सूक्ष्म,लघु और मध्यम उद्यम मंत्रालय, भारत सरकार
MINISTRY OF MICRO, SMALL & MEDIUM ENTERPRISES
GOVERNMENT OF INDIA

कयर बोर्ड
COIR BOARD

India International Coir Fair
IICF
2016

COIR
FLOOR COVERINGS

SAVE NATURE..USE COIR

Published on the occasion of the
India International Coir Fair 2016,
Coimbatore

COIR BOARD

सूक्ष्म,लघु और मध्यम उद्यम मंत्रालय, भारत सरकार
कयर हाउस, एम.जी.रोड, एर्णाकुलम, कोचीन-682016
दूरभाष: 0484-2351900 टोल फ्री नं: 1800 425 9091

Ministry of MSME, Government of India
Coir House, M.G.Road, Ernakulam, Cochin - 682016
Phone:0484 - 2351900 Toll Free no:1800 425 9091

Email: info@coirboard.org www.coirboard.gov.in

India International Coir Fair

IICF

2016

JULY 15-18

CODISSIA TRADE FAIR COMPLEX

COIMBATORE

Coir Floor Covering Materials

Save Nature Use Coir

Ministry of Micro, Small and Medium Enterprises, Government of India

MSME

MICRO, SMALL & MEDIUM ENTERPRISES

Coir Board

(Ministry of MS&ME, Government of India)

Coir House, M.G.Road, Ernakulam, Cochin - 682016

Phone: 0484 2351807, 2351788, 2354397

Email: info@coirboard.org, www.coirboard.gov.in

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India International Coir Fair 2016, Coimbatore

Coir Board

Ministry of MSME, Government of India
P.B No: 1752, “Coir House”, M.G.Road, Kochi – 682 016
Tel: +91-484-235807, 235788, 2383313. Fax: +91-484-2370034
Email: coir@md2.vsnal.net.in
www.coirboard.nic.in, www.coiboard.gov.in

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Editor: P.K. RAVI

Editorial Assistance : V.T. Asokan

Project Assistance:

Sunil Kumar. R
Joseph. K.J
Satheesh Kumar. R

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COIMBATORE

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कलराज मिश्र
KALRAJ MISHRA

सूक्ष्म, लघु और मध्यम उद्यम मंत्री
भारत सरकार
नई दिल्ली - 110011

Minister
of
Micro, Small & Medium Enterprises
Government of India
New Delhi-110011

MESSAGE

I am happy to learn that the Coir Board, under the Ministry of MSME is organizing the 4th Edition of the **India International Coir Fair (IICF)** at CODISSIA Trade Fair Complex, Coimbatore from 15-18th July, 2016. Coir Board, during its existence spanning over six decades, has been extending dedicated services for the development of coir industry in our country. I am sure that the IICF 2016 would turn out to be an excellent opportunity to consolidate the gains so far and to equip the industry to face the challenges ahead. I hope that the compilations on coir products like Coir geotextile, coir pith, coir wood and coir floor furnishing material proposed to be released in this event would emerge as treasure of knowledge to information seekers on the industry and as a reference for posterity.

I wish IICF 2016 a grand success.

(KALRAJ MISHRA)

Off. : Room No. 168, Udyog Bhawan, New Delhi-110011, Ph. : 011-23061566, 011-23061739 Fax : 011-23063141

एम. वेंकैया नायडु
M. VENKAIAH NAIDU

शहरी विकास,
आवास और शहरी गरीबी उपशमन एवं
संसदीय कार्य मंत्री
भारत सरकार
MINISTER OF URBAN DEVELOPMENT,
HOUSING & URBAN POVERTY ALLEVIATION
AND PARLIAMENTARY AFFAIRS
GOVERNMENT OF INDIA

28th June, 2016

MESSAGE

I am very happy to take note that the Coir Board, under the Ministry of Micro, Small and Medium Enterprises, is organizing the 4th edition of the India International Coir Fair (IICF) at CODISSIA Trade Fair Complex, Coimbatore from 15th to 18th July, 2016.

Coir industry in India holds its richest tradition and provides livelihood to lakhs of rural people across coconut producing regions. The industry produces wealth from waste and earns valuable foreign exchange to the exchequer. While lauding the Coir Board for its earnest commitment to promote coir industry, I convey my sincere appreciation to all those who are behind this endeavor.

I trust that the compilation on Coir Geotextiles, Coir pith, Coir Wood and Coir floor furnishing proposed to be released during this event would give complete information on application of these bio-degradable products.

I wish the IICF 2016 a grand success.

(M VENKAIAH NAIDU)

Office:- Room No. 104-C, Nirman Bhawan, New Delhi-110108; Phone: 011-23061166, 23061162, 23062089 (Fax)
Residence:- 30, Dr. APJ Abdul Kalam Road, New Delhi-110011; Phone: 011-23019387, 23019388 (Telefax)

नितिन गडकरी
NITIN GADKARI

सत्यमेव जयते

मंत्री
सड़क परिवहन, राजमार्ग
एवं पोत परिवहन
भारत सरकार
MINISTER OF ROAD TRANSPORT,
HIGHWAYS AND SHIPPING
GOVERNMENT OF INDIA

MESSAGE

It gives me a great pleasure that the Coir Board, under the Ministry of MSME is organising the fourth edition of the India International Coir Fair at CODISSIA Trade Fair Complex, Coimbatore from 15th to 18th July, 2016.

Coir products, by virtue of its eco-friendly and bio-degradable qualities, have tremendous possibilities for applications to preserve environment and arrest global warming. The organization of these type of activities would lead to all round and sustainable growth of the sector.

I earnestly believe that the publications on Coir Geotextiles, Coir Pith, Coir Wood and coir floor furnishings, to be released coinciding with the event, would help for a detailed understanding on the product and its application.

I wish the IICF 2016 all success.

(Nitin Gadkari)

Date: 4th July, 2016
Place: New Delhi

Transport Bhawan, 1 Sansad Marg, New Delhi-110 001, Tel. : 23711252, 23710121 (O), 23719023 (F)
E-mail : nitin.gadkari@nic.in

सुरेश प्रभु
SURESH PRABHU

सत्यमेव जयते

रेल मंत्री
भारत सरकार, नई दिल्ली
MINISTER OF RAILWAYS
GOVERNMENT OF INDIA
NEW DELHI

30 JUN 2016

MESSAGE

I am happy to learn that the Coir Board is organizing the fourth edition of the India International Coir Fair at Coimbatore from 15th to 18th July, 2016.

As evident from the growing affinity world over and the steady increase in exports, Coir products have proven to be ideal for preserving the mother earth. I believe that the outcome from the event and the publications on various Coir products would be of immense prospects for the future.

I wish the event all success.

(Suresh Prabhu)

239, रेल मंत्रालय, रेल भवन, नई दिल्ली-110001
239, Ministry of Railways, Rail Bhawan, New Delhi-110001
Tel. : 011-23381213, Fax : 011-23387333
sureshprabhu@rb.railnet.gov.in, sureshprabhu@gov.in

राधा मोहन सिंह
RADHA MOHAN SINGH

सत्यमेव जयते

कृषि एवं किसान कल्याण मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
& FARMERS WELFARE
GOVERNMENT OF INDIA

D.O. No. 1151 /AM.

New Delhi
Dated: 30-6-2016

MESSAGE

I am extremely happy to note that the Coir Board, under the Ministry MSME is organizing the fourth edition of the India International Coir Fair at Coimbatore from 15th to 18th July 2016.

Being an agro based industry, the coir products have got a worldwide acceptance by virtue of its eco-friendly and bio-degradable qualities. Coir products, as I understand, have tremendous possibilities in soil conservation and agri-horti applications. I trust that organization of international events like the instant one are in the right direction to take the coir industry further forward. I have no doubt that the publications on Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Coverings, proposed to be brought out by Coir Board, would help much for a detailed understanding on the products and their applications.

WISHING THE VERY BEST FOR IICF 2016.

Radha Mohan Singh

RADHA MOHAN SINGH

Office : Room No. 120, Krishi Bhawan, New Delhi-110 001 Tel.: 23383370, 23782691 Fax : 23384129

गिरिराज सिंह
GIRIRAJ SINGH

D.O. No. 09 / MOS (MSME)/2016

राज्य मंत्री
सूक्ष्म, लघु और मध्यम उद्यम
भारत सरकार
नई दिल्ली - 110011

MINISTER OF STATE
FOR
MICRO, SMALL & MEDIUM ENTERPRISES
GOVERNMENT OF INDIA
NEW DELHI-110011

MESSAGE

I am very much delighted to note that the Coir Board under the Ministry of MSME is organizing yet another edition of the India International Coir Fair 2016 at CODISSIA Trade Fair Complex, Coimbatore from 15th to 18th July, 2016. Coir Board has been instrumental in developing and proliferating this industry in different parts of the country. I firmly believe that the fourth edition of this event is going to add another feather to the glittering cap of Coir Board.

I firmly believe that the events would bring in more tangible results to the industry for the longer run and the publication on Coir Geotextiles, Coir, pith, Coir wood and Coir floor furnishing proposed to be released in this context will be of much use to the trade.

WITH BEST WISHES FOR IICF 2016.

(GIRIRAJ SINGH)

कमरा नं. 133, उद्योग भवन, नई दिल्ली-110011, दूरभाष: 011-23063836, 23063826
Room No. 133, Udyog Bhawan, New Delhi-110011, Ph. : 011-23063836, 23063826

HARIBHAI P. CHAUDHARY
MINISTER OF STATE
GOVERNMENT OF INDIA

भारत सरकार
सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय
उद्योग भवन, नई दिल्ली - 110011
GOVERNMENT OF INDIA
MINISTRY OF
MICRO, SMALL AND MEDIUM ENTERPRISES
UDYOG BHAWAN, NEW DELHI - 110011

MESSAGE

I am extremely happy to note that the Coir Board, under Ministry of MSME, Government of India is all set to organize the India International Coir Fair 2016 at Codissia Trade Fair Complex, Coimbatore from 15th to 18th July, 2016. I understand that the current edition of IICF is the fourth of its kind and organized in one of the major coir producing Statesin our Country.

Coir products, as known to everybody, has got a tremendous product range which can even address the current day issues on global warming etc. The efforts of Coir Board to release the compilation on products like Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Coverings during this event are definitely laudable.

I wish IICF 2016 the very best and congratulate all the stakeholders of Coir Industry for venturing into this important event.

New Delhi

Dated: 08.07.2016

Haribhai Chaudhary

(Haribhai P. Chaudhary)

कृष्ण कुमार जालान
सचिव
K. K. Jalan
Secretary

भारत सरकार
सूक्ष्म, लघु और मध्यम उद्यम मंत्रालय
उद्योग भवन, रफी मार्ग, नई दिल्ली-110 011
GOVERNMENT OF INDIA
MINISTRY OF MICRO, SMALL AND MEDIUM ENTERPRISES
UDYOG BHAWAN, RAFI MARG, NEW DELHI-110 011

MESSAGE

It is indeed a pleasure to note that the Coir Board under the Ministry of Micro, Small and Medium Enterprises, Government of India, is organising yet another edition of the India International Coir Fair at CODISSIA Trade Fair Complex, Coimbatore, Tamil Nadu.

Coir Industry, as I understand, has tremendous prospects to grow and develop in our country. I am confident that organisation of these type of event, followed by actual field level interventions would bring in incremental benefits to all the stake holders and sustainability to the coir sector for the longer run. I trust that compilations on products like Coir Geotextiles, Coir Pith, Coir Wood and Coir Floor Furnishings, proposed to be brought out during this event, would help to a greater deal in better understanding of the products and its varied end uses.

I wish IICF 2016 all success.

(K. K. Jalan)

New Delhi,
11th July 2016.

169, UDYOG BHAWAN, NEW DELHI-110 011, Tel. : +91-11-23062107 Fax : 2306 3045, E-mail: secretary-msme@nic.in; www.msme.gov.in

FOREWORD

The growing affinity world over towards ecofriendly and biodegradable products makes the situations ideal for further promotion and development of coir industry in our country. Coir Products, by virtue of these qualities and the unique reputation of being manufactured from a 100% renewable natural resources are heads and shoulders above the competing products.

Coir Board, with the unstinted co-operation and guidance of the Ministry of MSME, Govt. of India is embarking upon a variety of programmes to take the industry further forward. Organisation of events like the India International Coir Fair (IICF) is definitely going to lead to a quantum jump in the production and manufacture of Coir Products.

It gives me immense pleasure to see that this important compilation is referred on this occasion of the fourth edition of IICF. I hope that this book would provide vital inputs for information seekers on the versatility of Coir Products and their applications.

I congratulate one and all who have contributed to this compilation.

C.P. Radhakrishnan, Ex. M.P.
Chairman, Coir Board

P. K. Ravi

PREFACE

The application of coir products as floor covering materials is the major user areas of coir mats/mattings and mourzouks .It is one of the cheapest floor furnishing material available to the human kind. Coir is long lasting, eco friendly and leads to pollution free environment. The consumer has lot of choices with coir to be used as floor furnishing material, whether plain, bleached, stencilled or woven designs .This renewable material is a boon to the consumers as it is bio degradable. The wide selection available for coir products makes it a consumer acceptable product not only on account of cost but also due to innumerable variety of coir products present in the market.

It is the prime duty of every citizen of India to support the coir which is a traditional cottage industry extending the rural women coir artisans greatly for achieving their livelihood and helping to better their living conditions. The use of coir saves earth from pollution. It is a matter of fact that no one is cultivating coconut palm for coir. The by product of de husking of coconut is a renewable material and bio degradable but generating employment and wealth from the waste. The coir industry is focusing on technologies for zero wastage and succeeded to a great extent in this direction.

The coir has several uses that embraces entire facet of human's life and his activity as door mats, rugs, carpets. This agro based coir industry with the adoption of modern technologies and processing techniques have definitely supported to improve the living standards of the poorest of poor.

The coir industry is strengthening day by day and achieved commendable progress in the domestic and export markets due to the cumulative hard work and efforts of the Govt. of India and other state govts and ministries, exporters, workers and industrialists including promotional bodies like the Coir Board.

It is a fact that the demand for handloom coir mattings has decreased through these years but with the advent of coir wood, the need for handloom coir mattings may increase .We shall not to encourage and support for the export of coir fibre and coir pith in their raw forms but for value added products for generating employment and revenue from them.

We pray that every one shall co operate with a single mind for the future of coir so that we may able to bring back the golden days of coir industry. It is a humble effort from us to publish a book exclusively for coir mats/mattings that may help even a layman to understand the technology of processing of coir rmats/mattings. We are sure that it will extend to the coir fraternity to manufacture quality coir products uniformly meeting the requirements and taste of consumers properly. We sincerely expect that this publication is in the right direction and shall solve the dearth of documents on coir.

We thank the assistance, guidance and inspiration extended to us always by Shri C.P. Radhakrishnan, Ex.M.P., Chairman , Coir Board that really pumped unrelenting energy in to us enabling to compile this book in a very short time. It is worthy to record the unstinted and continuous advice and support of Shri M Kumara Raja, Secretary, Coir Board to us for completing this publication in time. Definitely we are highly thankful to the enthusiasm, instantaneous and active help from Shri P.R.Ajithkumar, Director (Marketing), Dr.Anita Das Raveendranath, Director, RDTE ,T.A.Rajendra Babu,Joint Director(Res) and V.T.Asokan, Regional Officer in shaping this book in a better way. Lastly it is our duty to thank the support staff for their tireless, selfless and silent hard work in designing and bringing this book in to reality.

We once again acknowledge with our sincere hanks and gratitude to the efforts of all behind this publication.

DIRECTOR'S MESSAGE

The India International Coir Fair 2016 has been organized by Coir Board to demonstrate and disseminate to public the findings of research on coir conducted at Central Coir research Institute (CCRI) and Central Institute of Coir Technology (CICT) and through In –house / collaborative projects with reputed organizations in India. The theme for the IICF-2016 envisages sustainable development of the grass root workers in the Coir Industry and expands to overseas niche markets for coir/coir products through futuristic technologies. We are currently facing dramatic economic and market changes surrounding our business enterprises. In these circumstances, R&D becomes increasingly important in order to overcome this unprecedented transition stage and to succeed in expanding globally. The ability to predict market needs, select and focus on research themes, keep relevant divisions working together as a team, and operate with flexibility and speed is important.

Recently, much emphasis has been given worldwide to the use of natural fibre as technical textiles for different end uses. Coir fibre, produced in abundance as a by-product in the coconut industry has immense potential for use in the manufacture of elegant floor coverings in combination with other natural fibres such as sisal, jute and silk. Through this book, an effort has been made to provide information about different coir floor furnishing in line with preferences to suit both an Indian & International consumers. Grateful acknowledgements are due to Shri. C.P. Radhakrishnan, Chairman, Coir Board for his continued guidance and valuable support. I hope the information being delivered through this book will be helpful to entrepreneurs, researchers and for all in the coir industry.

Dr. Das Anita Ravindranath
Director, RDTE, CCRI

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COIR FLOOR COVERING MATERIALS

Coir Mats, Mattings, Rugs, Mourzouks and Carpets

Coir mats, mattings, rugs, mourzouks and carpets are primarily used as door mats and floor furnishing material in households, offices, meeting halls, stairs / corridors and auditorium. These products are used both for decorative and functional purposes. A multitude of designs / patterns in natural, bleached and solid colours are available.

1. Coir mats

Mats are available in plain, natural and bleached, available with woven or stencilled designs and bevelled patterns for use in interior or exterior door fronts.

Coir mats are made on handlooms, power looms or frames. There are brush mats and non - brush mats. It is available in a wide range of colours, sizes and designs. The brushing qualities of coir doormats and their ability to keep the dirt away make the product a unique one. Coir mats are manufactured and supplied in various sizes.

Popular stock sizes are

Size No	Dimension	
	Inch	mm
1.	24 x 14	600 x 350
2.	27 x 16	700 x 400
3.	30 x 18	750 x 450
4.	33 x 20	850 x 500
5.	36 x 22	900 x 550
6.	39 x 24	1000 x 600
7.	42 x 26	1050 x 650
8.	45 x 28	1150 x 700
9.	48 x 30	1200 x 750

Mats are produced with the aid of hand loom and frames. There are brush mats and non - brush mats. Most of the non – brush mats are made on frames .

The most popularly and widely used coir mats are:

i) Rod mats
ii) Fibre mats
iii) Creel mats
iv) Loop mats

} Loom mats as they are manufactured on loom

v) Mesh mats
vi) Sinnet mats
vii) Corridor mats
viii) Rope mats

} Frame mats as these are manufactured without the aid of a loom, but with the help of frame.

ix) Rubber tufted mats
x) P.V.C tufted mats
xi) Matting mats

Creel mats are known for its thin brush, Rod mats for thick brush and Fibre mats for

compact brush. Latex and rubber backing makes the mats non-slip. The mats are dyed, designs or stencilled or in-laid with coir fibre or coir yarn.

1.1 Loom Mats

General Procedure for Weaving of Loom Mats

The warp yarn prepared on chain beam is placed at the back of the loom. The yarn from the chain beam that after passing over the back rest beam or chain rest beam is drawn through the heddle eyes and slayed through the reeds. This is then passed over the waist beam or front rest and tied to a rod and is attached to a wooden roller (tension beam) by means of pieces of rope. The take up of the woven fabric is effected by operating the ratchet wheel at one end of the wooden roller. By doing so the woven mat is uniformly taken up. There is another ratchet wheel fixed on the chain beam and by detaching the catch on the ratchet wheel, necessary length of warp from the chain beam can be released.

1.1.1. Rod Mat

In rod mats, the brush or pile is formed out of topping yarn. The topping yarn is normally of soft twisted variety which will help in getting good brush. The pile in the mat is produced by cutting the topping yarn wound over a grooved iron rod. The rod made use for the purpose is flat grooved steel bars. The pile height can be varied by using rod of different thickness.

The proportion of the topping yarn and weft can be varied to suit the required quality. Rods mats are available in natural, stencilled, mottled and inlaid designs. The formation of diagonal lines (rows) on the rear side of the mat is a characteristics feature for identification of the rod mat.

Preparation of Topping yarn (Punja yarn)

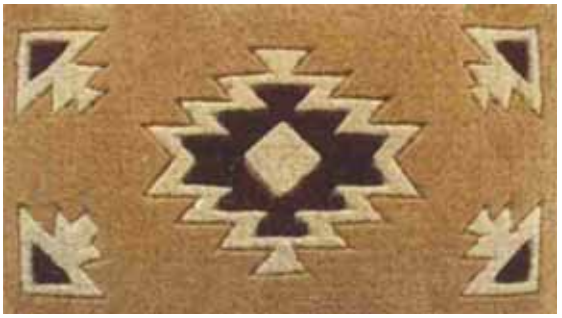
The yarn required for topping yarn is first sorted and is spliced to a continuous length. According to the quality of mat to be woven, these single yarns are drawn in 2, 3 or 4 ends together and stacked into a “punja” form. This heap of yarn is kept near the loom for weaving.

Weaving procedure

For rod mat, one warp beam with necessary number of warp threads is required. Two heddle frames and two treadles also required for the loom. The warp threads are drafted through the heddle eyes in the order 1, 2. There after the yarns are slayed through the reed one in a dent. To ensure firm edges for the mat, at extreme ends, two strands of warp yarn at both sides of the mat are drawn through the same heddle frame and they are slayed through a single dent in the reed. The count of the reed depends up on the quality of the mat. Generally 30’s reed is used.

To start weaving, depress the 1st treadle to make the shed. The grooved iron rod is then kept over the top layers of warp strands across the warp and the topping yarn is taken from one side of the warp to the other through the shed and wound spirally over the rod along with (alternate) strands of warp in the top layer. The iron rod now wound with yarn is brought to the fell of the cloth. Thereafter a weft is inserted through the same shed and slay is beaten fast to allow the weft close to the portion already woven. After changing the shed while depressing the other treadle, a knife is passed through the iron rod and the topping yarn wound over the rod is cut. The same process of weaving is continued to weave further length of mat.

1.1.2. Fibre Mat



As the name itself indicates that they are made out of coir fibre. Single chain and double chain fibre mats commonly produced in coir industry. Fibre mats are manufactured by insertion of tufts of coir fibre in the course of the weaving process unlike the brush mats in which the pile structure is obtained by cutting coir yarn, wound on a grooved iron rod inserted suitably between the warp chains. Fibre mats have a very compact brush firmly held by the base fabric and therefore these mats are very much durable. The mats are manufactured in plain, natural colour, striped or stencilled and fancy fibre mat with woven designs of intricate patterns obtained by insertion of coloured fibre in the course of weaving process are of greater demand in the markets.

The following are the details of construction of double chain fibre mats.

The fibre mat is made by inserting small tufts of fibres through every alternate ends of warp. The loom requires three heddles frames and three treadles for weaving. Being a two-chain fibre mat, two kinds of warp prepared separately on two chain beams is necessary. Out of these one is kept in the loom at maximum tension and is used for inserting the fibre tufts. The other one is kept slack in the loom and in comparatively lower tension. This warp works as a binding chain and offers a sturdier construction for the base fabric of the mat. The binding chain interlaces firmly with every pick in the mat and wraps around the bottom part of the fibre tufts. Because of this, the picks in between every row of pile are firmly held in the mat and bottom part of the fibre tufts is completely concealed.

The tight warp threads are drafted through first and second heddle frames and the slack warp threads through third heddle frame. In the mat distribution of tight and slack warp threads must be 1:1. Therefore the drafting is done in order 1,3,2,3. The warp threads are slayed two in a dent-1 slack and 1-tight.

Weaving is started after making the preliminary arrangements, by depressing the third treadle so that all the tight warp threads are raised up and slack warp threads lowered. This gives facility for inserting fibre tufts through every alternative tight warp threads. Usually the design to be woven on a fibre mat is prepared suitably on graph paper. Looking in to the graph paper the tufts of fibre according to the colour indicated in the graph paper are

inserted through every alternate strands of tight warp. While doing so care should be taken to see that fibre tufts inserted at the extreme ends(selvedges) of the mats are put a little downwards from bottom level of the other tufts. This is to give extra firmness for the pile at the sides of the mat. Thus prevents the falling off of the brush at the sides while in use. After completion of inserting the tuft, the 1st and 2nd treadles are depressed and a weft is passed in. Thereafter third treadle is depressed and another weft is inserted. Now a wooden plank according to the pile height required is placed in front of the fibre tufts and with the help of a big scissors, top part of the fibre is cut uniformly. Thus the weaving is progressed repeating the operations as described above to weave further length of mat. Reed used generally is of 42's and 36's.

Loom sketch of the pattern facilitate easy weaving of the fibre mat. Highly skilled craftsmen weave these. It is woven in a range of intricate designs and pile heights. The designs are bevelled to give clarity.

Method of Preparation of Loom Sketch of Designs for Weaving on Fibre Mat

In order to facilitate easy weaving of fancy fibre mats the designs which are intended to be woven on fibre mats are transferred to graph paper. In addition to the above advantage the drawing of design on graph paper also helps to get a uniform design on product with exactly similar designs in all the mats, when more number of weavers are engaged for weaving a particular design. In the absence of a loom sketch, the weaver finds it difficult to asses the tufts required for different portions of design and when the designs is woven by more than one weaver, the assessment of the tufts for each colour in the design may vary from weaver to weaver thus causing difference in design from mat to mat. The preparation of loom sketch helps to avoid the above anomalies and facilitate the weaver for easy weaving.

The principle followed in the preparation of loom sketch is that each column in the graph paper indicates a tuft of fibre and the vertical rows of column represents warp, while the horizontal rows of column the rows of pile. To transfer a design from the design card to the graph paper first of all the number of warp threads and rows required for a particular size of mat for which the loom sketch is prepared have to be find out. For this the quality of the mat has to be ascertained.

Here a No.2 size mat of FM3 quality can be taken for examples. The FM3 quality stipulates 42 ends per foot and 21 rows per foot, as its quality requirement in respects of warp and rows per foot. The length and width of No.2size mats is 27"× 16" respectively. Now the number of warp and rows required for preparation of loom sketch are found out as follows.

Width of No.2 size mat - 16”

Warp per foot - 42

No. of warp required for 16” width - 16×42/12 = 56

Length of No.2 size mat – 27”

Rows per foot-21”

∴ No. of rows required for 27” - 27×21/12= 47 OR 48

Since the tufts of fibre are inserted only through alternate strands of tight warp threads, while weaving FM3 mat, for the preparation of loom sketch we need take only half the number of warp threads. Therefore the number of warp and rows to be taken for the preparation of loom sketch is 28 vertical columns and 47/48 horizontal rows of column is taken in the graph paper for drawing the design.

Now draw a rectangle in the graph paper enclosing the above number of columns. In the rectangle make the design, which is to be woven in the mat. After thorough examination of the design tufts required for each column in the design is determined, and marking is made in the graph paper with respective colours. If the design is a geometrical one with repeating motif is carefully calculated basing on the column available for the particular size of the mat. After this, number of repeats of the motif in the width way and the length way of the mat is calculated and the whole design is marked on the graph paper with required colours.

If the design is a floral one, first draw a free hand sketch of the design in the graph paper and thereafter basing on that free hand sketch column wise marking has to be made. While marking such designs care should be taken to see that, as far as possible, the exact shape of the design is obtained in the graph paper also.

1.1.3. Creel mats

Creel mats are manufactured both on handlooms and power looms. They are specially noted for their low pile height. In creel type of mats, the pile formed from warp itself. The yarn for the pile structure is released from the beam in the course of the weaving process. There will be always more than one kind of warp for any type of creel mats. One kind of warp, which is always held at the maximum tension (tight) interlaces with the weft and produce the base fabric. On the base fabric so formed loops of pile structure either cut or uncut are projected by the yarn of slack warp. The pile structure is obtained by suitable positioning of the coir yarn in the fabric structure with the use of grooved rods and cutting the yarn passing over the rods with a sharp knife.

Creel mats are available in natural, solid shades, stripes, jaspe, mottled, stencilled

and tile patterns. 2 chain creel mats and 3 chain creel mats are available. 3 chain creel mats have a firmer structure than 2 chain creel mats. In 3-chain creel mats, one slacker warp (binding chain) is used. The binding chain gives added strength to the mat by way of going over and under the weft and rows of pile.

1.1.3.1. Creel Mat (2 Chain)

For two chain creel mat, a loom having three treadles and three heddles frames are necessary. The slack and tight warp threads are prepared separately on two chain beams and kept suitably at the back of the loom. Slack warp threads are drafted through the 1st heddle fram e and the tight through the 2nd and third heddle frames in the order 2-1-1, 3-1-1. Thus the order of warp in the mat will be in the ratio of 1:2 tight and slack. Three warp threads-2 slack and 1 tight are drawn through each dent in the reed.

To proceed with weaving, depress the 2nd and 3rd treadle. Now all the slack warp thread will be raised up. Through the shed insert a grooved iron rod and beat the slay. Then depress the 1st treadle and insert a weft. After proper beat up, the 1st and 2nd treadles are depressed followed by the insertion of another weft. By this process, the iron rod first inserted will be properly held in the mat with slack yarn bent over it. To insert the second iron rod, the 2nd and 3rd treadles are again depressed and after inserting the rod, the 1st treadle is also depressed to pass a weft through the shed formed. Lastly the 1st and 3rd treadles are depressed and one more weft is inserted. Now passing a knife through the groove of the 1st iron rod, the slack yarn bent over it is cut. This cycle of operation is repeated to continue the weaving.

1.1.3.2. Creel Mat (3 Chain)

Three Chain creel mat is the best quality under the creel family. When compared to 2chain creel mats, in this case, there is an addition of one more kind of slack warp which works as a binding chain in the finished mat. The binding chain gives added strength to the

mat by way of going over and under the weft, and rows of pile. 3-chain creel mat with the base fabric composed of jute twine and pile structure formed by thin vycome coir yarn of soft twist is termed as “Carnatic mat” in coir trade. Carnatic mat which has a wide application as door mats, car mats, pile carpets etc comes under this category. Carnatic mats have a special appeal due to low pile height, lightness and other refinements in product structure. To enable the mat to posses the low pile the base fabric of the carnatic mat is formed out of jute twines.

Normally 5ply jute for tight warp and 2ply for binding chain or 3ply jute for weft and vycome carnatic yarn as slack (brush) warp are being used in the mat. The reed count of carnatic mat is the highest in the range for coir mats.

