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MATERIAL OPTIMISATION AND COMPUTATION OF FOOTWEAR CONSUMPTION NORMS

Gautham Gopalakrishna, Md Sadiq, BN Das
CSIR-Central Leather Research Institute (CSIR-CLRI),
Shoe Design & Development Centre
CHENNAI. INDIA
gauthamgk@gmail.com

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NEED

- Leather: Single most important component of a shoe
- Every attempt must be made to optimize its usage by minimizing its wastage
- Rule of thumb procedures to arbitrarily fix the norms by adding an approximate percentage of waste over and above the traced out area of the upper patterns can lead to a lot of inaccuracies in arriving at the norms for cutting
- Consequently affect the profitability of a company
- Imperative that an accurate method of computing the consumption norms be adopted
- Methodology followed in developing the algorithm is

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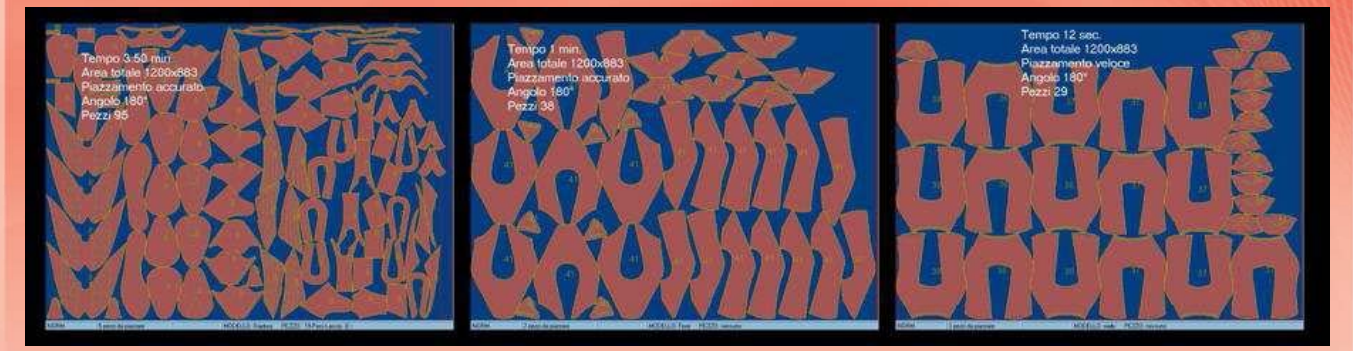
OBJECTIVE



To take a set of patterns and to accurately predict the area of Leather / Lining material that will be used for an article going into production

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An accurate figure is essential because :

- The 'Leather Consumed' is the largest single item of cost in the total cost of the Product
- The profitability of the company depends on accurate costing
- The Material Consumption Norm is used to demonstrate to the Clicker his target when cutting up leather
- The figure may be used as a basis for incentive payment or Leather Saving Bonus

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Summary of the procedure:

- **Layout the patterns** as described in 'Procedure for Pattern Scaling'. This figure includes the **'first waste'** or unavoidable interlocking waste.
- Using the **'Second Waste Table'** add the percentage that describes the relationship between the 'average pattern size' and 'skin size.'
- Add an allowance for the **'type or shape of leather.'**
- Add an allowance for the **'Quality' or 'cuttability'** of the leather.
- Adjust the **'Clickers Area allowance'** for any inaccuracy in the measurement of the skin. Tanner's measures can be inaccurate.
- Adjust the **'scale figure'** for the **'average shoe size of the order.'**

