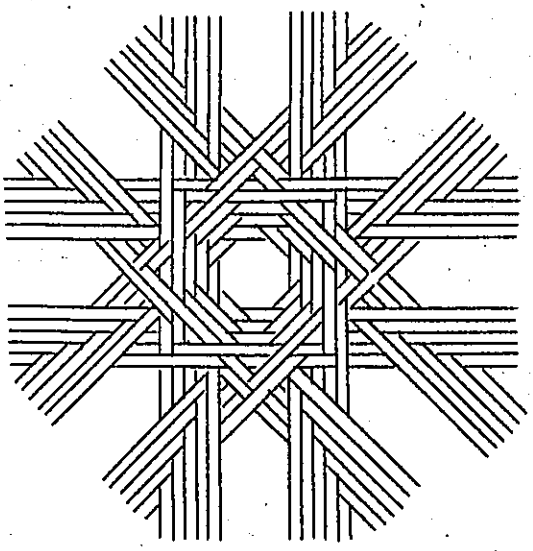


6. Octagonal Cobweb Pattern

This is the application of cobweb pattern, with an octagon in the center. After interwoven three parallel rounds like cobweb pattern, continue to weave under triangles.

This pattern is applied for fruit baskets and flower\baskets.

Fig. 35 Octagonal Cobweb Pattern



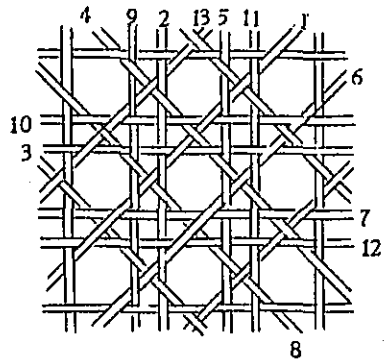
7. Octagonal Pattern (Octagonal basket pattern)

To interweave this pattern, make right pattern or left pattern octagon in the center, form large squares outside the octagon and continue the interweaving. This is applied for electric lamp shades, lamp shades, chair seats, show windows, etc.

(Interweaving Method)

To weave right pattern octagon in the center, make right angle triangle with 1, 2 and 3, make another triangle by inserting 4 over 1 and under 3. 5, 6, 7, 8 are inserted in exactly same manner, and rearrange 6 and 2, 7 and 1, 8 and 3.

Fig. 36 Octagonal Pattern



Then, insert 9 outside the crossing of 1 and 8, parallel to 2, insert 10 into neigboring crossing and perpendicular to 9, and continue to weave 10, 11 and 12. Rearrange 9 and 12 and make left pattern square. Insert 13 parallet to 1, making large square and develop the pattern.

8. Bull's Eye Pattern (Single Moon Pattern)

If the central pattern is formed with more than 10 bamboos, the polygon made up goes nearly into a circle. The numbers of bamboos depends upon each case. Bull's eye pattern is made up with such circle as its center, and often called moon bottom and is used for bottom interweaving. There are, of course, right pattern and left pattern, each called as right ring and left ring. Application is for electric lamp shades, cake containers, fruit baskets, etc.

(Interweaving Method)

We shall see here the interweaving method of pattern with 16 bamboos and right ring four skipping mode.

Place bamboo 1 at given position and cross 2 at an angle to form hexadecagon. Cross, in the same way, 3, 4 in left turn, and place 5 under 1. Place these bamboos exactly arranged so that 32 bamboos to make up pattern are uniformly set.

Place 6 under 2, 7 under 3, ..., 13 under 9. Insert 14 under 10 and 1 and over 2, 15 under 11 and 1, 2 and over 3. Place 16 under 12 and 1, 2, 3 and over 4. Rearrange the bamboos so that they cross alternatively at the top. Interweaving is especially hard in starting and finishing, and care must be taken not to deform the pattern.

Fig. 37 Bull's Eye Pattern (Single Moon Pattern)

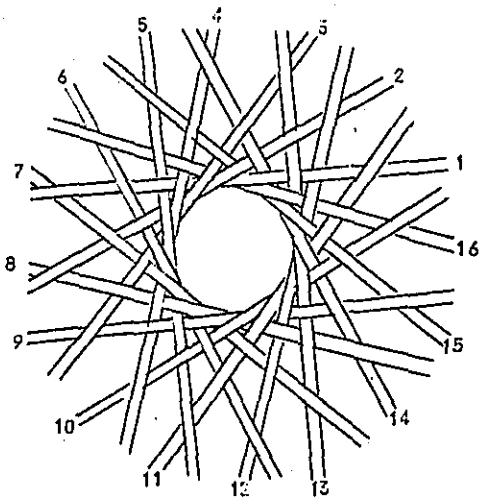
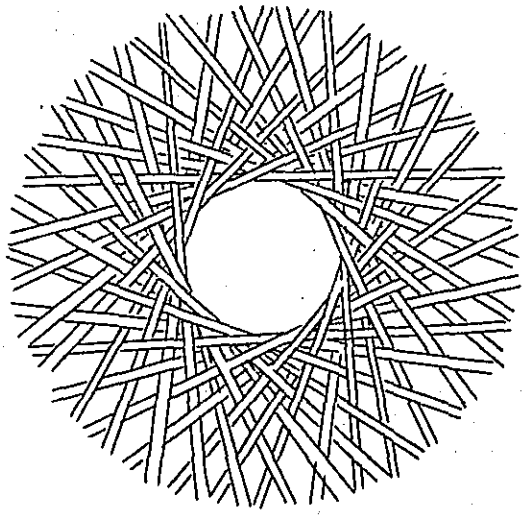


Fig. 38 Double Moon Pattern



The circle at the center must be made packed and smaller, without revealing the starting and finishing points.

If inserted under two bamboo instead of skipping four and under 1, 2 skipping netting pattern will be made up.

In case of 28 bamboos, 6 skipping will be effected with 1, 2, 4, 5, 6 crossed and with 7 and 8 under 1 and 2 respectively.

Continue in the same way down to 28, which should be inserted under 22. Then, hold the first 6 bamboos from 1 to 6 in your left hand and the last 6 bamboos from 23 to 28 in right hand, and cross 23 over 1, 24 over 2, ..., 28 over 6. Tighten the central pattern to make exact circle. Hidden the joint parts and rearrange the bamboo tops uniformly.

9. Double Moon Pattern

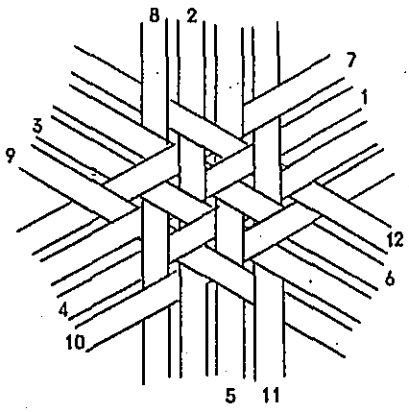
To reduce the size of the central pattern and increase the number of bamboos, double moon pattern is used. Prepare two separate single moon patterns and interweave them. This pattern is applied for waste paper basket in finishing the edge. In case of bottom weaving, insert circular netting plate between two moon patterns.

10. Triangle Pattern

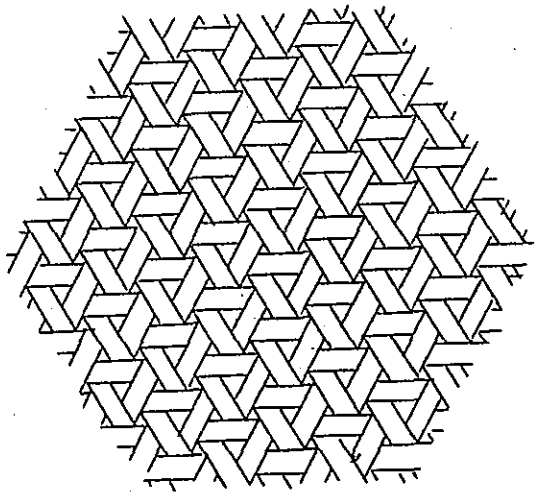
To weave triangle pattern, form the central pattern with 6 bamboos into the shape of paper windmill and continue the work. Like right or left pattern in the making of other pattern, windmill comes in two kinds: right turn and left turn. In general pattern, it is rather the continuance of triangle or windmill pattern than hexagonal pattern, while the center of windmill always forms small hexagon.

Fig. 39 Triangle Pattern

(1) Fundamental Pattern



(2) Triangle Pattern



This pattern is interwoven by inserting each bamboo over three and under three bamboos. Consequently, the surface of the pattern is rather even, and applied for matting materials.

(Interweaving Method)

Cross 6 bamboos in sequence of 1, 2 and 3, forming windmill of left turn. In the second round, insert 7 in hemp-type at the crossing of 2 and 6. 7 is under 2 and 5 in right and over 3 and 6 in the left. 8 is inserted in hemp type into the next crossing under two right bamboos and over two left - actually under three right because 7 is over two right bamboos. Continue to weave in the same way, and the last 12 is under 2, 5 and 7 and over three others. Insert the left end of 11 and 12 under 7 and 8, putting out the starting and finishing of interweaving.

In the third round, weave in right turn, leaving exact weaving pattern with three under and three over. Continue to weave in right and left turns alternatively.

11. Collecting Pattern

This is the application of hexagonal pattern, with two skinned bamboos formed in double hexagonal pattern (right pattern in center and left pattern next). Collect the ends of the interwoven bamboos to make various forms.

The pattern is applied for teacup stands, fruits baskets, etc. and has many variations in central hexagon and edges.

Fig. 40 Collecting Pattern

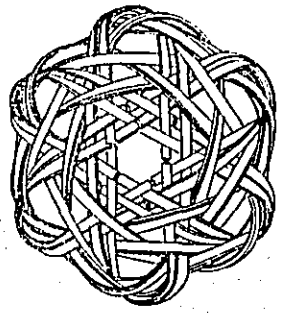
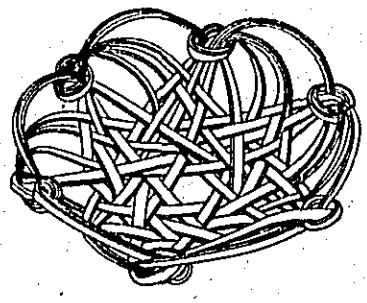


Fig. 41 Tying Pattern



12. Tying Pattern

This also is a variation of hexagonal pattern, with various decoration tyings in interweaving. As in the case of collecting pattern, reeled straight split bamboos may be used for more artistic finishing.

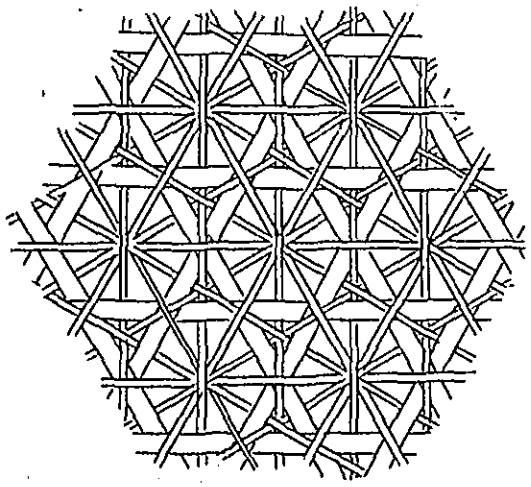
13. Cornflower Pattern

There are many other variations of hexagonal pattern with fine bamboo lines and coloured bamboos inserted in hemp type or other types, making various flower patterns. This is the simplest of them and widely used for decorating bamboo furnitures. This is often called variant chrysanthemum pattern because of the similarity with chrysanthemum pattern. The pattern is made by inserting left hexagonal pattern in the hexagonal pattern.

(Interweaving Method)

Insert 6 bamboo lines in hemp type into hexagon made up with wider bamboos. Then, form outside hexagon with fine bamboo lines as shown in Fig. 42.

Fig. 42 Cornflower Pattern



14. Two Skipping Netting Pattern

This is the most common netting pattern and has been used widely from earlier times.

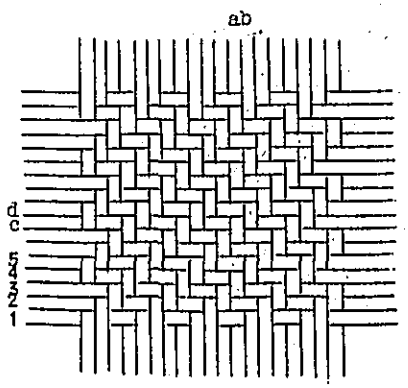
Netting patterns are generally used for basket-trunks, table-plates, screens, handbags, bookshelves, table-mats, light doors, ceiling coverings, flooring materials, waste-baskets, etc.

(Interweaving Method)

1. Line the bamboos lengthwize tightly fit each other, hold firmly this side, insert bamboo 1 across under the first two and over the next two and so on. Insert 2 over the first one, under the next two and over the next two and so on. 3 starts from over the first two, 4 starts from under the first one and 5 returns to the beginning as 1. Interweaving will be continued in the sequence of 1, 2, 3 and 4, but the starting can be made from any of these 4 steps. Be careful to have uniform patterns at the crossings.

2. Another method of interweaving is to have lengthwise bamboos a and b and across bamboos c and d, and continue to develop the pattern to each four direction. Also recommended is the method, in which across bamboo is inserted above c and d and lengthwize bamboo right to a and b and develop the pattern in upper right quarter. The other quarters are to be interwoven later.

Fig. 43 Two Skipping Netting Pattern



15. Three Skipping Netting Pattern

Three skipping netting pattern is exactly the same as in the case of two skipping netting pattern except skipping three instead of two. The inserting of across bamboos is repeated in this case in 6 steps between 1 and 6. Four skipping netting pattern is often applied.

16. Transforming Method from Cross Netting to Lengthwise Netting

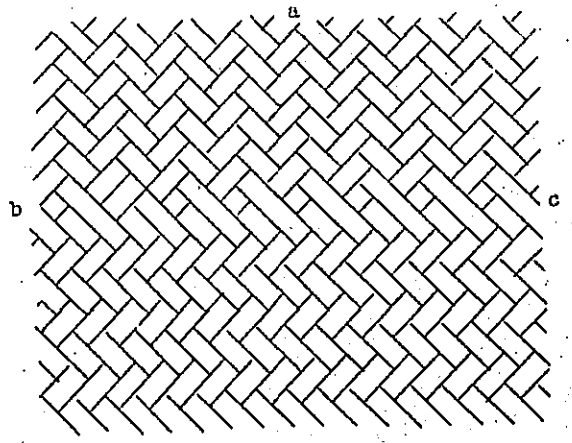
Netting pattern is divided into cross netting, lengthwise netting and diagonal netting by the direction of patterns at crossings, but there is no difference in interweaving procedure. Designed netting pattern is the application of regular netting pattern, and variation is effected by the pattern at the crossings. Netting pattern is transformed in the following ways:

(1) To transform cross netting to lengthwise netting.
(2) Right diagonal netting to left diagonal netting.
(3) Reverse of (1) and (2).