Horizontal rows on the rear side of the two chain and 3 chain creel mat is a characteristic for easy identification of creel mat. In carnatic mats, the ends/dm and picks/dm is almost doubled whereas the pile height and weight of the mat are almost reduced to half on comparison with 2 chain creel mats made of Vycome. For other types of mats in the three chains group, the yarns used for tight, slack and binding warp threads and weft will be used as per stipulated specifications of the respective quality.

In the traditional process of weaving three chain creel mats, 3heddle frames and 3treadles are required. Three kinds of warp threads-tight, binding and slack are prepared separately on three chain beams. The slack warp threads are drafted through the 1st heddle frame and the binding and tight through the 2nd and 3rd heddle frames respectively. The order of draft would be 3, 2, 1. These warp threads slayed 3 in a dent, 1-tight, 1-slack, and 1-binding.

Depressing the 2nd and 3rd treadles, weaving starts, through the shed thus formed insert a pile gauge. Changing the shed by depressing the 1st and 2nd treadles, insert a weft. Thereafter beat the slay properly and depress the 3rd treadle followed by the insertion of another weft. Now the pile gauge inserted will be properly held by the warp yarn having the slack warp through the weft properly bent over the pile gauge. Repeat the same operations for fixing one more pile gauge adjacent to the 1st pile gauge. After this, pass a knife through the groove in the first pile gauge and cut the warp bent over its. Same process can be repeated for weaving continuous length of mat.

1.1.3.3. Improved Weaving Technique for 3 Chain Creel Mat

The improved weaving technique evolved by the National Coir Training and Design Centre signifies the weaving of three chain creel mats necessitating the use of only two treadles and two heddle frames. One of the frames has specially designed heddles with the eyes for the pile warp fixed at a point 1.5” above the normal position and for the binding warp 1.5” below the normal position. The heddles with revised setting of eyes for pile warp and binding warp are arranged alternately in the 1st heddle frame. A 2nd heddle frame with the heddles having the eyes at the centre as usual is also arranged suitably in the loom.

The pile warp threads are drafted through the heddles having eyes at the upper part and the binding warp threads through the heddle with eyes at the lower part in the 1st heddle frame. The tight warp threads are drafted through the eyes in the 2nd heddle frame.

After usual tie-up, the 2nd treadle is depressed when 2 sheds simultaneously are formed – one at the top and one at the bottom. A weft is inserted through the bottom shed and the slay is beaten in position. Thereafter the pile rod is inserted in the top shed followed by depression of the 1st treadle for insertion of next weft through the top shed. 2nd pile gauge is also inserted by repetition of this cycle, after which the pile loops formed on the 1st pile gauge are cut as usual.

The following are the advantages of the improved technique over the traditional method

1. The number of heddle frames and treadles has been minimized to two thereby reducing the initial investment on the loom.

2. The weaving operation is made easier.

3. By limiting the number of depression of the treadles to only two for completing the process of weaving, instead of three in the existing method.

4. By facilitating the weaver to depress only a single treadle at a time throughout weaving (in the normal method followed at present the weaver has to depress the treadles twice in pairs and once in single).

5. In the stationary position of the heddle frames the three types of warp layers are kept at three different positions and therefore, inter thread friction is considerably reduced. This helps the weaver to get the warps for different sheds separate easily with lesser effort.

6. The production for weaver per loom can be increased by a minimum of 20%.

The new technique could be adopted in the loom without major modifications or additions. The replacement of heddles with the new type required only a very nominal investment. The 3rd treadle, heddles frame, pulley etc. eliminated from the existing loom could find use as spares or for fitting on new looms.

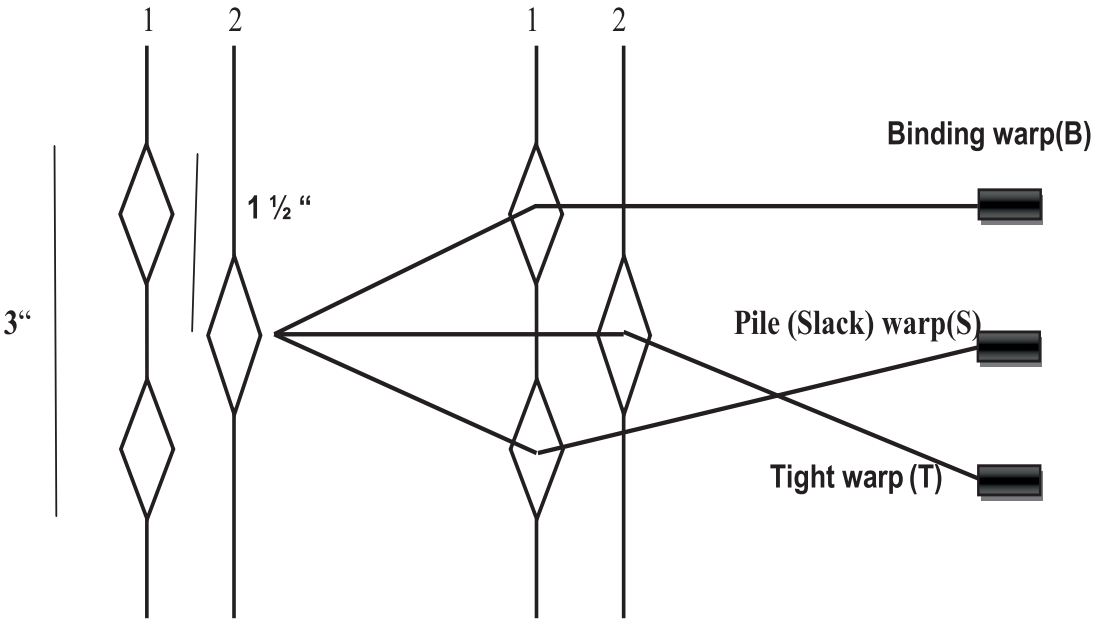


Fig (1) Position of warp layers when treadle frames are in the stationary position

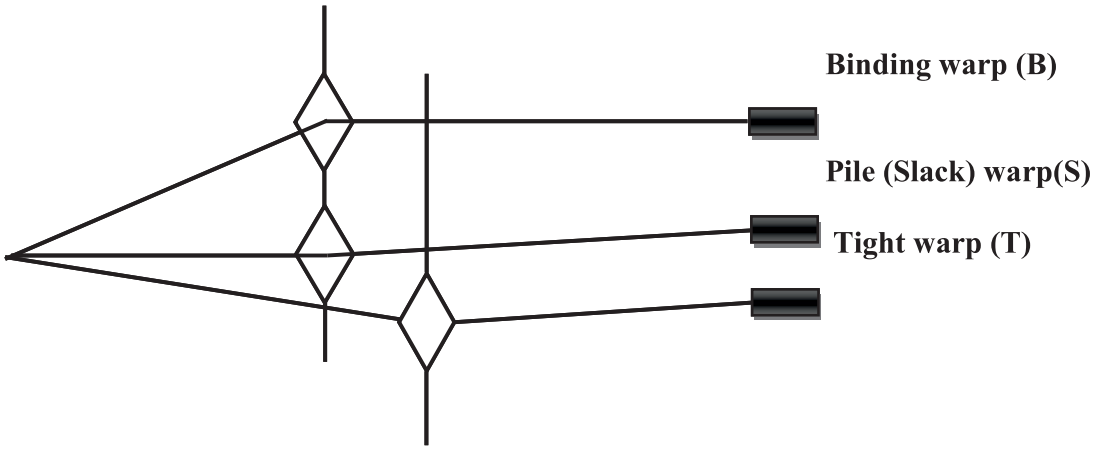


Fig (2) Position of warp layers when the 2nd treadle frame is depressed

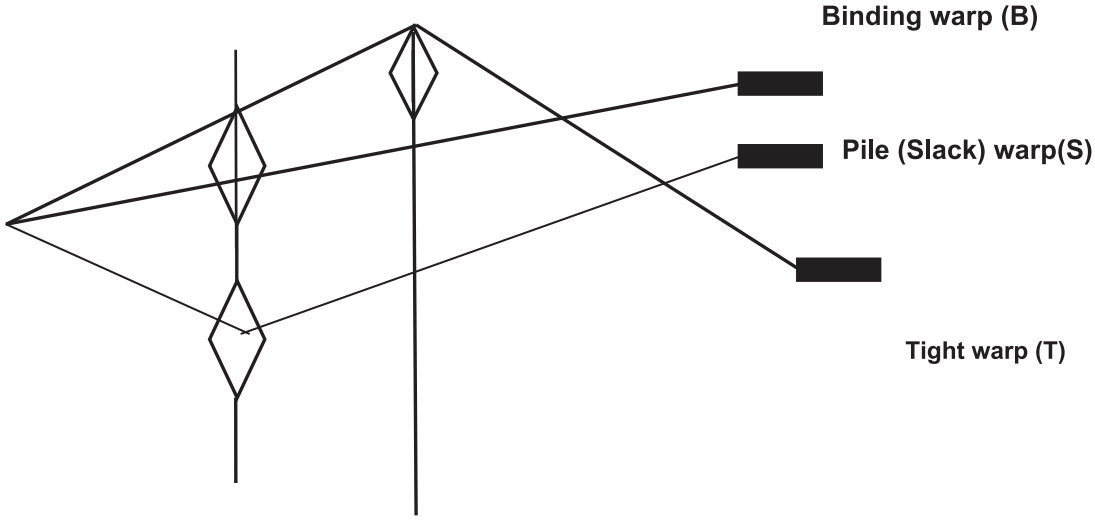


Fig (3) Position of warp layers when the 1st treadle frame is depressed

1.1.3.4. Coir pile carpets

Pile carpet is a novel item, usually manufactured in width up to 72", in different designs and colours. The piles of these carpets consist entirely of thin spun superior quality Vycome yarn, the base-fabric being made out of jute twine. Use of jute yarn in construction considerably improves the flexibility of the product, and the finer grade of soft twist Vycome yarn adds softness to the pile structure. Coir pile carpets are also of hand weaving type and form the cheapest floor covering amongst the pile carpets.Carnatic mats in wide width are excellent as rugs and also for wall-to-wall pile carpeting and car mats.

1.1.3.5. Power loom creel mat

Power loom creel mats are woven in roll and then cut into required size

1.1.4. Loop Mat

A mat made up by three chains, one tight and the others slack working as pile or

binding. The piles formed by loops formed out of slack chain in the weaving process.

This is one of the creel type of mats where in the pile is in the form of loops of yarn. The method of construction of this mat and the weave structure resembles the three chain creel mat and the main difference is that the piles are not cut as in creel mat and are allowed to project in the base fabric as loops. Available in stripe, tile forms; natural, bleached and tri coloured tile patterns are common.

This mat requires three warp beams – one tight and other two slacks of which one forms the loop and the other works as binding. The yarn used for pile should be preferably hard twisted to withstand the pressure while in use.

The loom requires 3 heddle frames and three treadles. The slack chain for pile is drawn through the first heddle frame. The binding slack and tight chain are drawn through the 2nd and 3rd heddle frames respectively. Generally 30's reed is used and 3 warp threads, one tight, one slack pile and one slack binding are slayed through each dent.

The weaving starts by depressing the treadles 2 and 3. Now introduce an iron rod without groove through the shed and beat properly. Then depress the treadle 1st and 2nd and a weft is inserted again after beating the shed is changed by depressing the 3rd treadle followed by the insertion of another weft. The same cycle of operation is repeated once again and after that the iron rod first inserted is pulled out and beaten hard. Now the yarn bent over the iron rod will project as loop on the surface of the mat.

Loop mats having loops in the form of stripes and squares are also produced. This is achieved by simple adjustments in drafting and treading. The stripes in the length way are formed by removing certain number of strands from the pile beam according to the size of the stripes required. Because of the absence of pile warp in those places no loops will be formed while weaving in those places, instead a base fabric inter woven by tight, slack binding and weft will be formed. It is advisable to substitute the removed pile warp by equal number of slack warp so as to maintain uniform density throughout the mat. Width way of stripes is produced by omitting the 1st treadling operation. In those places where loops are not required in the width way of mat, the weaving is done by following the treadling order 1+2 and 3 alone and completely avoiding the first process of treadling (2+3) and the pile rode insertion. The combination of the above two alterations will result in formation of squares of loops in the mat.

1.1.5. Rod Mat - Inlaid

Ordinary rod mat with the design produced in it by coloured tufts of fibre constitute the inlaid rod mat. Loom arrangements and other details of manufacture of this mat are the same as in the case of Rod Mat. Loom sketch by design is essential to facilitate easy weaving.

In the case of ordinary Rod Mat the pile is formed by cutting the topping yarn wound spirally over a grooved iron rod taken through every alternate warp threads. Normally the rod mats are woven plain. It is also possible to produce mottled effects in rod mats by arranging different coloured threads in topping yarn. Rarely horizontal stripes are also produced by

coloured punja yarn woven in a definite order to get stripes of different colour in the decided width.

But to produce the designs of different nature, it is necessary that coloured fibre tufts are also to be incorporated in the mat in addition to the usual topping yarn. To produce the design in the rod inlaid mat, the required design is first drawn on graph paper and kept in the loom to guide the weaver in putting the tufts at the required portions in the mat accurately. During weaving according to colour indicated on graph paper, the weaver inserts the fibre tufts through the required number of warp threads after forming the shed. Thereafter the punja yarn is taken through the warp strands through which the fibre is not inserted. After that a weft yarn is inserted and punja yarn is cut as usually passing a knife through the groove in the pile gauge. Now the top part of the fibre tufts is cut by a scissors.

Method of drawing design on graph paper for FM1&Inlaid

Rod mat

When compared to the method of drawing the design for double chain fibre mats, there are slight variations in drawing of designs on graph paper for inlaid rod mat and single chain fibre mat. In the 1ST case the working strands are the same through out the process of weaving, where as in the later case then working strands are changed for every row. This necessitates the column in the graph paper to be taken diagonally instead of the usual straight manner. The diagonally way of taking the coloumns facilitates the representation of both raised and lowered warp threads simultaneously in the same raw. Other advantages by taking in the diagonal way is that diamonds and such other shaped designs can be easily drawn.

As usual, the number of rows and warp required for drawing the design are calculated basing on the reed used and the rows per foot. If the reed used in 33's and the number of rows per foot is also 36 the number of rows and warp threads for No.1 size mat would be 72 and 38 respectively. For drawing a design for No.1 size mat the columns taken would be 19 vertical columns and 36 horizontal columns. After drawing a rectangle enclosing the above columns the design is marked on the graph paper as is done in the case of double chain fibre mat.

1.1.6. Bit Mat

A mat with the pile formed by insertion of bits of yarn on every alternate strands of chain.

1.1.7. Gymnasia Mats

A mat with pile formed by cutting three or more yarns folded together and wound around a grooved iron rod along with alternate ends of warp. The pile is made thicker to meet the specific requirements, usually has a pile height of 2 ½ inches.

1.2. Frame Mats

1.2.1. Sinnet Mat

This is also known as Chain Mat. A mat made of plaited (braided) coir yarn guiding it in an even zigzag manner with inter spaces giving patterns followed by stitching with the help of specially designed wooden boards.

Sinnet mat is a reversible non-brush mat. It is available in single chain and double chain and in a variety of colour combinations. For the preparation of fancy Sinnet mat, braids made out of different coloured coir strands are used. The braids used are generally 9 ply and 11 ply made out of hard twisted coir yarn. The length of the braid required depe nds upon the size of mat and the pattern to be produced.

A flat table upon which nails without heads are fixed according to the size and pattern of the mat required. To start with, the braid is put from one corner and is guided around the outer portion of the nails for one round, then it is guided to the inner side of the nails to form a second layer followed by stitching with the outer layer wherever required. Having completed the required number of layers for the border as described above, the braid is again guided to the inner part of the mat through the nails to form the required pattern.

1.2.2. Corridor mat

Corridor mat is also known as Hollander mat or Dutch mat. It is a mat in which both warp and weft strands are continuous without tucking in or binding. This is one of the mats that are woven without the help of a loom. It is a non- brush type one and the weaving is of carpet weaving in which the weft is predominant and warp is conceale d. The pattern effect being produced by the weft strands only and has rib effect on both sides. The iron rods temporarily function as warp.

It requires a wooden frame in which iron rods can be kept vertically through grooves cut on rails to the thickness of the iron rods .Basing on the length of mat, the rods are arranged on the frame according to the number of rods required for a particular length as per the ends per foot of each quality of mat. The number of ends per foot generally followed in the industry is 14/15 and 18/19. After arranging the rods, the weft yarn is passed in between the rods by hand alternately from one end to other and is turned back. This process of winding the yarn is continued until the required number of weft required for a particular width of mat is wound. For mats having designs, coloured threads are wound on the iron rods according to the designs. After completion of winding of yarn on one side the frame along with iron rods is turned to the other side so that the yarn can be wound on the latter portion of the iron rods. The process of winding the yarn on the iron rod is done similarly as with above case. The winding of yarn is done in this also as was done in the case of other half. Now the iron rods with yarn wound over it is removed from the frame and is placed in a pressing device.

The press consists of two iron rails out of which one is moveable by turning a handle. On the rails, small iron nails are fixed in such a way that the distance between the two iron nails equals to the distance between the grooves cut on the wooden frame to erect iron rods vertically to wind the yarn. This helps the iron rods to place them comfortably in the press while pressing. The iron rods with yarn placed on the two rails are subjected to pressing by turning the handle which causes the movable iron rail to move closer to the fixed rail to press the yarn to the required width. Now the iron rods are removed one by one and drawn roping yarn through the holes from where the rods are removed. All the iron rods are removed like this and the rope yarn is passed in. While passing the roping yarn through the holes at the extreme ends, a single thread of coir yarn is also passed in along with the roping yarn so that the protruding ends of thread can be utilised for preventing the weft threads of the mat at 4 corners from being loosened or removed while in use. The mat is then removed from the press and the 4 corners of the mat are made in tact by taking the protruding threads suitably to interlace with the weft in the mat.

1.2.3. Mesh Mat

This is a non-brush doormat having a regular mesh effect produced with the help of a specially designed rectangular wooden frame upon which nails without head are fixed in

equal distance. The size of the frame is made to the size of the mat to be made. The warp yarn is guided in between the nails in the length way and width way perpendicular to each other. There must be 4 layers of warp – two in length way and two in width way alternately. There will be 4 coir yarn crossing each other at the intersecting point. The mat is made by tying together the 4 coir yarn at the crossing point of warp layers by coir yarn with a special knot. Finer variety of coir yarn with the help of a needle is inserted through the mesh and circled over the warp yarn at the point of intersection in such a way that the stitching yarn should cross at the rear side of the mat. For getting designs, coloured yarn is used for tying.

A rectangular frame made out of 4 wooden planks up on which nails without heads are fixed in equal distance. The nails on one side of the frame are parallel to the nails on the opposite side of the frame. There should be 15 nails per foot. Usually for No-1 size, the number of nails would be 17 and 30 in width way and length way respectively. Similarly for No.2 size, the number of nails is 20 and 34.

Having completed the tying according to the pattern, the mat is taken out of the frame. The edges of the mat all round is finished by stitching with coir braid of suitable type or by a special braiding with 8 ends of coir yarn or finished with lace work.

1.2.4. Rope Mat

This is also known as Lovers' knot mat. A mat made with a coir rope guided through a number of upright nails fixed on a flat surface. It is available in oval, square, rectangular and round shapes. As its name indicates it is made of rope, usually hawser laid and shroud laid ropes are used. Separate wooden frames are necessary for different sizes of mats. The thickness of the rope varies with the size of the mat. Mat in the natural colour of the raw material, solid shades and with coir rope of multi coloured strands are available in this variety.

The following is the description of an oval shaped lovers knot mat.

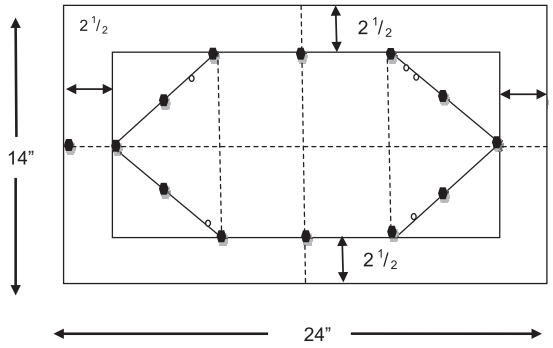
This mat is manufactured with the help of a flat wooden plank upon which long iron nails are fixed in a definite order. The rope is fitted at one end in between the nails and is guided through the other nails in the frame in a particular way so that each slab of mat will have five layers of rope throughout. There will be four double slabs and two single slabs in the length way of the mat and two double slabs and two single slabs in the width way of the mat. After completing the weaving, the starting and finishing ends of rope are merged with the slabs of mats in such a way that they cannot be identified. The side slabs around the mat are also stitched in order to avoid the slipping of single layers of rope from sides.

In the traditional process of manufacture, the thickness of rope used varies with the size of the mat. For a No.1 size mat, the thickness of rope used is ½" and for No.2 and No.3 size, the rope's thickness will be 5/8" and ¾" respectively. The length of rope required for No.1, No.2 and No.3 size are 78', 87'and 96' respectively. The weight of the mat will be 3lbs, 4lbs and 5lbs respectively for No.1, No.2 and No.3 sizes. The approximate output of 2 persons per day of 8 hours is 4 dozen mats

1.2.4.1. Nail Board for Lovers' Knot

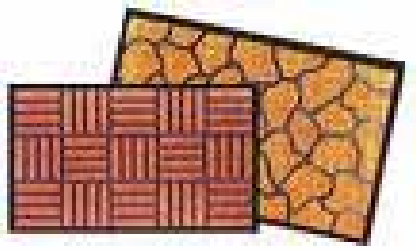
Take a wooden plank equal to the size of the mat to be produced. Draw two lines to divide the plank into two equal parts in the length way and width way respectively. For No.1 size mat, the rope's thickness is ½". Therefore, 5 layers of rope in a slab together will have 2 ½" width. Mark 2 ½" at the ends of the line drawn to divide the plank into two equal parts. Draw another rectangle inside leaving 2 ½" space all-round. Divide the rectangle into 4 equal

parts in the length way. Join the corners of the rectangles at the ends as shown in the figure.



Find out the midpoint of these diagonals and fix nails. Also fix nails at the ends of the diagonals and at the ends of the line drawn to divide the plank in the length way. Two nails may be fixed at the mid points of the length side of the inner rectangle. Now the Board is ready for manufacture.

1.3. Rubber backed/Tufted Mats



Coir mats formed by the bonding to the compounded rubber sheet base by vulcanising process. The brush portion of the mats are embedded over the rubber sheets and designs are produced on the surface of the mats.

1.4. PVC/Latex Tufted Mat

This machine is designed to produce coir mats in 200cm width with PVC/Latex backing and the production capacity of the machine is 100sq meter per hour with a pile height of 12 mm to 30 mm and consists of the following.

1. Creel stands to carry yarn in spools.
2. Pre heated to eliminate excess moisture in yarn.
3. Motorized stirrer/ Pulveriser unit for PVC/Latex mixing
4. PVC/Latex pumping system for pumping PVC compound
5. Spreading platform for PVC/Latex emulsion
6. Cutting head to cut the yarn into bits as per pile height of mat

7. Belt Joining device
8. Teflon conveyor
9. Heating panels of required quantities
10. Cooling zone of required length
11. Roll winding device
12. Electrical panel board.

The creel stand is provided with required number of yarn guide plates made of MS sheet having holes drilled on them for proper guiding of yarns towards the machine and placed near the nose end of the machine. The cutting head will comprise of side framing made out of heavy MS plate capable of absorbing heavy stroke while cutting. It is provided with suitable knife holders on the top and bottom and also with cutting knife capable of cutting yarn for tufting. It has arrangement to adjust the length of yarn to suit different pile with a chute. Cutting head has a spreading platform for PVC/Latex emulsion and device for controlling its thickness. Hanks of coir yarn are wound into spools by using spool winding machines. Hanks are placed on the flyers supplied with this machine and yarn is taken through yarn tensioners and attached to the empty spools on the winding drum. When the machines start the winding drum rotates and the yarn is wound into spools. The yarn released from the spools is first chopped into equal preset lengths and thickly implanted vertically onto the PVC resin/latex sheet by passing the materials through a chute. The pile height is controlled for achieving the required thickness of the sheet. The cutting head shall be supplied with 2 sets of long knives.

A conveyor with heat resistant Teflon belt running along the length of the machine provided with two rubber coated end rollers. The movement of this conveyor is regulated by the belt aligner. The conveyor belt is Teflon coated, capable of withstanding temperature up to 250^{0}C, so as to facilitate easy removal of the sheet after cooling.

An inline shearing unit with spiral and ledger blades at the tail end of the machine for uniformly shearing the top part of the brush portion of the mat according to the required pile height with facility for dust removal during shearing. An in built cutting system for cutting the tufted mat to preset rectangular sizes, both longitudinally and horizontally and a cross cutting station for cutting different size of mats automatically to the required length has been provided. A circular blade mounted on a traveler moves from one side to the other to facilitate cutting of mat in preset lengths. The tufted mat when needed in full length roll, bypasses the cutting device and wound in roll form with the help of this roll winding device.

1.4.1. PVC/Latex mixing

The Mixing Unit consists a stirrer, circular in shape revolves at a very high speed and whereby either the PVC or latex placed in a mix vessel underneath the stirrer is well stirred with all its additives to make a compound suitable for feeding to the tufting machine. This stirrer is provided with facility to move up and down whenever needed while stirring process. This is also provided with a dust collector with suitable hoper and blower to drive out the

dust during stirring and collect it in suitable container. The mixed compound on the mixing vat is carried to the tufting machine and the compound pumped into the platform near to the cutting head with the help of a diaphragm pump.

1.4.2. Process of Tufting

In the tufting machine, spooled coir yarn is placed on the creel stand which is cut into bits and positioned automatically upright over the moving conveyor platform over which PVC/Latex emulsion is pre spread. For feeding the latex compound to the spreading platform of tufting machine, the latex compound is stored in over head tank and the compound is conveyed to the spreading platform through PVC hose by gravitational force. The conveyor in its forward movement passes over the heating oven and cooling zone and by doing so, the bits of coir yarn gets implanted family over the PVC/Latex base and forms the mats. The mat can be rolled out of the machine in continuous length or cutting to mat size by longitudinal and cross cutting. Starting from the creel stand to the delivery end, the machine performs automatically.

Shape mat cutting machine is used for cutting the PVC Tufted mats into different shapes using templates. The Carpet Shearing machine will consist of a feed arrangement with 2 rollers to receive the carpet rolls and after that a shearing with spiral cutter and ledger blade. The packing machine is required for packing the coir mats in roll and in mat sizes. The spray bleaching machine is intended for bleaching of coir mats.

Handloom creel mats and other similar products lost their demand in the market with the introduction of PVC tufted coir mat. It has badly affected small scale handloom creel mat producers in the coir sector and they had to close their units for want of orders. The investment cost of standard tufting unit is very high and beyond their reach, therefore many small production units were closed and workers lost job.

Tufting of coir yarn over the PVC base using automatic device forms the brush pile of the mat. Mats with varying brush pile can be produced and the mats can be cut into any shape, size and in rolls are used as wall-to-wall carpeting material. Shaped mats, stencilled designs and flocked designs are available.

This was a serious issue in the coir market. Coir Board took the initiative and developed a Mini PVC Tufting unit costing less and which can be used by small units with

low investment i.e. less than 2 million rupees. Hence this innovation will help the small scale coir producers to start mini PVC tufting units for their profit and also give employment opportunity to the unskilled manpower. Women can operate the machine easily for more wages and earn profit towards the income generation.

Important features:

PVC backed non-woven mat in 50cm width and different length Pile height and PVC thickness can be adjusted by cutting and doctor blade

- The product can be rolled in a rolling machine attached with the unit
- The product can be cut into required size of door mats
- The mat can be finished by shearing and stenciling / flocking
- Production is 120 square meter per shift(8 hours)
- Manual power needed is three
- Machine cost is Rs.25 lakhs
- Coir yarn needed is Vycome quality of 160-180 kg for a shift
- Power consumption is 3 phase of 12 HP
- Women workers can simply operate the machine

1.5. Shape Mats

Shape mats, as its name suggests come in attractive ranges of shapes and sizes. Produced on handlooms or power looms, shape mats are intrinsically woven with hues of elegance and style.

1.6. Stencilled Mats

Using tin cut stencils, one each for one colour, multicolor designs are printed with dyes producing brilliant hues and from pigments. Wide range of designs is printed for consumer interest.

1.7. Non woven mats (Coir Braid carpets)

It is made by binding coir rope/coir yarn/coir braid to the rubber compound base by vulcanization. It is available in a range of patterns and colour combinations. Non-woven braid carpets can be made in round or oval shapes by interlocking flat braid layers together.

1.8 Carpet Mats

Coir mourzouks and coir carpets in mat sizes are available in natural and solid colours and in a range of woven patterns.

1.9. Coir Matting Tiles

Rubber backed coir matting in tile form with or without edging used for wall-to-wall carpeting. Mattings are cut, rubber backed and finished with narrow straight edges enabling it to be laid together, to form tiles.

1.10. Matting Mats

Coir mattings are cut into the sizes of mats and the edges are finished with all-round rubber edging or tucked back or stitched Latex backing or rubber sheet backing are also resorted in the manufacture of these mats to give a firm look for the product. Latex or rubber backing of these mats makes them non-slip. These are available in natural and solid colours, woven patterns, stripes, jaspe and stencilled patterns.

1.11. Inlaid Design

During the weaving process of fibre mats and rod mats, different coloured fibre tufts are inserted for embellishing the designs on the mat. The woven mats are subjected to bevelling or clipping process of the edges of the designs for giving an embossed look. Any intricate designs can be woven on these mats as per the requirement of the customer.

1.12. Flocked designs

Coir mats with flocked designs are available in the industry. It is done on a flocking machine using flock powder and gum. The patterns and designs are made on the stencils according to the requirement of the customer and the flocked designs are printed on the mats with various colour combinations.

2. Finishing of Mats

The mats taken out of the loom after weaving necessitate certain finishing operations before they are being used. The usual finishing operations adopted for the different types of mat are as follows.

2.1. Rod mats

1. Squaring
2. Tying
3. Binding & Stitching
4. Preliminary clipping
5. Smoking
6. Shearing
7. Final clipping
8. Bevelling

2.2. Creel mats

1. Squaring

2. Tucking in
3. Smoking
4. Shearing
5. Trimming

3. Finishing operations of Mats

The different finishing processes of the mats are detailed below.

3.1. Squaring

This is the process by which the size of the mat is made to the correct size of the measurement required. Usually rod mats, creel mats etc. are woven a little longer in length than required. The squaring process is done with the help of a wooden device on which the length and width of the mats are marked. According to the correct length and width, the excess length of the piece, if any will be removed by taking out the extra length of weft and pile tuft.