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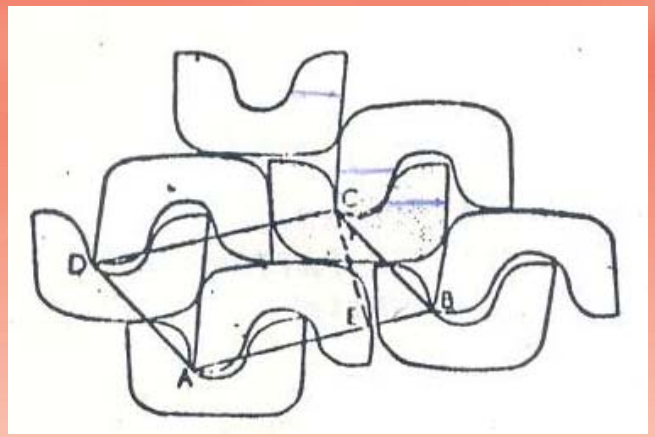
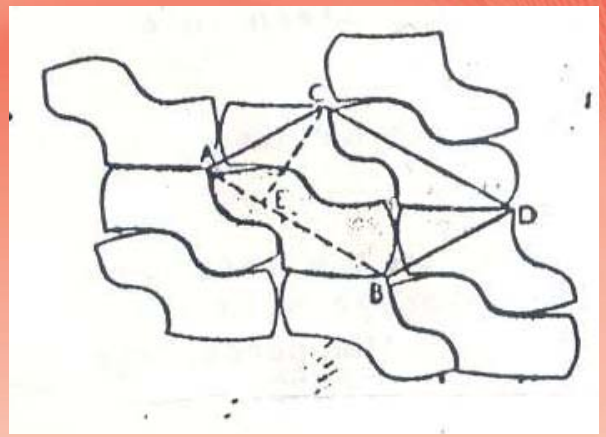
LAYING OUT THE PATTERNS





- Mark the patterns; Use a strict and repeatable layout
- Keep patterns parallel; If necessary, rotate patterns round 180^0 but still keep them parallel to the other patterns
- Form a parallelogram and compute its Area
- Repeat the complete process with an alternative system of laying out to ensure that the minimum amount of

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ADDING THE SECOND WASTE PERCENTAGE

- The average area per pattern is computed from the parallelogram area and number of patterns
- This is interpolated against the average skin size used and the second wastage percentage obtained

Avg. Scale of pattern (sq.ft.)	3'	4'	5'	6'	7'	8'	10'	12'	15'	20'	25'	30'
0.050	22.2	21.7	21.5	21.3	21.2	21.1	21.0	20.9	20.8	20.7	20.7	20.7
0.075	23.0	22.4	22.0	21.8	21.6	21.4	21.2	21.1	21.0	20.9	20.8	20.7
0.100	23.8	23.0	22.5	22.3	21.9	21.7	21.3	21.3	21.2	21.0	20.9	20.8
0.125	24.7	23.6	23.0	22.6	22.3	22.1	21.7	21.5	21.3	21.1	21.0	20.9
0.150	25.5	24.2	23.5	23.0	22.7	22.4	22.0	21.7	21.5	21.3	21.1	21.0
0.175	26.3	24.9	24.0	23.4	23.0	22.7	22.3	22.0	21.7	21.4	21.2	21.1
0.200	27.2	25.5	24.5	23.8	23.4	23.0	22.5	22.2	21.9	21.5	21.3	21.2
0.250	28.8	26.7	25.5	24.7	24.1	23.6	23.0	22.6	22.2	21.8	21.5	21.3
0.300	30.5	28.0	26.5	23.5	24.8	24.2	23.5	23.0	22.5	22.0	21.7	21.5
0.350	32.2	29.3	27.5	26.3	25.5	24.9	24.0	23.4	22.8	22.2	21.9	21.7
0.400	33.8	30.5	28.5	27.2	26.2	25.5	24.5	23.9	23.2	22.5	22.1	21.9
0.450	35.5	31.7	23.5	28.0	26.9	26.1	25.0	24.3	3.5	22.7	22.3	22.0
0.500	37.2	33.0	30.5	23.8	27.6	26.8	25.5	24.7	23.8	23.0	22.5	22.2
0.550	38.8	34.2	31.5	29.7	28.4	27.5	26.0	25.1	24.2	23.2	22.7	22.3
0.600	42.0	35.5	32.5	30.5	29.1	28.0	26.5	25.5	24.5	23.5	22.9	22.5
0.650	45.3	36.7	33.5	31.3	29.8	28.6	27.0	25.9	24.8	23.7	23.1	22.7
0.700	48.7	38.0	34.5	32.2	30.5	29.2	27.5	26.3	25.2	24.0	23.3	22.8
0.750	52.0	39.5	35.5	33.0	31.2	29.9	28.0	26.7	25.5	24.2	23.5	23.0
0.800	55.3	42.0	36.5	33.8	31.9	30.5	28.5	27.2	25.8	24.5	23.7	23.2
0.850		44.5	37.5	34.7	32.6	31.1	29.0	27.5	26.2	24.7	23.9	23.3
0.900		47.0	38.5	35.5	33.4	31.7	29.5	28.0	26.5	25.0	24.1	23.5
0.950		49.5	40.0	36.3	34.1	32.4	30.0	28.4	26.8	25.2	24.3	23.7
1.000		52.0	42.0	37.2	34.8	33.0	30.5	28.8	27.2	25.5	24.5	23.8
1.250			52.0	46.0	38.4	35.6	33.0	30.9	28.3	26.7	25.5	24.7
1.500				52.0	44.9	39.5	35.5	33.0	30.5	28.0	26.5	25.5