(1) and (2) do not differ in interweaving method but only differ in the angles of bamboos. Therefore, we shall see here the transforming method from cross netting to lengthwise netting.

(Transforming Method of Two Skipping Netting Pattern) - See Fig. 45

Fig. 45 Transforming Method from Cross Netting to Lengthwise Netting



Supposing that the bamboos running a - b direction are lengthwise and the ones running a - c direction are across, the lengthwise bamboo shall skip four at one point - the lengthwise bamboo skips 2 - 4 - 2 - 4 at the transforming point.

On the contrary, the lengthwise bamboo shall skip 4 - 2 - 4 - 2 when lengthwise netting is transformed into cross netting.

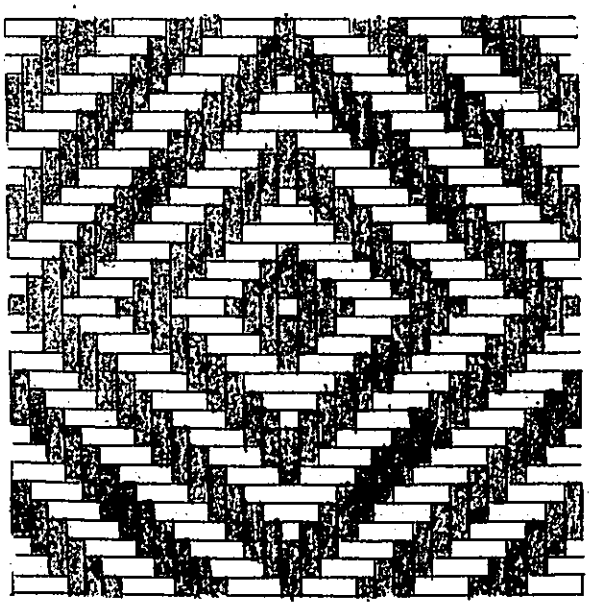
In the case of three skipping netting pattern, this shall be 1 - 3 - 5 and when transforming from lengthwise to cross netting this shall be 5 - 3 - 1, changing the direction of pattern at the crossings by right angle. (For application example, see square netting pattern)

17. Square Netting Pattern

(Interweaving Method)

This is a variation of netting pattern with lengthwise bamboos tightly lined and cross bamboos crossed over the center of lengthwise bamboos, skipping 3 bamboos each. With this as the center, weaving shall be continued to this side, inserting under 5, 3 and 1 with both ends skipping three. Next insert cross bamboo over 5, 3 and 1 with the same skipping at the ends. Continue to weave to the opposite direction.

Fig. 46 Square Netting Pattern



Also recommended is the fundamental method with 7 each of lengthwise and cross bamboos. Continue to develop the pattern with this as center.

18. Continuing Square Netting Pattern

This is a variant of square netting pattern. While square netting pattern is the development of central square, this is the continuing of square pattern. If the unit patterns were modified, the more complicated and interesting pattern will be produced. Flower netting pattern, variegated netting pattern, etc. are the variations.

Fig. 47 Continuing Square Netting Pattern

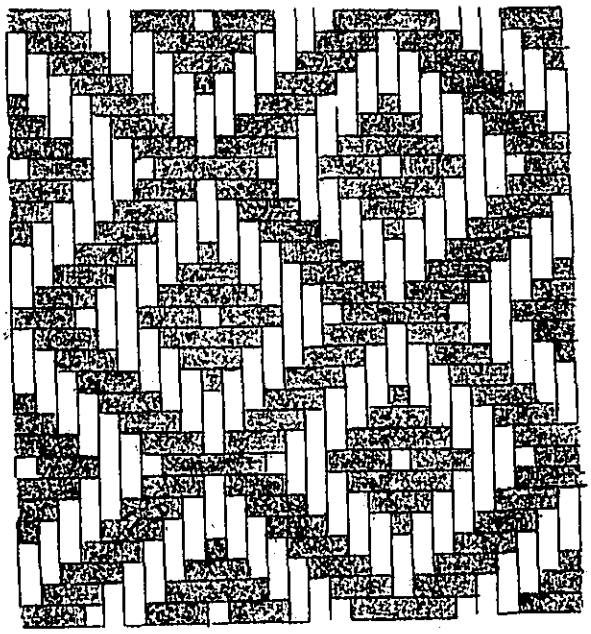


Fig. 48 Flower Netting Pattern

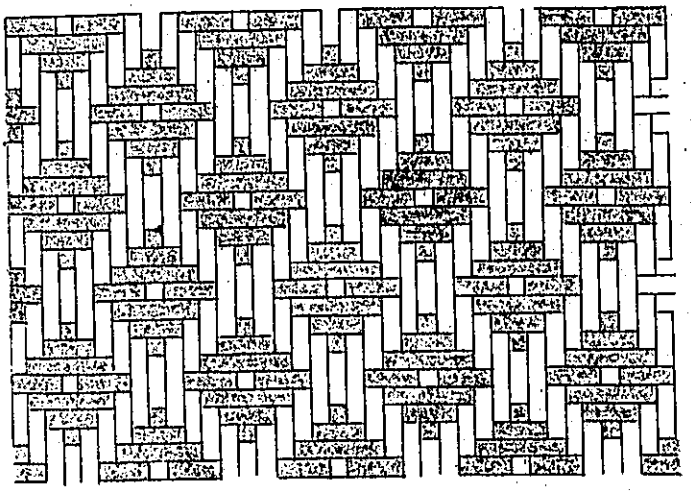


Fig. 49 Simpler Square Netting Pattern

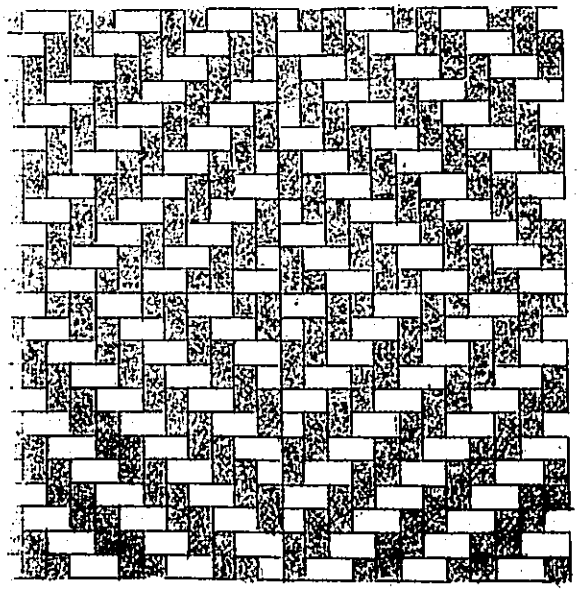
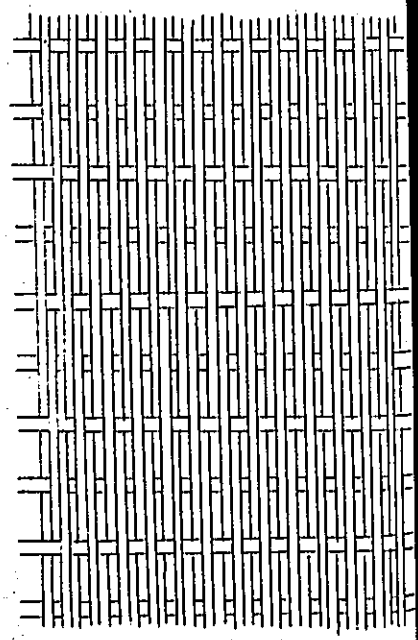


Fig. 50 Lattice Netting Pattern



19. Simpler Square Netting Pattern

Form paper-windmill-like shape with 2 each of lengthwise and cross bamboos at the center, and continue to weave two skipping or three skipping netting pattern. As shown in Fig.49 (in the case of two skipping pattern), square is produced above the central pattern, and squares are continued by skipping one for each, developing the pattern outwardly.

20. Lattice Netting Pattern

This is the pattern with long cross bamboo running over three and, then, under three of lengthwise bamboos. While the pattern looks like cross mat pattern, interweaving is performed like three skipping netting with few exceptions to produce flowing pattern.

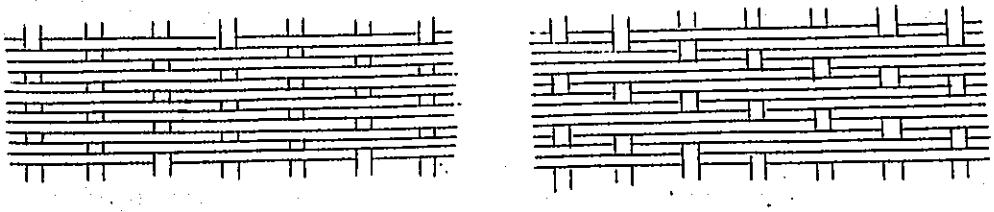
21. Variant Lattice Netting Pattern

As in the case of lattice netting pattern, this is effected with lengthwise bamboos lined loose and cross bamboos lined tightly. Variation will be effected with lengthwise bamboos regularly inserted over or under the cross bamboos. There are 2 - 1 (over 2 and under 1), 2 - 2, 3 - 1, 3 - 2, 3 - 3, 4 - 1, 4 - 3 and other methods, according to their mode the variations in pattern will be produced. This is widely used for mats, flooring materials, plating materials, etc.

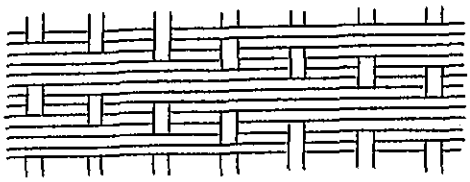
2 - 1, 3 - 2, 4 - 3 are often called 1 scooping pattern, 2 scooping and 3 scooping pattern respectively, and 1 scooping pattern is also called mat netting pattern. 2 scooping pattern is called flowing pattern.

Fig. 51 Variant Lattice Netting Pattern

(a) 4 - 7 (b) 3 - 2



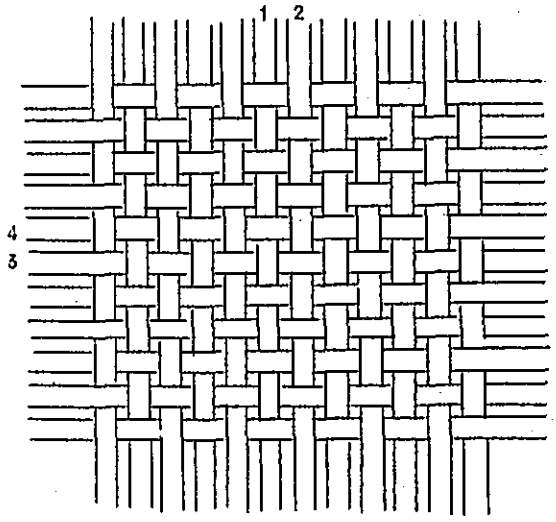
(c) 2 - 1



22. Cross Pattern

Cross pattern is the simplest and the commonest pattern with lengthwise and cross bamboos scooping alternatively. This is called cross because both bamboos are interwoven in cross. This is often called Genroku pattern because of its similarity with Genroku Kimono design. The cross is generally made to form exact squares, sometimes to form rectangular forms.

Fig. 52 Cross Pattern



(Interweaving Method)

As shown in Fig. 52, make the central pattern with two each of lengthwise and cross bamboos and develop the pattern to the desired size. Line the lengthwise bamboos on the floor

with designated distance, hold this side firmly with circular wood or plate and insert cross bamboos with designated distance.

23. Check Pattern

To weave this pattern, line 3 - 5 fine bamboos into one and with this make cross pattern. This is so called because of its pattern.

As variations of cross pattern, there are two-one pattern (Fig. 54), three-one pattern, diagonal pattern, diamond pattern, two diamond pattern, three diamond pattern and many other variants.

Fig. 53 Check Pattern

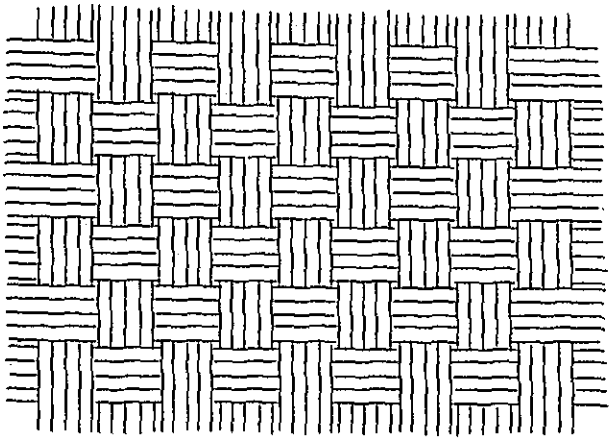


Fig. 54 Two-One Pattern

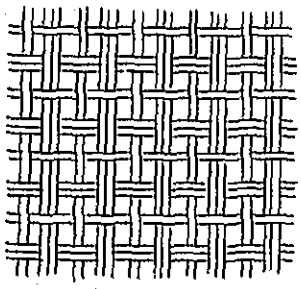
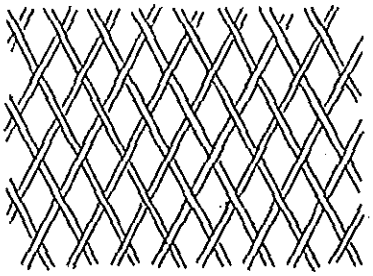


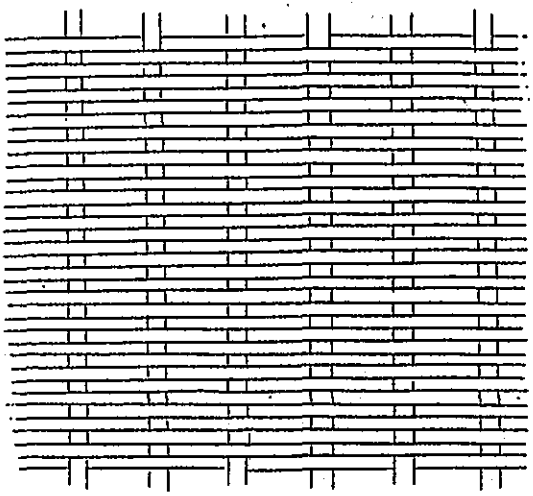
Fig. 55 Diamond Pattern



24. Mat Pattern (Kitchen-Basket Pattern)

This pattern is woven with strong or double lengthwise bamboo and tightly fit cross bamboos. This is often called kitchen-basket pattern and is applied for kitchen-baskets, fish-baskets, shopping-baskets, mats, etc. The name "mat pattern" is used for the ones in flat form.