3.2. Tying

This process involves the tying of the protruding warp threads at both sides of the mat with the help of jute twine (3 ply) so that the pile tufts are prevented from coming out from the edge.

3.3. Binding and stitching

In this process, coir braid is put all round the mat and stitched with the body of the mat keeping the braid in vertical position around the mat. This avoids the falling of the pile at the edges of the mat. Usually for mats having a low pile (less than 45 mm), 5 ply and for mats having higher pile height (45 mm and above) 7 ply coir braid of hard twist yarn are used. The stitches given to the braid with the mat should be minimum 8 per foot.

3.4. Tucking in

This process is usually adopted for double chain fibre mat and creel types of mats. The protruding ends of warp at both cut edges of mat are turned back by passing a needle at least through 3 rows of weft at the backside of the mat. This process besides ensuring strong edges prevents the weft and pile structure from loosening while in subsequent use.

3.5. Smoking

This process gives brightness in colour to the mat. The sulphur smoke produced by burning a mixture of rolled sulphur and alum is allowed to encircle in a closed chamber in which the mats are stocked suitably so as to allow the mat to absorb the smoke throughout the mat evenly. The mats are kept in the chamber for about 8-12 hours. The quantity

of sulphur and alum for the smoking depend on the size of the smoking chamber and the quantity of mats to be smoked. Best results are obtained with the following formula. For 100 sizes of mats of average size, 4 kg sulphur and 125g alum is required.

3.6. Shearing

The shearing process is aimed so as to cut the top portion of the pile structure uniformly. A machine called shearing machine does the shearing. In the shearing machine, there is a cutting arrangement, which consist of highly revolving spiral blade and a fixed ledger blade. The mat is pressed in between the feed rollers and the cutting edge and cutting arrangement during the shearing process. During the passage, the upper portion of the mat comes in to contact with the cutting arrangement and shearing takes place. The distance between the feed roller and cutting arrangement can be adjusted according to the pile height of the mat produced. The mats are packed one over the other as bundles during smoking which shall affect the surface of the mat (brush). The shearing is conducted after smoking so as to keep the uniformity of the brush structure.

3. 7. Trimming

This is the process, which is performed after shearing. Here the brush at the edges of the mat is cut uniformly so as to offer a neat edge to the mat using big scissors. Trimming can also be done by a trimming machine, which works almost in the same principle as for shearing machine.

3.8. Preliminary Clipping

Fancy fibre mats and inlaid rod mats are subjected to clipping process to give prominence to the design woven on them. This process is carried out before shearing, by cutting the outlines of designs with the help of small scissors.

3.9. Final clipping

The mats subjected to preliminary clipping after shearing and trimming are taken for final clipping A final finishing cut is given to the portion already cut during the process of preliminary clipping.

The stencilled mats are also subjected to final clipping in which the outlines of the designs are given a thin cut with the help of scissors so as to give the design more prominence. Clipping of stencilled design is also known as bevelling and the cutting is not as deeper as in the case of preliminary clipping.

3.10. Bevelling

Bevelling is done on a mat after stencilling to give prominence to the stencilled designs.

3.11. Passing

A final check up is carried out to the mat in this process. Packing is conducted only after passing the mats. While passing, individual mats are checked up and defects if any are removed.

3.12. Stencilling

Plain mats are printed with beautiful designs in this process. The dye solution is applied on the mat by the spraying or brushing with the help of stencil plates on which designs are cut. The spraying process gives better result. Spraying is done with the help of a compressor and a spray gun. The stencil plates are cut according to the designs and to the size of the mat. The number of stencil plates required for a particular design depends upon the number of colours used in the design. The stencil plate is placed on the face of the mat and after pressing it properly; the stencilling process is carried out either by spraying or brushing the colour solution. For best results, the dye solution should be kept as hot as possible.

5 to 6 g/ litre for basic dyes
10 to 15 g/ litre for acid dyes
15 g/ litre and above for direct dyes
DBA is not used

Apart from the traditional coir dyes other colours like Synthetic Enamel, Textile printing pigments, water based emulsions etc., are also used in mat Printing. The recipe for these types of colours depends up on the intensity of the colours used in the design. The method of application of these colours is same as in the case of Coir dyes.

Coir matting is, by and large, made on wooden handlooms of sturdy construction.

4. Coir Mattings

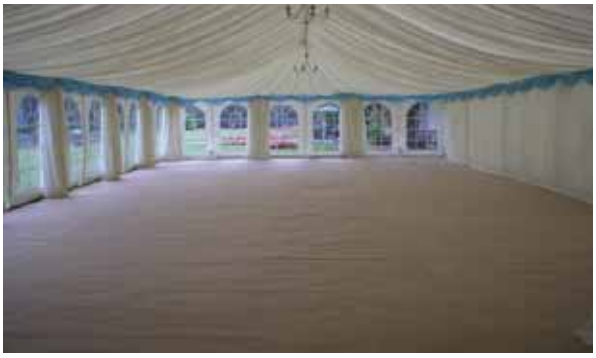
The skill of the craftsmen plays an important part in the get-up and finish of the final products. Coir mattings are produced on indigenously fabricated semi-automatic looms and power looms.

A wide range of designs can be produced in coir matting by adopting multi shaft weaving technique. Coir mattings are manufactured in varying width ranging from 60 cm to 5 meter and in 50-meter length rolls.

4.1. Applications of Coir Mattings

Coir matting is primarily used as a floor furnishing material.






It is widely used in exhibition and fairs as a temporary but neat and elegant floor coverings. Because of its sound deadening characteristics, it is being used on a large scale for furnishing stairs, corridors, and auditorium and cinema halls. A wide range of attractive designs and colours as well as quality makes it a favourite item of internal decorators.

It is one of t he best materials known throughout the world for its durability, sound proofing and damp resisting qualities. Coir mattings are backed with natural rubber latex to make it non-skid and for easy furnishing.

4.2. Weaving of Coir Mattings

4.2.1. Wooden Handloom and its Important Parts

Loom is an equipment with the aid of which coir products are produced by the process of weaving. A wooden hand loom in coir industry consists of the following parts.

1. Chain beam 2.Chain rest beam 3. Heddle frame 4. Pulley 5. Sley 6. Reed 7. Waist beam or front rest 8. Tension beam or cloth beam 9. Treadles 10. Lamp rod and 11. Shuttle

4.2.1. 1. Chain beam

Chain beam is a wooden roller upon which the warp yarn is would. The length of this will depend upon the width of the loom. It is provided with two flanges on both sides. The warp is wound on the beam in between the flanges. At one end of this beam is provided a wooden ratchet wheel, by operating which the warp can be released from the beam.

4.2.1.2. Chain rest beam

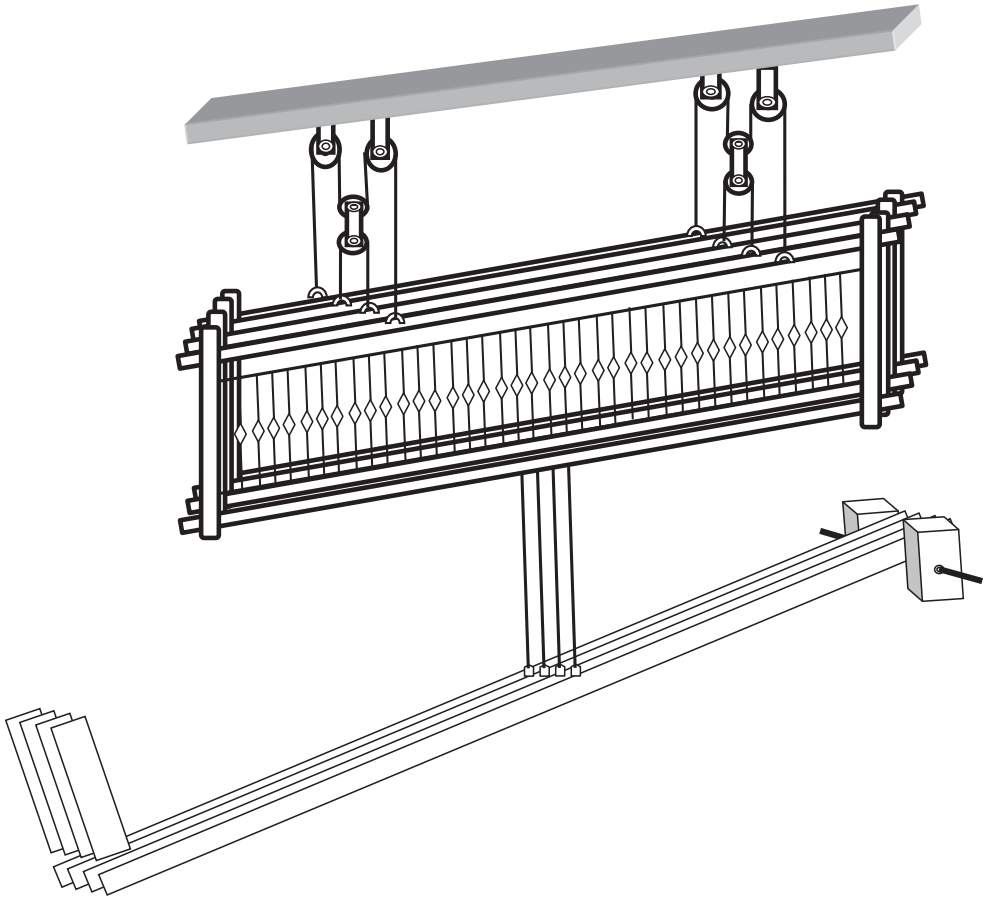
This is a wooden beam the size of which is equal to front rest. The function of this beam is to guide the warp yarn from the chain beam in a parallel sheet form to the heddles, reed etc. of the loom. Separate chain beams are provided for tight and slack chains. Chain rest beam for the slack chains are comparatively smaller in size then that of chain rest beam for the tight chain. The length of the chain rest beam is equal to the width of the loom.

4.2.1.3. Heddle frame

This is a wooden rectangular frame in which the heddles are arranged by suitable introduction of two iron rods at top and bottom which are called heddle staves. The number of heddle frames for a loom depends upon the design and the type of the fabric to be woven. The heddles are usually made of iron wires twisted to form a heddle eye at the centre and two holes at the top and bottom so as to insert the heddles through the heddle staves. Usually the heddles are made from 18 gauge G.I. wire. The length of the heddles is 18”. A hand loom in coir Industry is provided with maximum 4 heddle frames.

4.2.1.4. Pulley

They are meant for up and down movement of the heddle frames. By the help of single and double pulleys arranged suitably in the loom, the heddle frame gets compound movements when a treadle is depressed. i.e., when a treadle is depressed the corresponding heddle frame is lowered and at the same time it causes the other heddle frames in the loom to move up simultaneously. The pulleys are fixed on pulley beams placed on the pulley stand which are fixed on the top frame work of the loom. The diagram showing the tie-up of heddle frames with single and double pulleys is given below.



TIE UP OF PULLEY

4.2.1.5. Sley

The sley is used to bring the weft to the fell of the cloth, the process of bringing the weft to the fell of the cloth is called beating. The sley is composed of sley cap, sley sword, sley race, rocking shaft and reed. The upper part of the sley rests over the frame work of the loom. The sley is made to oscillate by introducing a knife edge at the place where the upper part of the sley and loom frame work touches each other at the top. In place of knife edge sometimes a rod and bush is also used.

4.2.1.6. Reed

Reed determines the width of the fabric woven in the loom. It is also responsible for the density of the fabric. The reed is fixed in the sley. It is made of loop iron slits distributed in a definite order in between the reed ribs. The space between the two iron slits is known as dent and the number of such dents in a specified length of a reed determines the quality of woven fabric in respect of density.

Regarding matting 100`s reed means there are 100 dents in one yard (3 feet). Usually 3 warp yarn are drawn in a dent. Regarding mats 30`s reed means there will be 30

dents in one foot depending upon the type of mat produced one or two or three warp yarn are drawn in a dent.

4.2.1.7. Waist beam (Front rest)

This is a support for woven material (fabric) and this guides the material to the tension beam.

4.2.1.8. Cloth beam (Tension Beam)

The shape of this beam is similar to chain beam and length is equal to the width of the loom. One side of this beam is attached with iron ratchet wheel and lever and catch. The ends of the warp are tied to upron rod which is connected to the tension beam by means of pieces of ropes. By operating the iron ratchet the take up of the woven material is made and tension of the warp is maintained. Regarding matting loom the woven product is wound on the tension or cloth beam by operating the iron ratchet. The tension beam of the mat loom is placed at the back side of the loom below the chain beam. The woven mats are collected at the back side of the loom by operating the iron ratchet provided on the tension beam.

4.2.1.9. Treadles

Treadles are meant for lowering and raising the heddle frames according to the design to be woven. The process of tying the heddle frames to the treadles is known as `tie-up`. By operating the treadle, heddle frames tied to its can be lowered or raised. The number of heddle frames and treadles are equal.

4.2.1.10. Shuttle

The shuttle is the carrier of the weft. It is a boat shaped device made of wood having arrangement to hold the quills inside it. The weft placed in the shuttle in the form of quills is carried by the shuttle from one side of the warp to the other side.

4.2.1.11. Lamp rod

Lamp rod is a wooden piece fitted on the loom just below the heddle frames. To ensure perfect working of the heddle frame, the heddle frames are first tied to the lamp rod and then to the treadle. In four shaft matting loom front and back heddle frames are not directly connected to the treadle. They are first tied to the lamp rod and then the lamp rods are tied to the treadles. The middle heddle frame is directly connected to the treadle.

Regarding mats loom each heddle frames are tied to separate lamp rod and treadles are connected to the centre of the lamp rod. This is to provide perfect working of the heddle frame and for the passage of woven mat from front to the back side of the loom.

4.3. Preparatory Processes

For manufacturing a product by adopting the process weaving, it is necessary that the raw materials used for the manufacture of the product has to be suitably processed so as to feed it conveniently to the loom and also to facilitate easy manipulation of the same in subsequent weaving process. Therefore, to achieve the above objects the raw material has to undergo certain preparatory treatment prior to weaving. The processes that are being followed in coir industry are Sorting, Splicing, Spooling, Warping and Beaming.

4.3.1. Sorting

The coir yarn generally available for manufacture is in the form of hanks of varied colour, twist, thickness and length. For a product that should be uniform through out in all respects a yarn of uniform colour, twist, scorage etc. is required. Therefore, it is necessary that the country hanks of the type mentioned above has to undergo a process of sorting in which case the yarn is selected basing on variety, colour, size, uniformity in thickness and twist cleanliness from pith and other foreign materials like sand, dust etc.

While sorting special care has to be taken in respect of colour. The yarn of the same variety, twist, thickness etc coming from the same region may vary in colour widely due to the difference in colour of the fibre used for spinning of that yarn. If this yarn is not effectively sorted out and thereafter used for the product manufacture, it will cause for the formation of a sort of unwanted streaky lines. This effect is known as `streakiness`.

4.3.2. Splicing

Splicing is the process of joining together the hanks of yarn of different length in order to get a continuous length of yarn. There are three methods of splicing followed in coir Industry. They are

(i) Ordinary splicing

(ii) Scrape splicing

(iii) Braid splicing

4.3.2.1. Ordinary splicing

Ordinary splicing is usually resorted to splicing of dyed yarn

4.3.2.2. Scrape splicing

The scrape splicing is followed for undyed yarn

4.3.2.3. Braid splicing.

Where a strong splicing is required usually the choice is for braid splicing.

Materials like jute, sisal, aloe are subjected to braid splicing.

The length of splicing should not be less than 3 inches.

4.3.3. Spooling

For weaving a product, having pre determined quantity, a long length of continuous yarn is required. Length of a country hank will range from 15 to 25 meter. These hanks after splicing are made in longer lengths and are wound on to the spools as per the quantity and

colour pattern of the final product. This process of winding the yarn on the spools is called spooling. In the usual practice splicing and spooling are done simultaneously. Normally a spool can hold a length of 1500 to 2500 yards of yarn. The spooling process is done with the help of a spool stand and flyer.

4.3.4. Warping

Before weaving, the yarn required for warp has to be prepared in a uniform and parallel sheet form in the required length. This is done according to the colour pattern of the products to be woven.

The warping is usually done using sectional warping drum. This consists of a drum about 5 yards in circumference. Its surface is covered by stripes of wood parallel to its axis on which long nails are fixed so as to form parallel rows both axially and circumferentially. These nails serve as guide and help to keep each section separate.

A creel stand having arrangement to hold the spools properly is kept at a distance from the warping drum. As many spools as are required by each section as per the colour pattern of the warp are arranged in a definite order on the creel stand. The ends of yarn from the spools on the creel stand are taken through the 1st lease reed one each through every dent and there after passed through the second lease reed in convenient group of strands as per total number of strands in each section. These groups of yarn are then taken through a single dent in the fixed reed kept adjacent to warping drum and is tied to a hook of the concerned section on the warping drum. The lease reeds can be moved or slided on rails kept parallel to the axis of the drum. This help in keeping the yarn straight and condensed

when it is being wound on the warping drum and also eliminates the entanglement of warp as it is coming from the spools. The drum is rotated manually. After necessary number of sections of warp has been wound on the warping drum, they are transferred to the weavers beam or chain beam.

4.3.5. Beaming

In sectional system of warping the required quantity of yarn for a definite length of matting or mat is first wound on the warping drum and thereafter it is transferred on the chain beam according to the length of warp required for that particular chain beam. This process of transferring yarn from the warping drum to the chain beam is called beaming.

Tension on the yarn while winding from the warping drum to the chain beam is maintained by putting a restraint on the formers' rotation by a pair of steel straps taken round the circumference of the drum. Ends of which on side are attached to springs bolted to the ground. The free ends of the holes are attached to heavy weight which is hanged freely. A number of chain beams can be prepared with warp on the warping drum.

The yarn from the warping drum is taken through a reed placed immediately after the warping drum and is tied on the apron bar fixed on the chain beam. The chain beam is then rotated in suitable manner and the yarn from the warping drum is wound on to the chain beam.

4.3.5.1. Motorised Beaming Machine

For weaving, it is required to prepare the warp chain beams on traditional equipment namely **"Vembly"** for feeding of the warp yarn uniformly. Creel stand with bobbins wound with coir yarn are used for feeding of warp yarn in place of the warp chain beams prepared on Vembly. Looms with creel stand need not require chain beams. Vembly is costly as it is made of wood. A motorised beaming system made of metal has been developed with a 1 HP single-phase electric motor for winding the yarn. It consists of a creel stand, reed and two metallic rollers of 100 mm diameter and a stand for fixing the warp beam. The motor and reduction gear effects the rotation of the warp beam. The productivity and quality of beaming is increased.

5. Looms used in Coir Industry

5.1. Coir Wooden Handloom

With the aid of loom, the process of weaving manufactures coir products.

5.1.1. Differences between Matting and Mat Looms in Coir Industry

1. Generally the notation for dent in a reed of matting and mat loom is different. For example, 100's reed in a matting loom means that there are 100 dents in one yard (3 feet) where as 30's reed in a mat loom means that there are 30 dents in one foot.
2. Usually 3 warp yarns are drawn in a dent for matting loom whereas one or two or three warp yarns are drawn in a dent for mat loom depending upon the type of mat produced.
3. Generally matting loom has four heddle frames and four treadles (maximum) whereas mat loom has 3 heddle frames and 3 treadles (maximum).
4. Generally matting loom (4 shafts) is having 4 single and 2 double pulleys. The double pulleys are tied to the 2nd & 3rd heddle frames and single pulleys to the 1st and 4th heddle frames whereas in mat looms with 3 heddle frames and 3 heddles, the two double pulleys are tied to the 1st and 2nd heddle frames and the 2 single pulleys are tied to the 3rd heddle frames. Only two single pulleys are required for two treadle/ heddle mat looms and both are tied to the two heddle frames.
5. The woven product is wound on the tension or cloth beam for matting loom and the cloth beam is placed below the front rest whereas the cloth beam is placed below the chain beam at the backside of the mat loom. The woven products are not wound on the cloth beam but collected at the backside of the mat loom.
6. For matting loom, boat shaped shuttles is used whereas for mat loom stick shuttles are used.
7. In the mat loom, each heddle frame is tied to separate lamp rods and treadles are connected to the centre of the lamp rod for providing perfect working of the heddle frames and for the passage of woven mat from front to back side of the loom. In the matting loom having 4 heddle frames, the front and back heddle frames are tied to the lamp rod and then the lamp rods are tied to the treadles. The middle heddle frames of the matting loom are directly connected to the treadles.
8. Generally the treadles are numbered from the left to right in matting loom and vice versa in mat looms.
9. Two heddle frames and two treadle mat looms are having only two single pulleys.
10. It is possible to produce matting in continuous length of 50 metre whereas it is not possible to weave mats in continuous lengths after a certain extent in mat looms as

the pile of the mat will be spoiled and uniform tension cannot be maintained on the woven product if it is wound on the cloth beam.

"Uday" Pneumatic Wooden Hand Loom for Weaving Coir Mats/Mattings

To modernize the coir industry with eco friendly technologies, CCRI has designed and developed a new traditional handloom operated by pneumatic system. This loom can produce different types of mats, mattings, carpets and coir geo textiles easily.

"UDAY" - Pneumatic Wooden Handloom

Women workers can easily operate the loom. No special training is necessary in this system. It offers high quality products with more production compared to the traditional wooden handloom and eliminates drudgery in weaving. This loom is operated by pneumatic system and pressure is produced by air generated from 1-2 hp single phase compressor which could be utilized for stencilling of coir products, an additional advantage of this loom without additional investment. Unique designs can be woven on this loom. The pneumatic system can be attached to the existing traditional wooden hand looms available in the weaving sector of coir industry. This new system is also considered as the transitional technology from traditional way of weaving towards the most sophisticated weaving technology for coir industry.

Comparison of Uday (Pneumatic) wooden handloom with traditional wooden handloom

Sl. No.	Uday (Pneumatic) wooden handloom	Traditional wooden handloom
1	Operated by pneumatic control.	Operated by hand and foot.
2	One male or female worker can operate.	Two male workers are needed to operate.
3	Easy to operate.	Drudgery in operation.
4	300 gm of force is enough to operate the foot pedal control valves.	Minimum 30 kg force is needed to operate the wooden foot pedals.

5	Even beating can be done by air pressure	Uneven beating force may occur
6	Beating pressure can be controlled by regulator of the pneumatic system.	Beating pressure controlled by skill only.
7	Good quality can maintain by adjusting the pressure for each product according to specification.	Quality is maintained by skill of the operator.
8	Higher productivity.	Low productivity
9	Higher wages due to higher production and good quality of mats/matting.	Low wages due to less production of mats/matting.
10	Less maintenance cost.	High maintenance cost.
11	Quality will be same from person to person due to equal pressure of beating.	Quality may vary from person to person.
12	Single phase 2 HP compressor is needed.	No need of electricity.
13	Women workers find it convenient to work on the loom.	Women workers are not able to operate.
14	No skill is needed and can be operated by the women workers for better wages.	Wooden loom has to be kept idle due to lack of skilled male workers and poor wages.
15	The air compressor can be used for stenciling operation and save the capital for the finishing segment of coir industry.	No additional provision for income generation.
16	New generation women are keen to work on the pneumatic system for higher wages with lesser effort.	The new generation is reluctant to do the tedious works on traditional loom.

Cost for the conversion of traditional wooden handloom to "Uday" system of pneumatic wooden handloom.

Sl. No	Particulars	Amount (Rs.)
1	Pneumatic cylinders 8 nos. with connectors	30,000.00
2	PU Tubes for 12 mm and 8 mm dia with end connector	6000.00
3	Metal frame and rail connection for heddles	5000.00
4	Mild steel channel, angle, rollers, flat, pipes	16,000.00
5	Air compressor constant 10 bar pressure, starter	50,000.00

6	Ball valves and other relay, connectors	1000.00
7	FRL unit with junction box	10000.00
8	Air control foot valve with silencer, male connectors	7000.00
9	Labour charges	25,000.00
	Total	**1,50,000.00**

5.2. Semi- Mechanised Loom

The main problem of weaving on hand loom is the high force needed to operate the pedal for lifting the shed and the force to beat the sley. Usually healthy male workers are engaged for weaving.

In power loom, both this operation is done by motor but the high cost of the loom is restricting the user to purchase the power loom.

To overcome these difficulties, a semi mechanised loom has been designed and fabricated. In this loom, beating, shedding and winding are carried by motor and the picking is done manually.The quality of the mating woven in this loom is good. The picks also can be changed depending on thickness of weft yarn. One roll of 50m^2 can be woven per day.

5.3. Power Loom

Most of the big coir export houses are having power operated imported loom, as the small-scale coir manufacturers cannot afford the cost of the power loom. The small-scale manufacturers are still using the wooden handloom.

As an alternative to this scenario, the effort to manufacture indigenous power loom have succeeded to design and fabricate a power loom. All the components of the loom were fabricated locally; the loom has a speed of 90 picks per/hour.240 sq meter of coir matting can be woven per day with the help of one operator and one helper. Bobbin winding machine and creel stand is required for the loom.

5.4. Dobby Loom

5.4.1. Dobby Shedding Mechanism

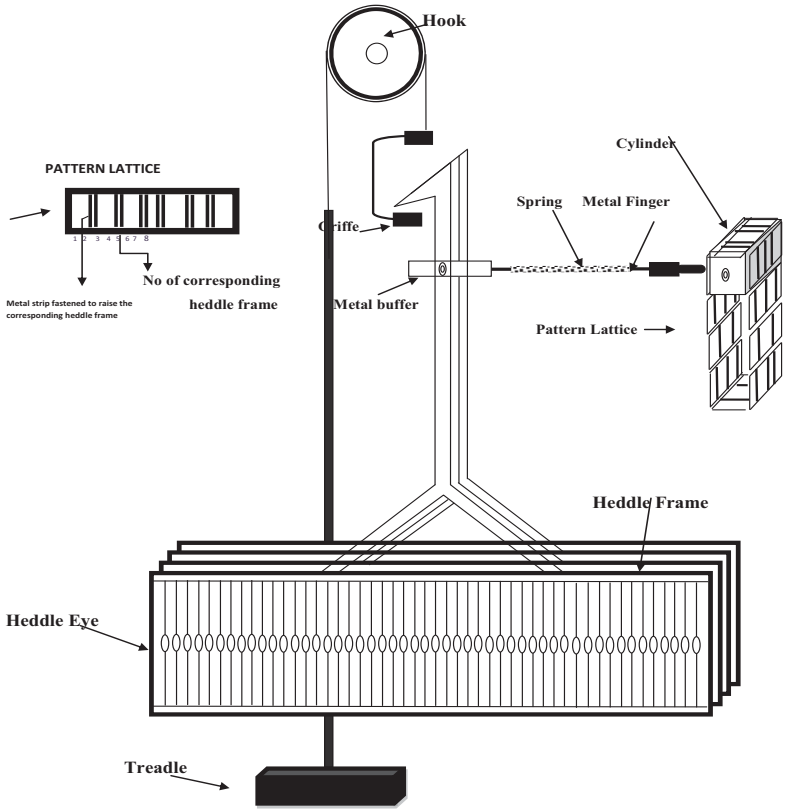
Dobby is employed when a pattern is beyond the range of usual number of heddle frames, which can be conveniently manipulated and is at the same time too small to be economically produced by a Jacquard loom. The number of shaft in a dobby loom may vary from 6 to 40. Dobby looms, which are used in coir industry usually, have 12 to 16 shafts.

The mechanism facilitates control of more number of heddle frames by operating a

single treadle. The heddle frames have upright hooks riveted at their top parts. The hooks extended upwards towards the top mechanism and the bend upper part of the hook rest near to the griffe, but are slightly away from the line of action of the griffe. The hooks have metal buffers, fixed on it just below their bend upper part. Buffers are connected to spring placed horizontally. The other end of the springs is connected to metal fingers. The fingers project from a metal frame at the other end facing a cylinder, on the surface of which the pattern lattice in an endless chain manner rest.

The treadle is connected by means of suitable chain, pulleys, etc. to the griffe in such a way that when a treadle is depressed the griffe is moves up. Similarly, the cylinder is also made to move 1/4th of its revolution axially by means of suitable mechanical contrivances, when the treadle is depressed. Thus the cylinder, because of its above axial movement will present fresh pattern lattice for every treadling to the metal fingers. The cylinder gets side way movement also while treadling. This helps the cylinder to come into contact with metal fingers before picking and to be away from them after picking is over.

The pattern lattice is made of rectangular plywood pieces correct to the length and width of one face surface of the cylinder, by cutting out the centre portion so that when the cylinder with pattern lattice on its surface came into contact with metal fingers, the pattern lattice will not in the normal course disturb the metal fingers. On the surface of the card, the position of the entire metal fingers will be marked. Then metal stripes are fastened on the pattern lattice according to the order of heddle frames to be lifted for each picking. The total number of pattern lattice will depend upon number of picks in a repeat of the design to be woven.



All the pattern lattices after having fastened with metal stripes as per treadling order (lifting order) will be laced together and made into an endless chain manner which will be placed over the surface of the cylinder.

When the treadle is operated the cylinder will strike the metal fingers with pattern lattice. Now because of the presence of the metal stripes on the pattern lattice, which were fastened according to the lifting order, the corresponding metal fingers will be pushed forward. Where there are no metal stripes on the lattice, the fingers those which are corresponding to those place are allowed a free entry into the inner part of the cylinder and thus they remain in their original position without any disturbance due to the striking action of the cylinder. The fingers which were pushed forward will cause the same movement on the hooks of heddle frames and will cause them to be in the line of action of the griffe (path of upward movement of the griffe). When the treadle is depressed the griffe move up along with the hook which is in the line of action of the griffe. Thus when the griffe is moving up it will carry those hooks also up. As the hooks are directly connected to the heddle frames the corresponding heddle frames will be raised up. Thus shed is formed.

When the treadle is depressed the cylinder move side wise and complete ¼ of its axial rotation. So that a fresh card may be facing the metal fingers.When the picking is over the cylinder strikes the metal fingers and metal stripes of the fresh pattern lattice cause the hook to move forward to bring them into the line of action of the griffe so that while treadling for the next pick necessary numbers of heddle frames would be picked up.