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ADDING THE ALLOWANCE FOR THE SHAPE AND TYPE OF THE SKIN

- This allowance seeks to provide a mathematical way to adjust for variations in shape and colour
- A Table of Leather Coefficients is worked out for different leather types
- Based on the inputs given the appropriate Leather Coefficient is selected from the Database and the required allowance is calculated

Type of Upper Leather	Black	Brown	Colours
Patent and Cellulose Leather	1.00	1.00	1.00
Calf	1.01	1.02	1.03
Veal	1.01	1.02	1.03
Printed and Grain Sides	1.00	1.00	1.00
Smooth Sides	1.01	1.02	1.03
Grained Goat	1.01	1.01	1.01
Glace Kid	1.03	1.04	1.04
Suede Calf	1.05	1.05	1.05
Suede Kid	1.05	1.05	1.05
Suede Yeovil	1.10	1.10	1.10
Suede Split	1.05	1.05	1.05
Rounded Butt and Square Shoulders	0.95	0.95	-
LINING Leathers			
E.I. Calf	1.00	1.00	1.00
E.I. Kips	1.01	1.01	1.01
Goat	1.02	1.02	1.02
Sheep	1.05	1.05	1.05

Table of Leather Coefficients

Grade	Average Waste	Coefficient
0	-	1.00
1	5%	1.05
2	10%	1.11
3	15%	1.18
4	20%	1.25

Table of Leather Grades

- This is an allowance for the grade of leather being used and is a measure of the usable area
- The coefficients are computed for each leather grade and fed into a Table of Leather Grades which is stored in a database
- Based on the quality of Leather being used, the Cuttability Coefficient is calculated and from this the Cuttability Allowance is computed

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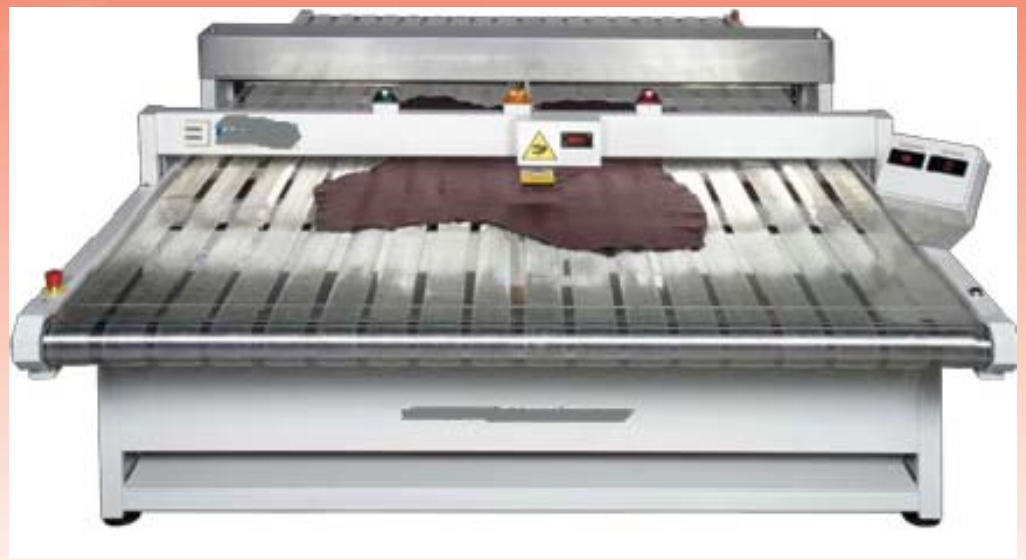
ADDING THE AREA ALLOWANCE

An Area Allowance is also an added option which can be used in case of any discrepancy in Area Measurements



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ADJUSTING FOR AVERAGE SIZE OF ORDER