Fig. 56 Mat Pattern



(Interweaving Method)

As in the case of cross pattern, lengthwise and cross bamboos are scooped alternatively, while if the number of lengthwise bamboos is even it is difficult to weave round patterns as in bottom or body interweaving (see Fig. 57 (a)). To prevent this two bamboos are inserted alternatively (Fig. 57 (b)), and inventions were made to reduce the number of lengthwise bamboos to odd. The following methods are generally used to change the number of lengthwise bamboos.

(1) To insert additional standing bamboo from the beginning in proper position. (Square bottom, cross bottom pattern)

(2) If double standing bamboo is used for bottom or body interweaving, divide it into two and increase the number.

(3) Interweave as usual for bottom and waist parts, and before entering into body part, choose strong standing bamboo, split it into two and weave with two lengthwise bamboos.

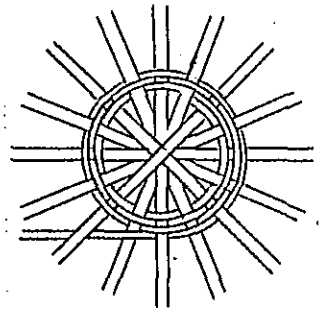
"Standing bamboo" In case of interweaving basket bottom with lengthwise and cross bamboos, their ends become rib bamboos and further reach to the edge. Such lengthwise or cross bamboos are called standing bamboos. (See paragraph 2, III, Section 1).

25. Chrysanthemum Pattern

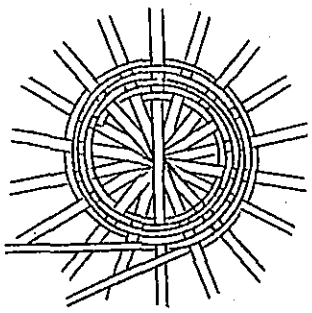
This is generally called chrysanthemum bottom pattern, and is applied for interweaving bottom of baskets, and often applied for lids of circular objects, too.

Fig. 57 Chrysanthemum Pattern

(a) Cross Kitchen-Basket Pattern



(b) True Chrysanthemum Bottom Pattern



Cross the designated number of standing bamboos at the center with their ends in radiant form, and interweave from the center. The central pattern of standing bamboos is divided into two: true chrysanthemum bottom pattern with standing bamboos crossed in right or left turn, and cross pattern with crosses of each two standing bamboos. The former is also named as folding fan pattern or twisted chrysanthemum pattern, while the latter is easier to form exact radiant shape if the number of standing bamboos is even. In each case, the standing bamboos shall be closely arranged. Whether the number of standing bamboos is even or not, the radiated ends become even, and mat pattern with

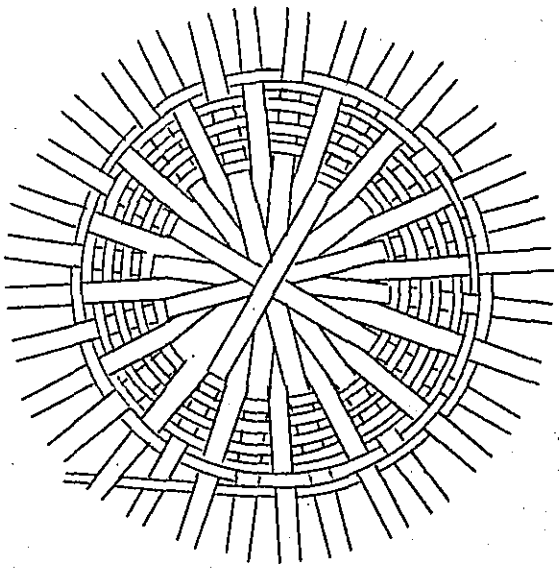
l weaving bamboo cannot be continued after the first round. To cover this, following methods are used:

(a) After every round, skip two standing bamboos.
(b) To weave with two weaving bamboos.

In the starting of chrysanthemum pattern, much skill is required. The center becomes sometimes too thick, endangering the weaving operation. In cross weaving, standing bamboos seldom break up, while in folding fan pattern they are likely to decompose. To save this, reinforcement ring is often inserted, which should be cut out by scissors after the pattern is well fixed. This bottom pattern is called moon bottom - or single moon bottom against double moon bottom to be discussed in the following paragraph.

26. Double Chrysanthemum Pattern

Fig. 58 Double Chrysanthemum Pattern



Single chrysanthemum pattern is suitable to weave small objects, while double chrysanthemum pattern with more standing bamboos is suited to objects with larger diameter. First, weave in chrysanthemum pattern with half of the whole standing

bamboos. After weaving for a while (generally 1 - 2 inches), cross the remaining standing bamboos on the center, inserting between the first standing bamboos. If the triangle crevices between the first standing bamboos and weaving bamboo are small, weaving bamboo must be cut off for the first one or two rounds. In this connection, it is recommended to make proper crevices for the second standing bamboos from the beginning. Double chrysanthemum pattern is woven in the same manner as in single chrysanthemum pattern, while various kinds of variations have been invented. Further, triple chrysanthemum pattern is applied for bigger baskets with standing bamboos two times as much as those of double pattern.

27. Dykes Pattern

This is effected with interweaving method of kitchen-basket pattern with one wide and strong bamboo and one fine and soft bamboo interwoven alternatively. The strong bamboo runs straight while soft bamboo waves as it goes over and under standing bamboos.

As the variations of this pattern, there are two dykes pattern and three dykes pattern with two or three strong parallel bamboos.

Fig. 59 Dykes Pattern
(Three Dykes Pattern)

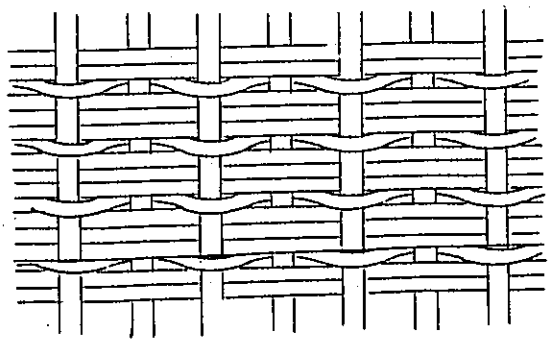


Fig. 60 Brick-Laying Pattern

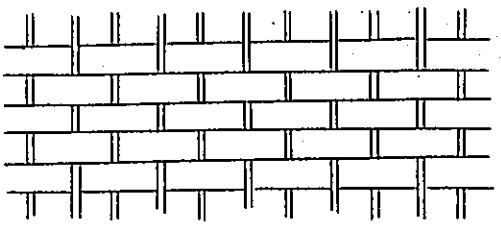


Fig. 61 X Pattern

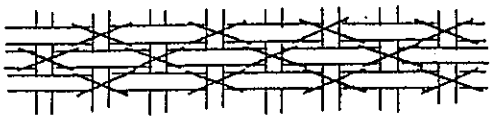
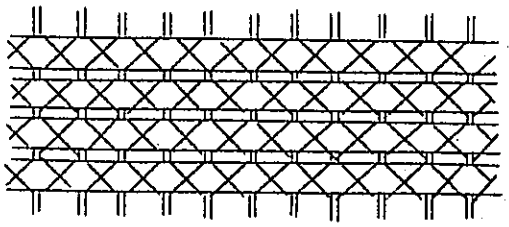


Fig. 62 Stone Fence Pattern



28. Brick-Laying Pattern

Brick-laying pattern is produced with fine standing bamboo and wide weaving bamboo.

29. X Pattern

This is the crude variation of kitchen-basket pattern with wide weaving bamboo and two extremely fine bamboo lines crossed in X shape. The X shall be shaped over the standing bamboos running over weaving cross bamboos.

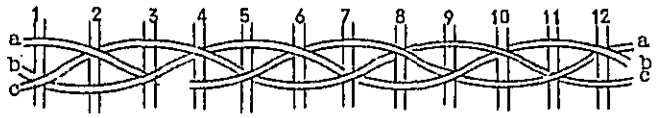
30. Stone Fence Weaving

Outside the lined standing bamboos, place wider bamboos and interweave with two extremely fine bamboo lines to cover the surface, forming stone fence pattern.

31. Wave Pattern

This pattern is applied for special type of flower baskets, and not for general practical use. The pattern has three-dimensional effects with wavy impression.

Fig. 63 Wave Pattern



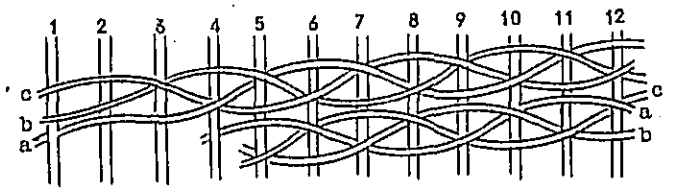
(Interweaving Method)

Insert weaving bamboo b inside the standing bamboo 1, over 2 and 3 and inside 4. c is inserted inside 2 and 5, and a inside 3 and 6. In this way, form wavy pattern alternatively going up and down, skipping two standing bamboos.

32. Pine Needle Pattern

This is exactly same as wave pattern, while, if the number of standing bamboos is odd, the pattern slips down by one standing bamboo in the second round, leaving pine needle-like pattern. If the number of standing bamboos is even, skip three standing bamboos after each round and continue to weave.

Fig. 64 Pine Needle Pattern



The pattern is applied for flower baskets, trays, etc.

Reverse Wave Pattern, Reverse Pine Needle Pattern

As in the case of rear cob-web pattern, these are the rear patterns of wave and pine needle patterns. Pattern becomes smaller and operations are harder than regular patterns.

33 Rope Pattern

Rope pattern is effected with 2, 3, 4 or 5 cross weaving bamboos, and is called three rope pattern or four rope pattern. Generally, three rope pattern is most commonly used. These are applied for flower baskets, waist decorations of general baskets, etc.

(Interweaving Method of Three Rope Pattern)

Insert weaving bamboo a inside standing bamboo 1, skip 2 and 3 and scoop 4. Insert b inside 2, skip 3 and 4 and scoop 5. Insert c inside 3 under a and b, skip 4 and 5 and scoop 6. Continue the weaving a, b and c, skipping two standing bamboos and scooping one.

(Four Rope Pattern)

Weave with 4 weaving bamboos as in the case of three rope pattern, skipping 3 standing bamboos and scooping one. Each of weaving bamboos a, b, c and d runs over the others, skipping three standing bamboos and scooping one. Another method is to have each weaving bamboo skipping two and scooping two. The pattern in this case has much similarity with three rope pattern. Five rope pattern is interwoven with 5 weaving bamboos, each skipping 3 and scooping 2 standing bamboos. If standing bamboos were lined closely and fine bamboo lines were used for weaving bamboos. The pattern will be of beautiful and elegant tastes.

Fig. 65 Rope Pattern (Three)

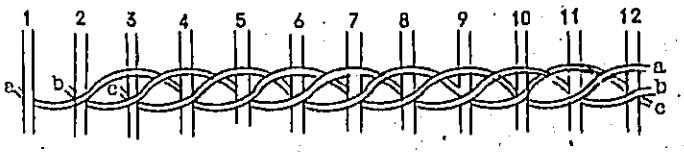
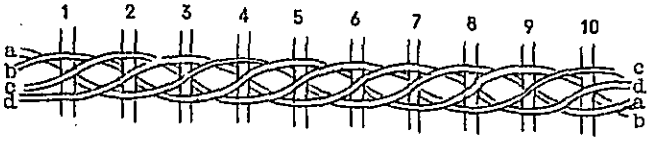


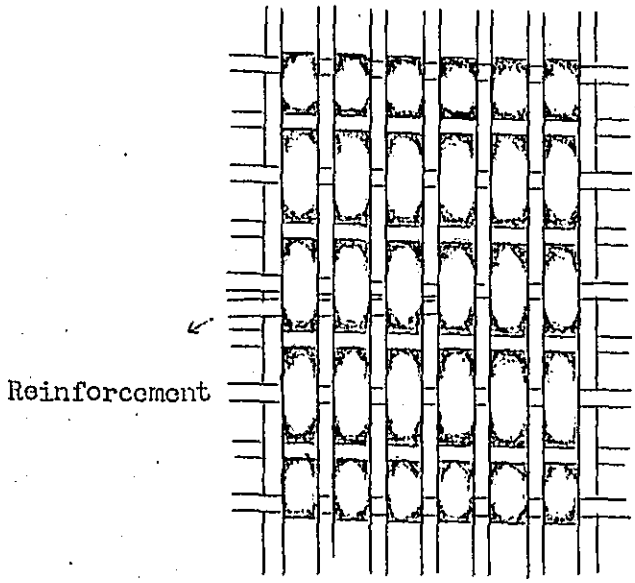
Fig. 66 Rope Pattern (Four)



34. Raft Pattern

Raft pattern is often applied for bottom weaving of a rectangular objects, and widely known and raft bottom. This is also used for lids of fish baskets.

Fig. 67 Raft Pattern



(Interweaving Method)

This is the application of cross pattern, with wider blinding bamboos covering the crevices. Lengthwise and cross weaving bamboos are generally in odd numbers.

First, line 5 bamboos in sequence of weaving bamboo, bottom applying bamboo, weaving bamboo.

Next, insert cross weaving bamboo under three lengthwise bamboos and over two bottom applying bamboos. Next cross bamboo shall be inserted over lengthwise bamboos and under bottom applying bamboos and continue to weave with other cross bamboos alternatively running up and down - 9 bamboos in all. Two cross bamboos at both ends must be under bottom applying bamboos.

Further, rearrange the bottom applying bamboos. The number of bamboos is determined by the width and length desired and the width of weaving bamboos.

35. Random Pattern

This is not the pattern with fixed rules, but the pattern with free idea and weaving operations. At first sight, it may look a pattern woven at random - and that's why it is called "random pattern". Actually, it must be interwoven with simple but harmonious tone, and is very hard to enter and harder to proceed. The pattern is often applied for fan settler, various types of interior decorations, shallow trays, electric lamp shades, flower baskets, etc.