5.5. Jacquard Loom

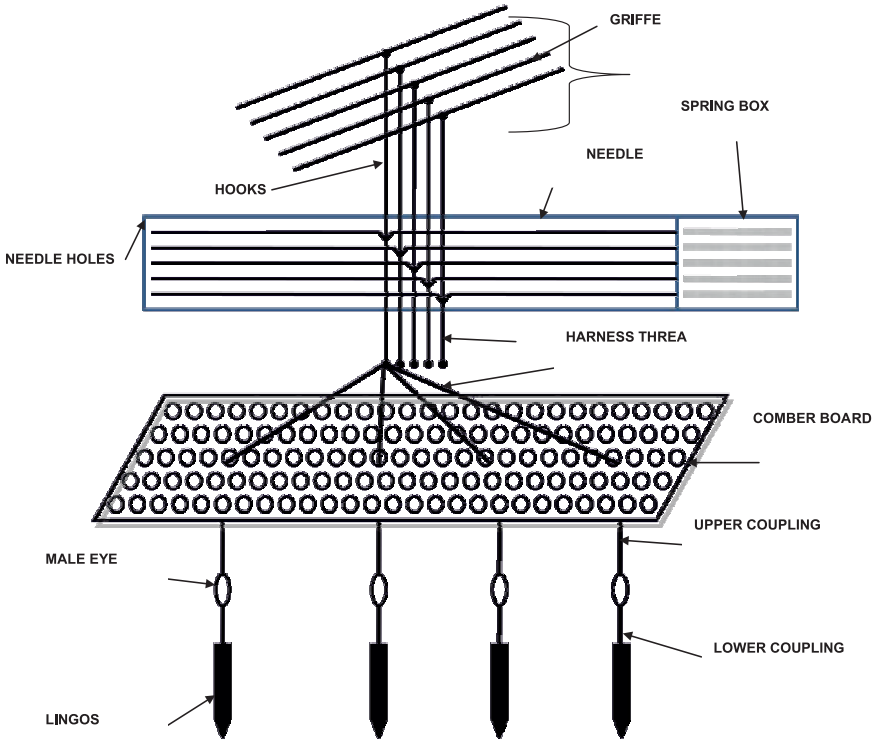
5.5.1. Jacquard Shedding Mechanism

It is the most improved type of mechanism that exists in the weaving. The mechanism facilitates control of warp threads individually and provides a very large scope for producing complicated designs. In ordinary and dobby looms, only a group of warp threads drawn through the heddle frames depending upon the number of heddle frames used can be either raised or lowered for every picks, whereas in Jacquard shedding mechanism each and every warp threads can be individually controlled according to the will and pleasure of the weaver as per the design.

The design making capacity of the jacquard machine is expressed in terms of number of hooks in the machine. In coir industry the machine having 100-400 hooks are in

practice. The machine is kept at the top of the loom. The design to be woven is first drawn on a graph paper and is punched on pattern cards. The size of the card depends upon the capacity of the Jacquard machine. In the Jacquard design, draw the design in the ratio 2:1 for warp and weft for getting a square design and take a ratio of 1:1 for producing a rectangle in the matting.

The hooks in the machine are placed vertically and neck cord is attached to the bottom part of every hook. The neck cord branches into as many number of harness threads as there are repeat of the design in the width of the matting.eg: if there are 4 repeat in the width way of the matting each neck cord will be branched into 4 harness threads. Harness threads are drawn through the comber board and are attached to the upper coupling of male eyes. In between the upper coupling and lower coupling male eye is arranged. Lingoes are attached to the lower coupling.



The machine is operated by a single treadle. This is connected to a lever at the top by means of a pipe or thick cord. There are needs placed horizontally connected to each hook and are in the same numbers as the number of hooks in the machine. A four sided cylinder having holes drilled on all sides is kept at one side of the machine facing the needles. Each side of the cylinder will have the same number of holes as to the number of hooks in the machine.

The design to be woven is first drawn on a graph paper and is punched on pattern cards. The size of the card depends upon the capacity of the jacquard machine and on each card the provision is made for punching the holes equal to the number of holes in one

side of the cylinder. Each card will represent a pick and the holes are punched in the card according to the order of raising and lowering of warp threads for that particular design are laced together one be one in an endless chain manner and are arranged on the cylinder in such a way that one card will be always resting over the face of the cylinder which is facing the needle board.

There are iron bars known as griffes or knives equal in number to the number of long rows of the hook in the machine. They are fitted in the machine horizontally and can be moved up and down while treadling. In the normal condition the griffe will be positioned just below the bend upper part of the hooks. For every treadling the cylinder is revolved axially for 1/4th of its revolution facilitating the cylinder to present fresh card before the needle board. During treadling the cylinder will come into close contact with the needle board and will allow certain needles to enter into the holes of the cylinder through the holes punched in the card. Now the corresponding hooks connected to those needles will keep their position as it is and when the griffe is moving up those hooks also will be lifted up. Thus the warp threads attached to those hooks will be raised up. Where there are no holes in the card the pressing action of the cylinder against the needle board will cause the corresponding needles to move backwards. This movement of the needles will affect the position of those hooks causing them to move away from the path of movement of the griffe and prevents those hooks from carrying upward by the griffes when it is moved up. The warp thread attached to those hooks thereafter, will keep up their position as it is without any movement and forms the bottom layer of the shed. This is how the formation of shed is achieved in the Jacquard Shedding Mechanism.

The restoration of the normal position of the needles after the action of the cylinder is performed by the introduction of small springs to every needle at one end, kept in a spring box.The axial movement of the cylinder is actuated by the help of a fork that is connected to a spring by pulley which the fork can be moved up. In the normal condition, the upper part of the fork will engage the metal lattern of the cylinder and rotates it. It is required to reverse the rotation of the cylinder for reasons of any error in the design or so, the spring is pulled down so that the lower part of the fork will engage the cylinder and rotate it in the opposite direction.

5.6. Metallic Handloom

Fabrication of wooden handloom requires one cubic meter of wood such as Sal, Thembavu, Maruth etc. A tree of height 15 meters and diameter 0.5 meter can produce 2.25 cubic meters of planks and struts. Therefore two wooden handlooms require cutting of a tree. The metallic handloom could save trees, which are very essential for maintenance of ecology. As there is no power requirement for this loom, it can be installed in the remote villages where women workers can easily operate it.

Comparison of Traditional Wooden Handlooms & Metallic Handlooms

Sl. No.	Traditional Wooden Handlooms	Metallic Handlooms
1	Heavy weight.	Light Weight.
2	Difficult to shift from one place to another.	Easy to shift.
3	Occupies large space.	Occupies less space.
4	Maintenance and repair cost is high.	Less Maintenance.
5	Movement of sley is regulated by hand, thus gives weft per unit length not uniform.	Uniform weft per unit length.
6	Foundation is required.	Needs no foundation.

5.7. Pneumatic Loom

It is a versatile loom for weaving different kinds of coir products like coir mats such as Rod mats, Rod inlaid mats, Loom mats, Carnatic mats, Creel mats, Fibre mats, different kinds of two shaft and three shaft mattings, Carpets & Geo textiles.

Pneumatic system offers basic advantage of high efficiency in comparison to the manually operated traditional handloom. Handlooms are known for weaving of coir yarn into woven products such as mats, mattings and carpets. However, the known handloom is incorporated with treadles for movement of the heddles and sley, which were manually operated. The load applied to such treadles is as high as 45 kilograms. Since such a load has to be applied manually by workers, the productivity gets substantially reduced due to fatigue. In pneumatic loom, the treadles are replaced by pedals, which are no longer manually operated and give a higher productivity. The additional advantage is that the exhaust air from the compressor can be used for stencil printing on doormats.

The pneumatic drive is connected to the pedal for the up and down movement of the treadles. A second pedal is provided for causing a movement of the sley. Therefore beating is not manual as in traditional handloom. It is more advantageous for a women worker who has no difficulty in operating the loom.

Comparison of Traditional Coir Wooden Handlooms & Pneumatic Loom

Sl. No.	Pneumatic Loom	Traditional Coir Wooden Loom
1	Woman can operate easily.	Requires healthy male workers
2	Only one operator can run the loom	Requires at least 2 operators.

3	450 gm of foot pressure is sufficient for treadling	Requires 45 kg of pressure for treadling
4	Mats can be made in running length.	Mats are produced in pieces.
5	Higher output	Comparatively lower output
6	Less and easy maintenance	Requires tedious and time consuming maintenance
7	Automatic winding mechanism	Intermittent manual winding is needed.
8	Beating force regulating mechanism	No beating force regulating mechanism thereby irregular formation of weft is observed
9	Shedding, beating and winding done automatically	Shedding beating and winding done manually resulting in low production
10	Versatile to produce all types of mats and mattings and geo textiles	Separate loom is required for each product

6. Fundamentals of Weaving

Fabrics made by weaving are by the process of interlacement of two kinds of threads known as warp and weft.

6.1. Shedding

The warp threads are kept in the loom in a parallel sheet form and the weft threads pass in between the warp layers form interlacement in certain order according to the type of fabric to be woven. To achieve the above, the warp threads have to be divided and raised to the required order to pass a weft in between the warp strands. This process is called shedding. The space between the two layers of warp when divided is called shed.

6.2. Picking

The process of inserting the weft from one side of the warp to the other side is called picking.

6.3. Beating

The inserted pick in the shed has to be brought nearest to the last pick already inserted in the fabric (near to the fell of the cloth). This process is known as Beating.

The above three processes are essential for the manufacture of the fabric by the process of weaving. It is not possible to produce a fabric by weaving without any one of these processes and therefore they are called fundamentals of weaving.

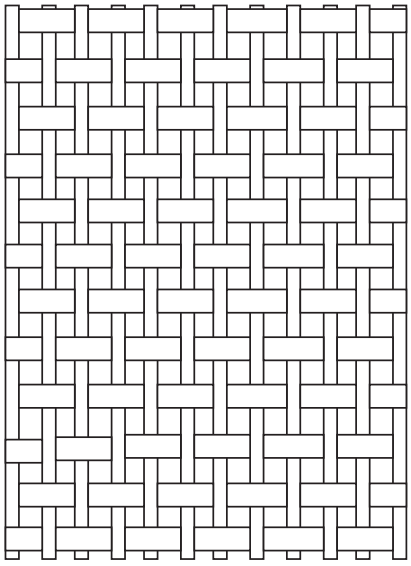
7. Handloom matting

7.1. Plain Weave (Two treadle plain weave)

Plain weave is the most simple of all weaves. The warp threads are lifted one up, one down and the weft thread interlaced one under and one over alternatively and continuously. The odd number of warp threads is lifted up and even numbered warp threads lifted down for the insertion of the 1st pick. Then the order of lifting is reversed and the second pick is inserted.

This repeated performance gives a plain weave. As a rule only two heddle frames would be sufficient for this weave. But it is the usual practice to use four heddle frames coupled up in two pairs. This reduces the count of the heddles to half of what they would be on two heddle frames. With four heddle frames the warp threads are drafted in the order 1-3-2-4 and weaving is done raising 1st and 2nd heddle frames together for the 1st pick and 3rd and 4th heddle frames together for the second pick.

The thread diagram and its graphical representation of the motif are given below.



Warp

2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
1	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		**X**		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**

Drafting order

7.1.1. Two Treadle Basket Weave

This is a modification of plain weave instead of single threads raised and lowered alternately in a plain weave, here the warp threads are allowed to raise and lower 2, 3 strands together and interlace with the weft which also will be in 2 or 3 fold.

Since the order of interlacement is only in two different manners, as in the case of plain weave, 2 heddle frames and two treadles would be sufficient for weaving this design. But for practical convenience four heddle frames and four treadles coupled up in two pairs are used. In this case the drafting order would be 1-2-1, 3-4-3, 2-1-2 and 4-3-4.

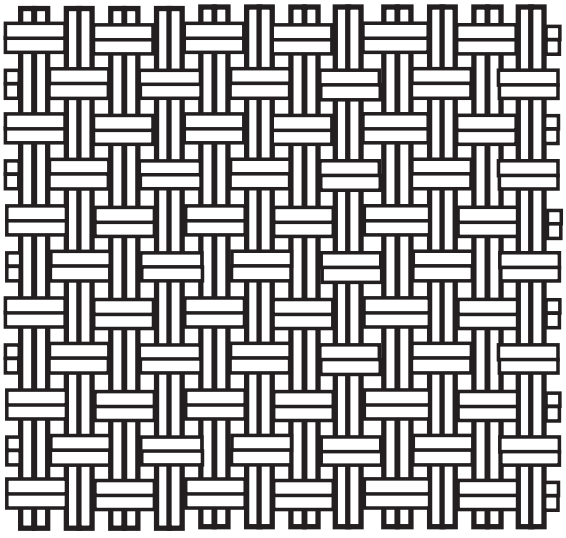
After drafting the threads as above the first and second heddle frames are tied together and is attached to the 1st and 2nd treadles tied together and connected to 3rd and 4th treadles. Thus 1st and 2nd treadles together works as 1st treadle and 3rd and 4th treadles together works as second treadle. The weft threads are inserted two or three together in the same shed by treadling in the order 1, 2.

The proportion of the number of warp and weft can be varied to get different types of basket weave.

7.1.1.1. Panama matting

Panama matting is one type of basket weave in which two warps are raised and two lowered together and weft interlaces in pair. The drafting order for this matting is 1-2-3-4.

The thread diagram and graphical representations of panama matting are given below.



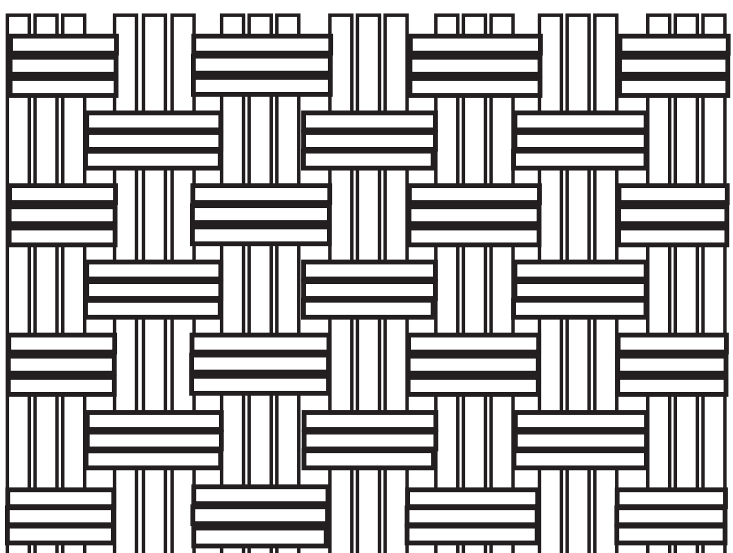
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
		X	X			X	X			X	X			X	X			X	X			X	X
		X	X			X	X			X	X			X	X			X	X			X	X
X	X			X	X			X	X			X	X			X	X			X	X		
X	X			X	X			X	X			X	X			X	X			X	X		
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Panama matting 2:2(4 Shaft loom)

7.1.1.2. Saloon matting

Saloon matting is two treadle basket weave in which 3 warp threads are raised and lowered together and interlacing with weft threads in pairs. The drafting order is 121,343,212,434 and treadling order is 1, 2.For saloon matting (3 x 2), a drafting order of 111, 222 for two heddle / treadle loom is followed.

The thread diagram and graphical representations of saloon matting are given below.



3+4	X	X					X	X	X				X	X	X				X	X	X			
	X	X					X	X	X				X	X	X				X	X	X			
	X	X					X	X	X				X	X	X				X	X	X			
1+2				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
3+4	X	X					X	X	X				X	X	X				X	X	X			
	X	X					X	X	X				X	X	X				X	X	X			
	X	X					X	X	X				X	X	X				X	X	X			
1+2				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
3+4	X	X	X				X	X	X				X	X	X				X	X	X			
	X	X	X				X	X	X				X	X	X				X	X	X			
	X	X	X				X	X	X				X	X	X				X	X	X			
1+2				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
				X	X	X				X	X	X				X	X	X				X	X	X
3+4	X	X	X				X	X	X				X	X	X				X	X	X			
	X	X	X				X	X	X				X	X	X				X	X	X			
	1	2	1	3	4	3	2	1	2	4	3	4	1	2	1	3	4	3	2	1	2	4	3	4

Drafting -Saloon matting (3 warp: 2 weft) 4 Shaft loom

7.1.1.3. Ribbed Matting

Ribbed fabrics are one of the categories of plain weave in which a rib like structure exhibited on the surface. The base structure of the fabric will be plain weave. To obtain the ribs, a group of the warp threads in the required proportion are allowed to work at a lower

tension than the other warp threads (tight). These less tensioned warp (slacks) threads bend over the weft threads during the process of weaving to form the ribs. The slack and tight warp threads are prepared on separate chain beams. The drafting depends upon proportion of the tight and slack warp threads. Two heddle frames and two treadle loom is necessary and all the tight warp threads are drawn through one of the heddle frame and the slack warp threads through the other.

Ribbed mattings are heavier and denser than the ordinary plain matting. Using different proportion of tight and slack warp threads can vary the structure of the ribbed

mattings. There are three types of proportions for tight & slack warp threads viz.

i) One tight and one slack

ii) One tight and two slack and

iii) Two tight and one slack

In the case of two tight and one slack matting, the drafting is done by drawing two tight warps through one of the heddle frames and one slack through the other and repeat the drafting for other threads. Treadling order is 1,2.

If 4 heddles are used and tight and warp slack threads is the ratio of 1:2, the drafting order is 3,2,1 and 4,2,1. The slack is drawn through the heddle eyes of the 1st and 2nd heddle frames and tight through the 3rd and 4th heddle frames. The slack warp threads always drafted through the 1st heddle frame. Thicker and hard twisted yarns are used as slack so as to avoid the breakage. Usually a length ratio of 1:3 for tight and slack warp thread is required and for the manufacture of 50 metre rolls ribbed matting, 150 metre of the slack yarn is required as it bends over the weft. Ribbed matting in natural, bleached, woven stripe and jaspe patterns are manufactured.

7.2. Twill Weave

The twill order of interlacing causes diagonal lines in the matting. This is one of the

important basic weave which has wide application. There is different kind of twill, but in coir industry twill weave confirmed to a maximum of four shafts which is commonly in use.

The weave is employed for the purpose of ornamentation and to enable a fabric of greater weight, sturdiness and firmness that cannot be attained in plain weave.Twilled effects are made in various ways, but in simple or ordinary twills point of intersection move one upward and one outward successively and continuously. The twill can be produced either on one side or on both sides of the fabric and the direction of lines may be either to the right or to the left but the direction on one side is opposite to that of the other side when the fabric is reversed.

2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1

Drafting order

Diagonal lines in the right direction in 3 shaft twill weave

1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1

Drafting order

Diagonal lines in the left direction in 3 shaft twill weave

7.2.1. Three Shaft Twill Weave

This is the simplest of all twill weave Three shaft twill is non-reversible and it requires a minimum of 3 heddle frames and three treadles. Twill lines are formed only on one side of the fabric. The design repeats on 3 ends and 3 picks. The warp threads are lifted 2 up one down and the weft thread interlaces two under and one over successively and continuously.

As the order of interlacement of warp and weft in one repeat of the design is in three different manners, it requires 3 heddle frames and three treadles for weaving. The ends are drawn through the heddle frames in 1-2-3- order. ie 1st warp thread is drawn through the heddle eye in the first heddle frame, the second warp thread through the heddle eye in the second heddle frame and the third warp thread through the heddle eye in the 3rd heddle frame. By this one repeat is over and for the next repeat fourth warp thread is drawn through the heddle eye in the 1st heddle frame again. The subsequent warp threads are also drawn in the order indicated above through the 2nd and 3rd heddle frames.

1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1

The heddle frames have to be connected to the treadles in order to raise and lower the heddle frames. In this case the first heddle frame is tied to the first treadle and also the 2nd and third heddle frames are tied to the second and third treadle respectively. Having completed the tie – up as described above, the loom is ready for weaving and the matting is woven by operating the treadles as follows.

The 3rd treadle is depressed and the first weft is inserted, thereafter first and second treadles are depressed for the insertion of 2nd and 3rd picks. This completes one repeat and the weaving is progressed for further length of matting by repeating the treadling order as given above.

7.2.2. Four Shaft Twill Weave 2/2

This is the most common twill weave which has wider application in coir matting weaving. Wide range of patterns having modifications and attractions can be made in this weave. This is reversible weave and both sides of the matting exhibits similar pattern. Warp and weft floats on one side of the matting respectively coin side with the weft and warp float on the other side. Thus if warp float predominates on one side, weft float will predominates in the same portion on the other side.

The weave repeats in four ends and four picks. The ends in one repeat of the design works in four different manners and therefore to weave this design 4 heddles frames are essentially required for the loom.

The draft for this design is 1-2-3-4 i.e. the 1st warp is drawn through the heddle eye of the 1st heddle frame. The 2nd, 3rd and 4th warp threads are drawn through the heddle eyes of the 2nd 3rd and 4th heddle frames respectively. The treadling order is to depress 3rd and 4th picks are inserted through the shed obtained by depressing 1st and 4th treadle, 1st and 2nd treadle 2nd and 3rd treadle respectively.

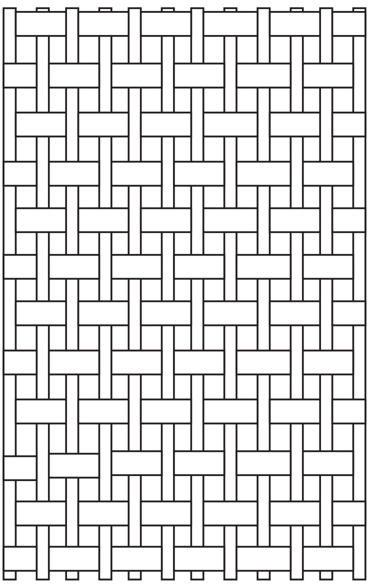
7.2.3. Use of Graph Paper for Structural Designs

Fabric made by weaving is by the interlacement of two kinds of threads known as warp and weft. Usually warp yarn is prepared on beams and kept parallel in the loom. The weft yarn made in small bunches in the form of quill is introduced through the layers of warp by hand or by some other mechanism to weave the fabric.

To explain the way how the structural designs are prepared on the graph paper, here, plain weave is taken for example.

7.2.3.1. Plain Weave

The plain weave is the simplest of all the structural weaves and can be woven on looms having two heddle frames and two treadles. The order of interlacement in a plain weave is given in fig (1) by the help of horizontal and vertical lines. The vertical lines represent the warp and horizontal line the weft.



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Warp - Fig (1)

2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
1	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		**X**		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
1		X		X		X		X		X		X		X		X
2	X		X		X		X		X		X		X		X	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**

Drafting order

Fig (2)

In the figure(1), there are 4 warp threads and 4 weft threads marked as 1,2,3,4. On examination of warp and weft threads in fig (1) it can be observed that 4 vertical lines and 4 horizontal lines representing 4 warp threads and 4 weft threads cross at each other at 16 points. Each such crossing point is called an intersecting point. It is also observed from the fig (1) that at each intersecting point either a warp or weft is seen. Exhibition of warp and weft at each intersecting point depends upon the nature of weave. In this case the 1st warp crosses the 4 wefts 1,2,3,4 it goes over the 1st and 3rd weft goes beneath the 2nd and 4th weft. Therefore at the intersecting points where the 1st warp crosses 1st or 3rd weft, the warp is seen on the face of the fabric. Similarly at the intersecting points where the 1st warp crosses the 2nd and 4th weft, weft is seen on the face of the fabric. Thus at each and every intersecting point either a warp or a weft will be allowed to make its appearance. This phenomenon of exhibition warp and weft can be easily represented on the paper with the help of graph paper.

In the graph paper the vertical rows of columns represent the warp and horizontal rows of columns represent the weft. Each column in the graph paper represents an intersecting point. A marked column with `X` in the graph paper indicates that the warp is seen in the face of the fabric at that particular intersecting point. A blank column indicates that a weft is seen on the face of the fabric at that intersecting point.

The thread behaviour in fig (1) can now be considered for representing it on the graph paper. To represents the 4 vertical and 4 horizontal lines contributing 16 intersecting points in fig (1), 4 vertical rows of columns and 4 horizontal rows of columns have to be taken on graph paper to get 16 columns as in fig (2). Now considering the thread behaviour in fig (1), it can be seen that the weft No.1 goes below warp No.1 and 3 and over the warp No.2 and 4 exhibiting the warp on the face of the fabric at the place where the 1st weft crosses the 1st and 3rd warps and exhibiting the weft at the intersecting points where the 1st weft crosses the 2nd and 4th warps. Therefore in the graph paper, columns 1& 3of first row in the horizontal direction are marked and the columns 2nd and 4th left blank without marking. Considering the 2nd weft, it goes over the 1st and 3rd warps and below the 2nd and 4th warps. So in the graph paper 2nd and 4th columns in the 2nd horizontal row are marked and the 1st and 3rd columns are left blank. On further examination of the thread behaviour in fig (1), it can find that the behaviour of the 3rd and 4th weft is exactly similar to the 1st and 2nd weft respectively. Therefore, similar markings as done in 1st and 2nd horizontal rows of columns in the graph paper can be followed in the case of 3rd and 4th horizontal rows of columns also to complete the marking.

7.2.3.2. Three Shaft Twill

2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**

Fig.(3)

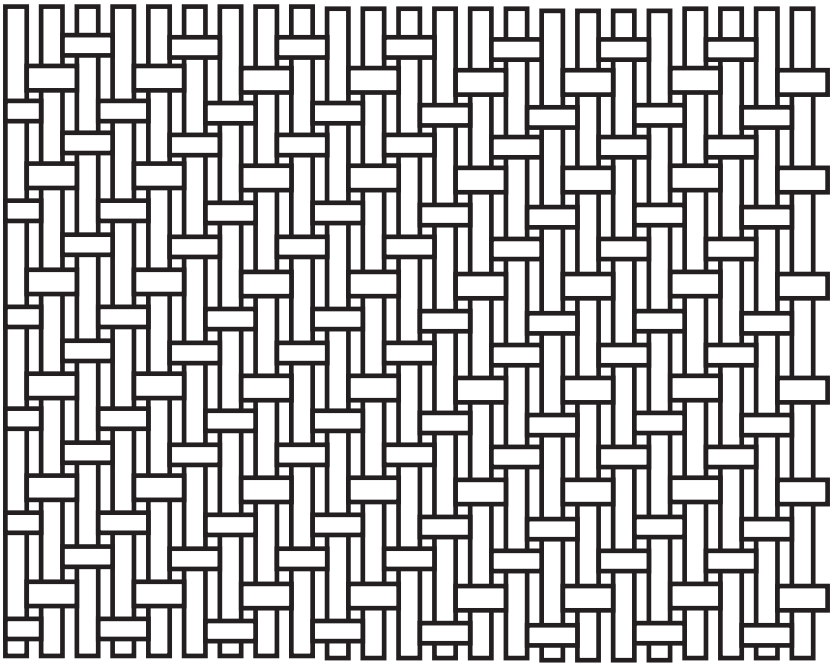


Fig.(4)

Fig (3) represents the 3 shaft twill (2 up one down) as it can be seen on the graph paper. The sectional thread diagram of the same design is given in fig (4).As in the former case, here also the vertical rows of columns marked as 1,2,3 which represent the warp in fig (3) corresponds to the vertical lines 1,2,3 in fig (4) and so also the horizontal rows of columns in fig (3) corresponds to the horizontal lines in fig (4) to represent the weft.

1 st weft interlaces with the warp by going below the 1st and 2nd warp and over the 3rd warp.This order of interlacement is marked on the columns in fig (3) by putting marks in the 1st and 2nd column in the horizontal direction and leaving the third column as blank. In the case of 2nd weft, it goes over the 1st warp and below the 2nd and 3rd. So the 1st column in the 2nd horizontal line is left blank and the other two are marked. The 3rd weft interlaces by going below the 1st and 3rd warp threads and over the 2nd. Thus the 1st and 3rd columns are marked and the 2nd is left blank.

7.2.3.3. Wavy lines and Diamond effect in Twill Weave

Certain ornamentation in the form of wavy lines in the warp and weft direction and diamond effect in the twill weave can be made by simple alteration in drafting and treadling orders.

7.2.3.3.1. Wavy Lines in Weft Direction

By the alteration of order of drafting wavy lines in weft direction of the matting can be produced. The draft for 3 shaft 2/1 twill is 1-2-3; this order is reversed to 2,1,3 after certain number of warp thread has been drawn initially.eg. if 1st 9 warp threads are drawn in the order 1,2,3, the order is reversed to 2,1,3 for the next 9 warp threads to get wavy effect.

An example is shown in fig (5).

2	X		X	X		X	X		X	X		X		X	X										
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**1**

Fig.(5)

7.2.3.3.2 Wavy lines in Warp Direction

The warp wavy lines can be produced by the alteration of treadling order. The treadling order of a 2/1 twill is 3-1-2. To get wavy lines in the warp direction, the order has to be changed to 1-3-2 after inserting a few number of weft threads initially in the former order. Eg. If the wavy line in the warp direction has to repeat after 9 weft threads, the treadling order to be followed for inserting the 1 st 9 weft threads is 3-1-2, the treadling order is reversed to 1-3-2 for the next 9 weft threads to get the wavy lines. The fig (6) represents the above alteration.

3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X
1		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X	
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**

Fig.(6)

7.2.4. Diamond effect in Twill Weave

Diamond effect is obtained by the result of combined alternation of drafting and treadling order. To get the diamond effect, the warp threads are first drawn in the order 1-2-3 and thereafter the order is reversed to 2-1-3 to the subsequent warp threads. Similarly the treadling order for a few number of weft threads is 1-2-3. This is reversed to 2-1-3 for the subsequent weft threads. The resulting design which gives the shape of a diamond is given in fig (7)

3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
3	X	X		X	X		X	X		X	X		X	X		X	X		X	X		X	X		X
2	X		X	X		X	X		X	X		X		X	X		X	X		X	X		X	X	X
1		X	X		X	X		X	X		X	X	X		X	X		X	X		X	X		X	
	1	2	3	1	2	3	1	2	3	1	2	3	2	1	3	2	1	3	2	1	3	2	1	3	1

Fig (7)-Diamond design in 3 shaft twill weave

2+3	X			X	X			X	X			X	X			X	X			X	X			X
1+2			X	X			X	X			X	X			X	X			X	X			X	X
1+4		X	X			X	X			X	X			X	X			X	X			X	X	
3+4	X	X			X	X			X	X			X	X			X	X			X	X		
2+3	X			X	X			X	X			X	X			X	X			X	X			X
1+2			X	X			X	X			X	X			X	X			X	X			X	X
1+4		X	X			X	X			X	X			X	X			X	X			X	X	
3+4	X	X			X	X			X	X			X	X			X	X			X	X		
2+3	X			X	X			X	X			X	X			X	X			X	X			X
1+2			X	X			X	X			X	X			X	X			X	X			X	X
1+4		X	X			X	X			X	X			X	X			X	X			X	X	
3+4	X	X			X	X			X	X			X	X			X	X			X	X		
2+3	X			X	X			X	X			X	X			X	X			X	X			X
1+2			X	X			X	X			X	X			X	X			X	X			X	X
1+4		X	X			X	X			X	X			X	X			X	X			X	X	
3+4	X	X			X	X			X	X			X	X			X	X			X	X		
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

Fig (8) -four shaft 2/2 twill design

Fig (8) is a four shaft 2/2 twill design. This weave is a reversible one and the number of warp and weft predominates in both directions in the same proportion. The drafting for this design is 1,2,3,4 and the treadling order 3+4, 1+4, 1+2, 2+3.