Size	Children's		Women's			Men's		
	0-10	7-1	Narrow	Medium	Wide	Narrow	Medium	Wide
0	0.646							
1	0.692							
2	0.746							
3	0.804							
4	0.866							
5	0.931							
6	1.000	0.672						
7	1.012	0.721						
7.5	1.110	0.741						
8	1.148	0.771						
8.5	1.187	0.798						
9	1.227	0.825						
9.5	1.269	0.853						
10	1.311	0.881						
10.5		0.910						
11		0.939						
11.5		0.970						
12		1.000						
12.5		1.031						
13		1.063						
13.5		1.096						
1		1.129						
1.5		1.162						
2				0.893				
2.5				0.919				
3			0.928	0.946	0.964		0.766	
3.5			0.954	0.973	0.992		0.788	
4			0.981	1.000	1.019	0.795	0.810	0.825
4.5			1.009	1.024	1.047	0.817	0.832	0.848
5			1.037	1.056	1.075	0.840	0.855	0.871
5.5			1.066	1.085	1.104	0.863	0.878	0.894
6			1.094	1.114	1.134	0.886	0.902	0.918
6.5			1.124	1.144	1.164	0.910	0.926	0.942
7			1.153	1.174	1.195	0.934	0.950	0.967
7.5			1.183	1.204	1.225	0.958	0.975	0.992
8			1.214	1.235	1.256	0.983	1.000	1.017
8.5				1.267		1.008	1.025	1.043
9				1.298		1.034	1.051	1.069
9.5						1.060	1.077	1.095
10						1.086	1.104	1.122
10.5						1.113	1.131	1.149
11						1.167	1.158	1.176
11.5						1.195	1.186	1.204
12						1.223	1.214	1.233
12.5						1.251	1.242	1.261

Size	Women's	Men's	Children's
27			0.894
28			0.929
29			0.965
30			1.000
31			1.035
32			1.070
33	0.913		1.106
34	0.942		1.141
35	0.970		
36	1.000		
37	1.029		
38	1.057	0.901	
39	1.087	0.926	
40	1.116	0.951	
41	1.146	0.975	
42	1.174	1.000	
43	1.203	1.023	
44		1.050	
45		1.074	
46		1.099	
47		1.124	
48		1.148	

Table of Coefficients to allow for Variable Average Sizes

- Clearly the amount of leather used will vary with the size of shoe being cut.
- If multiple fittings are made this will also make a difference.
- Therefore each order needs to be adjusted for the average size and fitting and the charts provide

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UPPER LEATHER AREA ALLOWANCES		
Style No.		
Sl. No.	Parameter	Area (sq. Ft.)
A	SCALE AREA PER PAIR including 1st WASTE	1.5012
B	NUMBER OF PARTS PER SHOE ODD	5
C	AVERAGE AREA OF PARTS PER PAIR (A/B)	0.3016
D	AVERAGE SIZE OF SKIN	15
E	SECOND WASTAGE %	22.5
F	BASIC ALLOWANCE (A+E)	1.847
G	COEFFICIENT FOR TYPE OF LEATHER (1.02*F-F)	0.037
H	COEFFICIENT FOR CUTTABILITY (1.11*F-F)	0.203
I	COEFFICIENT FOR AREA ERROR	0.013
J	AVERAGE ORDER SIZE	0.094
K	TOTAL ADJUSTMENTS (G+H+I+J)	0.347
L	TOTAL ALLOWANCES (CLICKERS STANDARD FEETAGE)	2.19

Upper Leather Area Allowances and the Clickers Standard Feetage

SUMMATION

The summation of all the above allowances will help compute the Clicker's Standard Feetage i.e. the Leather Consumption Norm for that particular Footwear Style

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INNOEST

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The INNOEST - Innovative Footwear Norms Estimator is a software Program which was conceived, designed and developed by Shoe Design and Development Centre, Central Leather Research Institute, Chennai, India.

- Towards minimizing material utilization and estimating the product costing, it is necessary to derive the pattern area as well as the unavoidable waste that results from the interlocking of the patterns.
- The Innovative Footwear Norms Estimator is a standalone software to establish a standard system for measuring shoe patterns and upper materials to produce computerized cutting allowances.
- It is fast and accurate and allows users to interactively monitor and control material utilization.

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Limitations In Existing Systems

- CUT file is used as an input parameter
- First wastage only is calculated
- Doesn't support DXF file (customers use only the DXF file)
- First wastage, second wastage and third wastage are not calculated in single software.