(Interweaving Method)

Make irregular polygonal pattern at the center, and develop the pattern from free angle in double hexagonal pattern or octagonal pattern. Interweave firmly.

Various types of decorative bamboos are inserted into waist part of flower basket for artistic effects. Most of these are applied for the baskets in hexagonal or cross pattern. As these are not very important from practical points of view, we shall see here only the types and names of them:

(1) Herring-bone pattern
(2) Random inserting
(3) Armor inserting
(4) Lengthwise inserting
(5) Wave type
(6) Pine needle type

III. Nomenclature of Materials for Interweaving Manufacturing

The materials used for interweaving kitchen-baskets, baskets, etc. have different nomenclatures from their forms and purposes. In the preceding Fundamental Method of

Interweaving, we have referred only to lengthwise or cross interweaving bamboos. Here we shall have general nomenclatures for necessary materials.

(1) Flesh bamboo, skin bamboo. Split bamboo is reeled in several layers to become materials. Inner layers are too weak and only skin bamboo and two flesh bamboos directly under skin (called under skin bamboo) are utilized. In most cases, products were made of one skin bamboo and two flesh bamboos (called skin-flesh three). In some cases, 5 - 6 layers may be reeled but have no artistic value. They are not used except in the case of long jointed bamboo.

(2) Standing bamboo. The bamboo starting from bottom weaving and reaching to the edge through body part of kitchen-baskets or general baskets. Also called rib bamboo.

(3) Spatular bamboo, fine bamboo line. Thinly reeled wide split bamboo is called spatular bamboo. Fine, circular bamboo like ribs in paper lantern is called bamboo line, while this is often called circular bamboo line or drawn bamboo line.

(4) Side turning bamboo. The bamboo weaving bottom and body part through standing bamboo. Bottom turning bamboo is the one for bottom weaving. Side turning bamboo is usually long — mostly 9 - 12 ft. or 15 - 16 ft.

(5) Seven-and-half turn bamboo. To weave circular body for rectangular netting bottom, bottom turning bamboo wider and thinner than standing bamboo should be used. This is so called because, after 7 and half turns around bottom, waist weaving will be completed.

(6) Rectangular bamboo line. The bamboo line with rectangular section is used for waist weaving. Usually stronger one than standing bamboo is needed for waist weaving, while wider bamboo is hard to bend, and rectangular bamboo line (2.5 bu wide and 2 bu thick) is used. This is also utilized for weaving of industrial arts objects with friangular or half-circular bamboo lines.

(7) Reinforcing bamboo, temporary reinforcing bamboo These are inserted in cross or projected parallels at the bottom to maintain the form. If inserted temporary, it is

called temporary reinforcing bamboo. If more firmness is needed, reinforcing bamboo is turned from bottom to edge and inserted inside the weaving bamboo. The bending methods are through burining or inside reeling. No joint shall be found on the part to be bent.

(Stopping of reinforcing bamboo)

a. Reel the top finely and insert it into weaving bamboo. — bottom inserting reinforcing bamboo.

b. Make a hole at the top of reinforcing bamboo, turn the edge and tie it with ratten or thin wires — shopping baskets.

c. Turn the edge, bend to inside and tie up at two points with thin wire.

The reinforcing bamboo is called bottom applying bamboo, waist applying bamboo or pillar applying bamboo depending on the part to be applied.

(8) Under-edge bamboo. The uppermost weaving bamboo in body weaving which comes under edge when edge is finished. To finish the edge firmly, strong bamboo or fine bamboo lines woven in rope pattern are often used. Also called "edge core".

(9) Edge applying bamboo. When finishing coiled edge, this bamboo is applied both inside and outside the edge. Flesh bamboo is used in most cases. Preparation is same as in the case of edge bamboo.

(10) Edge bamboo (edge ring bamboo). Hold standing bamboos with edge bamboos which are applied inside and outside the edge, making the bound edge. Skin bamboo is used for outside, and flesh bamboo for inside ring. If skin bamboo is used for inside, skin must be turned inward. (For preparation, see edge preparation.)

(11) Looking bamboo (fine edge bamboo). When binding the edge with thin wires or ratten, this bamboo is inserted between inside edge and outside edge, bound with edge bamboo, to finish the edge surface finely. The width of the bamboo depends upon the mode of binding standing bamboo and the size of baskets, but usually bamboos of 5 - 1 bu straightly split are used.

(12) Blinding bamboo. To cover larger crevices in cross or hexagonal patterns, this is inserted. (See, hexagonal pattern.)

(13) Edge binding bamboo. (Edge binder or binding bamboo) This is the bamboo used for finishing bound edge. Soft bamboo thinly reeled is used for its flexibility. Root bending bamboo, female bamboo of one year old are mostly used.

(14) Arm bamboo, leg bamboo. Used for arms or legs of baskets.

(15) Inserting bamboo. For reinforcing or artistic purposes, special bamboos with tops finely cut are used by inserting into weaving bamboos.

Section II. Edge Finishing (Edge Preparation)

Edge preparation is the general finishing operation for practical baskets, and important to make strong items. Many of the bamboo wares for practical use are often broken up. This is the most important process to determine the practical value of commodities.

I. Edge fastening

Edge preparation is effected after bottom weaving, waist weaving and body weaving are finished. Standing bamboos must be fastened not to make the edge loose. This processing is called edge fastening, edge taking or edge folding.

1. Fastening for basket pattern

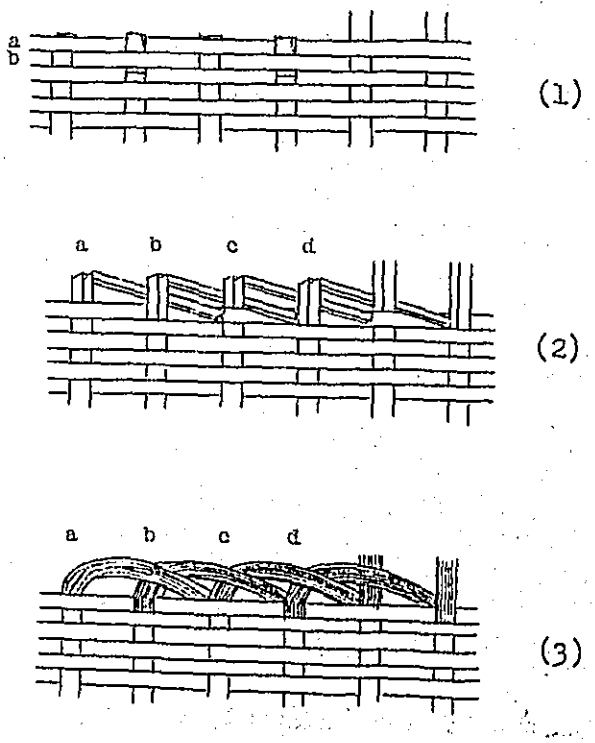
(1) Fold every other standing bamboo from under-edge bamboo (a) and hold it by weaving bamboo b. The other half of the standing bamboos are cut along the edge of a.((1) of Fig. 68)

(2) Split the top of the standing bamboos into two, fold it inwardly, pass inside the neighboring standing bamboo, and fasten outside the second neighboring bamboo, cutting off

the remaining part. Or fold the standing bamboo outwardly and fasten in the same manner. The former is called in-folding and the latter out-folding, widely used for daily bamboo wares. The height of the folded bamboo should be as low as possible.

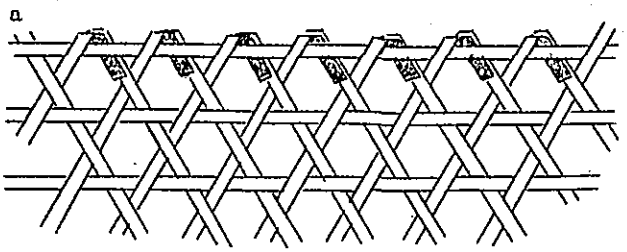
(3) When making large size baskets or edges especially strong, split standing bamboo into several lines and interwoven and fastened as shown in Fig. 68. (3). The tops are inserted inside the second neighboring standing bamboos and the remaining parts are cut off. The standing bamboos must be fastened in such way that the finishing edges are perfect in their solidness and appearance. If standing bamboos are excessively wide and no strong edges are needed, cut 1/2 or 1/3 of the width at the height of edge, and fold and fasten the remaining part.

Fig. 68 Fastening for basket pattern



2. Fastening for hexagonal pattern

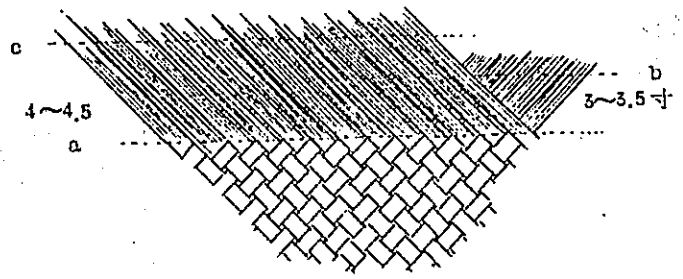
Fig. 69 Fastening for hexagonal pattern



To fasten the standing bamboo for hexagonal pattern, fold the weaving bamboo outside under-edge bamboo a inwardly, insert between under-edge bamboo and standing bamboo and fasten. The tops of inside standing bamboos must be cut off along the edge of under-edge bamboos.

3. Fastening for cross pattern

Fig. 70 Fastening for cross pattern



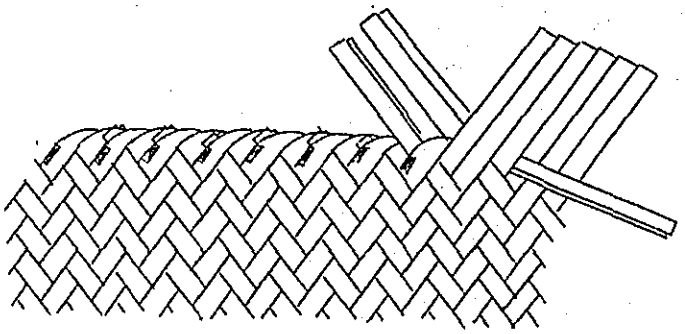
In cross pattern, as in netting pattern, lengthwise and cross weaving bamboos are crossed diagonally, and edges may be prepared by cutting of the remaining parts. Edges will be finished stronger, when the bamboos running upper left are turned outwardly, split finely down to the line a and folded.

4. Fastening for netting pattern

Fastening may be performed in the same way as in cross pattern, but if interwoven as shown in Fig. 71, the edges will be stronger. Cut the bamboo running upper right after skipping

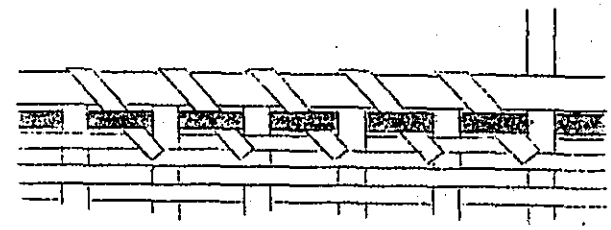
three bamboos to the right and cut off others at the height of edge.

Fig. 71 Fastening for notting pattern

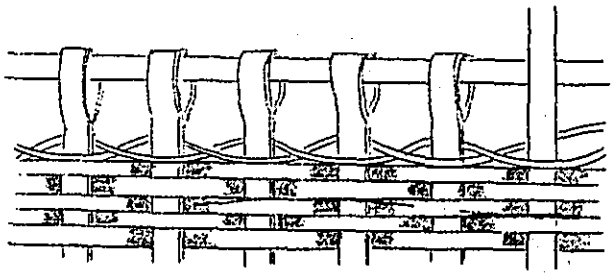


5. Fastening with edge-core bamboo

Fig. 72 Fastening with edge-core bamboo



(1)



(2)

(1) Apply strong edge-core bamboo outside the standing bamboo, fold standing bamboos around it, hold the tops by side-turning bamboo (b) and fasten. Strong edges are prepared with the aid of edge-core bamboo.

(2) Apply edge-core bamboo inside the standing bamboos, fold the standing bamboos around it, and fastened with bamboos (b) woven in two-rope pattern. This fastening leaves crevices between body weaving and edge-core bamboo, facilitating the edge binding process. This is the strongest fastening.

II. Edge Preparation

Edge preparation is classified into the following three:

a. Associating edge. No special bamboo for edge preparation is used, and standing bamboo is used for preparing edges. Edges are finished concurrently with the fastening of standing bamboos. Also called uniting edge.

b. Binding edge. Edge-ring bamboos are applied and bound with thin wires or rattan.

c. Winding edge. Edge applying bamboos are applied and wound with edge-winding bamboo or rattan.

There are some other method of artistic edge finishing, but we shall see here the commonest methods with practical finishing.

1. Associating edge, double associating edge

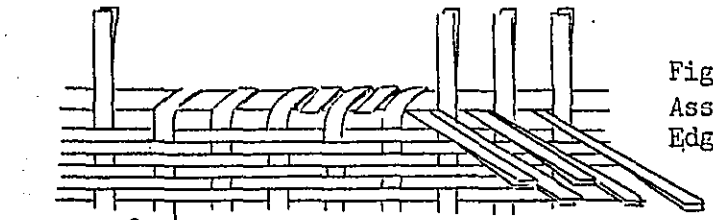


Fig. 73
Associating Edge

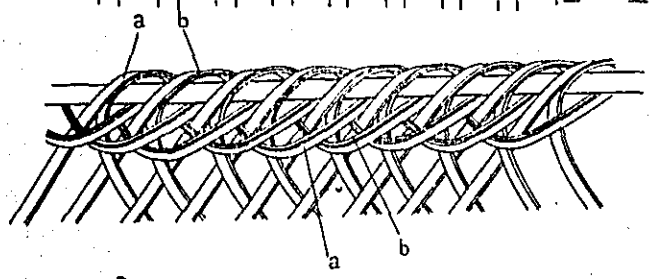


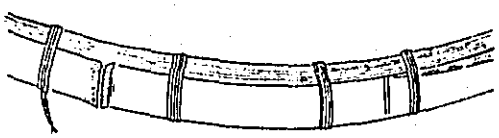
Fig. 74
Double Associating Edge

Reel standing bamboo into two or three layers, apply the edge-core bamboo 3 - 5 bu smaller than diameter of the basket inside the object, wind the standing bamboo around edge-core, skip two neighboring standing bamboos and insert under the edge-core between second and third bamboos. Continue to weave for a whole round. Wind all standing bamboos around the edge-core in the same way. If three bamboos are skipped in the second round, stronger edge will be prepared. In the case of diagonal standing bamboos for cross or hexagonal patterns, unite two bamboos into one at the crossing of standing bamboos and weave in the same manner. In preparing flower baskets and other artistic objects, double edges may be made. This is mostly applied for flower baskets of hexagonal pattern. To facilitate the operation in edge preparation, the tops of standing bamboos are reeled usually into two or three layers.