The wavy lines and diamond effect are possible in the four shaft 2/2 twill weave also. As was done in the case of 3 shaft twill, here also the drafting order is changed to its reverse order after drafting a few numbers of threads in the 1st order to get wavy lines in the weft direction. For wavy lines in the warp direction, after inserting a few number of weft threads following the usual treadling order, the treadling order is reversed for the subsequent picks. Combination of both the above alterations will result in diamond effect in the matting.

The drafting order for 4 shaft twill is 1,2,3,4 and after drafting a few numbers of threads in the above order, it is reversed to 3,2,1,4 for the next few threads. With the alteration in drafting and following the usual treadling order 3+4, 1+4, 1+2, 2+3 wavy lines in weft direction is obtained. For wavy lines in the warp direction, first a few number of weft threads are inserted following the treadling order 3+4, 1+4, 1+2, 2+3, thereafter subsequent picks are inserted by treadling in the order 1+2, 1+4, 3+4, 2+3. The drafting order has no change.

The diamond effects are produced by drafting the threads, first in the order 1,2,3,4 and after a few threads are drawn,the drafting order is changed to 3,2,1,4 followed by the treadling order for the 1st few weft threads as 3+4, 1+4, 1+2 and 2+3 and thereafter changing it to 1+2, 1+4, 3+4 and 2+3.

Fig (9), (10) and (11) shows the resulting designs.

1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
1+4		X	X			X	X		X	X			X	X				X	X			X	X		
3+4	X	X			X	X				X	X			X	X		X	X			X	X			
2+3	X			X	X			X			X	X			X	X	X			X	X			X	
1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
1+4		X	X			X	X		X	X			X	X				X	X			X	X		
3+4	X	X			X	X				X	X			X	X		X	X			X	X			
2+3	X			X	X			X			X	X			X	X	X			X	X			X	
1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
1+4		X	X			X	X		X	X			X	X				X	X			X	X		
3+4	X	X			X	X				X	X			X	X		X	X			X	X			
2+3	X			X	X			X			X	X			X	X	X			X	X			X	
1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
1+4		X	X			X	X		X	X			X	X				X	X			X	X		
3+4	X	X			X	X				X	X			X	X		X	X			X	X			
2+3	X			X	X			X			X	X			X	X	X			X	X			X	
1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
1+4		X	X			X	X		X	X			X	X				X	X			X	X		
3+4	X	X			X	X				X	X			X	X		X	X			X	X			
2+3	X			X	X			X			X	X			X	X	X			X	X			X	
1+2			X	X			X	X	X			X	X			X			X	X			X	X	X
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**3**	**2**	**1**	**4**	**3**	**2**	**1**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**3**

Fig (9) wavy lines in the weft direction in 4 shaft twill

1+4		X	X			X	X			X	X			X	X			X	X		
4+3	X	X			X	X			X	X			X	X			X	X			X
3+2	X			X	X			X	X			X	X			X	X			X	X
2+1			X	X			X	X			X	X			X	X			X	X	
1+4		X	X			X	X			X	X			X	X			X	X		
4+3	X	X			X	X			X	X			X	X			X	X			X
3+2	X			X	X			X	X			X	X			X	X			X	X
2+1			X	X			X	X			X	X			X	X			X	X	
1+4		X	X			X	X			X	X			X	X			X	X		
4+3	X	X			X	X			X	X			X	X			X	X			X
3+2	X			X	X			X	X			X	X			X	X				X
2+1			X	X			X	X			X	X			X	X			X	X	
1+4		X	X			X	X			X	X			X	X			X	X		
2+1			X	X			X	X			X	X			X	X			X	X	
3+2	X			X	X			X	X			X	X			X	X			X	X
4+3	X	X			X	X			X	X			X	X			X	X			X
1+4		X	X			X	X			X	X			X	X			X	X		
2+1			X	X			X	X			X	X			X	X			X	X	
3+2	X			X	X			X	X			X	X			X	X			X	X
4+3	X	X			X	X			X	X			X	X			X	X			X
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**

Fig (10) wavy lines in the warp direction in 4 shaft twill

1+4		X	X			X	X		X	X			X	X			X	X		
4+3	X	X			X	X				X	X			X	X			X	X	
3+2	X			X	X			X			X	X			X	X			X	X
2+1			X	X			X	X	X			X	X			X	X			X
1+4		X	X			X	X		X	X			X	X			X	X		
4+3	X	X			X	X				X	X			X	X			X	X	
3+2	X			X	X			X			X	X			X	X			X	X
2+1			X	X			X	X	X			X	X			X	X			X
1+4		X	X			X	X		X	X			X	X			X	X		
4+3	X	X			X	X				X	X			X	X			X	X	
3+2	X			X	X			X			X	X			X	X			X	
2+1			X	X			X	X	X			X	X			X	X			X
1+4		X	X			X	X		X	X			X	X			X	X		
2+1			X	X			X	X	X			X	X			X	X			X
3+2	X			X	X			X			X	X			X	X			X	X
4+3	X	X			X	X				X	X			X	X			X	X	
1+4		X	X			X	X		X	X			X	X			X	X		
2+1			X	X			X	X	X			X	X			X	X			X
3+2	X			X	X			X			X	X			X	X			X	X
4+3	X	X			X	X				X	X			X	X			X	X	
	1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**3**	**2**	**1**	**4**	**3**	**2**	**1**	**4**	**3**	**2**	**1**	**4**

Fig (11) Diamond design in 2/2 4 shaft twill

7.3. Bi coloured Diamond effect in 4 shaft weaving

The formation of bicoloured diamond effect is one of the main features in the 4 shaft weaving. This can be achieved by the sectional warping, different drafting and treadling orders. Warp threads of two different colours are required and it should be arranged alternatively. Let red and blue are the warp threads, the odd numbered threads are red and even numbered threads are blue.

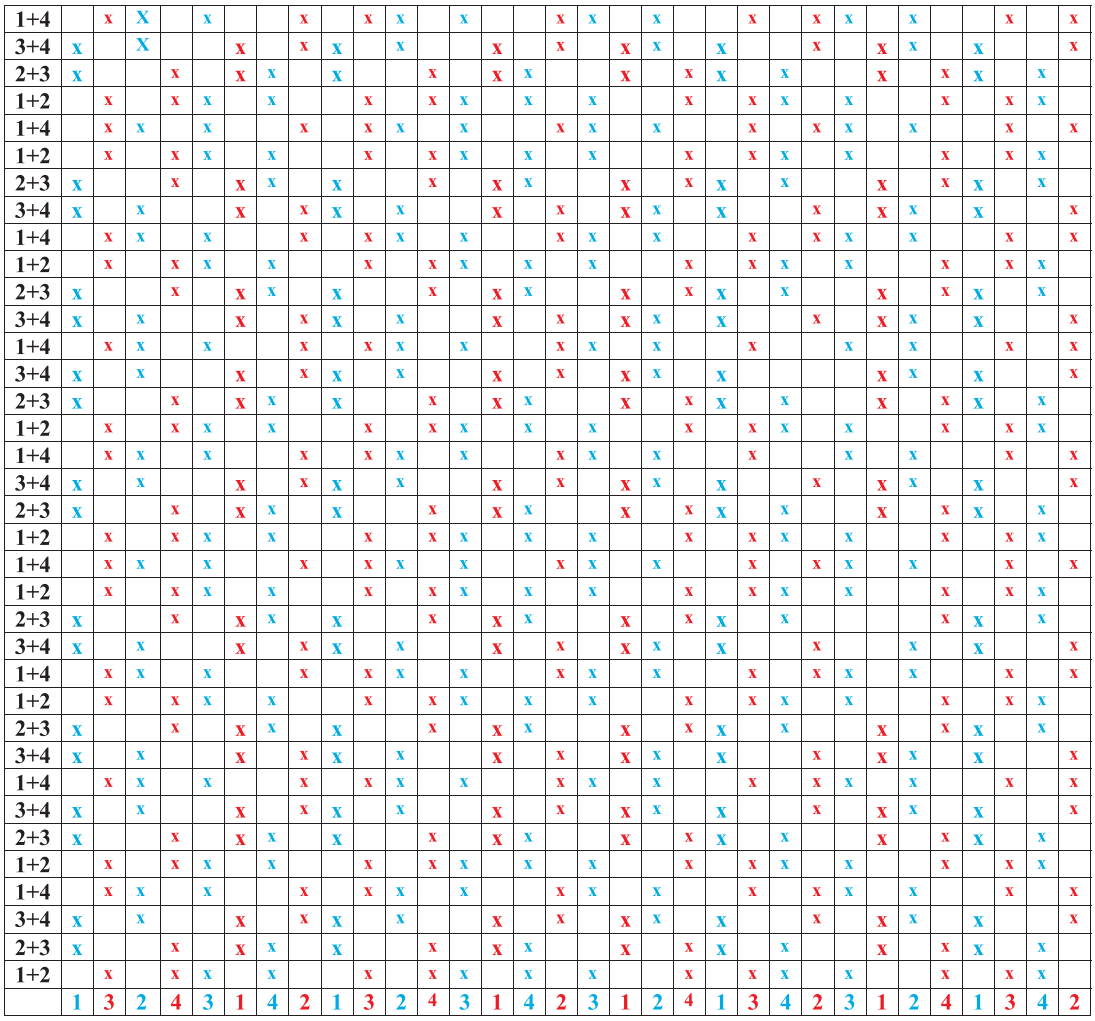
Since the diamond design is the derivative of the twill weave, the upward and downward direction of the design (twill) can be achieved by forwarding and reversing of drafting and treadling orders. The weave selected for weaving is diamond design on 2/2 twill. The repeat of the design is 32 ends and 16 picks. The required number of shaft is 4.The drafting order are 1324; 3142; 1324; 3142 and 3124; 1342, 3124; 1342.

The first four orders for upward direction of the design and next four orders are down ward direction of the design. So the warp threads can be drafted as the first end through first heddle frames first hook the second end through 3rd heddles first hook and it should be followed continuously. After drafting, the drafted ends can be drawn through the reed same as followed in the 4 shaft matting weaving.

Finally for the above effect, the treadling orders are followed for 1st to 8th picks as 12, 23, 34, 14, 12, 23, 34, 14 and the orders can be reversed after 8th pick as 34, 23, 12, 14, 34, 23, 12, 14. The above said methods are adopted for achieving the bicoloured diamond design on 2/2 twill effect in 4 shaft weaving.

Modification in the bicoloured diamond design can be effected by changes made on the drafting by drawing a group of strands (4 or 6) after the ascending and descending order to form the design. The drafting order may be

1324	3142	4242	3124	1342	4242
			OR		
1324	3142	131313	3124	1342	131313



Bi coloured Diamond

7.4. Spot or Dot Matting

This is one of the most attractive patterns in coir matting, produced with the aid of 4-shaft loom. Spot matting is used as coir mats, stair case matting and wall to wall covering material. The spot effect is produced by colour and weaves combination method. The base structure is a twill weave. It is 3 up 1 down (3/1) continuously for 2 warp threads and 1 up 3 down (1/3) for next warp. To get the spot to be exhibited on the fabric predominantly, two colours are arranged in the warp in the proportion of 2:1 for ground warp and spot warp respectively.

Drafting order is 131,424 and

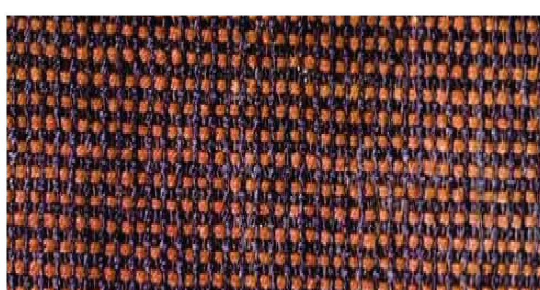
Treadling order is 1+2, 2+3,3+4,2+3

2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
3+4	x		x		x		x		x		x		x		x		x		x		x		x		x
2+3	x		x	x		X	x		x	x		x	x		x	x		x	x		x	x		x	x
1+2		x		x		X		x		x		x		x		x		x		x		x		x	
	1	3	1	4	2	4	1	3	1	4	2	4	1	3	1	4	2	4	1	3	1	4	2	4	1

7.5. Multi shaft matting

Patterns/designs beyond the capacity of 4 shaft looms are woven on Dobby/Jacquard looms.

7.6. Power loom mattings



8. Drafting & Treadling orders for matting with special design

Types of Matting	Drafting order	Treadling order
Butterfly Matting	122 322 144 344	1+2, 2+3, 1+4, 3+4
Biscuit Matting	11 33 22 44 22 33  Colour pattern -2:2	2, 1+4, 3, 1+2, 3, 1+4
Star Matting	122 122 133 133 Colour Pattern- 5: 1	1+2, 2+3, 3+1, 2+3
Spot Matting	131 424 Colour Pattern -2:1	1+2, 2+3, 3+4, 2+3

In the matting, most of the designs are formed by warp whereas in butterfly matting, the design is formed by weft.

9. Coir Mourzouks


A carpet in coir trade is called as Mourzouk. Coir Mourzouks are usually manufactured in a variety of sizes and patterns. They are mostly used for furnishing a selected area either at the centre of the room or any part there of where generally the other portion might have furnished by other type of furnishing materials. They are also used for all-round furnishing.

The usual sizes in which carpets are manufactured are given below:

2` x 4` 3` x 6` 4 ½` x 7 ½` 6` x 9` 9` x 12` 12` x 16`

OR

60cm x 120cm, 90cm x 180cm, 135cm x 225cm, 140cm x 200cm, 180cm x 270cm, 270cm x 360cm, 360cm x 480cm

Mourzouk can also be manufactured in rolls of continuous length.

The speciality of the mourzouk weave is that in the ultimate product, the warp threads are completely concealed by the weft threads, which present the surface appearance, pattern and design. The design produced in the mourzouk is visible on both sides in equal proportions. The mourzouk has very even surface and it is sturdier in construction and heavier too. Complicated and intricate woven designs are produced by the use of coloured weft threads according to the design. Coir mourzouk are woven with a base structure of plain weave.

In mourzouks having designs, which has more than one colour in the weft direction, the weft used cannot be continuous but in sections of smaller length according to the design and continuity of the weft is maintained.

The warp threads are drafted in the order 1, 2 and they are sleyed one in a dent. Usually 30`s reed is used. The weft threads are prepared in the form of `ooly` or wound over stick shuttles, The weaver opens the shed by depressing a treadle and start weaving by putting the weft in sections according to the designs. In carpet having designs which has more than one colour in the weft direction; the weft used cannot be continuous but in sections of smaller length according to the design required. In such case continuity of the weft is maintained by joining the sections of weft threads by interlocking. To enable the weft to bent over the warp conveniently and to conceal the warp threads completely, the weft threads are put slacks in the shed. After changing the shed, depressing the other treadle and by proper manipulation they are brought to the fell of the fabric keeping the slackness of the weft as it is. This process is repeated through out to weave a required length. The carpets are also made in solid colour where the weft is put in full width at a stretch. After weaving, the carpet is taken out of the loom and the cut ends of warp on both sides are drawn back to the body of the carpet taking alternate warp thread into the fabric.

Usually finer yarn is used as warp, vycome coir yarn, 2 ply threads aloe and 5 ply jute are commonly used as warp and finer alapat yarn, soft twisted Anjengo yarn, vycome yarn etc. are used for weft.

10. Coir Carpets

Coir carpets commonly known as “Aleppey Carpets” are manufactured similar to Mourzouk weaving, but difference is that the warp thread works in pairs and has a rib effect in the direction of the warp.

The warp threads are drafted in the order 1,1 – 2,2 and they are sleyed two in a

dent. These arrangements of warp provide a rib effect in the direction of warp. The reed used commonly are 30`s and 36`s.The carpet after taking out of the looms are finished at the edges by tucking in projecting alternate warp threads in the body of the carpet a length of about 1 ½ inch to 2 inch. The other alternate warp threads are cut off.

Aleppey carpets are manufactured in number sizes with simple designs and stripes of various combinations

11. Coir matting rugs

Coir mattings cut to specified length, and suitably finished are marketed as "Coir Rugs". Coir rugs are available in plain natural colour of the fibre, or in different shades, in woven patterns or printed designs. Rugs of various sizes with attractive designs are specially produced for overseas markets. The versatility of the design that can be produced is practically unlimited. In the preparation of rugs, the cut length of mattings is finished by three principal methods-knotting the warp strands (fringed ends), Dra-in ends (or tucked-in ends), Bound ends (ends bound with jute / cotton webbing) or rubber sealed are used as area rugs.

The standard sizes of rugs and mourzouks available in the industry are

cm.	cm.
75 X 45	180 X 115
120 X 60	180 X 140
140 X 70	225 X 140
225 X 70	270 X 180
165 X 90	270 X 225
180 X 90	480 X 360

Differences between Coir Matting and Carpet

Matting	Carpet
The warp threads predominate on both sides.	Weft threads predominate on both sides.
Design is formed by warp thread.	Coloured weft threads form design.
Warp and weft are visible on both sides.	Warp threads completely concealed.
No. of weft threads are comparatively low.	No. of weft threads are comparatively high.
No. of warp threads are comparatively high.	No. of warp threads are comparatively low.
Warp threads are not turned back into the body.	Cut ends of warp threads are alternatively turned back into the body of the fabric. Surface is even on both sides.
Weft thread is continuous and not put in slack condition in the shed.	Weft is put slack in the shed during weaving.

12.Coir matting for Cricket Pitches

The coir matting for cricket pitches is a special type of matting, usually herringbone pattern in three treadle or four treadle weave and in a single shade. The coir matting for cricket pitches may be provided with canvas or leather binding at the 2 ends. The width of the binding usually is 6 to 7.5 cm and double stitched at two places with waxed cotton cord. On the width side at every 45 cm from the ends and at the length side at every 1.6 to 1.8 metre, circular or square patches of leather or canvas are stitched with waxed cotton cord. In the centre of these patches, eye lets having holes not exceeding 20 mm diameter and with top and bottom catches of 25 mm diameter are firmly fitted. The leather or canvas patch may be square having 25 mm sides or if round, of 75 mm diameter. The matting shall be firmly and evenly woven from selected yarn of uniform scorage with least number of splicing. Whenever splicing is done, it shall be so even as to avoid non-uniformity in diameter.

13. Passing of Coir Mattings

A final check up is carried out to the matting in this process. Packing is conducted only after passing the mattings. While passing, individual mattingss are checked up and defects if any are removed.

Bundling

14.Use of Coir Matting for Roof Surface Cooling

Cooling of buildings by Roof Surface Evaporation is an established technology. It is an effective, simple, economical and environmental friendly method of improving the indoor thermal conditions and reducing the capital and running cost of air-conditioning in the order of 60% and 30% respectively, under Hot – Dry conditions.

Human energy lies in his brain and under hot environment, if his brain can be kept cool and thermally comfortable it can bring higher efficiency and productivity in all sphere of his life, i.e. provision of comfortable environment for work and living can be termed as an instrument of higher efficiency and productivity.

The thermal environment is much worse in industrial buildings due to excessive heat flow through the GI/AC sheet roofs and evolution of more heat by the industrial workers and operations of furnaces, etc.

Therefore, it is now advocated to cool buildings artificially either by desert coolers or Air conditioners. They are highly costly (Capital, Running / maintenance wise) and are beyond the reach of common man. They provide artificial indoor thermal environment, not conducive to human health.

The degree of improvement in the indoor thermal conditions by natural building design procedures is very limited with the adoption of low cost modern schemes of construction like

(i) Minimum ceiling heights.

(ii) Thin wall and roof sections.

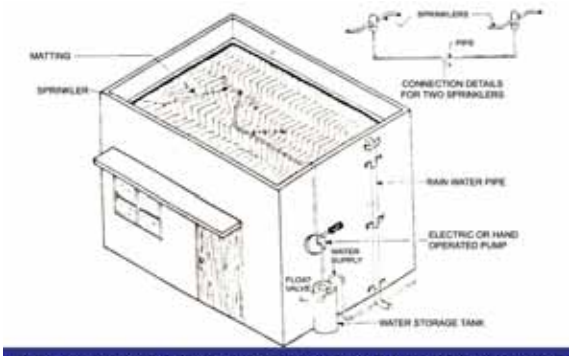
(iii) Increasing of more window glass areas.

(iv) Omission of ventilators and

(v) Multi storied buildings.

14.1. General Know how of the Cooling Process

Cooling of buildings by Roof Surface Evaporation process consists of maintaining a thin uniform organic material lining (Made of double layered empty jute bag or coir matting) laid in close contact with the terraces of buildings and water is sprinkled uniformly over it. The bags / coir matting remain soaked in water throughout the days and nights during summer.



MODEL UNIT FOR ROOF SURFACE EVAPORATIVE COOLING SYSTEM USING COIR MATTING

Thermodynamic Mechanism of Roof Surface Evaporative Cooling Process

60 to 80 % total heat that enters in to a single storey building through its roof, as the roof is exposed to sun throughout the day and 20 to 40% that enters through the fenestration (arrangement of windows in a building) .

Water may be sprayed manually or with the help of sprayers. Water trapped in Jute bags / Coir matting evaporates

continuously at all temperatures. This is due to heat received by roof and the air movement.

Water which is life and available wherever man exists, acts as the refrigerant in this system.

The process depends on three basic requirements

- ➢ Proper roof surface and its topography.
- ➢ Suitable organic material lining.
- ➢ Efficient spraying systems.

14.2. Advantages of Roof Surface Evaporative Cooling Process

Ideal for all types of buildings viz. low cost, multi-storied, industrial, conditioned or thermally uncomfortable buildings to bring appreciable savings in energy, running & capital cost of air-conditioning and increase human welfare, efficiency & productivity

The process can lead to achieve

1. Indoor dry bulb temperatures near to the outdoor wet bulb temperatures.

2. Dry, natural, pleasant, healthy cooling effects in indoors without polluting outdoor environment.

3. Minimum savings up to 60% and 30% in capital & running cost of air-conditioning under worst exposure conditions of walls and roofs.

4. Cost less than 2% of air-conditioning and less than 9% of desert cooling in general.

5. Boosting low cost housing schemes. Even the poorest can enjoy thermal comfort in their low cost apartments.

6. Conducive thermal comfort to workers in industrial buildings.

7. Indoor temperature can be reduced by 10^{o}C.

8. Energy requirement is 1% of centrally air-conditioned system and 4% of desert coolers.

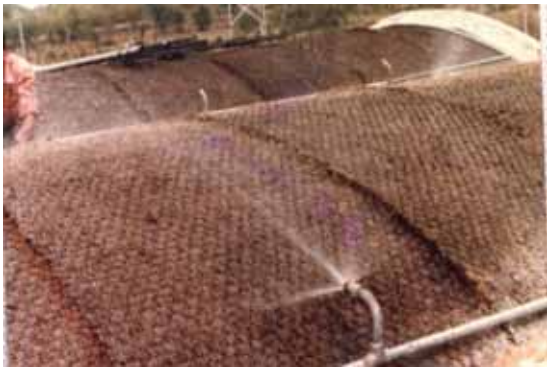
9. Water consumption is low in roof surface evaporative cooling compared to centrally air-conditioned and desert cooling system.

14.3. Benefits of Coir Matting in Roof Surface Cooling

Coir matting is found to be more useful than other organic materials as they are more durable, has more life and possesses better appearance. It fulfills the following purposes.

1. To absorb and retain water for evaporation.
2. To protect roof surfaces from penetration of sun's rays.
3. To increase surface area of roofs with troughs and crusts.
4. To disintegrate water into minute particles.

14.4. Installation & Operation of Roof Surface Evaporation Cooling System on Buildings



1. Check the roof surface for proper slope (1 cm slope in 40 cm length) and drainage. Make necessary repairs to avoid any chance of leakage, seepage and accumulation of water.
2. Lay, in close contact with the roof, a layer of coir matting. The matting should be sewn together without overlapping sufficiently large enough to cover the roof terrace, but leaving a gap of 10 cm all along the parapet walls.
3. Install sprayer @ one sprayer for 4 m x 3 m roof or part thereof. Water should be sprayed uniformly five times a day to keep the entire matting continuously in water soaked condition.
4. Sprayers may be connected to water supply line if water is available at sufficient pressure at the rooftop. A stopcock may be provided at suitable place (to stop and start) in the pipeline to manually control the sprayer.
5. If sufficient water pressure is not available at the roof level, a hand or electrically operated water lifting pump may be used to lift water from a water tank / container at the ground level to sprayers.
6. A 1/8 H.P centrifugal mono block pump is normally enough for supplying water to one sprayer fixed at about 4 m height from a water tank at ground level. A ¼ HP pumps is preferred for a double storied building for two sprayers.
7. An economical and simple automatic control system utilising a matching pump, electronic switch actuated by water and sensor is enough to automatically start the pump when the matting gets dried and stop the pump, when it gets wet.
8. Initially it takes about 72 hours for the existing heavy roofs to cool down indoors but once the cooling has started and the process is continued the system's performance gets stabilised. The thin GI / AC sheet roofs hardly take few hours to produce cooling indoors.
9. For building complexes and large roofs, specially designed nozzles, automatic controlling and fault indicating systems are required.
10. The coir matting has to be removed and stored after drying at a suitable place for its reuse and to avoid discomfort by extra cooling during rainy days of winter.

15. Coir – Its uses as a Thermal Insulating Material

Thermal insulation implies a process aimed to prevent loss or gain of heat by the insulated environment. Thermal insulation serves to increase the comfort of living spaces and conserves heat or some other form of energy by facilitating temperature control. The primary requirement of a thermal insulator is that it should be a poor conductor of heat i.e. its thermal conductivity should be low. Other properties such as strength, thermal coefficient of expansion, hardness, density and specific heat are also important depending upon the actual requirement. Thermal insulations are used at temperatures from - 300^0 F to 3000^0 F.

A wide range of products covering cork blocks, mineral wool, silica aerojel, red wood bark, wood-fibre wool, cellular glass, foamed plastics, cellular rubber boards, cattle hair, wood felt, corrugated asbestos, paper sheets insulating boards from wood fibres of bagasse etc. in plaster base are used as materials for thermal insulation over the temperature range below 300^0 F. When low cost is the prime consideration corn husks, sawdust, wood shearing etc could also be used for thermal insulation. The thermal insulating materials are used in the form of sheets or slabs or used as granules, shredded bits etc.

The essential requirement of a material for use as a thermal insulator is that it should have low thermal conductivity. It should also withstand the temperature range in which it has to serve as the insulator, without any adverse effect. Coir being a fibre of combustible nature, can be used for purposes of insulation to serve at the temperature below the ignition temperature of the fibre material.

The thermal conductivity of coir and other materials determined by LEE'S Disc method is furnished below

Sl.No.	Material	Thermal conductivity(K)
1	Carnatic mat	0.000166
2	Coir fleeces	0.000256
3	Needled pad	0.000149
4	Jute felt	0.001785
5	Glass wool	0.001876
6	Pith board with latex adhesive	0.000583
7	Thermocol	0.002802
8	Pith board with UF adhesive	0.001773
9	Cork sheet	0.002012

The result indicates that coir-needled pad is suitable for thermal insulation. In view of the combustible nature of the material at elevated temperatures, the use of coir for thermal insulation has to be confined to low temperature range covering cold stage, refrigeration and general purpose building insulation.

16. Use of Coir as Acoustic material

Excessive noise and adverse temperature and humidity conditions are prone to retard human efficiency due to fatigue. Annoyance due to noise in the working enviroment could also cause distraction advesersely affecting the output and efficiency in certain jobs requiring concentration and careful attention. It could also hinder effective communication

and hearing and could form potential cause for mistakes and lower output. Sudden impulses of sound could result in nervous distraction and tension of the human element leading to upsets in work turn - over.

The source of noise in a building could be internal, external or both. In Industrial establishment, machinery in operation and the human element are internal sources of noise. Noise due to human element outside the building, movement of vehicles and operation of machinery within the proximity of the building could be external sources. When sound waves encounter a wall or any other medium, part of the sound energy is absorbed, part is reflected and what is not absorbed/ reflected is transmitted through the structure of the wall of the medium on which the sound wave had impinged. The sound nuisance is due to the confusion resulting from the clashing of incident sound waves from the source and the reflecting sound waves from hard surfaces.

Sound Absorbing Coefficient of Coir & Other Materials Frequency, cps

Sl. No	Material	500	1000	1500	2000	2500	3000	4000
1	Carnatic carpet	0.5	0.5	0.6	0.6	-	0.7	0.9
2	2 shaft Anjengo, plain matting	0.2	0.2	0.2	0.2	-	0.5	0.6
3	3 shaft Anjengo matting	0.1	0.2	0.2	0.2	-	0.4	0.5
4	4 shaft Anjengo matting	0.2	0.2	0.3	0.3	-	0.5	0.6
5	Coir fibre pad (1.5 cm thick)	0.2	0.5	0.7	0.8	-	0.8	0.8
6	Coir Needled Pad (1cm thick)	0.5	0.5	0.6	0.6	-	0.6	0.7
7	Rubberised coir (1.74 cm thick)	0.4	0.4	0.6	0.6	-	0.6	0.6
8	Thermocol(1” thick)	-	0.1	0.2	0.3	-	0.5	0.5
9	Coir Matting, closely woven (on brick wall)	0.2	0.2	-	-	0.5	-	0.5
10	Coir matting, ordinary (on brick wall)	0.5	0.3	-	-	0.5	-	0.5
11	Coil pile carpet, carnatic (on brick wall)	0.5	0.5	-	-	0.7	-	0.9
12	Rubberised coir	0.1	0.6	-	-	0.9	-	0.6
13	Wool pile (on concrete)	0.21	0.26	-	0.27	-	-	0.37
14	Wool pile with under pad	0.35	0.40	-	0.50	-	-	0.75
15	Unlined carpet on wood	0.30	0.30	-	0.30	-	-	0.30

17. Constructional Details for Coir Mats, Coir Mattings and Mourzouks

17.1. COIR MATS

(IS: 11420 (Part 1 to 9) 1985: Specification for Coir Mats)

Quality parameters for Coir Mats

Ends per decimeter

Picks per decimeter

Pile height

Dimension

Mass

Constructional details

17.1.1. GENERAL REQUIREMENTS

The mats shall be firmly and evenly woven. Pile tufts shall be well secured and the shearing of the pile shall be uniform and level, Mats may also be supplied without shearing of the pile if so required by the buyer.