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SALIENT FEATURES

- Developed on JAVA Platform
- Stand alone
- Platform independent
- Minimum hardware requirements
- Patterns can directly be imported in as a dxf file independent of any CAD system

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What the 'PROGRAM' does

- Establishes a standard system for measuring patterns and materials to produce a computerized cutting allowance and allows users to interactively monitor and control material utilization
- Calculates the parallelogram area (first wastage)
- Computes the Clicker's feetage incorporating a lot of essential parameters such as leather coefficients, leather grades, coefficients for size & fit, adjustments for average size of order
- Results in accurate computation of Material Consumption Norms value

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LOGIC FLOW DIAGRAM

SCAN INDIVIDUAL PATTERNS

CONVERT IMAGE FILE TO JPEG FILE FORMAT

EDGE DETECT SCANNED INPUT PATTERNS AND SAVE AS IMAGE FILES

CONVERT IMAGE FILES TO DXF FILE FORMAT

USE GUI TO SELECT, MOVE, FLIP OR ROTATE PIECES

INTERLOCK PIECES FOR OPTIMIZATION OF MATERIAL RESOURCES

CALCULATE SHEER AREA AS WELL AS INTERLOCK AREA (I.E WITH FIRST WASTAGE) OF EACH PIECE

COMPUTE SECOND AND THIRD WASTAGE

SUM UP ALL AREAS (INCLUDING 1ST, 2ND & 3RD WASTAGE) OF THE INDIVIDUAL PIECES TO ARRIVE AT THE CONSUMPTION NORMS FOR A PARTICULAR STYLE

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ADVANTAGES OF USING THE SOFTWARE

- This software directly supports the DXF file
- Error messages are shown then and there itself while interlocking
- It doesn't allow the user to continue if any mistakes are committed
- Calculation of first wastage, second wastage and third wastage in a single interface
- Multiple results stored and the most efficient and optimum interlock can be selected automatically

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APPLICATIONS

This software finds readymade application in any Leather Product manufacturing unit for use in deciding :-

- Cutting norms
- Estimating clicker efficiency
- Accurate costing
- Optimization in material usage

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PROCEDURE

Laying out the patterns

- Read in the patterns via a dxf file
- Separate the patterns individually
- Nest the patterns by laying it adjacent or by a 180 degree flip
- Ensure minimum amount of interlocking waste
- Repeat until original outline is surrounded by patterns
- Mark the vertices of a parallelogram formed by the nested patterns
- The parallelogram contains two pieces of the nested pattern plus the interlock waste (also called the First Wastage)
- Find the area of the parallelogram

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- Using the second waste table add the percentage that describes the relationship between the average pattern size and the skin size.
- Add an allowance for the shape of the leather
- Add an allowance for the quality or cuttability of the leather.
- An Area Allowance is also an added option built into the software which can be used in case of any discrepancy in Area Measurements
- Adjust the scale figure for the average size of the order.
- The summation of all the above allowances will help compute the Clicker's Standard Feetage i.e. the Leather Consumption Norm

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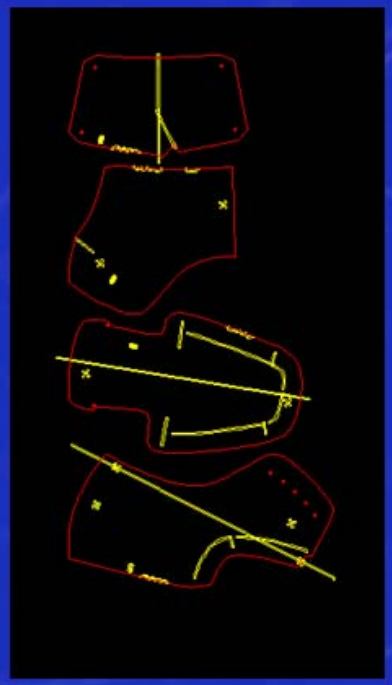
Input dxf file