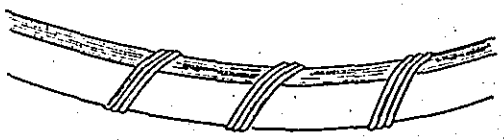
2. Binding edge

Fig. 75 Binding Edge (1)

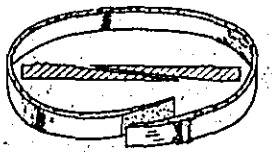
(1) Wire binding edge



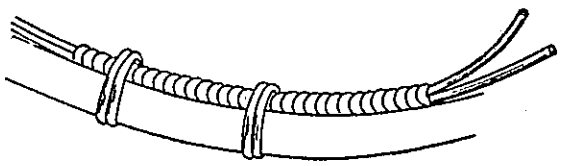
(2) Rattan winding



(3) Edge bamboo



(4) Core winding edge rattan binding edge



The preparation of edge ring and width and thickness of edge bamboos vary according to the kinds of baskets. To prepare, cut skin part for inside end and flesh part for outside end in the shape of edge. Bind the ring and adjust the shape (Fig. 75 (3)). Apply two edge rings for binding edge, insert looking bamboo for fine finishing. The following method is used for binding:

(1) Wind 2 - 3 times at one point with wire (No.20 - 22), twist it under the edge, cut the top and insert into the edge bamboo. (Fig. 75 (1))

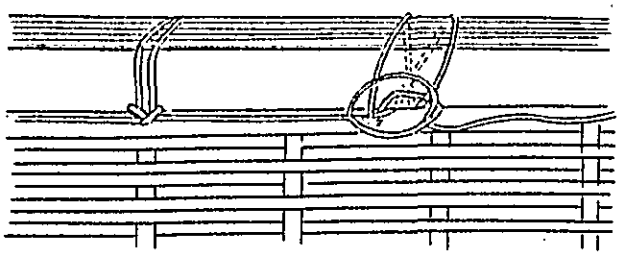
(2) Wind 1 - 2 times at one point with wire or rattan, continue to wind in the same way without cutting. (Fig. 75 (2))

(3) Insert circular bamboo lines between inner and outer edges, wind it with rattan and bind edge bamboo at designated intervals. This is applied for flower baskets of artistic use. Commonly known as core winding edge. (Fig. 75 (4))

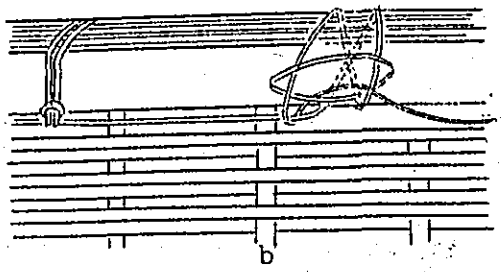
(4) Bind with rattan or other strong materials and continue to bind without cutting. Usually tied up as shown in Fig. 76 (a) or (b).

Fig. 76 Binding edge (2)

a



b. Rattan tying



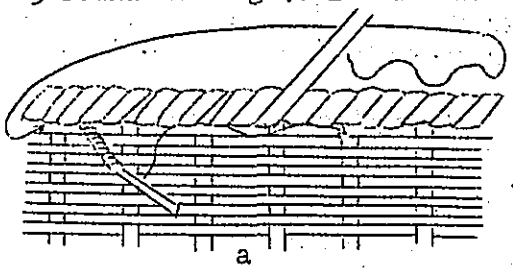
a. Insert the line from left under the edge, wind around edge bamboo for one round, insert into the same place and wind another round. Rear side of edge bamboo is in X pattern (shown in dotted line.). Further, insert the end of this line to inside the line from the right, firmly bind, insert left line again through newly formed ring and make a tie. Extend the line to right and make next tie.

b. Insert two times as in case of a, bind with two lengthwise lines and tie.

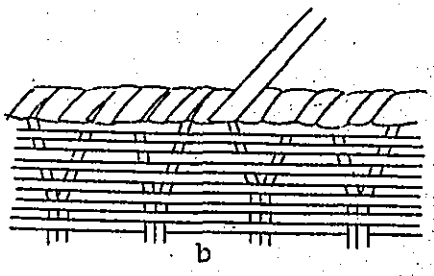
3. Winding edge

Fig. 77

a. 3 round winding (twist and fasten)



b. 2 round winding (two-lined standing bamboo)



Apply edge applying bamboo as edge bamboo in case of binding edge, and continue to wind with edge winding bamboo. Various winding methods are applied for appearance and use of each products. As in case of associating edge or binding edge, this is not final and various inventions are recommended.

Usually, winding edge is effected from inside to outside, winding in right turn and fasten at the top. This is widely used for baskets of practical use.

(1) Single winding, double winding.

The most common way is to wind with edge winding bamboo lined closely or loosely, or to wind each one round or skipping 1 or 2. Sometimes, 5 - 6 rounds winding is effected.

Double winding is effected with upper winding over the first winding. Upper winding is effected usually from outside to inside in left turn and crosswise over lower winding. 2 - 3 rounds winding of flesh bamboo is common for lower winding, and 1 - 2 rounds loose winding of skin bamboo for upper winding.

To fasten edge winding bamboo, insert into weaving bamboo with standing bamboo, or wind 2 - 3 times around under-edge bamboo, or wind under-edge standing bamboo and fasten. In finishing, twist edge winding bamboo and insert into weaving bamboo over standing bamboo, or twist the top and insert two or three times through standing bamboo. If edge winding bamboo is exhausted in the way, fasten the top and start new winding, or wind new bamboo around the exhausted bamboo and continue to weave.

(2) Double applying edge.

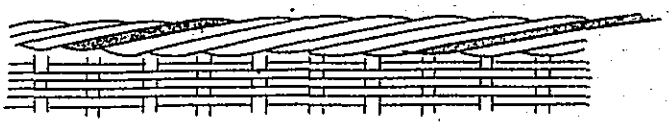
For stronger edge, effect under-winding, apply another edge applying bamboo and finish upper winding.

(3) Chinese Winding.

Fine edge will be prepared by winding fine bamboo in right turn, skipping 7 - 9 standing bamboos. In starting the winding, insert into edge from under, and in finishing, draw from inside, insert into the edge and fasten.

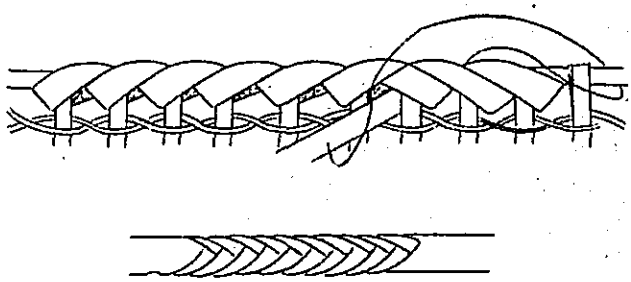
To have constant number of skipped standing bamboos and effect fine finishing, use 7 - 9 standing bamboos, insert one each into standing bamboos and skip the standing bamboos by the number of winding bamboos.

Fig. 78 Chinese winding edge (7 skipping)



4. Cornice winding edge

Fig. 79 Cornice winding edge



This is more beautiful and artistic edge finishing than Chinese winding, and widely used for practical purpose because of its strong edge preparation. This is mostly used for netting pattern and cross or hexagonal patterns, and sometimes for kitchen basket pattern with metal spatula and other implements. For winding bamboo, thinly reeled soft bamboo is used to skip 4 - 5 standing bamboos and to return by 3 - 4 bamboos.

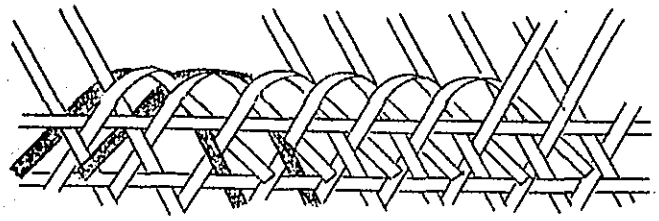
To wind, first insert one end into the edge with winding edge and fasten. Skip 4 standing bamboos and draw outward between 4th and 5th bamboos, return the top, wind standing ba bamboo 4 and under-edge bamboo and draw out from between standing bamboos 1 and 2.

Continue in this way by proceeding 1 bamboo. To finish winding, insert into body weaving and fasten as in the case of winding edge. For artistic finishing, effect harmonious processing in width and angle of the pattern, watching carefully

the width of edge winding bamboo and skipping width. (Fig. 79)

5. Netting bending edge

Fig. 80 Netting bending edge

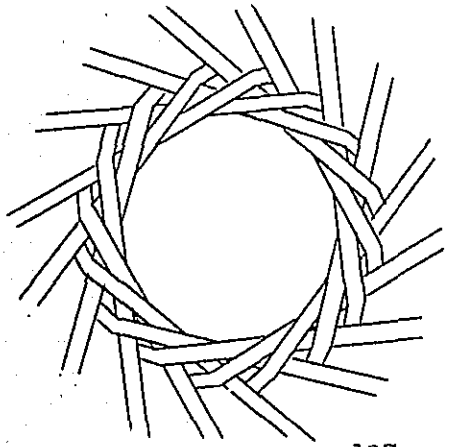


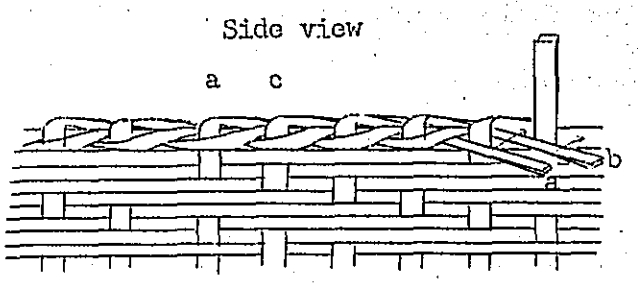
This is a veriation of associating edge and used for edges of baskets in cross or hexagonal patterns. Draw the standing bamboo outside the topmost side-turning bamboo (the one running to upper right) through other standing bamboos inside two standing bamboos at right and take out. The inner standing bamboo is drawn out through inside the two standing bamboos at left. As the upper surface of the edge is woven in netting pattern, this is called netting bending pattern. 3 - 4 skipping bending is also applied.

6. Folding edge

Fold the standing bamboo inwardly, skip 2 - 6 and draw out. When woven for a whole round, the top will make radiant form.

Fig. 81 Folding edge (3 skipping 1 passing)

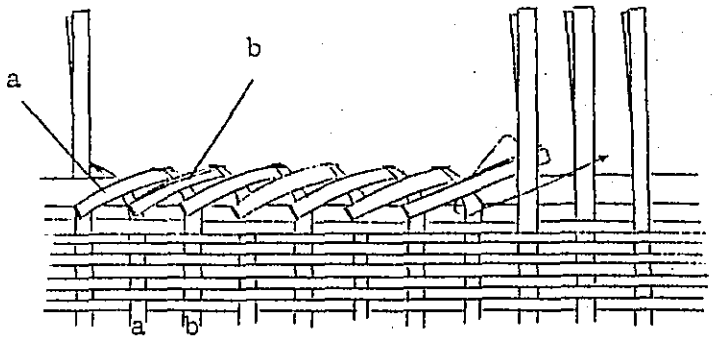




The drawn-out top is inserted between standing bamboos, skipping 1 - 3 standing bamboos, and the remaining parts are cut off. Another way is to make crevices between edge and body (with higher edge) and to weave in rope pattern with another bamboo. In case of diagonal standing for cross, hexagonal or netting patterns, double folding edge may be effected inside and outside.

7. Lobster fastening

Fig. 82 Lobster fastening



Apply edge-core bamboo, turn left standing bamboo from inside to outside, insert inside the right standing bamboo and edge and fasten. If too long end, draw out between 2nd - 4th bamboos, skip 1 - 2, insert inside under-edge and fasten.

8. Other Edge Preparation

Many other preparation methods are important from artistic points of view:

(a) Rectangular edge with edge applying bamboos bent by burning in rectangular or polygonal forms or in ring.

(b) Wavy edge with thick wire (Nos. 8 - 9) formed in various curving lines.

(c) Tying edge with various kinds of tyings for edge finishing. For fastening of edge winding bamboos, there are many variations, while most of them are important in industrial arts, and more study and inventions in this fields should be contrived for practical firmness and beauty.

III. Installing of Arm Bamboo

Arm bamboos for bamboo baskets vary from simple objects like vegetable baskets to artistic objects like flower baskets. Here we shall deal with the installing of common arm bamboo.

(1) Flat arm bamboo for vegetable baskets, carrying baskets, etc.

Plane the split bamboos with desired width, thickness, length, cut thinly both ends and sharpen. Insert this from outside the edgering into weaving bamboo along the central standing bamboo, make gimlet hole through arm bamboo and edge bamboo at edge ring, fasten with nail, bend inside the edge and finish.

(2) Arm bamboo for shopping baskets

Arm bamboos for this kind of baskets must be strong to bear considerable weight. Make long arm bamboo, turn to basket bottom, pile both ends at the ends and fasten with wires. In body weaving, insert along standing bamboo and fasten with weaving bamboo.

If wide and thick split bamboo is used, cut thinly the inner side of the part to be bent from body to bottom, and for piling at the bottom, cut thinly both ends, effecting even thickness. The part to be turned outward in piling must be with skin. If cutting-in were made for wire binding, the arm will be perfectly fastened.

(3) Arm for fruit baskets

For apple baskets or orange baskets of cross or hexagonal patterns, divide standing bamboo into two parts, unite the top of each end, bind at 2 or 3 points with wire.

(4) Arm bamboo for circular hand baskets.

Two arm bamboos are used at the symmetrical positions with one end tied up with edge and standing bamboos and another end in body weaving. The central part, where two arm bamboos come together, is wound by edge winding bamboo into one.

(5) Arm bamboo for flower baskets and other artistic objects.

This method is not applicable for practical purpose, and we must deal with it briefly.