The mats may be of plain natural, chemically bleached, dyed, designs and/ or lettering stencilled or inlaid with coir fibre or coir yarn as may be specified by the buyer. When inlaid with coir fibre or coir yarn, the designs and/or lettering may be bevelled to give clarity of outline. Inlaid mats may also be supplied without bevelling, if so required by the buyer.

The mats shall be squared by removing one or more weft threads and protruding warp threads shall be treated as follows:

a) In Creel mats and loop mats threads shall be doubled back and interlaced in the mats but in the case of mats sealed with rubber latex or other edge sealing compound at ends or braided ends, the threads need not be doubled back and interlaced in the mat.

b) In Fibre mats, the threads shall be doubled back and interlaced with the body of the mats.

c) In Rod, Bit and Gymnasia mats, threads shall be tied with jute twine and merged with the body of the mats.

Rod and Bit mats shall be bound with braid made of five or more strands of hard twisted coir yarn around the edges in the case of mats having a pile thickness of less than 45mm and of 7 strands for those having pile thickness of 45mm and above. There shall be at least 3 stitches per dm, in the braid.

Gymnasia mats shall be bound with braid of 11 strands of hard twisted coir yarn and having a width of 30mm, around the edges. The cords of the braid shall be securely fastened.

There shall be at least 3 stitches per dm in the braid. The cordage used in Gymnasia mats shall be coir rope made out of hard twisted yarn having a circumference of 38mm. For defense requirements each mat shall be securely, fitted with 4 cordage handles woven inside the mat up to a distance of 23cm,8cm. of which shall be turned backwards.

d) In Rope mats, the starting and finishing ends of rope shall be merged in to the adjacent layers of rope suitably, so that the ends cannot be identified. All the side slabs in the mat shall be stitched properly so as to prevent slippage of layers of rope.

The mats shall be reasonably free from extraneous matter.

The mats may also be supplied in half oval or in any other shape if required by the buyer. However, the dimensions of such mats shall be subject to an agreement between the buyer and the seller.

Each mat shall be legibly or indelibly marked on the back side or label shall be attached with giving the following particulars or in accordance with the agreement between the buyer and the seller.

a. Designations

b. Size or dimensions and

c. Manufacturer's name, initials, trade mark or any other identification mark.

The mats shall be suitable packed as agreed to between the buyer and the seller care being taken to see that the pile of mats is not crushed while packing. Each package shall be marked with the following or in accordance with the agreement between the buyer and seller.

a. Name of the material

b. Gross mass

c. No. of mats packed in the package

d. Size No. or dimensions and

e. Name, initials, trade mark or any other identification mark of the manufacturer

17.1.2 Dimension of Coir Mats

The dimension of mats shall be as specified in the agreement between the buyer and seller and the standard sizes of mats are given below:

Size No	Dimension, mm
0	550 x 330
1	600 x 350
2	700 x 400
3	750 x 450
4	850 x 500
5	900 x 550
6	1000 x 600
7	1050 x 650
8	1150 x 700
9	1200 x 750
10	910 x 550 (for defence use)

The dimension of Gymnasia mats for defence purpose shall be 183 x 183 cms.

Mass

The mass of mats shall be as stipulated in the constructional details of the respective varieties.

a) An increase of 1200 gm/ sq. mtr shall be allowed for every increase of 6mm pile height over the specified values for mats having mass 6000 gm/m^2 and above.

b) An increase of 600 gm/m^2 shall be allowed for every increase of 3 mm pile height over the specified values for mats having mass below 6000 gm/m^2.

c)When the mass reaches 6000 gm/m^2 the lift in pile height and the corresponding mass in gm/m^2 as given in (a) above shall be made applicable.

Gymnasia Mats

An increase of 900 gm/m^2 will be allowed for every increase of 6mm pile height over the specified nominal value.

For defence requirement, the total mass of mat of size 183 cm. x 183 cm. including four cordage handles shall be 38 kg.

17.1.3 Tolerances for Coir Mats

1. Dimension	
1.1. Length	± 1 % or 13 mm whichever is higher and for Corridor, Mesh and Rope mats: + 19 mm and minus 13 mm
1.2. Width	± 1 % or 13 mm whichever is higher
2. Mass Mats of width 300 mm and below Mats of width above 300 mm and below 760mm Mats of width 760 mm and above Gymnasia mats for defence requirements of size 183 x 183 cm. with mass 38 kg. Special tolerance for beveled mats Corridor Mats and Rope mats	 Plus 12.5% and minus 5% Plus 7.5% and minus 5% Plus 5% and minus 10% Plus 4 kg and minus 2 kg. Creel Mats 1% Rod and Bit mats 1.5% Fibre mats 2%. Plus 7.5% and minus 5%

In respect of qualities where the formula for increase in mass for increased pile height is applied the maximum and minimum limits of tolerance would stand raised by the applicable standard lift from the stipulated levels of the basic quality.

3. Ends Ends	Plus 1 per dm and minus 0
4.Picks For mats of width less than760 mm For mats of width 760 mm and above For Gymnasia mats	 Plus 0 and minus 5% Plus 0 and minus 10% ±1 per dm
5. Diameter of Rope Lovers' Knot mats	 ±3mm
6. Pile Height Creel Mats Gymnasia mats	 ±1.5 mm ±3 mm

17.1.4. Constructional details of Creel mats

General Characteristics

A mat made of two or more chains, one tight and other slack working as pile or binding, the pile being formed by cutting slack chain bent over a grooved iron rod suitably inserted between slack and tight chains.

CONSTRUCTIONAL DETAILS OF CREEL MATS

Desig nation	Type of yarn				Construction	Ends per dm	Picks per dm	Pile Height mm	Mass gm/m²
	Slack Chain	Tight Chain	Weft	Pile					
1	2	3	4	5	6	7	8	9	10
5.1.1.Hand loom creel mats									
BC1	----	Beach /Vycome/ Alapat	Beach	Beach	Warp cut pile	9	24	22	4800
BC2	----	Do	Do	Do	Do	9	24	25	5400
BC3	----	Do	Do	Do	Do	9	25	28	6000
BC4	2 or 3 ply Jute	Do	Do	Do	Do	9	24	25	6000
BC5	Vycome	Vycome	Vycome	Alapat	Warp cut pile	9	22	28	6600
VC1	----	Vycome/Al apat	Do	Vycome	Do	9	25	22	5400
VC2	----	Do	Do	Do	Do	9	25	25	6000
VC3	----	Vycome	Do	Do	Do	9	25	28	6600

VC4	2 or 3 ply Jute	Do	Do	Do	Do	9	25	22	5400
VC5	Do	Do	Do	Do	Do	9	25	25	6000
VC6	Do	4 or 5 ply Jute	4 or 5 ply Jute	Do	Do	14	40	19	5100
VC8	Do	Do	3 ply Jute	Do	Do	17	52	13	4350
VC9	Do	Do	Vycome	Do	Do	16	43	16	4800
VC10 (Spl.C-1)	2 ply Jute	Vycome	Vycome	Vycome	Warp cut pile	14	40	19	4200
VC11 (Spl.C-10)	3 ply Jute	Do	Do	Vycome and Fibre	Do	17	24	25	6300
VC12 (Spl. C-14)	Do	Do	Do	Vycome (centre Wool Border)	Do	9	28	19	5100
VC 13* (Spl. C-16)	Anjengo	Do	Do	Anjengo	Do	10	24	15	3965

*** Unsheared and large size mats having a minimum width of 100 cm.**

Powerloom Creel Mats

Power loom creel mats are woven in rolls and then cut into required size.

CONSTRUCTIONAL DETAILS OF POWERLOOM CREEL MATS

Quality No.	Type of yarn				Chains/ Ends / dm.	Picks/ dm.	Pile Height, mm.	Weight gm/m²
	Slack Chain	Tight Chain	Weft	Pile				
1	2	3	4	5	6	7	8	9
SPC1	3 ply jute	2 ply sisal	5 ply jute	Vycome	9	28	18	5700
SPC2	Do	5 ply jute	Do	Do	9	28	18	5700
SPC3	Do	2 ply sisal	Do	Do	9	26	20	5700
SPC4	Do	5 ply jute	Do	Do	9	26	20	5700
SPC5	Do	5 ply jute	Do	Do	9	26	20	6000
SPC6	Do	Mangadan	Do	Do	9	26	20	6000
SPC7	Do	Mangadan	Do	Do	9	26	24	6000
SPC8	Do	Mangadan	5 ply jute	Brown Fibre Yarn (Medium)	9	22	24	5600

SPC9	Do	Do	Do	Vycome	9	26	28	7200
SPC10	Do	Do	Do	Brown Fibre Yarn (Medium)	9	22	28	6000
SPC11	Do	Do	Do	Brown Fibre Yarn (Medium)	9	22	20	5200
SPC12	Anjengo	Do	Anjengo	Vycome	9	22	32	8000
SPC13	Poly 700M/kg	Mangadan	Poly 700 M/kg	Quilandy 130 M/kg & Poly 180 M/kg	9.5 (Tight) 4.75 (Slack)	21	40	11600

NOTE: Brown fibre yarn shall be of medium quality free from impurities and pith.

Tolerances Permitted: Tolerances as applicable to handloom mats of Creel Variety.

17.1.5. Constructional Details of Rod and Rod inlaid mats

General Characteristics

A mat with pile formed by cutting two or more strands of yarn folded together and wound around a grooved iron rod along with the alternate ends of warp.

CONSTRUCTIONAL DETAILS OF ROD AND ROD INLAID MATS

Desig nation	Types of Warp Yarn	Type of Weft Yarn	Type of pile Yarn	Construction	Ends/ chain/dm	Picks / dm	Pile Height, mm	Mass gm/m²
1	2	3	4	5	6	7	8	9
BR1	Beach or Vycome	Beach	Beach	2 x 2	9	9	25	4200
BR2	Do	----	Do	2 x 2	9	11	28	4800
BR3	Do	Do	Do	2 x1	10	11	25	4800
BR4	Do	Do	Do	2 x 1	10	13	28	5400
BR5	do	Do	Do	3 x2	10	9	28	5400
BR6	do	Do	Do	3 x 2	10	9	32	6000
BR7	do	Do	Do	3 x 1	10	11	28	5400
BR8	do	Do	Do	3 x 1	10	12	32	6000
BR9	do	Do	Do	3 x 1	10	13	35	6600
BR10	do	Do	Do	3 x 1	10	13	38	7200
BR11	do	Beach	Alapat	2 x 1	9	9	32	6000
BR12	do	Alapat	Do	3 * 1	9	10	32	6600

BR13 (SplR15)	do	Beach	Beach	4 x 1	10	11	38	7200
BR14 (Spl R-16)	Beach	Do	2 strands Beach 2 strands Vycome	4 x 1	10	10	35	6600
BR15 (Spl R-1)	Beach or Vycome	Beach	Beach	3 x 3	10	8	32	5100
VR1	Vycome	Vycome	Vycome	3 x 1	10	12	32	7200
VR1D *	Do	Do	Do	4 x 1	10	12	40	8400
VR2	Do	Do	Do	4 x 2	10	9	32	7200
VR4	Do	Do	Do	4 x1	10	11	35	7800
VR5	Do	Do	Do	4 x 1	10	11	38	8400
VR6	Do	Do	Do	4 x 1	10	12	41	9000
VR7 (Spl R-7)	Do	Do	Do	6 x 1	12	13	35	7800
VR8@ (SplR19)	Tight- Vycome Slack - Vycome	Do	Do	----	12	20	----	5490
TR1	Vycome	T.Vycome/ Vycome	T. Vycome	3 x 1	10	9	32	7200
TR2 (Spl R-4)	Vycome/ Beach	Do	Do	3x 2	10	8	32	6600
RR1 (Spl R-12)	Vycome/ Alapat	Vycome	Aratory	4 x 1	10	12	32	7200
LR1 (Spl R-8)	Vycome	Do	Alapat	4 x 1	10	10	32	7200
FIBRE INLAID								
BR1	Beach/ Vycome	Beach	Beach	2 x2	10	10	28	5400
BR2	Do	Do	Do	2 x 2	11	11	32	6000
BR3	Do	Do	Do	3 x 1	11	11	28	6000
BR4	Do	Do	Do	3 x 1	11	11	32	6600
BR5	Do	Do	Do	3 x 2	11	11	35	7200
BR6 (Spl-Rl-1)	Do	Do	Do	3 x 2	11	11	28	6000
BR7 (Spl-l-10)	Do	Do	Beach/ Alapat/ T. Vycome	3 x 1	10	11	35	7200

VR1	Vycome	Vycome	Vycome	4 x 1	11	12	32	7800
VR2	Do	Do	Do	4 x 1	11	12	38	9000
TR1 (Spl Rl-12)	Do	Do	T. Vycome	3 x1	10	10	35	7800
RR1 (Spl-Rl-8)	Do	Do	Aratory	4 x 1	10	12	38	8400
LR1 (Spl-Rl-11)	Vycome/ Alapat	Vycome	Alapat	4 x1	10	11	38	8400
SPI Rl 9	Vycome	Do	Vycome	4 x 1	11	12	28	7200
YARN INLAID								
BRY1 (BRIY-1)	Beach/ Vycome	Beach	Beach	3 x 1	11	12	32	6000
BRIY- 2	Do	Do	Do	3 x 1	10	12	28	5400

* Mainly for defence use

@ A mat having the Rod construction basically but has features of fibre mat since. It has slack and tight chains.

The pile is uncut and hence it has the appearance of Loop Mat also.

Note: The Construction 2 x 2, for example, implies that the pile is formed by two strands of coir yarn working as one and the weft comprising of 2 strands of coir yarn is inserted between two rows of pile.

17.1.6. Constructional Details of Fibre Mats

General characteristics:

A mat made up of two chains, one tight and the other binding, the pile being formed by insertion of tufts of coir fibre on alternate strands of tight chain.

CONSTRUCTIONAL DETAILS OF FIBRE MATS

Desig nation	Slack Chain	Tight Chain	Weft	Pile	Constr-uction	Ends/ dm	Picks/ dm	Pile Height mm.	Mass gm/m²
1	2	3	4	5	6	7	8	9	10
FM 1	----	Vycome/ Alapat	Vycome	Fibre Grade 1 or 2	Inserted Fibre	12	12	31	7800
FM 2	Vycome/ Alapat/ Anjengo	Vycome/ Alapat/ Anjengo	Do	Retted Fibre Gr. 1 or 2	Do	12	12	28	7800
FM3	Do	Do	Do	Do	Do	14	14	32	8400

FW 1	Vycome	Do	Do	Wool border + retted fibre at centre	Do	14	15	19 (border) 28 (inside)	6600
FW 2	Vycome	Alapat/ Vycome	Do	Retted Fibre & Wool	Do	12	12	35	10200

17.1.7. Constructional Details of Bit Mats

General characteristics

A mat with the pile formed by insertion of bits of yarn on every alternate strands of chain.

CONSTRUCTIONAL DETAILS OF BIT MATS

Desig nation	Warp	Weft	Pile	Constru ction	Ends/ dm	Picks/ dm	Pile Height, mm	Mass gm/ m^2
1	2	3	4	5	6	7	8	9
BB1	Beach/ Vycome	Beach	Beach Bits	Inserted Yarn bits	9	9	32	6600
VB 1	Vycome	Vycome	Vycome Bits	Do	9	9	35	7800
AB 1	Do	Do	Hard twisted yarn bits	Do	9	9	35	8400
FIBRE INLAID								
AB 1	Vycome	Vycome	Hard twisted yarn bits	Inserted Bits	11	12	35	9000

17.1.8. Constructional Details of Corridor Mats

General characteristics

A mat in which both warp and weft strands are continuous without tucking in or binding.

CONSTRUCTIONAL DETAILS OF CORRIDOR MATS

Designation	Type of warp Yarn	Ends / dm. Min.	Type of weft Yarn	Runnage m/kg	Mass gm/m²
1	2	3	4	5	6
AC 1	Rope Yarn	6	Anjengo	240	4550
AC 2	Do	5	Do	240	4250
AC 3	Do	5	Do	220	3650
AC 4 (Spl. CD-1)	Anjengo double strands 12 score	6	Do	275	3650
AC 5@(Spl. CD-9)	Aratory 3 ply twisted 6.4 mm. dia	5	Anjengo 3 ply twisted 6.4 mm dia	----	5400
RC 1	Rope Yarn	6	Aratory	240	4250
RC 2	Rope Yarn	5	Aratory	240	4000
RC 3	Do	5	Do	220	3350
RC 4 (Spl. CD – 2)	Aratory double strands 12 Score	6	Do	280	3350
RC 5 (Spl. CD – 5)	Rope Yarn	6	Do	280	3650
LC1	Do	5	Alapat	190	4250
WC 1	Do	5	Vycome	260	4250
WC 2	Do	5	Do	240	3650
WC 3	Rope Yarn	5	Vycome	220	3050
WC4 (Spl. CD – 4)	Do	3	Vycome/ Aratory	220/220	5800
QC 1 (Spl. CD -3)	Do	5	Quilandy	110	4000
QC 2 (FSQ 1)	Wooden reapers fully covered with Quilandy Yarn	3	Do	120	10750
YC 1(Spl.CD – 6)	Beypore	5	Beypore	70	3200
YC 2 (Spl. CD – 8)	Do	5	Do	80	4250

CC 1 (Spl. CD – 7)	** Laccadive Rope No.2	5	Laccadiv Rope No.2	40	5450
DC 1 (Spl.CD – 10)	2 ply yarn spun, from unretted fibre	5	2 ply yarn spun from unretted fibre	----	4050
TC 1	Rope yarn	5	T.Vycome	----	3650
SCD – 12	Hawser laid Rope (3 ply) of 10 diameter made of Anjengo A yarn:	3	Hawser laid Rope (3 ply) of 15 mm diameter made of Anjengo A yarn	Picks dm 7	6100

* Binding weft Aratory 12 scorage minimum.

** Definition of Laccadive Rope Yarn: Hand spun yarn, spun from coir fibre extracted from retted husks; containing little or no pith less hairy; evenly spun; ranging from natural golden colour to natural reddish brown; grades as per scorages given Below:

Laccadive No. 1 : 6 to 8 and Laccadive No. 2 : 4 to 6

@ The number of layers of rope on the four side of the mat shall be two or more to make the border prominent. The four sides are knitted with Anjengo yarn prevent slipping of the warp and weft.

17.1.9. Constructional Details of Sinnet Mats

General characteristics

A mat made of plaited (braided) coir yarn of 3 or more strands stitched together in a frame.

CONSTRUCTIONAL DETAILS OF SINNET MATS

Designation	Type of Yarn	Runnage m/kg	No of Strands of Ply	Thickness, mm (Minimum)	Mass gm/m²
1	2	3	4	5	6
SA1	Anjengo	220	9	19	3650
SA 2	Do	220	9	19	4250
SA 3	Do	220	11	25	4850
SA 4	Do	220	11	25	5450
SA 5	Do	220	11	25	6100
SA 6 (Spl. S-2)	Do	220	11	28	7300
SA 7(Spl. S-8)	Do	275	9	19	5490
SA 8 (Spl. S- 7)	Anjengo	275	3	10	3000

SB 1	Beach	250	9	19	3350
SB 2	Do	250	9	19	3950
SB 3	Do	250	11	25	4600
SR 1	Aratory	220	9	19	3350
SR 2	Do	220	9	19	3950
SR 3	Do	220	11	25	4600
SR 4	Do	220	11	25	5200
SR 5	Do	220	11	25	5800
SR 6 (Spl. S – 5)	Anjengo/ Aratory	220/220	19	28	7300
SL 1 (Spl. S – 3)	Alapat	180	11	25	7900
SL 2 (Spl. S – 6)	Do	190	12	31	6700
SD1 (Spl. S – 1)	Ashtamudy	110	9	25	6100
SV 1	Vycome	220	9	19	3650
SV 2	Do	220	9	19	4250
SV 3	Do	220	11	25	4850
SV 4	Do	220	11	25	5450
SV 5 (Spl. S – 4)	Do	240	19	28	6700

Note: - Coir yarn for inner strands of the braid may be of a suitable quality.

17.1.10. Constructional Details of Gymnasia Mats

General characteristics

A mat with pile formed by cutting three or more yarns folded together and wound around a grooved iron rod long with alternate ends of warp. The piles are made thicker to meet the specific requirements.

CONSTRUCTIONAL DETAILS OF GYMNASIA MATS

Desig nation	Type of Warp Yarn	Type of Weft Yarn	Ends (Chains) /dm	Picks/ dm	Type of Pile Yarn	Pile Height, mm	Mass gm/m²
1	2	3	4	5	6	7	8
VG 1 (BVG-1)	Vycome	Vycome yarn single, sufficient to guarantee tight weave	10	10	Vycome yarn free from impurities min. 4 fold yarn drawn together	63	12200
BG 1 (BBG-1)	Do	Beach yarn single, sufficient to guarantee tight weave	10	10	Beach yarn min. 3 fold yarn drawn together	63	11000

17.1.11. Constructional Details of Loop Mats

General characteristics

A mat made up by three chains, one tight and other slack working as pile or binding. The pile is formed by loops formed out of slack chain in the weaving process.

CONSTRUCTIONAL DETAILS OF LOOP MATS

Desig-ation	Type of yarn for tight chain	Runn-age m/kg	Type of yarn for binding chain	Runn-age m/kg	Type of yarn for loop chain	Runn-age m/kg	Type of yarn for weft	Ends / dm Min	Picks / dm Min.	Mass gm/m²
1	2	3	4	5	6	7	8	9	10	11
RL 1	Vycome	220	Vycome	240	Aratory	220	Vycome	10	22	4250
RL 2	Do	220	Do	240	Do	240	Do	10	22	3650
RL 3	Do	220	Do	240	Do	240	Beach	10	22	3650
RL 4	Do	220	Do	240	Do	260	Vycome	9	22	3050
VL 1	Do	220	Do	240	Vycome	260	Do	10	28	3650
AL 1 (Spl. L – 2)	Vycome	220	----	----	Anjengo	220	Vycome	10	24	4880
AL 2 (Spl. L – 4)	Do	220	Anjengo	275	Do	275	Do	10	20	3650
AL 3 (Spl. L-5)	Do	220	Vycome	240	Do	240	Quilandy	10	20	5490

17.1.12. Constructional Details of Loop Fabrics (Geo Textiles)

General characteristics

A product made with loop construction usually manufactured in rolls for use as Geo fabrics for soil erosion control and soil stabilization.

CONSTRUCTIONAL DETAILS OF LOOP FABRICS (GEO TEXTILES)

Quality Number	Tight Chain	Bind-ing Chain	Loop Chain	Weft	Tight	Bind-ing	Loop	Picks / dm	Weight gm/ m²
1	2	3	4	5	6	7	8	9	10
SPL L 7	Vycome	Vycome	Vycome	Vycome	5	10	5	8	1300
SPL L 8	Do	Do	Quilandy	Do	4	8	4	8	1600
SPL L 9	Beach	Beach	Beach	Beach	5	5	5	9	1200

17. 1.13. Constructional Details of Rope Mats (Lover's Knot Mats)

General characteristics

A mat made with a coir rope guided through a number of upright nails fixed on a flat surface. This mat may be made either in oval or oblong shapes.

CONSTRUCTIONAL DETAILS OF ROPE MATS (LOVER'S KNOT MATS)

Designation	Type of Rope	Type of Yarn	Diameter of Rope, mm	Mass gm/m²
1	2	3	4	5
LKA	Shroud laid	Anjengo	14	6100
LKR	Do	Aratory	14	5490
LKV	Shroud laid	Vycome	25	11450

Note: For oval shaped mats the nominal mass in gm/m2 shall be 10% less than specified.

17. 1.14. Constructional Details of Mesh Mats

General characteristics

A mat made by laying coir yarn in criss-cross manner between a number of nails fixed on a frame and knotting the intersecting with coir yarn.

CONSTRUCTIONAL DETAILS OF MESH MATS

Designation	Type of yarn used in the base	No. of Strands / dm(min.)	Binding Yarn	Mass gm/m²
1	2	3	4	5
MBA	Beypore	10 x 10	Anjengo/Aratory	3660
MRA	Aratory	20 x 20	Anjengo	3660
MVV	Vycome	20 x 20	Vycome	3050
MQA	Quilandy	20 x 20	Anjengo	5490

Note: The number of strands used at the edges of MBA may be suitably increased and all the four edges may be knotted properly. All the four edges of MRA, MVV may be finished either by stitched with 7 ply braid on both sides or by plaiting with coir yarn to give the appearance of braid and the edges of MQA may be finished by plaiting with coir yarn give the appearance of braid.

17.2. COIR MATTINGS, MOURZOUKS AND CARPETS

(IS: 12503 – (Part 1 to 6) 1988: Specification for Coir -Mattings, Mourzouks and Carpets)

17.2.1 General Requirements

The Coir Mattings, Mourzouks and Carpets shall be manufactured from natural, bleached or dyed yarn as agreed to between the buyer and the seller. The yarn shall be of 2 ply. The Coir Mattings, Mourzouks and Carpets shall be firmly and evenly woven. The Coir Mattings, Mourzouks and Carpets shall be plain, dyed or stenciled or may have designs woven in to them. The Coir Mattings, Mourzouks and Carpets shall be free from moisture and other extraneous matters.

The Coir Mattings, are woven on power loom and handloom. It is customary to use aloe, sisal or jute strands in both warp and weft to pick out the pattern.

Coir Mattings may be made in to matting rolls, matting rugs or matting mats. Unless otherwise agreed to between the buyer and the seller, the cut ends of the matting mats or rugs shall be either stitched with suitable cotton thread or bound with jute, rexin or leather webbing (plain, coloured or fancy) or ends doubled back and interlaced in the body of the matting mats or rugs or sealed with suitable edge sealing compound, like rubber based adhesive or glue.

Coir Mourzouks are usually manufactured in a variety of sizes and patterns and heavy and durable. Mourzouk weaving differs from matting weaving in so-far-as it is woven on special looms and the surface and the pattern of the mourzouks are formed by the weft and not by the warp. On completion of weaving, the ends of the warp are drawn back in to fabric give a strong straight edged finish. This type of weaving enables the production of intricate, geometrical and floral designs.

Coir Carpets, commonly known as ‘Alleppey Carpets’ are manufactured in the same way as mourzouks, but with double warp threads instead of single, to produce a very much thicker and heavier material. Because of this doubling of the warp, a ribbed effect is produced in the finished material.

The Coir Matting for Cricket Pitches is a special type of matting which is usually fabricated out of only certain types of coir yarn in accordance with well accepted practices. The matting is usually be in twill weave 3 treadle or 4 treadle. The coir matting for cricket pitches may be provided with canvas or leather binding at the 2 ends. The width of the binding usually be 6 to 7.5cm and double stitched at 2 places with waxed cotton cord. On the width side at every 45 cm from the ends and at the length side at every 1.6 to 1.8 meter, circular or square patches of leather or canvas are stitched with waxed cotton cord. In the centre of these patches, eyelets having holes not exceeding 20 mm diameter and with top and bottom catches of 25 mm diameter are firmly fitted to the leather or canvas having 25mm sides or if round of 75 mm diameter. The matting shall be firmly and evenly woven from selected yarn of uniform scorage with least number of splicing whenever splicing is done, if shall be so even as to avoid non-uniformity in diameter.

Coir matting/mourzouks/carpets shall be legibly and indelibly marked on the back or a label shall be attached with it giving following particulars or in accordance with the agreement between the buyer and seller.

a) Designation

b) Size or Dimensions

c) Manufacturer's name, initials or trade mark or any other identification mark.

The mattings/mourzouks /carpets shall be suitably packed as agreed to between the buyer and the seller. Each package shall be marked with the following or in accordance with the agreement between the buyer and seller.

a) Name of the products

b) Gross mass

c) Number of pieces packed in the package

d) Size number or dimensions

e) Designation and

f) Name, initials, trade mark or any other identification mark of the manufacturer.

17.2.2. Dimensions

The dimensions of coir mattings/mourzouks/carpets shall be as specified in the agreement between the buyer and the seller. The coir mattings are generally supplied in rolls of length not less than 11 metres and width ranging from 300 to 5000 mm. Coir mourzouks and carpets generally supplied are manufactured in specific sizes to suit the buyer's requirements.

The preferred dimensions for coir mattings for cricket pitches shall be as follows.

Length	Width
1) 20.12 or 10.06 Metres	2.74 Metres
2) do	2.44 "
3) do	1.83 "

17.2.3 Tolerance for Coir Mattings, Mourzouks and Carpets

The following tolerance is allowed for Coir Mattings, Matting Mats and rugs, Mourzouks, Coir Carpets etc.