Edge Detection

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Pattern Nesting

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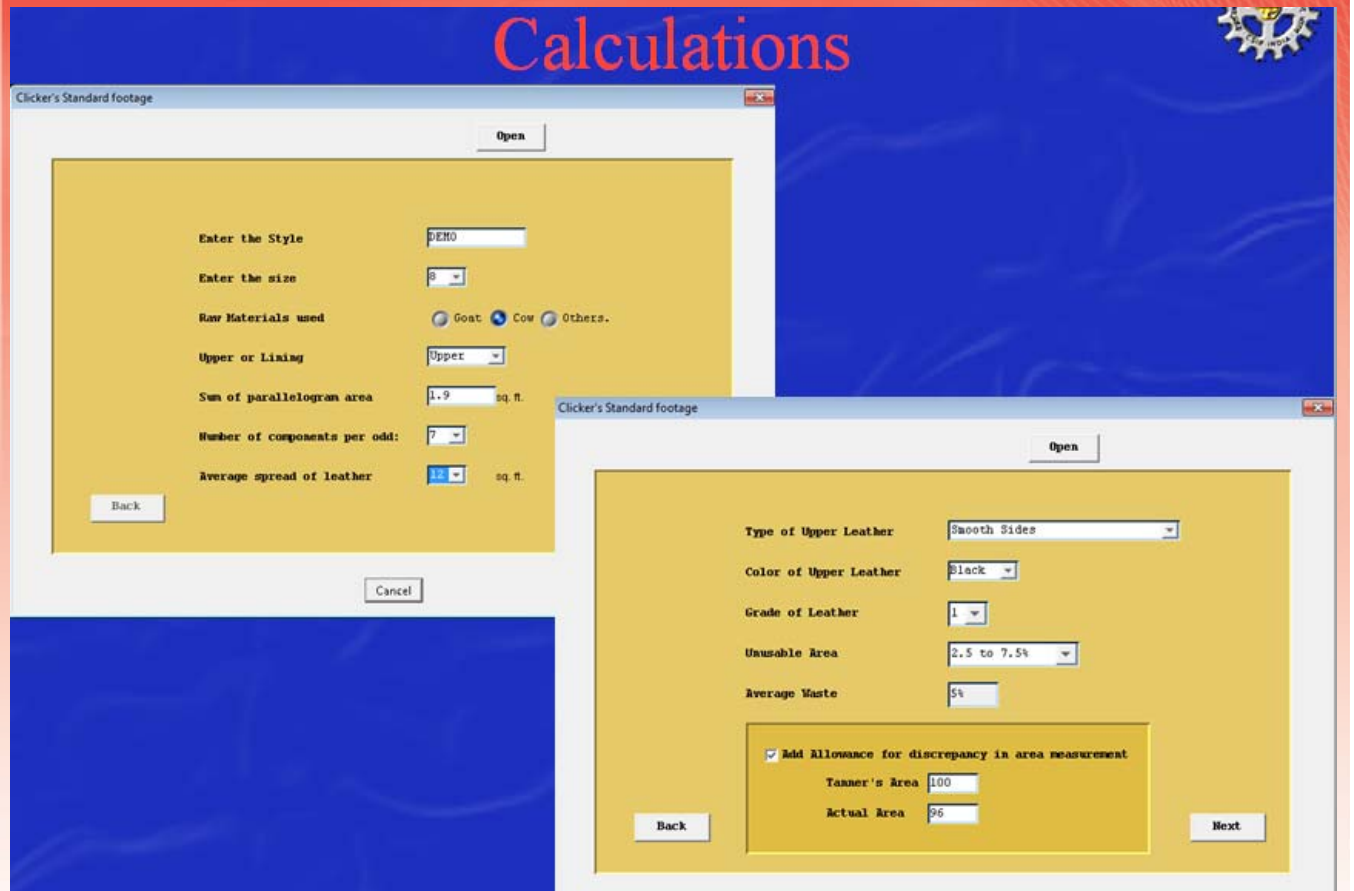

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Consumption Norm Value

Clicker's Standard footage

Open | Save | Print

Style DEMO **Size** 8

Material Cow **Type/Spec** Upper/ Smooth Sides **Colour** Black

Title	Values
Scale Area per Pair	1.9 SQ. FT.
Number of parts per Shoe	7
Average Area of Pattern per Pair	0.271 SQ. FT.
Average Size of skin	12 SQ. FT.
Second Waste	22.77143 %
Basic Allowance	2.333 SQ. FT.
Allowance For Shape and Type	0.023 SQ. FT.
Grade of Leather	1
Cuttability Allowance	0.117 SQ. FT.
AREA MEASUREMENT ALLOWANCE	0.097 SQ. FT.
Allowance for Average Size of order	0 SQ. FT.
SIZE COEFFICIENT	0 SQ. FT.
Clicker's standard Feetage (per pair)	2.57 SQ. FT.

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