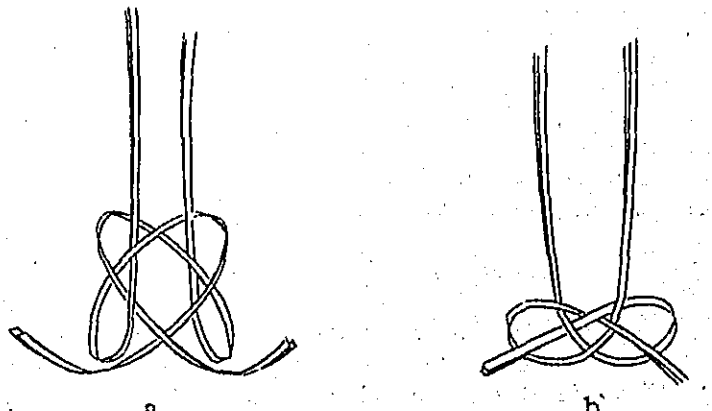
- o Twisted arm: Two arm bamboos are used with central part twisted 2 - 3 times into one, and both ends are inserted into body weaving. For actual installing, insert one end into basket, twist at central part, and insert another end into the opposite side.

- o Core winding arm: Cross two bamboos diagonally and insert into basket. Wind with thin edge winding bamboo.

- o Rope pattern arm: Reel arm bamboo into 4 thin layers, pass under the edge and twist but 1/3 of the whole length. Pass the other 1/3 under opposite edge and twist. Make three rope pattern with the former. The top is inserted into basket and fasten.

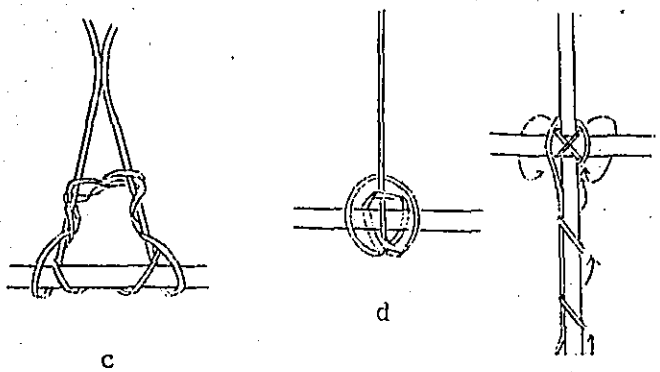
IV. Decorative Tie and Decorative Winding

Fig. 83 Decoration Tie (1)



a b

Fig. 84 Decoration Tie (2)



In the manufacture of bamboo wares, various types of ties are effected on weaving bamboos, on fastening arm bamboos, or handgrips for decorative purpose. This is mostly applied for flower baskets and other decorative objects, and seldom for practical objects. But if skilled in making, little time is needed to finish wonderful decorations, and more inventions and improvements are expected in this field. Various methods have been widely used in decorative tie and decorative winding from earlier times, and some of rattan manufacturing method are also applicable.

1. Decorative Tie on Arm Bamboo

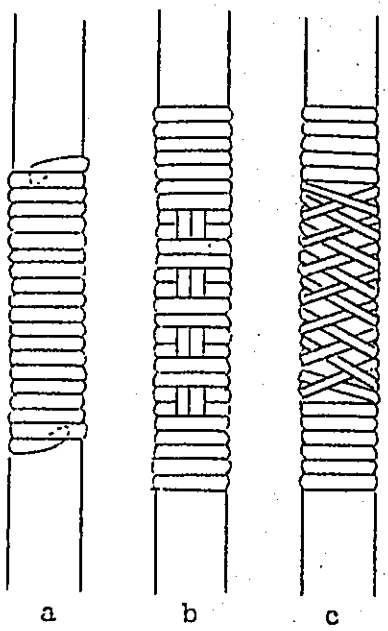
a. Koman tie (Koman: Buddhist decoration)

b. Awaji tie (Awaji: Name of the place)

Both are used for tie-fastening of arm bamboos. Reel the tops of two arm bamboos into 2 - 4 layers for easy tying, wind around edge of the basket, and tie. The end is inserted under edge or into body weaving.

2. Decorative winding

Fig. 85 Decorative Winding Bamboo



a. Plain winding
b. Lined winding
c. Patterned winding

All of these are used for handgrips, edge winding, etc. of various bamboo wares. There are many variations in patterned winding. As already described, cornice winding is a type of decorative winding, and many other patterns like check pattern, twirl wind pattern, etc. are widely applied.

CHAPTER VIII. MANAGEMENT OF MANUFACTURING FACTORIES & PRACTICAL BAMBOO MANUFACTURING

Section I. Management of Bamboo Ware Factories

Bamboo manufacturing in agrarian districts has been prospering with the increase in export of bamboo wares, and manufacturing operations are toward co-operative management, together with bamboo cultivation. The reason of dull operation of bamboo manufacturing in agrarian districts has been its small-scaled management, which cannot fill the massive demand of vegetable and carrying baskets. In the field of export bamboo wares, too, side-job manufacturing in agrarian districts with no substantial program on date due or quantity could not respond the order, and the promotion of this enterprise must be started from co-operative management. The following are the examples of management on co-operative basis:

o Bamboo Ware Manufacturing as Side Job in Tochigi Prefecture

1. Organization

Union is formed with all farmer homes engaged and operation is effected by division of labor.

a. Co-operative factories. Acceptance of bamboo materials, splitting, bamboo reeling and other fundamental processing. Distribution of materials, selling of products.

b. Member home. Makes products.

c. For special types of processing like dyeing, half-made products are collected in co-operation factories for final preparation, unification of standards and co-operative sales.

2. Co-operative factories

a. One-storied house: 70 tsubo (20 tsubo wooden floor and 10 tsubo concrete floor)

b. Ground: 100 tsubo (including bamboo sterage ground)

c. Mechanical equipments: 1 electric motor (2 - 3 horse power), 1 circular saw, 1 bamboo splitter, two bamboo reelers, and various types of other implements (for 10 operational workers).

Equipments to be installed for second period: (bamboo burning furnace, dying kettle, 4 weaving machines for bamboo curtain).

d. General outline of operation:

(1)	Total production:	7 million yen
(2)	Net profit:	550,000 yen (40% of which should exempted for machinery redemption and public taxation.)
(3)	Operative fund:	700,000 - 800,000 yen for three turns a month.
(4)	Equipment cost:	350,000 - 400,000 yen.

e. Labor allotment. Objects of industrial arts and practical home use are allotted to skilled workmen at home, and objects of mass production and simpler products (vegetable baskets, export bread baskets, etc.) are made by apprentice workmen.

o Bamboo factory in Tokyo

1. Facilities

a. One-storied house: 15 tsubo (wooden floor)

b. Warehouse: 8 tsubo (no floor)

c. Ground: 100 tsubo including bamboo drying ground

d. Mechanical equipments: 1 electric motor (1/2 horse power), automatic sen (with two-sen, cutting on both sides), 10 bamboo splitters (2 each of 2-, 3-, 4-, 5- and 6- splitters) and various types of other implements.

2. Estimated revenue and expenditures for operation (1953).

a. Expenditures

Materials

Female bamboos	820 bundles	@ 85 yen	69,700 yen
Long-jointed bamboos	100 "	@ 240 yen	24,000 yen
Charcoal (for burn bending)	18 bags	@ 450 yen	8,000 yen
Machines repair; oils, etc.			5,100 yen

Personnel expenditures

Permanent workers	4 men @ 86,000 yen	344,000 yen
Temporary workers	3 women @ 24,000 yen	72,000 yen
	Total:	522,800 yen

b. Receipts

Proceeds of products

Waste baskets in set	6,000 sets	@ 90 yen	540,000 yen
Charcoal container	3,000 "	@ 40 "	120,000 yen
Other products			15,000 yen
	Total:		675,000 yen

c. Direct profit 152,200 yen

(indirect operational cost, taxation exempted)

3. Material data (Female bamboo - 1 bundle: 2 shaku circumference, 150 bamboos)

Thickness of Bamboo in a bundle (Circumference)	Quantity Entered		Split	Finished Material Bamboo	
	Percentage	Quantity		Width	Number
1 sun bamboo	25%	38	4-split	2.2 bu	152
1.2 sun bamboo	15	22	5- "	2.2 bu	110
8-1 sun "	30	45	4-5- "	1.7-1.8bu	200
6-7 bu bamboo	10	15	4- "	1.3-1.4bu	60
5-6 bu bamboo	20	30	5- "	0.9 bu	150

In case of mechanical splitting, materials of under-quality cause reduction in quantity of about 10%. 600 bamboos of 6-shaku for materials are obtained from one bundle. (in the case of chrysanthemum bottom waste-paper baskets materials.)

Section II. Manufacture of Bamboo Wares

I. Composition of Bamboo Wares

General bamboo wares like kitchen-baskets, baskets, etc. are completed with materials prepared for each purpose. The manufacturing process is usually as follows:

a. Bottom composing

Weaving standing bamboo to form bottom.
Cross pattern bottom, raft pattern bottom (rectangular), hexagonal bottom, netting bottom, chrysanthemum bottom, etc.

b. Waist weaving

This is the transition process from bottom weaving to body weaving with bending operation on standing bamboos. To bend standing bamboos, soft bamboos may be bent by hand, but harder standing bamboos are bent by burning or moulding or dipping methods.

c. Body weaving

Body weaving can be effected with standing bamboos only in case of objects with cross, hexagonal or netting bottom, but usually side-turning bamboo is used.

d. Edge finishing

Winding edge is widely used for kitchen baskets, arm baskets, charcoal carrier, etc., binding edge is for fish baskets, circular baskets, etc., and uniting edge for waste baskets. Cornice winding is for stronger purpose; Chinese winding for artistic purpose.

The manufacturing process should not necessarily be in this order, and sometimes edges are prepared first, and, then, body weaving and bottom weaving are effected. In some other products (circular baskets, flower baskets, etc.) there is no demarkation between bottom weaving and body weaving.

II. Practical Bamboo Manufacturing

1. Chrysanthemum waste-paper baskets

(1) Material (Female bamboo - long-jointed bamboo for edge applying bamboo, 2 layer reeling)

	Length	Width	Thick-ness	Quantity		
				Total	Large	Small
	shaku	bu	bu			
Standing bamboo	6	1.7-1.8	0.3	11	6	5
Increasing bamboo	6	1.7-1.8	0.3	9	5	4
Side-turning bamboo	6	2.2	0.2	35	20	15
Bottom weaving "	5	1.3-1.4	0.2	8	4.5	3.4
Rope pattern weaving	5	0.9	0.5	14	8	6
Edge winding bamboo	6	1.7-1.8		12	6.5	5.5
Edge applying bamboo (large)	2.7	2.5				
" (small)	2.35	2.5				

(2) Bottom weaving

Cut standing bamboo by 3 shaku (2.7 shaku for smaller ones) and interweave 12 bamboos (10 for smaller) into chrysanthemum bottom pattern of 6.4 sun in diameter (5.5 for smaller).

(3) Waist weaving

Bend standing bamboo by burning, and weave three times in 4 rope pattern.

(4) Increasing

Insert 24 increasing bamboos of 1.1 shaku (20 of 1.02 for smaller) at intermediate positions between standing bamboos. The number of standing bamboos will double at the body part (single chrysanthemum at bottom).

(5) Body weaving

Insert side turning bamboo over 1 standing bamboo and under 3 standing bamboos (1-3), and effect special pattern as shown in Figure at desired parts. Finally, weave 1 round in 3 rope pattern, making the height of body to 9.5 sun (9 sun for smaller). (For fundamental weaving, see 17. 12).

(6) Edge preparation

Weave two rounds of two rope pattern under edge and fasten standing bamboos. To fasten, effect outward bending on every other or every third standing bamboo, and cut the others along the edge. Edge will be woven in cornice winding.

(7) Dying and finishing

Material bamboos must be cut by sen on central part of the skin by 1/3 of the width. When dyed in brown or dark brown, beautiful striped pattern will be given.

Fig. 86 Chrysanthemum Bottom Waste Paper Basket

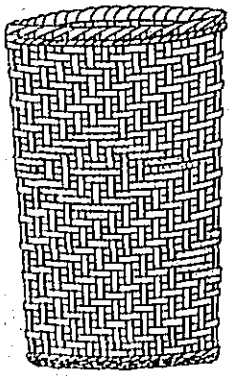
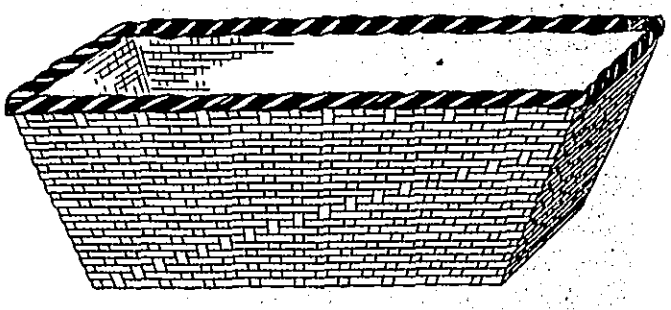


Fig. 87 Rectangular Kitchen Basket



Finishing Measurements (in bu)			
	Height	Edge Diameter	Bottom Diameter
Larger	102	78	67
Smaller	97	68	55

2. Rectangular Kitchen Basket

(1) Material (Female bamboo - Long-jointed bamboo for edge applying bamboo)

	Length (in bu)	Width (in bu)	Thickness (in bu)	Number
Standing bamboo	135	1.5	0.25	38
Side turning bamboo	650	0.5	0.2	20
Outer edge applying bamboo	340	2	0.4	1
Inner edge applying bamboo	330	2	1	1
Under edge bamboo	650	0.3	0.3	4
Edge winding bamboo	650	1.5	0.15	6

(2) Bottom weaving

Weave cross pattern bottom with 19 bamboos each in lengthwise and across. 62 square bu at bottom.

(3) Waist weaving

Choose rather thick turning bamboos for the first round and weave in loose kitchen basket pattern. Bend standing bamboos by hand and weave waist.

(4) Body weaving

From the second round, scoop 2 bamboos and continue kitchen basket pattern. At every round, open the standing bamboos bit by bit. Insert rectangular bamboo lines in two rope pattern under edge and faston. Weave rectangular form of 250 bu at bottom circumference and 310 at edge.

(5) Edge preparation

Bend outwardly every third standing bamboo, and cut the others at the height of edge. Apply edge applying bamboos

both inside and outside, effecting double winding edge. The product is used for home basket.