1) Scorage of yarn ± 1

2) Dimension

a) Coir Mattings } Length + 1% minus –Nil
Width up to 180 cm ±1 3mm
Above 180 cm ± 25 mm

b) Coir Matting rugs, coir carpets in roll from or in rug size and Coir Mourzouks. } Length ±13 mm
Width up to 180 cm ± 13 mm

		Above 180 cm ± 25 mm
c) Coir Mattings, Mourzouks		Length &Width ±13 mm
Coir Carpets in mat sizes,	}	
Non woven matting mats		
and Carpets.		
d) Coir matting for cricket	}	Length & Width ± 1%
pitches.		
3) Ends		
Coir Mattins, Matting		+ 2 strands per dm
Rugs and Matting mats	}	- 2 strands per dm
a) Coir Mattings,		
Mattings rugs		
Matting mats,		Width up to 275 cm – 5 %
Mourzouks and	}	Width over 275 cm - 2 per dm.
Coir Carpets.		
b) Special tolerance for		
Power loom Coir Matting	}	– 5%
4) Picks		
a) Coir Mattings,		
Mattings rugs		
Matting mats,		Width up to 275 cm – 5 %
Mourzouks and	}	Width over 275 cm - 2 per dm.
Coir Carpets.		
b) Special tolerance for		
Power loom Coir Matting	}	– 5%
5) Mass		
a) Coir Mattings,		
Matting rugs, Matting mats		
Mourzouks, Coir Carpets	}	+ 7.5%
Non-woven Carpets and		-5%
Hand knotted Coir Nettings		
b) Non-woven Matting mats }	±10%	

c) Permissible limits in weight for chemically (Hydrogen peroxide) +10% bleached matting. } + 5% Thus making the range in weight as 15%

(The special tolerance is not allowed to M2BQ1 (S2BM7), as the weight specified is for chemically bleached yarn)

c) M2BQ1 (S2BM7)

Extra weight for rugs with tucked in ends. } 5 gm/dm for the length of the tucked in portion.

d) Extra minus tolerance

when mattings are woven with gaps throughout the length } 0.75 % on the total weight for every gap of 1 cm. width

RBMA Diameter of Rope : + 2 mm

No. of Rope per dm : ±1

17.2.4. Constructional Details of Coir Mattings - Two – Treadle Plain Weave

1) Definition

In this weave, each warp thread gets interlaced alternatively over and under by successive weft thread that is, when the odd ends are up even ends are down and vice-versa. Both sides of the matting present the same appearance and the matting is, therefore, reversible.

Designation	Type of warp Yarn	Approximate Scorage of Warp yarn	Ends/ dm	Type of weft yarn	Picks/ dm	Mass, kg/m^2
1	2	3	4	5	6	7
Handloom mattings						
M2A1	Anjengo	15	33	Vycome/Beach	11	1.50
M2A2	Anjengo	14	31	Vycome/Beach	11	1.55
M2A3	Anjengo	13	29	Vycome/Beach	10	1.62
M2A4	Anjengo	12	27	Vycome/Beach	9	1.70
M2R1	Aratory	15	33	Vycome/Beach	11	1.42
M2R2	Aratory	14	31	Vycome/Beach	11	1.47
M2R3	Aratory	13	29	Vycome/Beach	10	1.55
M2R4	Aratory	12	27	Vycome/Beach	9	1.62
M2V1	Vycome	15	33	Beach/Vycome	9	1.35
M2V2	Vycome	14/13	30	Beach/Vycome	9	1.42
M2V3	Vycome	12	27	Beach/Vycome	9	1.52
M2V4 (S2M3)	Vycome	11	22	Vycome/Beach	9	1.25
M2V5(S2M10)	Vycome Thin	----	36	Vycome	12	1.10
M2B1	Beach	11/10	22	Beach	9	1.30

M2B2	Beach	9	20	Beach	9	1.40
M2Q1(S2M11)	Quilandy	----	17	Aratory	6	1.85
S2M4	Anjengo	13	19	Vycome	10	1.40
S2M12	Mangadan	----	21	Vycome	8	2.30
Power loom Mattings						
PM2A1 (P2A1)	Anjengo	13	28	Vycome	13	1.70
PM2A2	Anjengo	12	26	Aratory/Vycome	13	1.80
PM2A3(P2A6)	Anjengo	15/16	42	Anjengo	11	1.70
PM2Q1(P2A2)	Quilandy /Ashtamudy	10	22	Vycome	10	2.00
PM2Q2(P2A3)	Quilandy /Ashtamudy	9	16	Vycome	7	1.80
PM2Q3(P2A4)	Quilandy	9	21	Vycome	17	2.40
P2A7	Mangadan	11	23	Vycome	10	2.10
P2A8(2 x 1)	Anjengo	15	36	Anjengo	12	1.60

17.2.5. Two- Treadle Basket Weave

Definition

This weave is the same as that of two-treadle plain weave, both warp-wise and weft-wise (vertically and horizontally), but two or more strands of coir work together in the same order. This enables the production of attractive patterns in both stripe and check (tile). Both sides of the matting have the same appearance and the matting is, therefore; reversible.

Designation	Type of Warp Yarn	Approximate Scorage of Warp Yarn	Ends/dm	Type of Weft Yarn	Picks/ dm	Mass, kg/m²
1	2	3	4	5	6	7
Handloom Mattings						
M2BA1	Anjengo	15	30	Anjengo/ Aratory	17	1.72
M2BA2	Anjengo	14	28	Anjengo/ Aratory	17	1.80
M2BA3	Anjengo	13	26	Anjengo/ Aratory	16	1.82
M2BA4	Anjengo	15	30	Vycome	17	1.62
M2BA5	Anjengo	14	28	Vycome	17	1.68
M2BA6	Anjengo	13	26	Vycome	16	1.72
M2BA7 (S2BM1)	Anjengo	16	34	Anjengo	17	1.62
M2BA8 (S2BM3)	Mangadan	12	25	Anjengo-M	12	2.62
M2BR1	Aratory	15	30	Aratory	17	1.68
M2BR2	Aratory	14	28	Aratory	17	1.72
M2BR3	Aratory	13	26	Aratory	16	1.80
M2BR4	Aratory	15	30	Vycome	17	1.58

M2BR5	Aratory	14	28	Vycome	17	1.62
M2BR6	Aratory	13	26	Vycome	16	1.68
M2BV1	Vycome	14	28	Vycome	16	1.47
M2BV2	Vycome	13	26	Vycome	16	1.52
M2BV3	Vycome	12	24	Vycome	15	1.58
M2BB1	Beach	10	20	Beach	15	1.38
M2BQ1 (S2BM7)	Quilandy	10	20	Quilandy	15	2.80

Note: Special minus tolerance of 5% is not allowed for M2BQ1 (S2BM7) as mass fixed is for Bleached Yarn matting.

1	2	3	4	5	6	7
Power loom Matting						
PM2BA1	Anjengo	12	30	Vycome	16	2.00
PM2BA2 (P2BA2)	Anjengo	14	32	Anjengo/Aratory	18	2.20
PM2BA3 (P2BA3)	Anjengo	14	28	Anjengo/Aratory	16	2.00
PM2BA4 (P2BA4)	Anjengo	13	28	Anjengo, Loose Twist	14	1.80
PM2BA5	Anjengo	16	32	Anjengo	22	2.00
PM2BA6	Anjengo	15	32	Anjengo	21	1.80
PM2BA7 (P2BA8)	Anjengo	15	36	Anjengo (16 score)	18	1.80
PM2BQ1	Quilandy	9	10	Anjengo	16	2.10

17.2.6. Three – Treadle Weave.

Definition

This weave is employed to obtain thick and better looking matting than the two-treadle one. This type of weave produces a diagonal or herringbone effect. As the twill lines are formed on one side only of the fabric, this matting is non reversible. The use of this weave is principally for the manufacture of plain and solid coloured matting.

Designation	**Type of Warp Yarn**	**Approximate Scorage of Warp Yarn**	**Ends/ dm**	**Type of weft Yarn**	**Picks/ dm**	**Mass, kg/m²**
1	2	3	4	5	6	7
Hand loom Mattings						
M3A1	Anjengo	16	35	Vycome / Beach	11	1.58

M3A2	Anjengo	15	33	Vycome / Beach	11	1.62
M3A3	Anjengo	14	31	Vycome / Beach	11	1.68
M3A4	Anjengo	13	29	Vycome / Beach	10	1.75
M3A5	Anjengo	12	27	Vycome / Beach	10	1.82
M3A6 (S3M2)	Anjengo	16	40	Vycome / Alapat	11	2.00
M3A7 (S3M4)	Anjengo	15	31	Vycome / Beach	11	1.52
M3A8 (S3M9)	Anjengo	13 (50%) 17 (50%)	36	Anjengo	19	1.90
M3R1	Aratory	16	35	Vycome / Beach	11	1.50
M3R2	Aratory	15	33	Vycome / Beach	11	1.55
M3R3	Aratory	14	31	Vycome / Beach	11	1.60
M3R4	Aratory	13	29	Vycome / Beach	10	1.68
M3R5	Aratory	12	27	Vycome / Beach	10	1.75
M3C1	Ashtamudy	11	24	Vycome / Beach	9	2.08
M3V1	Vycome	14	31	Vycome / Beach	10	1.40
M3V2	Vycome	13	29	Vycome / Beach	9	1.45
M3V3	Vycome	12	27	Vycome / Beach	9	1.52
M3B1	Beach	10	22	Beach	9	1.40
Power loom Mattings						
PM3A1 (P3A1)	Anjengo	13	28	Anjengo	14	1.80
PM3A2 (P3A2)	Anjengo (50%) & 2- ply Aloe thin (50%)	18 (Anjengo)	42	Anjengo (18 Score)	24	1.85

17.2.7. Four – Treadle Weave.

Definition

In this type of weave the twill lines are formed on both sides of the fabric and the matting is, therefore, more ornate in appearance and reversible. It is used for the production of superior quality mattings in a variety of patterns such as reversible twill, reversible herringbone, reversible diamond, etc.

Designation	Type of warp Yarn	Approximate Scorage of Warp Yarn	Ends/ dm	Type of Weft Yarn	Picks/ dm	Mass, kg/m^2
1	2	3	4	5	6	7
Handloom Mattings						
M4A1	Anjengo	15	33	Vycome	13	1.70
M4A2	Anjengo	14	31	Vycome	13	1.75
M4A3	Anjengo	13	29	Vycome	13	1.82
M4A4	Anjengo	12	27	Vycome	13	1.90
M4A5 (S4M4)	Anjengo	13	32	Vycome	15	2.13
M4A6 (S4M11)	Anjengo	14	31	Anjengo /Aratory	14	1.82
M4R1	Aratory	15	33	Vycome	13	1.62
M4R2	Aratory	14	31	Vycome	13	1.68
M4R3	Aratory	13	29	Vycome	13	1.75
M4R4	Aratory	12	27	Vycome	13	1.82
M4V1	Vycome	14	31	Vycome	12	1.47
M4V2	Vycome	13	29	Vycome	12	1.55
M4V3	Vycome	12	27	Vycome	12	1.62
M4V4 (S4M22)	Vycome Thin	20	40	Vycome	17	1.35
M4Q1 (S4M17)	Quilandy	9	20	Quilandy	9	2.62
M4Y1 (S4M13)	Beypore	6	14	Beypore	7	2.80
Power loom Mattings						
PM4A1 (P4A1)	Anjengo	13	30	Vycome	16	1.95

PM4A2 (P4A2)	Anjengo	14	32	Vycome / Aratory	17	2.20
PM4A3 (P4A3)	Anjengo	14	28	Vycome / Aratory	16	2.00
PM4A4 (P4A4)	Mangadan & Sisal (1/3)	13	26	Vycome	17	1.96
PM4A5 (P4A5)	Mangadan- & Sisal (1/3)	13	25	Vycome	16	1.80
PM4A6 (P4A6)	Mangadan	13	29	Vycome	12	2.20
PM4A7 (P4A7)	Anjengo	12	28	Vycome	14	1.80
PM4A8 (P4A8)	Anjengo	16	32	Anjengo	22	2.00
PM4A9 (P4A9)	Anjengo	15	32	Anjengo	21	1.80
PM4A10 (P4A10)	Anjengo	12	27	Vycome	14	2.20
PM4A11 (P4A12)	Anjengo	11	28	Aratory / Vycome	15	2.10
PM4A12 (P4A13)	Anjengo or Quilandy	13 or 9	11	Aratory	13	2.10
PM4Q1 (P4A11)	Quilandy	9	10	Anjengo	16	2.10

17.2.8. Mesh Mattings (Geo Textiles)

Definition

A matting of two-treadle weave in construction with the difference that the warp and weft strands are positioned at a distance to get mesh effect.

Designation	Type of Warp Yarn	Approximate Scorage of Warp Yarn	Ends / dm	Type of weft Yarn	Picks / dm	Mass, kg/ m^2
1	2	3	4	5	6	7
Hand loom Mattings						
MMA1 (H2M1)	Anjengo	14	9	Vycome	8	0.650
MMA2 (H2M4)	Anjengo	12	19	Aratory	11	1.400

MMA3 (H2M8)	Anjengo	12	11	Aratory	7	0.700
MMA4 (H2M9)	Anjengo	11	13	Aratory	7	0.900
MMA5 (H2M10)	Anjengo	11	18	Anjengo	9	1.300
MMR1 (H2M3)	Aratory	15	14	Aratory	14	0.875
MMV1 (H2M5)	Vycome	13	9	Vycome	8	0.740
MMV2 (H2M6)	Vycome	12	4.6	Vycome	4	0.400
MMB1 (H2M2)	Beach	9	8	Beach	7	0.700
MMY1 (H2M7)	Beypore	----	4	Beypore	6	1.250

Note :

MMA2 (H2M4)	In this matting the warp threads are arranged in groups of three strands.
MMR1 (H2M3)	In this matting, the warp and weft threads are arranged in pairs, each warp strand is woven alternately with the adjacent strands.
MMA5 (H2M10)	In this matting the warp strands are arranged in groups of 6 strands leaving a gap of 1 cm between each group. After 6 such groups 4 jute strands are provided to protect the warp after cutting. A gap of 1.5 cm is provided after the jute strands to facilitate cutting of matting in strips of 20 cm width.
MMB1 (H2M2)	In this matting extra warp strands are allowed to reinforce over a width of 2” at both sides, when the width of matting is 36” and less. Above 36” width a reinforcement of 4” width at the centre and sides of the matting is allowed.

17.2.9. Multi shaft Mattings

Definition

A matting generally woven on looms mounted with Dobby or Jacquard shedding mechanisms. This matting incorporates more elaborate patterns and designs which require more than four – shaft.

Designation	Type of Warp Yarn	Approximate Scorage of Warp Yarn	Ends/dm	Type of weft Yarn	Picks/ dm	Mass, kg/m²
1	2	3	4	5	6	7
Hand loom Mattings						
MSA1 (SOM1)	Anjengo	12	30	Vycome	14	2.00
MSA2 (SOM2)	Anjengo	14	26	Anjengo	18	2.00
MSA3	Anjengo	16	35	Anjengo / Aloe/Sisal	12	1.70
MSA4	Anjengo	15	21	Vycome	26	1.32
MSQ1	Quilandy	8	20	Quilandy	15	3.20
MSQ2	Quilandy	9	20	Quilandy	8	2.62
MSQ3	Quilandy	9	20	Quilandy	18	4.00
Power loom Mattings						
PMSA1 (POA1)	Anjengo	15	32	Vycome	18	2.20
PMSA2 (POA2)	Anjengo	15	32	Vycome	13	2.10

17.2.10. Rubber Backed Matting

Definition

Matting specially intended for the purpose of providing rubber backing and to cut to sizes. At the centre of the matting a gap is provided by omitting warp strands.

Designation	Type of Warp Yarn	Approximate Scorage of Warp Yarn	Ends/ dm	Type of weft Yarn	Picks / dm	Mass, kg/ m²
1	2	3	4	5	6	7
Hand loom mattings						
RB 2R1 (S2RB1)	Aratory	5/16	24/25	Vycome	12	1.290
(In this matting, two warp strands are omitted at the centre)						

17.2.11. Special Reed Mattings

Definition

Matting which exhibits warp strands in pairs working together, woven on closer reeds to ensure distribution of warp uniformly and without overlapping.

Designation	Type of Warp Yarn	Approximate Scorage of Warp Yarn	Ends/ dm	Type of weft Yarn	Picks/ dm	Mass, kg/ m^2
1	2	3	4	5	6	7
SR4A1 (SR4M2)	Anjengo	14	29	Aratory	16	1.75
SR4R1 (SR4M1)	Aratory	15	26	Vycome	18	1.40
SR4R2 (SR4M3)	Aratory	13	26	Vycome	16	1.68

(The designations indicated within brackets are popularly known 'Export designations')

17.2.12. Ribbed Mattings

Definition

A matting of two – treadle weave in construction, which exhibits ribbed effects on the surface. They are comparatively denser than the ordinary plain weave matting.

Desig nation	Warp						Weft		Mass, kg/m^2
	Slack		Tight		Ends / dm		Type of Yarn	Picks /dm	
	Type of Yarn	Apprx scor age	Type of Yarn	Approx scor age	Slack	Tight			
1	2	3	4	5	6	7	8	9	10
Handloom Mattings									
KA1	Anjengo	13	Vycome	14	8	16	Vycome	16	2.15
KA2	Anjengo	14	Vycome	13	9	18	Vycome	20	2.75
KA3	Anjengo	15	Vycome	14	9	9	Vycome	16	2.15
KA4	Anjengo	14	Vycome	13	12	12	Vycome	24	2.75
KA5	Anjengo	14	Vycome	13	18	9	Vycome	20	3.35
KA6	Anjengo	14	Vycome	13	18	9	Vycome	24	3.65
KA7 (SK1)	Anjengo	15	Anjengo	17	20	10	Aratory	20	2.35
KA8 (SK19)	Anjengo	15	Anjengo	16	9	18	Anjengo	22	2.20
KA9 (SK26)	Anjengo	13	Anjengo	13	18	9	Quilandy	16	3.20
KC1	Ashtamudy	8	Vycome	12	8	16	Vycome	20	3.05

KR1	Aratory	15	Vycome	14	8	16	Vycome	16	1.85
KR2	Aratory	12	Vycome	13	9	18	Vycome	20	2.45
KR3	Aratory	15	Vycome	14	9	9	Vycome	16	1.85
KR4	Aratory	14	Vycome	13	12	12	Vycome	24	2.45
KR5	Aratory	16	Vycome	14	18	9	Vycome	17	2.75
KR6	Aratory	15	Vycome	14	18	9	Vycome	20	3.35
KR7	Aratory	13	Vycome	13	16	8	Unsoaked	10	3.62
KR8 (SK8)	Aratory	12	Vycome	14	16	8	Vycome	16	2.14
KV1 (SK7)	Vycome	11	Vycome	13	8	16	Vycome	16	1.83
KV2 (SK3)	Vycome	11	Vycome	13	9	18	Vycome	20	2.44
KV3	Vycome	14	Vycome	14	9	9	Vycome	13	1.83
KV4	Vycome	12	Vycome	12	11	11	Vycome/ Beach	24	2.30
KV5	Vycome	13	Vycome	13	18	9	Vycome	17	3.05
KV6	Vycome	13	Vycome	12	18	9	Vycome	20	3.62
KV7	Vycome	12	Sisal	----	20	10	Vycome	16	2.40
KV8 (SK 18)	Vycome	12	Anjengo	14	20	10	Anjengo	18	3.00
*KV9 (SK28)	Thin Vycome	----	Thin Aratory	----	22	11	Thin Vycome	22	1.80
KQ1 (SK25)	Quilandy	9	Anjengo	14	14	7	Beypore	10	4.10
SK29	Anjengo	13	Anjengo	14	18	9	Vycome	17	20.50
Power loom Mattings									
PKA1	Mangadan	13	Mangadan	14	13	13	Vycome	13	2.10
PKA2 (PKM3)	Anjengo	14	Anjengo	15	18	9	Anjengo/ Aratory	16	2.10
PKA3 (PKM5)	Anjengo	13	Anjengo	14	15	15	Beach	16	2.20

PKA4	Anjengo	14	Sisal	600 m/kg (See Note2)	18	9	Sisal	18	2.30
PKA5 (PKM8)	Anjengo	16	Sisa	l ----	22	11	Sisal	18	2.00
PKA6 (PKM9)	Anjengo	13	Anjengo	12	18	9	Aratory	18	2.90
PKA7	Anjengo	15	Anjengo	17	22	11	Aratory	18	2.10
PKA8	Anjengo	15	Aloe Thin	----	22	11	Aloe Thin	18	2.00
**PKA9 (PKM12)	Anjengo	18	2 ply Aloe Thin	-----	22	22	2 ply Aloe Thin	36	1.85
PKA10 (PKM13)	Mangadan	12	2 ply Sisal 330 m/kg	20	10	Si sal	(330m/ kg) (See Note 2)	20	3.20
PKA14 (P KM13)	Mangadan	18	5 Ply Jute	----	22	22	3 Ply Jute	36	1.85
PKK1 (PKM1)	Mangadan	12	Mangadan	13	10	10	Vycome	14	2.00
PKK2 (PKM4)	Mangadan	12	Mangadan	13	12	12	Aratory	13	1.80
PKV1	Vycome	12	Sisal	690m/ kg (See Note 2)	18	9	Vycome	18	2.40

NOTES:-

1. The designations indicated within brackets are popularly known export designations,

2. For sisal yarn, instead of scorage value, the runnage value (m/kg) has been indicated.

* 3. KV-9 (SK-28) shall not be manufactured in widths above 1.75m.

**4. PKA-9 (PKM-12) This matting is allowed to be manufactured in the ratios of 1:1 and 2:2 for tight and slack warps.

17.2.13. Three Shaft Ribbed Mattings

Definition

This is a matting of three Treadle weave with warp rib exhibited on the surface. This fabric offers sturdy and heavier construction.

Quality No	Warp						Weft			Mass, kg/m²
	Slack		Tight		Ends / dm		Type of Yarn	Approx scorage	Picks/ dm	
	Type of Yarn	Approx Scorage	Type of Yarn	Approx Scorage	Slack	Tight				
1	2	3	4	5	6	7	8	9	10	11
S3K1	Anjengo	14	Alapat	11	20	10	Anjengo Vycome	14 13	10 20	4.285

17.2.14. Coir Mourzouks

Definition

In coir Mourzouks, the surface and pattern are formed by the weft on both sides concealing the warp threads completely. The number of warp threads in the fabric is comparatively lesser than weft.

Designation	Type of warp yarn	Approximate scorage of warp yarn	Ends / dm	Type of weft yarn	Picks /dm	Approximate scorage of weft yarn	Mass, kg/m²
1	2	3	4	5	6	7	8
BMEL	Aloe Thin	15/16	10	Alapat	----	45	2.15
BMER	Aloe Thin	15/16	10	Aratory	13/14	45	2.05
BMEA	Aloe Thin	15/16	10	Anjengo	15	47	1.90
BMVA (BMVN)	Vycome	13/14	10	Anjengo	13	38	2.05
BMVL	Vycome	13/14	10	Alapat	----	38	2.05
BMVR	Vycome	13/14	10	Aratory	12/13	42	1.90
BMJL	5 Ply Jute	----	10	Alapat	----	40	2.35
BMEV	Aloe Thin	15/16	10	Vycome	13/14	52	2.35
BMAQ (SMNQ)	Anjengo	14	5	Quilandy	9	28	2.70
BMVP	Vycome	13/14	5	Roping	5/6	15/16	3.95

17.2.15. Coir Carpets (Alleppey Carpets)

Definition

Coir Carpets are manufactured in the same way as Mourzouks, but with double warp threads. Because of this doubling of the warp, a ribbed effect is produced on both sides of the material.

Desig nation	Type of warp yarn	Approxi mate scorage of warp yarn	Ends/ dm	Type of weft yarn	Approxi mate scorage of weft yarn	Picks / dm Min.	Mass, kg/m²
1	2	3	4	5	6	7	8
BCBC (BCSD)	Beach	7/8	6	Ashtamudy	8/9	29	3.05
BCQQ BCSQ1)	Quilandy	----	4	Quilandy	----	48	5.20
BCVR	Vycome	13/14	12	Aratory	15/16	57	2.35
BCVR1 (BCSR1)	Vycome	13/14	12	Aratory	13/14	52	2.45
BCVV	Vycome	13/14	12	Vycome	12/13	50	2.15

NOTE:- The designations indicated within brackets are popularly known export designations. BCBC (BCSD): All the six Warp strands have to be securely tucked in at least to within six strands of the weft on one side. BCQQ (BCSQ1): Each warp is made up of 8/10 strands of Quilandy yarn to make up the overall thickness of 25mm. This specification is applicable to mats with fringed ends and also with tucked in ends.

17.2.16. Four Shaft Carpet

Definition

The carpet is woven in 4 shaft weave structure having pattern effect accentuated by weft, same way as Mourzouks.

Desig nation	Type of warp yarn	Approxi mate scorage of warp yarn	Ends /dm	Type of weft yarn	Approxi mate scorage of weft yarn	Picks / dm Min.	Mass, kg/m²
1	2	3	4	5	6	7	8
BM 4 NN	Anjengo	14	12	Anjengo	14	64	2.30

17.2.17. Coir Matting for Cricket Pitches

Definition

Matting specially made for use in Cricket Pitches, generally twill or herringbone pattern, three treadle or four treadle weave and in single shade.

Desig nation	Warp			Weft		Mass, kg/ m^2
	Type of warp yarn	Approximate scorage of warp yarn	Ends/ dm	Type of weft yarn	Picks/ dm	
1	2	3	4	5	6	7
Three-Treadle Weave						
C3A1	Anjengo	14	31	Vycome	11	1.75
C3A2	Anjengo	13	29	Vycome	11	1.80
C3R1	Aratory	15	33	Vycome	11	1.65
C3R2	**Aratory**	14	31	Vycome	11	1.70
C3V1	Vycome	13	29	Vycome	9	1.50
C3V2	Vycome	12	27	Vycome	9	1.55
C3C1	Ashtamudy	11	25	Vycome	9	2.15
Four-Treadle Weave						
C4A1	Anjengo	15	33	Vycome	13	1.75
C4A2	Anjengo	14	31	Vycome	13	1.80
C4R1	Aratory	15	33	Vycome	13	1.70
C4R2	Aratory	14	31	Vycome	13	1.75
C4V1	Vycome	13	29	Vycome	12	1.60

18. Draft Indian standard

PVC TUFTED COIR MATS - Specification

1. SCOPE

1.1 This standard prescribes the constructional particulars and performance requirements of PVC tufted mats made from coir and PVC.

1.2 This standard does not specify the general appearance, design etc. of the PVC tufted coir mats.

2. REFERENCE

The standards listed at Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 Vycome yarn

Wheel spun 2-ply yarn soft or medium twisted made out of coir fibre of natural brown to grey usually spun in 11 to 17 score.

3.2 Pile or Tuft

Length of the yarn,delivered to a single binding site, are considered to create one tuft which form the pile/tuft of a PVC tufted coir mat.

3.3 Pile Yarn

The yarn used in the manufacture of pile or tufts of PVC tufted mats shall be made from Vycome type coir yarn.

3.4 Backing

PVC compound used as a medium into which the pile yarn is tufted.

3.5 Tip-sheared pile

Pile of a mat, which has been subjected to a shearing process after manufacture to cut the tips of the longer pile loops.

4 REQUIREMENTS

4.1 Length and Width

The length and width of the mat shall be as agreed between the buyer and the seller or as declared by the seller on the label of the PVC tufted coir mat.

4.1.1 Tolerances

In case of PVC tufted coir mat made as square and rug, tolerance of 15 mm per metre shall be permitted on agreed or declared value of length and width subject to a maximum of 10 cm for length and 5 cm for width. In case of PVC tufted coir mat sold as piece goods in running length, a tolerance of 15 mm per metre subject to a maximum of 5 cm shall be permitted on agreed or declared value of width only and the length shall not be less than the declared or agreed value.

4.1.2 The length and width of the PVC tufted coir mat shall be determined by the method prescribed in Annex B

4.2 Pile Density

The pile density of the PVC tufted coir mat shall be as agreed to between the buyer and the seller declared on the label subject to a minimum of 50 g/m2/mm pile thickness. However, a tolerance of minus 5 percent shal1 be permitted on the agreed or declared value.

NOTE - Normally tufted PVC tufted coir mats are manufactured in the range of 50 to 120 g/m2/ mm pile thickness.

4.2.1 The pile density of the PVC tufted coir mat shall be determined by the method prescribed in Annex C-1.

4.3 Pile Thickness

The pile thickness of the PVC tufted coir mat shall be as agreed to between the buyer and the seller subject to a minimum of 3 mm.

4.3.1 The pile thickness of the PVC tufted coir mat shall be determined by the method prescribed in Annex C-1 or C-2.

4.4 Colour Fastness

The cumulative colour fastness ratings of PVC tufted coir mat towards light, water, shampooing and dry rubbing shall be not less than 8 subject to a minimum of 2 for each agencies. For the purpose of this requirement the minimum rating obtained by any shade to PVC tufted coir mat a tolerance of - 1 unit shall, however, be permitted on the declared value of the cumulative colour fastness rating.

4.4.1 The colour fastness of the sample can be determined by the method prescribed in Annex D

4.5 Tuft **Withdrawal Force**

The minimum tuft withdrawal force shall be 1.5 kgf for cut pile.

4.5.1 The tuft withdrawal force shall be determined by the method given in Annex C-3.

5. MARKING AND LABELLING

5.1 Each PVC tufted coir mat shall be legibly and indelibly marked on the back or a label shall be attached with it giving the following particulars or in accordance with the agreement between the buyer and the seller:

a) Size or dimensions; and

b) Manufacturer's name, initials, trade-mark or any other identification mark.

5.1.1. The product may also be marked with the ISI certification Mark.

NOTE - The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards

6. PACKING

6.1 The mats shall be suitably packed as agreed to between the buyer and the seller, care being taken to see that the pile of mats is not crushed while packing.

6.2 Each package shall be marked with the following or in accordance with the agreement between the buyer and the seller:

a) Name of the material;

b) Gross mass;

c) Number of PVC tufted coir mats packed in the package;

d) Size number or dimensions; and

e) Name, initials, trade-mark or any other identification mark of the manufacturer.

7. SAMPLING AND CRITERIA FOR CONFORMITY

7.1.1 Lot - In any consignment PVC tufted coir mats of the same designation and size shall be grouped together to constitute a lot, unit being an individual piece of mat.

7.1.2 The conformity of a lot to the requirements of this standard shall be determined on the basis of the tests carried out on the mats selected from the lot.

7.1.3 The number of PVC tufted coir mats to be selected at random from the lot shall be in accordance with col 2 of Table 1. The door mats shall be selected from at least 10 percent of the packages, and equal number of door mats, as far as possible being drawn at random from each package.

TABLE 1 SAMPLE SIZE AND PERMISSIBLE NUMBER OF DEFECTIVES

LOT SIZE	SAMPLE SIZE	PERMISSIBLENUMBER OF DEFECTIVES MATS
(1)	(2)	(3)
UP to 100	5	1
Above 100	10	2

7-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

7.2.1 For evaluating (a) pile height (wherever applicable) (b) mass per square metre, and (c) dimensions of the PVC tufted coir mats in the lot, the sample selected as in Col. 2 of Table 1 shall constitute the test sample.