3. Dharma type waste basket (Simple processing)

(1) Material Long-jointed bamboo

	Length	Width	Thickness	Number
	(in bu)	(in bu)	(in bu)	
Standing bamboo	215	2	0.25-0.3	56
Bottom outer ring	200	4	0.5-0.6	1
Bottom inner ring	200	4	1.5	1
Bottom circular plate	51	3	1	1

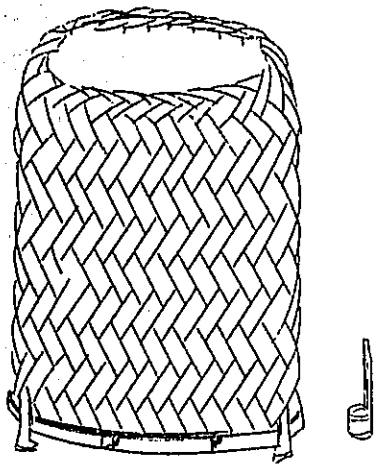
(2) Edge preparation and body weaving

Weave separate single moon ring pattern by 28 each of skin and flesh bamboos. Pile these two and make double moon pattern as shown in Fig. 38. To combine, pile skin bamboos above and flesh bamboos under with each bamboo slightly slipped. Insert alternatively each skin and flesh bamboo. When finished, bend standing bamboo inwardly and weave in 2 skipping netting pattern.

(3) Bottom weaving.

Insert bottom circular plate into body weaving in advance. For bottom plate and bottom inner ring, use waste materials of skin and flesh bamboos. Skin bamboo is used for bottom outer ring, put this into body and cut standing bamboo along the ring. Apply bottom inner ring, bind at 6 points by copper wire through body and bottom plate, cut the remaining parts and insert the ends into inner ring. For better finishing, effect joining winding by rattan. Leg bamboos as shown in Figure may be installed.

Fig. 88 Dharma type waste basket



Leg bamboo

(4) Material and Production Efficiency

a. From material bamboo of 650 x 80 (bu), 84 standing bamboos (168 skin and flesh bamboos) for three waste baskets are prepared.

b. Edge, body and bottom weaving - 20-25 baskets by 1 workman a day (8 hours)

4. Small Flower Basket

(1) Material (Bleached bamboo - reeled in skin and flesh)

	Length	Width	Thickness	Number
Weaving bamboo	210	1.5	0.2	24 each skin & flesh
Bottom reinforcing bamboo	20	5	1	3 skin
Arm bamboo	160	3	0.5	1 skin
Edge applying bamboo	120	2	1	2
Edge core bamboo	230	-	-	3
Edge winding bamboo	360	1.5	0.2	2
Neck binding bamboo	230	1.5	0.2	1

(2) Bottom weaving

Unite skin and flesh bamboos into one and weave in variant hexagonal pattern in right and left patterns alternatively for 6 times. Next, insert 3 provisional reinforcing bamboos in cross into the bottom hexagon so that the top of each reinforcing bamboo slightly touches outer side of hexagon.

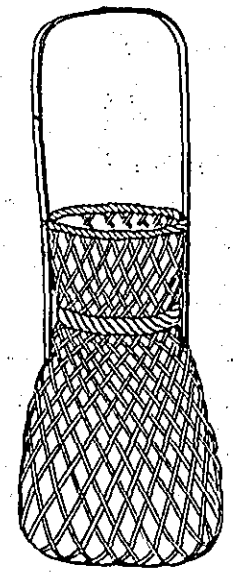
(2) Waist weaving

Weave diamond cross pattern 1 - 2 rounds to form bottom with skin under. Bend weaving bamboo inwardly and effect cross pattern.

(3) Body weaving

Weave in the same way with weaving bamboos ever closing together and make "neck" of 23 bu in diameter at 5 sun height. Make hoop separately and put on at the neck with the ends inserted in body weaving. Continue to weave upward with weaving bamboos ever opening to the edge of 29 bu in diameter.

Fig. 89 Small Flower Basket



(4) Edge preparation

Use fine circular bamboo line for edge core and effect under winding with flesh bamboo in cross and friangle pattern. For upper winding, use skin bamboo.

(5) Arm bamboo

Cut the ends thinly, insert at the points slightly under the center of the body and fasten. At the edge, arm bamboo is fastened with planed rattan of 0.6 bu in width in X shape. Also bind the arm bamboo with three gimlet holes

under edge in decorative tying. Arm bamboo must be bent by burning in advance so the upper part becomes horizontal.

(6) Reinforcing bamboo

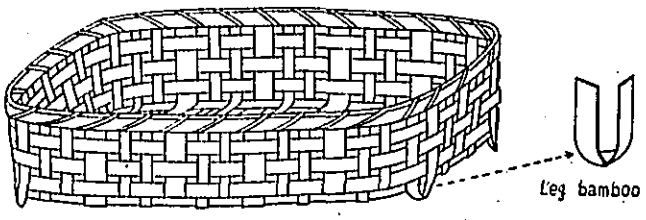
Take off provisional reinforcing bamboo and insert reinforcing bamboo in triangle.

5. Oval Receiver

(1) Material (Long jointed bamboo - bleached and dyed)

	Length	Width	Thickness	Number
Longthwise standing bamboo	75	2	0.25	4
	75	1	0.2	6
Cross standing bamboo	55	2	0.25	6
	55	1	0.2	10
Side turning bamboo	160	2	0.2	3
Leg bamboo	30	2	0.25	4
Under edge bamboo	65	1.5	0.25	1
Edge applying bamboo	150	2	0.25	2
Edge winding rattan	280	0.6	-	1

Fig. 90 Oval receiver Leg Bamboo



(2) Bottom weaving

Weave cross pattern with 2 bu longthwise and cross standing bamboos outside and 1 bu bamboos inside. Make bottom of

24 x 43 (bu). 1 bu bamboo must be dyed and cut in striped pattern, 2 bu bamboo is bleached.

(3) Waist weaving

Bend in oval shape

(4) Body weaving

Insert 3 side turning bamboo in cross pattern. Weave firmly.

(5) Edge preparation

Fold every other standing bamboo outwardly and cut off the others. The tops of the bent parts must be cut inside edge applying bamboo. Use skin bamboo for both inner and outer edge applying bamboos, and finish with rattan.

(6) Leg

Fold and twist with skin outward. Insert at each corner of the basket and fasten the end under edge.

For materials, use flesh bamboo only for inner edge. Skin bamboos must be used for other parts. The skin of standing bamboos must be inside the basket, while skin of side turning bamboo and outer edge must turn outward. Finishing measurements: 52 x 32 x 11 (bu)

6. Export Bread Basket (for mass production)

The basket of this type is considered to be consuming product for one time use, and the price must be cheaper. Oval, circular and many other types are common. Sizes and materials are also varied. For standing bamboos, waste bamboo may be used. Side turning bamboo is better strong, but long-jointed bamboo is also used.

Manufacturing example: Oval type, diameters (6.6-5.5), depth 20.

(1) Material

	Length	Width	Thickness	Number
Standing bamboo	100	3	0.4	12
Side turning bamboo	800	1	0.4	3
Edge applying bamboo	220	2	0.5	2
Edge winding bamboo	400	3	0.2	1

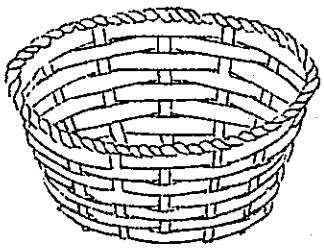
(2) Bottom weaving

Weave chrysanthemum bottom with 12 standing bamboos. Twist weaving or crossed weaving may be applied, but 6 twist weaving is much easier. In case of mass production, draw general scheme on plate, set nails in number of standing bamboos so that unskilled workmen may weave easier. In the same way, wooden jigs for bottom turning and side turning may be prepared. For bottom turning, effect kitchen basket pattern closely fit to standing bamboos.

(3) Waist weaving

In case wooden jig is used, continue to weave after the jig. If 6-7 reeled flesh bamboo is used, care must be taken for possible breaking.

Fig. 91 Export Bread Basket



(4) Body weaving

Colored bamboo of 1 - 2 rounds may be inserted between kitchen basket pattern.

(5) Edge preparation

At the height of edge, bend every other standing bamboo outwardly and cut off the rest. Apply edge applying bamboo both inside and outside. Edge must be right turn two winding.

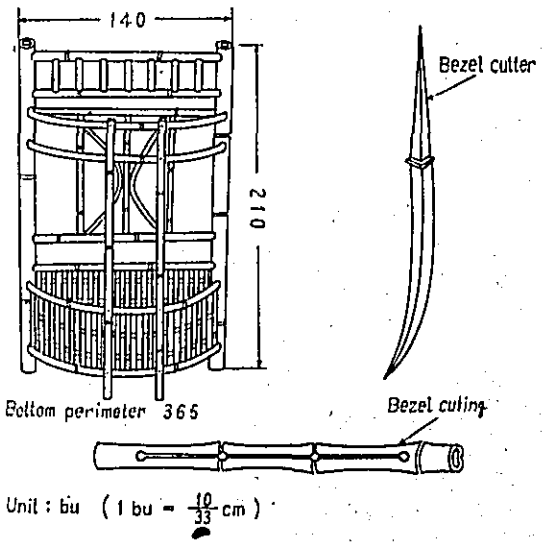
7. Semicircular Umbrella Stand

(1) Material (Long-jointed bamboo - burnt and black)

	Length	Circumference	Number
Pillar bamboo	210	30	2
Side penetration	135	20	6
Front penetration	250	20	4
Front small pillar	175	20	2
Decorative bamboo	25	10	7
"	83	10	3
"	100	10	2
Stretching bamboo	43	3 in diameter	12

Galvanized plate 140 long, semicircular

Fig. 92 Semicircular Umbrella Stand



(2) Manufacturing process

a. Assembly of back skeleton

Inserting, joining and bamboo-nailing.

b. Insertion of stretching bamboo

For stretching bamboo, split 3-sun bamboo into 8 and plane. Insert opposite sides of side penetration and front penetration and cut bezel. Make small holes at each end and joint parts, and cut bezel by knife and bezel cutter. Insert stretching bamboo in the bezel.

c. Fastening

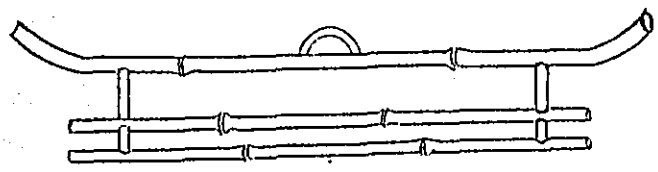
Secure front small pillar on 4 front penetrations by wooden screws. The size of holes must be around 1 bu, about same as crew thickness, and care must be taken to charge burden on materials.

8. Towel Hanger

(1) Material (Black bamboo - 3-4 bu)

	Length	Number
4 bu bamboo	130	1
3 bu "	110	2
2 bu "	20	2
Hanger ring	20 x 1 x 1 (bu)	1

Fig. 93 Towel Hanger



(2) Manufacturing process

a. Material cutting

Sawed in desired measurements

b. Filing

Filed to remove agnails.

c. Burning bending

Bend both ends of 4-bu bamboo in Torii type, and cut the ends diagonally.

d. Lining

Determine the inserting holes and make gimlet holes.

e. Holing

Make 2-bu holes under 4-bu bamboo, 2.5 bu holes on middle bamboo and 2-bu holes on 3-bu bamboo by boring machine.

f. Hole cleaning.

g. Assembling.

Insert 2 2-bu bamboos into middle bamboo and also into upper 4-bu and lower 3-bu bamboos. Fasten by bamboo nails.

Ring installing

Bore 2 gimlet holes upper center of 4-bu bamboo, insert the ring and nail for fastening.

(3) Material and production efficiency

500 pieces a day (8 hours)by 5-men co-operative work.
3 pieces from 2 3-4 bu bamboos.

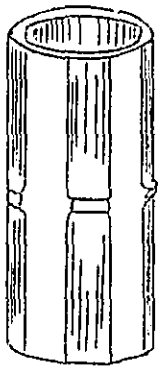
9. Flower cylinder

Trunk or root part of bamboo of more than 1 shaku thickness is used for cylinder in flower arrangements. Some of this cylinder are put on flower table, some others are hanged on pillars. The cylinder is also classified by the number of joints or the position of flower window.

(1) Material

Moso bamboo 1 shaku thick, 1.4 shaku high with on joint abount center.

Fig. 94 Flower Cylinder



(2) Manufacturing process

a. Preparation

Long-time drying and oil pressing must be effected.

b. Cutting

To stand the cylinder vertically, cut horizontally.

c. Marking

Divide 8 equal parts on the trunk and mark.

d. Shaping

Cut every other marked part by bamboo cutter, reel skin thoroughly and make octagonal shape.

e. Polishing

Effect skin parts with sen and polish. Also polish reeled parts. Finish the whole surface by sand paper.

f. Painting

Clean the material thoroughly, polish the edge with special grinder, remove water and apply persimmon tannin. After being dried, the whole trunk is applied with rough pigment. Dry lightly under sunshine. For finishing, apply lacquer, and black varnish for inside. Dry for a day and effect water polishing.