7.2.3 Criteria for Conformity - The lot shall be considered to be in conformity with the requirements of the standard, if the following conditions are satisfied:

7.2.4 The number of coir mats found defective in respect of any characteristic mentioned in 7.2.1 does not exceed the limits specified in col 3 of Table 1

8. ATMOSPHERIC CONDITIONS FOR TESTING AND CONDITIONING OF TEST SPECIMENS

8.1 The tests shall be carried out in a standard atmosphere of 65± 2 percent relative humidity and 27 ± 2° C temperature (see also IS 196 : 1966).

8.2 Prior to testing, the test specimens shall be conditioned to moisture equilibrium in the standard atmosphere. When the test specimen have been left in such an atmosphere for 72 hours in such a way as to expose, as far as possible, all portions of the test specimens to the atmosphere, they shall be deemed to have reached moisture equilibrium

9 REQUIREMENTS FOR ECO MARK

9.1 GENERAL REQUIREMENT

9.1.1 The PVC tufted coir mats manufactured shall meet the requirement specified in this Indian Standard

9.1.2 The Manufacturer shall produce to BIS environmental consent clearance from State pollution control board, as per the provisions of Water (Prevention and Control of Pollution) Act 1974 and Air (Prevention and Control of Pollution) Act 1981 and Water (Prevention and Control of Pollution) Cess Act 1977, along with the authorization and rules made as under the Bureau of Indian Standards IS 15651: 2006 while applying for the ECOMARK

9.1.3 The product or product packaging may display in brief the criteria based on which the product has been labeled Environment Friendly.

Annexure A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title
196:1966	Atmospheric conditions for testing (reaffirmed 2001)
7877 (Part 5): 1976	Methods of sampling and tests for handmade carpets-determination of dimensions
2454 : 1985	Method for determination of colour fastness of textile materials to artificial light (Xenon Lamp (First revision)
11205 : 2011	Textile floor coverings — vocabulary *(first revision)*
5884 : 1993	Textile floor covering – tufted Carpets - specification (*second revision*)(reaffirmed 2003)

ANNEX B

(Clause 4.1.3)

METHODS OF TEST TO DETERMINE DIMENSIONS OF TUFTED PVC TUFTED COIR MATS

B.1 APPARATUS

A rule or instrument capable of measuring accurately to the nearest millimetre shall be used for determination of length, width and diagonals of rectangular and square PVC tufted coir mats, diameter in case of circular PVC tufted coir mats and major and minor axes in case of oval-shaped PVC tufted coir mats.

B.2 PROCEDURE

Spread the PVC tufted coir mat on a smooth flat surface taking care that no wrinkles are present. Make the measurements between the outer edges of the base of the pile on the opposite edges of the PVC tufted coir mat. Make all the measurements to the nearest millimetre.

B.2.1 Rectangular and Square PVC tufted coir mats

B.2.I.1 *Length* - Make the measurement in the warp direction in such a way that two measurements are made at an approximately 10 cm within each selvedge of the PVC tufted coir mats and one approximately in the middle. Calculate the average length to the nearest 5 mm for PVC tufted coir mat measuring up to 100 cm and to the nearest 10 mm for larger PVC tufted coir mats.

B.2.1.2 *Width* - Make five measurements in the weft direction in such a way that two measurements are made at an approximately 10 cm within each edge of the PVC tufted coir mat and three measurements made at distances approximately L/4, L/2 and 3L/4 from one edge of the PVC tufted coir mat (L being the length of the PVC tufted coir mat). Calculate the average width to the nearest 5 mm for PVC tufted coir mats measuring up to 100 cm width

and to the nearest 10 mm for larger PVC tufted coir mats.

B.2.1.3 *Diagonals* - Make the measurements along the line joining the two diagonally opposite corners of the PVC tufted coir mat to the nearest 5 mm for PVC tufted coir mats having diagonals up to 100 cm and to the nearest 10 mm for larger PVC tufted coir mats.

B.2.2 Circular PVC tufted coir mats

B.2.2.1 *Diameter* - Make the measurement of the diameter of the PVC tufted coir mat at four different points distributed along the periphery. Calculate the average of the four readings to the nearest 5 mm for PVC tufted coir mats measuring up to 100 cm in diameter and to the nearest 10 mm for larger PVC tufted coir mats.

NOTE- To facilitate the measurement of diameters the centre of the PVC tufted coir mat may be determined by first folding the PVC tufted coir mats into half and then refolding it into further half, making it into a quarter size. The point where the two folds cross may be taken as the centre of the PVC tufted coir mats.

B.2.3 Oval Shaped PVC tufted coir mats

B.2.3.1 Major and Minor Axes - Make the measurement of the major and minor axes of the PVC tufted coir mats at least at two points. Calculate the average of the two readings to the nearest 5 mm for PVC tufted coir mats measuring up to 100 cm in major or minor axes as the case may be and to the nearest 10 mm for larger PVC tufted coir mats.

NOTE -To facilitate the measurement of major and minor axes the centre of the PVC tufted coir mats may be determined by first folding the PVC tufted coir mat into half along the major axis and then refolding it into further half along the minor axis thus making it into a quarter sizes. The point where the two folds cross may be taken as the centre of the PVC tufted coir mat.

ANNEX C

(Clauses 4.2.1, 4.3.1 and 4.**5.1)**

METHODS OF TEST TO DETERMINE PILE THICKNESS, PILE DENSITY AND TUFT WITHDRAWAL FORCE OF PVC TUFTED COIR MATS

C.1 DETERMINATION OF PILE THICKNESS AND PILE DENSITY (METHOD A)

C.1 .1 Test Specimens

C.1.1.1 Cut four specimens, each at least 200 x 200 mm with the two sides parallel and the other two perpendiculars to the selvedge.

C.1.1.2 If there is any tendency for the edges to fray, seal them with adhesive and allow to dry. Condition the specimens to constant weight in the standard atmosphere.

C.1.2. Apparatus

C-1.2.1 Carpet Shearing Machine

Capable of shearing the pile close to the backing of the PVC tufted coir mat.

C1.2.2 Carpet Thickness Tester

a) Should have a circular plane pressure-foot of area between 300 and 1000 mm^2.

b) Should be capable of exerting a pressure of 20 gf/cm^2 normal to the plane of the specimen.

c) Should be capable of measuring thickness to any accuracy of 0.1 mm over a range of 25 mm.

C-1.2.3 Sharp Pointed Knife

C-1.2.4 Measuring Scale - graduated in millimetres.

C-1.2.5 Weighing Balance - to weigh to an accuracy of 10 mg.

C-1.2.6 Press and Cutter - of known area of at least 10 000 mm^2, which may be circular or square in shape.

C.1.3 Test Procedure

C.1.3.1 Measure the thickness of each specimen at 5 places under the standard pressure of 20 gf/cm^2.

C.1.3.2 Determine the mass of pile using the method given below before the edges of the pile have been sealed.

a) Weigh each specimen to the nearest 10 mg (M1)

b) Measure the length and width at four places on the back of each specimen to the nearest mm.

c) Shear the pile from the specimen using forward strokes with the clipper in all directions. Shear as close as possible to the backing by running the points of the comb and cutter along the backing without digging in. Avoid plucking any tufts or damaging the backing yarn. Brush, blow or suction clean the specimen during and after shearing. Continue shearing until no further significant amount of pile yarn dust appears on the shearing blades or flies away when the specimen in shaken. It is not necessary 'to shear to the edges of the specimen provided the area of at least 10 000 mm^2 in the centre is closely shorn.

d) After shearing, cut the area of 10000 mm^2 from the centre of each specimen using a cutter. The backing yarns in this area shall be undamaged and no tufts shall have been plucked from it.

e) Condition each area cut out of the shorn PVC tufted coir mat specimen in the standard atmosphere until successive weighing at intervals of 2 hours shown no progressive change greater than 0.25 percent. Record the final conditioned mass of the shorn area to the nearest 10 mg (M,).

f) From the measurements made in (b), calculate for each specimen the average length and width and the area in square millimetres (A1).

g) Calculate the total mass per square millimetre of PVC tufted coir mat for each specimen separately (M1) / (A1)

h) Measure the area of the specimen cut out of shorn PVC tufted coir mat (A2).

i) For each area of shorn PVC tufted coir mat, calculate the mass per square millimetre (M2) / (A2)

j) For each specimen, calculate the shorned mass of pile above unit area of backing, using the formula:

$$10^6 \left[\frac{M_1}{A_1} - \frac{M_2}{A_2} \right] \text{g/m}^2$$

where

$\frac{M_1}{A_1}$ = mass per mm² of carpet before shearing, and

$\frac{M_2}{A_2}$ = mass per mm² of carpet after shearing

k) Calculate the mean value of the shorned mass of pile above unit area of backing from the values obtained from all the specimens (*M*).

C.1.3.3 Measure the thickness of each shorn specimen as obtained in B-2.3.2 (d) at 5 places under the standard pressure of 20 gf/m^2.

C.1.4 Calculations

C.1.4.1 Pile Thickness

For each specimen, calculate the mean thick-ness unshorn and the mean thickness shorn. Calculate for each specimen the thickness of pile as the difference between these figures in mm to the nearest 0.02 mm. Calculate the mean value of pile thickness for all the specimens in mm to the nearest 0.1 mm (t).

C1.4.2 Pile Density

The pile density (in g/m' per mm pile thickness) shall be calculated by dividing the mean value of mass of pile above unit area of backing *(M)* by mean value of pile thickness (t).

C.2. DETEREMINATION OF PILE THICKNESS (METHOD B)

C.2.1 APPARATUS

Gauges made of a metal strips of shape as shown in Fig. 1, available in intervals of 1 mm shall be used.

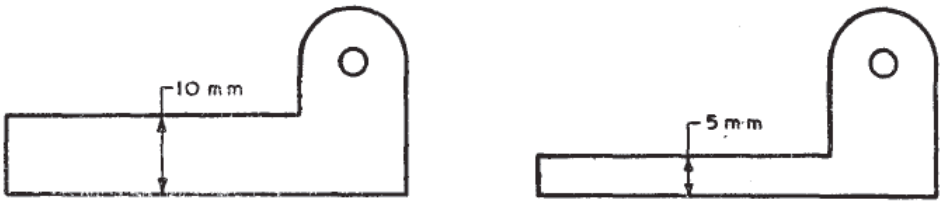


FIG. 1 GAUGES

C.2.2 PROCEDURE

C.2.2.1 Insert a gauge between two rows of pile (tuft legs) ensuring that the firm contact is made with the woven ground. Select for measurement the row of pile lying adjacent to the gauge but towards the end of the PVC tufted coir mat last woven. Stroke the pile into vertical position besides the gauge thus giving necessary support to the pile to keep them into vertical position. By successively using different gauges, select the gauge that corresponds to the pile height. Check that this is the nearest gauge by inserting in the same position gauges a unit higher and lower than selected. Determine the pile height to the nearest millimetre.

C.2.2.2 If the carpet, due to its design, contains pile of different heights, determine the pile height at all level portions.

C.2.2.3 Repeat the measurement in the different areas of PVC tufted coir mat.

C.2.3 REPORT

Calculate the average pile height and report the same to the nearest millimetre.

C-3. DETERMINATION OF TUFT WITHDRAWAL FORCE OF PVC TUFTED COIR MAT

C-3 Apparatus

C-3.1 Tensile testing apparatus with suitable ranges and an accuracy of 5 percent. Full scale loads ranging from 0.5 to 10.0 kgf are generally adequate.

C-3.2 Apparatus shall preferably have a constant rate of loading but alternatively, constant rate of traverse or extension may be used. In any case the average test time for achievement of the maximum withdrawal force of the tufts and loops tested should be between 5 and 10 seconds. This may be achieved in machines which would give very short test time, for example, those using load cells, by inserting a spring between the loading mechanism and the specimen.

C-3.3 The apparatus shall have a means of clamping a specimen of PVC tufted coir mat to a base plate so that it is flat in a plane perpendicular to the direction of pull upon the tuft or loop. The flat, horizontal part of the clamp, which is brought into contact with the specimen during testing, shall be at least 60 mm x 60 mm, shall have a circular cut out of 12 mm radius around the tuft, or loop to be withdrawn and shall retain the specimen inside this cut-out area (see Fig. 2). The cut-out may have a throat to allow easier positioning cf the specimen with the tuft grip or hook attached.

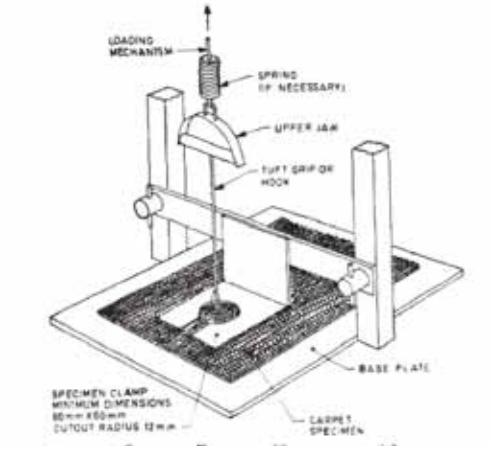


Fig.1 A Typical form of Horizontal Mounting

C-3.4 The load sensing mechanism of the machine shall be calibrated with the tuft grip or hook in position.

C-3.5 Test Samples and Specimens

Samples shall be selected from at least five places across the width of the PVC tufted coir mat. Samples shall be conditioned as mentioned in B-1.2.Specimen should be cut one from each

sample to a size which is convenient for clamping on the testing machine and which will allow for at least 10 tufts to be removed from each. No tufts shall be removed from within 25 mm of the edge of a specimen or of any previously withdrawn tuft.

C-3.6 Procedure

C-3.6.1 Cut Pile PVC tufted coir mats

Select one end of one tuft and attach the tuft grip. Clamp the specimen firmly and attach the tuft grip to the upper jaw. Set the machine in motion and withdraw the tuft completely in a direction essentially perpendicular to that of PVC tufted coir mat specimen. Check that only one complete tuft is withdrawn, and record the maximum force.

C-3.6.2 Repeat the procedure for a minimum of 20 tufts or loops, spread evenly through available samples, taking care that these are at least 25 mm between the previously withdrawn tuft or from the edge of the specimen.

C-3.6.3 Report

Report the average of the tests to the nearest 50 gf as the tuft withdrawal force.

ANNEX D

(Clause 4.4.1)

METHODS OF TEST TO DETERMINE COLOR FASTNESS OF PVC TUFTED COIR MATS

D-1 PREPARATION OF TEST SPECIMENS

D-1.1 Draw a specimen of area not less than 1 X 4.5cm from each piece in the test sample.

D-1.2 To facilitate handling, the specimen(s) and strips of standard patterns of similar size may be mounted on a card in some such arrangement as indicated in Fig. 1 or Fig. 2. Each exposed and unexposed area shall not be less than 1 cm x 1 cm.

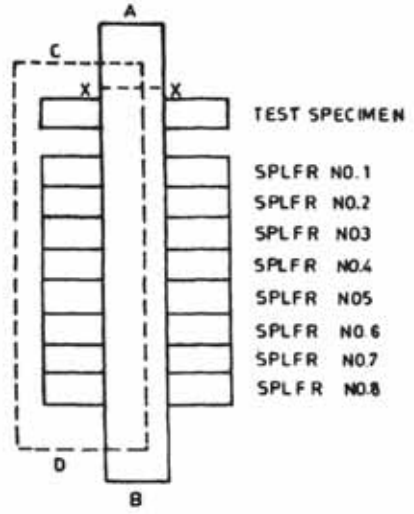


FIG. 1 MOUNTING OF TEST SPECIMEN AND STANDARD PATTERNS FOR METHOD 1

D.1.3 The specimens and the standard patterns should be of equal size and shape in order to avoid errors in assessment due to over-rating the visual contrast between exposed and unexposed parts on the longer specimens as against the narrow standard patterns.

D.1.4 When testing carpets, the standard patterns shall be arranged in such a way that they are at the same distance from the light source as the surface of the carpet specimens. This can be achieved by underlayed cardboard.

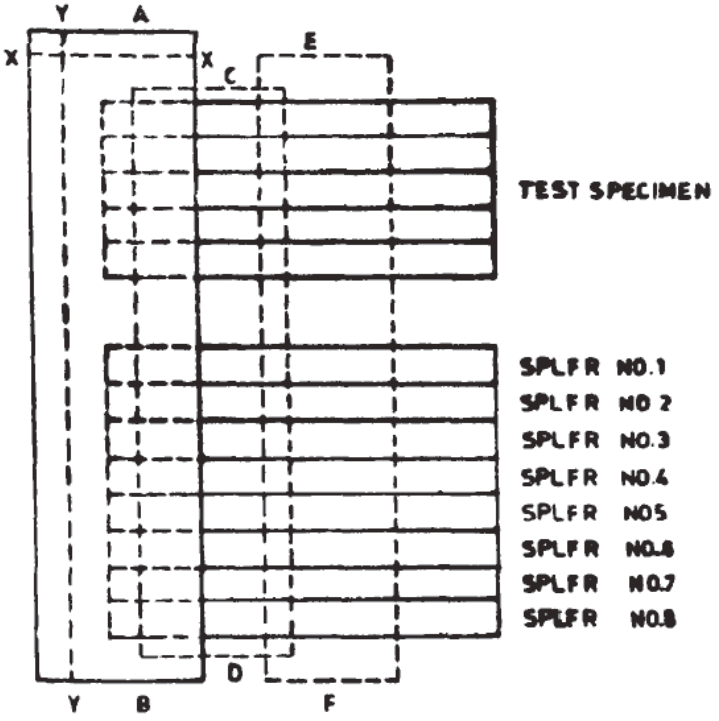


FIG. 2 MOUNTING OF TEST SPECIMENS AND STANDARD PATTERNS FOR METHOD 2

D.2 Standard Patterns

D.2.1 Standard patterns of blue wool cloth ranging in light fastness from rating No. 1 (very low light fastness) to rating No. 8 (very high light fastness) and dyed with the dyes listed in Table 1, shall be used *(see* Note).

Note - Sets of standard patterns of light fastness rating No. 1 to 8 may be obtained from the Indian Standards Institution or the British Standards Institution. They are specially dyed to match a master set of standard patterns in colour and in fading behavior. It has been found that, when repeated dyeing. For the dyed standard patterns are made, the amount of dye required to match a previous lot is often different from that originally used. The dyeing strengths would, therefore be misleading and they are intentionally omitted from this list.

D.2.2 The humidity test control of red azoic dyed cotton cloth of an area not less than 1cm X 4.5cm shall be used.

NOTE - The humidity test control may be prepared by impregnating bleached mercerized poplin with 4 g/l brenthol AN (C. I. azoic coupling component 4) and developing with 20 g/l brentamine fast scarlet R salt (C.I. azoic diazo component 13). The above humidity test control may be obtained from the Indian Standards Institution.

TABLE 2 DYES FOR STANDARD PATTERNS

(Clause 5.1)

FASTNESS RATING No.	DYE-COLOR INDEX DESIGNATION*
1	C. I. Acid Blue 104
2	C. I. Acid Blue 109
3	C. I. Acid Blue 83
4	C. I. Acid Blue 121
5	C. I. Acid Blue 47
6	C I. Acid Blue 23
7	C. I. Solubilized Vat Blue 5*
8	C. I. Solubilized Vat Blue 8#

*The Colour Index (Third edition) published by the Society of Dyers and Colourists, P.O. Box 244, Perkins House, 83 Gratton Road, Bradford BDI 2JB, West Yorks, United Kingdom.

#The patterns dyed with these dyes should be decatized after dyeing.

D.3. APPARATUS

D.3.1 Light Source - Xenon arc lamp of correlated colour temperature of 5500 to 6500 K. In case Xenon arc lamp is not available, any other lamp as agreed to between the concerned parties may *be* used.

D.3.2 Light Filter - A filter to be placed between the light source and the assembly of test specimen(s) and standard patterns so that the ultraviolet spectrum is steadily reduced. Window glass may be used as filter. The glass used shall have a transmission of at least 90 percent between 380 and 750 nm, falling to zero percent between 310 and 320 nm.

D.3.3 Opaque cardboard or thin opaque material - Such as thin sheet aluminium *or* cardboard covered with aluminium foil or, in the case of pile fabrics, a cover that avoids surface compression.

D.3.4 Geometric Grey Scale - for assessing the change in colour (*see* IS : 768-1982*).

*Method for evaluating change in colour *(First revision).*

D.3.5 Heat Filters - The spectrum of xenon arc contains an appreciable amount of infrared radiations, which should be minimised by heat filters. The temperature conditions *(see*

D.4.1.1 *and* **D.4.1.2**) can then be satisfied. The filters should be cleaned regularly to avoid undesirable reduction in light intensity by dirt.

D.3.6 Black Panel Thermometer (see Note 2 under D.4.1.2).

D.4. EXPOSURE CONDITIONS

D.4.1 The test specimens are exposed in a well ventilated exposure chamber.

D.4.1.1 Normal Conditions

D.4.1.1.1 Moderate effective humidity - Light fastness of the humidity test control 5, black-panel temperature 45°C Max.

D.4.1.2 Extreme Condition -For testing the sensitivity of specimens to humidity, the following extreme conditions are useful.

a) Low effective humidity - Light fastness of the humidity test control 6-7, black-panel temperature 60°C Max.

b) High effective humidity - Light fastness of the humidity test control 3, black-panel temperature 40°C Max.

NOTE I - The variation of the light intensity over the area covered by the test specimens and standard patterns should not exceed ± 10 percent of the mean.

NOTE 2 -The black panel thermometer should consist of a metal panel of at least 4.5 cm x 10 cm whose temperature is measured with a thermometer or a thermocouple with its sensitive portion located in good contact with the panel. The side of the panel facing the light source shall be black with a reflectance of less than 5 percent throughout the spectrum reaching the specimen, the side of the panel not facing the light source shall be thermally isolated.

D.5. PROCEDURE COMMON TO METHODS 1 AND 2

D.5.1 Humidity Control - Expose partially covered strips of the humidity test control and standard patterns mounted on a card simultaneously until a contrast is produced on the humidity test control equal to grade 4 on the grey scale. Asses the light fastness of the humidity test controls and, if necessary, adjusts the controls on the lamp to give the selected exposure conditions (see *D.4.*1.1 *and D.4.1.*2).

NOTE - Ensure that the strip of humidity test control is mounted uppermost in the sample holder.

D.5.2 Mounting and Testing of Test Specimens

8.2.1 Expose the specimen(s) and the standard patterns simultaneously for 24 hours per day under the conditions enumerated in *D.4.*1.1 *or D.4.1.*2 in such a manner and for such times as are necessary to evaluate fully the light fastness of each test specimen relative to that of the standard patterns by successively covering both the test specimens and exposed standard patterns throughout the test duration (either by Method 1 or by Method 2).

D.5.3 Method 1

D.5.3.1 Mount the test specimen and the standard patterns as shown in Fig. 1 with an opaque cover AB across the middle one-third of the specimen and the standard patterns. Expose the specimen and the standard patterns to artificial light under the conditions enumerated in *D.4.*1.1 *or D.4.1.*2. Follow the effect of light by lifting the cover AB and

inspecting the specimen frequently. When a change in colour of the exposed portion of the specimen can just be perceived, equal to grey scale grade 4-5, note the number of the standard pattern showing a similar change. (This is preliminary assessment of light fastness of the specimen).

D.5.3.2 Continue to expose the specimen and the standard patterns until the contrast between the exposed and the unexposed portions of the specimen or the standard pattern 7 is equal to grey scale grade 4.

D.5.3.3 If the standard pattern 7 fades to a contrast equal to grey scale grade 4 before the specimen does, terminate the exposure at this stage. If the specimen fades to a contrast equal to grey scale grade 4 before the standard pattern 7 does, replace the cover AB exactly in the previous position, cover the left hand one-third of the specimen and the standard patterns with another opaque cover (CD *in* Fig. 1) and continue *to* expose until the contrast between the fully exposed and unexposed portions of the specimen is equal to grey scale grade 3. At this stage, terminate the exposure.

NOTE - When a test specimen has light fastness rating of 7 or higher, it would require unduly long exposure to produce a contrast equal to grade 3 on the grey scale. Moreover, this contrast would be impossible to obtain when the light fastness rating is 8. Assessments in the region 7 to 8 are made, therefore, when the contrast produced on standard pattern 7 is equal to grade 4 on the grey scale. The time required to produce this contrast being long enough to eliminate any error which might result from inadequate exposure.

D.5.3.4 Assess the light fastness of the specimen as given in **D.5.5**

D.5.4 Method 2

D.5.4.1 Mount the test specimens and the standard patterns as shown in Fig. 2. Cover one quarter of the total length of each test specimen and Standard pattern with opaque cover AB. Expose the assembly to artificial light under the conditions enumerated in D.4.**1.1** *or* D.4.1.**2**. Follow the effect of light by lifting the cover AB periodically and inspecting the standard patterns. When a change in colour of the exposed portion of the standard pattern 3 can just be perceived equal to grey scale grade 4-5, inspect the specimens and assess their preliminary light fastness by comparing any change that has occurred with the changes that have occurred in standard patterns 1, 2 and 3.

D.5.4.2 Replace the opaque cover AB in exactly the same position and continue to expose until a change in colour of the exposed portion of the standard pattern 4 can just be perceived, equal to grey scale grade 4-5. Place an additional opaque cover CD in the position as shown in Fig. 2, overlapping the first cover AB.

D.5.4.3 Continue to expose until a change in colour of the exposed portion of the standard pattern 6 can just be perceived equal to grey scale grade 4-5. Place an opaque cover EF in the position as shown in Fig. 2, the other two covers remaining in position.

D.5.4.4 Expose the assembly until either:

a) a contrast is produced on standard pattern 7 equal to the Contrast illustrated by grade 4 on the grey scale, or

b) a contrast equal to grade 3 on the grey scale, has been produced on the most resistant specimen, whichever occurs first.

Remove the three covers and conclude the experiment.

D.5.4.5 Compare the changes in the colour of the specimens and those of the standard patterns and assess the light fastness of each specimen as given in **D.5.5.**

D.5.5 Assessment of Light Fastness

D.5.5.1 The final assessment in numerical ratings is based on contrast equal to grey scale grade 4 and/or grade 3 between exposed and unexposed portions of the specimen (s).

D.5.5.2 Compare the change in colour of the specimen with the changes which have occurred in the standard patterns under suitable illumination.

The light fastness of the specimen is the number of standard pattern which shows similar changes in colour (visual contrast between the exposed and unexposed portions of the specimen). If the specimen shows change in colour, approximately half way between two standard patterns, the intermediate rating, for example, 3-4 shall be given.

NOTE I - In case of doubt in the colour fastness rating as assessed by an observer, the assessment may be made by three observers and the overall rating may be reported accordingly.

NOTE 2 - The term 'change in colour' includes not only true fading, that is, destruction of dyes but also changes in hue, depth, brightness or any combination of these characteristics of colour. If the difference in colour is a change of hue or brightness, this may be indicated by adding abbrevations as follows to the numerical fastness ratings.

B1	=	bluer,	γ	=	yellower,	*D*	= duller, and
R	=	redder,	G	=	greener,	Br	= brighter.

If the change in hue is accompanied by change in depth, this may also be indicated as follows:

W	=	weaker,	and	*Str*	= stronger.

NOTE 3 - In order to avoid a misrating of the light fastness of the specimen due to photochromism, the phototropic specimens shall be allowed to remain in the dark at room temperature for 24 h before the light fastness is assessed.

D.5.5.3 If the different assessments are obtained at the different degrees of contrast, the light fastness of the specimen is the arithmetic mean of these expressed to the nearest whole or half grade. When three areas are being rated, take the mean of the contrasts closest to grade 4 and 3. Assessments, however, shall be confined to whole or midway ratings only. When the arithmetic mean gives (a quarter or three-quarter rating, the assessment is defined as the next higher half or whole grade).

D.5.5.4 If the colour of the specimen is more fugitive than that of standard pattern No. 1, a rating of 1 shall be given.

D.5.5.5 If the light fastness is of rating 4 or higher, assign the test specimen its light fastness rating number but also add within parentheses its preliminary light fastness rating number, if any *(see* **D.5.3.1**).

Example:

A light fastness rating of 5 (2) indicates that the test specimen changes very slightly in

colour, when the standard pattern of light fastness rating No. 2 just begins to fade but that on continuing the exposure, the resistance to light of the test specimen is equal to that of the standard pattern of light fastness rating No. 5.

D.5.5.6 If specimens larger than the standard patterns were exposed because of certain other requirements a mask of a neutral grey colour midway between the grade I and grade 2 of the grey scale (approximately Munsell N5) should be used in assessment which covers the surplus area of the specimens leaving an area equal to that of the standard patterns open for comparative evaluation.

D.6. REPORT

D.6.1 Report individually, the numerical light fastness rating of test specimens.

D.6.2 If the rating is equal to 4 or higher and the preliminary assessment is 3 or lower, report the latter figure in brackets.

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For more details,

Coir Board
"Coir House", Kochi - 16,
Ph : 0484 – 2351900, 2351807, 2351788
Email-coirboard@nic.in

Central Coir Research Institute
Kalavoor.P.O, Alappuzha,
Ph: 0477 – 2258094, 2258933
Email- ccri.coriboard@gmail.com, ccrikalavoor@gmail.com
Website: ccriindia.org

Central Institute of Coir Technology
Peenya Industrial Area, Bangalore - 560 058
Ph: 080-28394875
e-mail : coirtechnology@gmail.com

Coir Board Regional Office
Peenya Industrial Area, Bangalore - 560 058
Ph : 080 28375023.
e-mail:cbrobangalore@gmail.com

Coir Board Regional Office
Swaraj Nagar, AC Gardens, Doulesaram Road, Rajamundry,
Andhra Pradesh - 533101,
Ph:08832420196.
e-mail: coirboardrorjy@yahoo.co.in

Coir Board Regional Office
Jagamara (Udyogpuri), P.O. Khandagiri, Bhubaneswar - 751 030
Ph: 0674 2350078.
e-mail:robbsrcoirboard@gmail.com

Coir Board Regional Office
No-30, Mariyammal Layout, Palladam Road, Pollachi, Coimbatore,
Tamil Nadu – 642002
Ph : 04259-222450.
e-mail: coirpollachi@gmail.com

कयर बोर्ड
COIR BOARD
सूक्ष्म,लघु और मध्यम उद्यम मंत्रालय, भारत सरकार Ministry of MSME, Government of India
कयर हाउस, एम.जी.रोड, एर्णाकुलम, कोचीन-682016 Coir House, M.G.Road, Ernakulam, Cochin - 682016
दूरभाषः 0484-2351900 टोल फ्री नं: 1800 425 9091 Phone:0484 - 2351900 Toll Free no:1800 425 9091
Email: info@coirboard.org www.coirboard.gov.in