10. Vegetable Carrying Basket

The demand on vegetable carrying baskets has been rapidly increasing in recent years. This is the most suitable products for agrarian districts. There are many types of this basket varying in capacity and structure. Hexagonal pattern is common.

o Vegetables and baskets in kanda Vegetable Market (as reported in Special Industry Section Survey of Ministry of Agriculture and Forestry)

Basket type - vegetable contained and quantity - place of production - measurements - weaving materials - packing.

a. Hexagonal basket - string bean, 3 kan - Fukushima - oval, 48 x 40 x 20 cm - Side turning bamboo of 2cm wide, standing bamboo 1 cm wide, edge bamboo 2 cm wide (skin bamboo), edge finishing with wire - crossed rope packing.

b. Hexagonal basket - pompkin, 7 kan - Ibaragi - oval, 50 x 40 x 25 cm - edge bamboo (skin bamboo), edge finishing by wire - double crossed rope packing, straw base.

c. Kitchen basket pattern basket - Japanese medlar - Kagoshima - rectangular bottom, circular, 19 x 19 x 15 cm - standing bamboo (skin bamboo) 1 cm wide, side furning bamboo (flesh bamboo) 0.5 - 0.6 cm wide, edge winding bamboo 2cm wide, edge finishing by winding edge - paper base.

d. Hexagonal basket - field pea, 2 kan - chiba - long oval, diameters 56 and 28 cm, 17 cm high - standing bamboo and side turning bamboo 1.5 cm wide and 0.1 - 0.15 cm wide (skin and flesh bamboos), upper edge (skin bamboo) 1.2 - 1.5cm wide, edge finishing by wire - packing by 3-bu rope - paper base (old newspaper).

e. Hexagonal basket - bamboo shoot - Shizuoka - Oval, diameters 54 and 42 cm, 22 cm high - standing and side turning bamboos 1.6 cm wide, edge bamboo (skin bamboo) 3cm wide, 0.5 cm thick, edge finishing by wires - rope packing.

f. Hexagonal basket - Chinese citron - Matsuyama - barrel type, 43 cm diameter, 55 long - standing and side turning bamboos 1.3cm wide, 0.5cm thick, reinforcing bamboo 2.7 x 0.3cm - double crossed rope packing (Manufacturing example 1) - Chinese cabbage basket in Tochigi:

(1) Material

	Length	Width	Thickness	Number
Standing bamboo	420	4	0.25	20
Side turning bamboo	630	7	0.3	3
Waist bamboo	630	4	0.3	1

Under edge bamboo	630	4	0.3	1
Edge winding bamboo	850	4	0.2	1
Edge applying bamboo	630	4.5	0.3	2

(2) Bottom Weaving

Supposing that 6 parallel standing bamboos run lengthwise, weave 7 each of front and rear bamboos (crossing with lengthwise bamboos) and effect waist weaving without corner.

(3) Waist weaving

Fig. 95 Hexagonal Basket Waist Weaving (1)

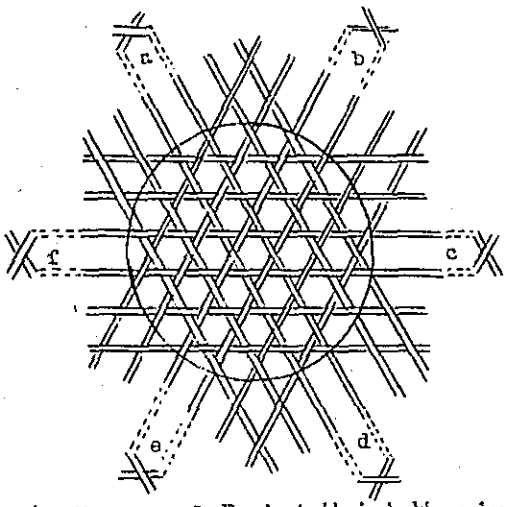
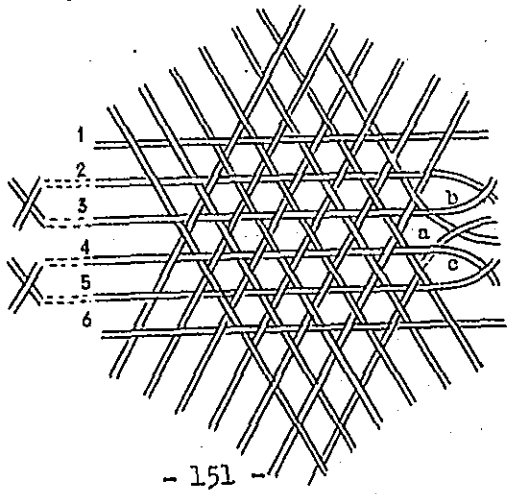


Fig. 96 Hexagonal Basket Waist Weaving (2)



Weaving without corner is common for hexagonal basket waist weaving with 6 pentagonal crevices at each points of bottom hexagon (a, b, c, d, e, f as shown in Fig. 95). As shown in Fig. 96, 6 parallel bamboos of 1, 2, 3, 4, 5 and 6 are interwoven with 2 and 3 or 4 and 5. Insert strong bamboo for waist weaving under 2 and over 3 at point b, and under one and over one at point a, and under 4 and over 5 at point c. In this case, make large polygonal form at a, and small pentagons at b and c.

(4) Body weaving

To keep the bottom flat, provisional reinforcing bamboo is recommended. For more quick production, use wooden jig and insert side turning bamboo along jig. Side turning is effected in three steps.

(5) Edge preparation

Apply under edge bamboo, and fasten standing bamboos by hexagonal pattern fastening method. Effect edge winding in right turn for 3 - 4 times. Edge applying bamboo may be waste bamboo at inner edge, but must be strong bamboo at outer edge. To start edge winding, insert inside edge applying bamboo and bind in right turn. The ends are inserted between edge winding bamboo and edge applying bamboo repeatedly and theremaining parts are cut off. When finished, adjust the general shape of the basket.

(Manufacturing example 2) Cucumber basket in Tokyo

(1) Material (Long-jointed bamboo - 5-7 sun bamboo)

	Length	Width	Thickness	Number
Standing bamboo	300	3	0.25	18
Side turning bamboo	380	3	0.3	3
Under edge bamboo	510	4	0.5	1

(2) Processing

Weave bottom with 4 lengthwise standing bamboos and 7 each of front and rear cross standing bamboos in hexagonal pattern. After effecting waist weaving and side turning for three times, insert under edge, fold the tops of standing

bamboos at the height of edge and insert deep into edge bamboo.

(3) Material preparation

Cut edge bamboos and, then, side turning bamboos from root part of material bamboo, and standing bamboos from the top. Split in desired measurements, dry thoroughly and reel into 5 each. Materials for 90 - 100 baskets are obtained from 1 bundle of material bamboo. Production rate is 70 - 100 baskets by one workman a day. Bamboo reeling machine is used. Finishing measurements: oval, 45 - 35cm in diameter, 20cm deep.

11. Bamboo Chair

Root bending bamboo has smaller center hole, is rich in elasticity and many other practical features, but easy to be hurt by insects. Consequently, special precaution will be necessary to cover this disadvantage.

(1) Cutting and drying

After cutting, dry under direct sunshine for one week to facilitate for further processing (reeling and cleaning).

(2) Water cleaning

Use rice chaffs dipped in clean water, and polish trunk with rope. 1 month is needed for drying.

(3) First correcting

In case of circular bamboo, heat and correct bending. Cool with wet rag.

(4) Cutting

Cut into the desired measurements.

(5) Bending processing

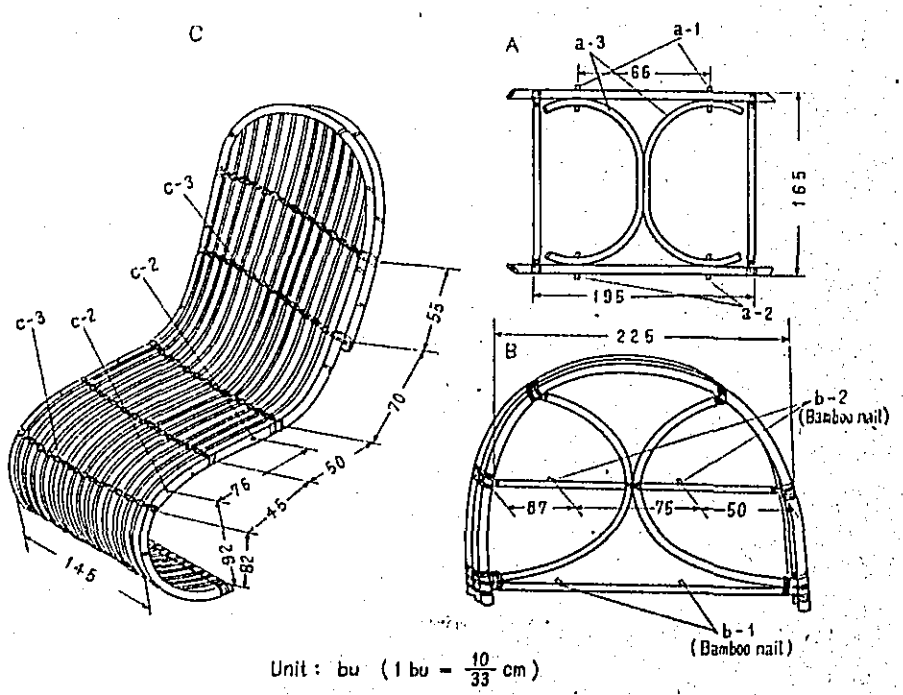
Effect heating method for desired shape. Heating is effected by gas, charcoal, cokes, etc. the detailed procedure must depend on experience. Root bending bamboo is the easiest material to bend or correct, and heating time, temperature, heating conditions must depend on practical experiences.

Apply fat when material is heated at early stage of bending operations. In case of mass production, apply before operation. Bend with correcting implements

(6) Material

		Length (in bu)	Diameter (")	Number
A.	Base rack	220	6	2
	"	155	6	2
	"	230	5	2
B.	Side frame	480	6	6
	"	220	6	4
	"	212	6	2
	"	245	5	4
C.	Back plate	835	6	1
	"	625	6	1
	"	145	6	6
	Stretching bamboo	350 long, 8 wide, 1.5 thick,		13

Fig. 98 Bamboo Chair



Unit : bu (1 bu = $\frac{10}{33}$ cm)

(7) Assembling

Prepare three parts separately as shown in Fig. 98 (A: base rack; B: side frame, 2 pcs.; C: back plate) Joint a1 with b1, c2 with b2 by bamboo nails. Raise a3 and fasten at c3 of part c by thin aluminum plate and secure by wooden screw. Several other parts must be secured. Rattan and other similar materials must be used to fix bamboo. For jointing of bamboo, rattan binding is effected instead of navel jointing.

12. Bamboo Curtain

(1) Classification

Export bamboo curtain, as well as general bamboo curtain, is divided into split bamboo curtain and drawn line bamboo curtain, and standards are set forth separately. $\frac{1}{2}$ inch wide split bamboo curtain is most widely known as export bamboo curtain. (2.5 - 12 ft x 6 ft)

For domestic use, bamboo, marsh-reed, etc. are used for materials. Bamboo is most commonly used as finely split bamboo, drawn bamboo line or fine circular bamboo. Bamboo line curtain with ten line in 3 bu is called "3-bu line". 4-bu line or 5-bu line are also produced.

(2) Material

Long-jointed bamboo is most frequently used. Soft bamboo materials are blue and beautiful, but when dried up they lose their luster. 3-4 year old long-jointed bamboo of 6-8 sun with fresh skin is the best material. Material bamboo is polished with chaffs, and usually reeled into three layers.

(Manufacturing example) Split bamboo curtain 370 x 570

Main material	270	1	0.3	460
Cross bamboo	270	8	0.5	4
Cotton yarn	(No. 20 12-15 spinning)		8 shaku long	16

(3) Preparation

a. Fine cutting, polishing

Cut in desired measurements, polished with chaffs and dried.

b. Bamboo splitting

Split as already described. When split 2-4 times bigger than final measurements, reel the flesh, determine the thickness and effect fine splitting. Dry in sunshine with flesh up.

(4) Weaving

Threading method is divided into Misufu and Junpu. Misufu is to weave with two line as one, while junpu is to thread for each. Junpu is classified as 7-fu, 8-fu, ..., 12-fu, and curtain with bigger number is considered to be good in quality. Threading is sometimes effected in curving lines to make variant pattern.

Usually, joints are line when woven. Finished product with one joint is called "1-joint", with 2 joints "2-joint". If joints are not closely arranged, it is called "irregular joints". 1-joint is the first-rate product, while irregular joints are not so highly appreciated. Joints are sometimes lined and arranged in special pattern, but mechanical process cannot fill this demand. For threading, cotton yarn, hemp yarn and silk yarn are used. Cotton yarn is most widely used.

(5) Finishing

When weaving is finished, crosspieces are installed upper and lower ends. Upper cross must be wider. Cut the line ends by scissors. For the products of higher quality, attach special cloth edges and other metal accessaries.

13. Bamboo Skin Ware (Kettle seat)

(1) Material

Bamboo skin of 120 - 130 (bu) long is the best material. Material must be thoroughly washed by sodium peroxide and bleached by sulphur.

(2) Manufacturing method (Side job training course in Aichi Prefecture)

a. Material preparation (fine splitting)

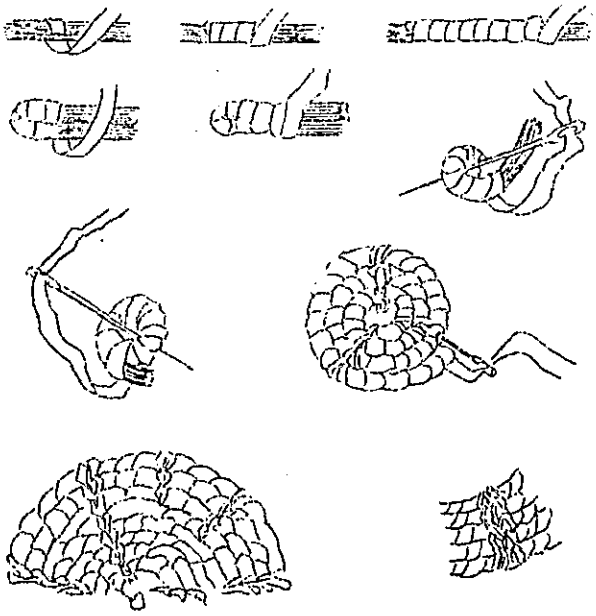
Finely split the bleached materials, usually in 4-bu wide. Use tatami needle for splitting. The both edges are further split and used as core. The harder part in the center must be exempted for 3-bu width. To facilitate further operation, dip in water and cover with wet rag.

b. Weaving method

Wind the material prepared as above around the core made from edges. (1) Start the winding, (2) (3) when wound 5 - 6 rounds, (4) fold the core into two, (5) wind the folded part into one and make circular part to become center. Fasten the skin through the inner hole by needle (6).

Wind 2 rounds and pass the hole (7) and again pass the hole after 2 rounds. Next (8) wind 2 rounds and pass through the skin as shown in Figure

Fig. 99 Bamboo Skin Kettle Seat



The pattern develops in three directions. As the seat is made up, make 6-7 short rush as core and wind bamboo skin. If seat becomes too big, make another pattern by needle.

c. Fastening

Make thicker core at the part where you wish to fasten, and after one round make thinner core and wind hardly to form perfect round shape with thicker core. The top of the skin is passed through inner ring repeatedly and after passing 1 - 2 times, cut off.

d. Splicing of weaving skin.

Insert splicing skin into inner ring, wind one round and wind the old skin with core.

Beside the above, belt-mat, fruit dish, shopping baskets, carrying basket, shoulder-bag (circular and rectangular), etc. are manufactured. For needling and shaping, much skill and dexterity are required.

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