MATERIAL OPTIMISATION AND COMPUTATION OF FOOTWEAR CONSUMPTION NORMS

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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 based on empirical and scientific reasoning
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.
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
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.’
• Mark the patterns; Use a strict and repeatable layout
• Keep patterns parallel; If necessary, rotate patterns round 180° 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
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.
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.

<table>
<thead>
<tr>
<th>Type of Upper Leather</th>
<th>Black</th>
<th>Brown</th>
<th>Colours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent and Cellulose Leather</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Calf</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
</tr>
<tr>
<td>Veal</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
</tr>
<tr>
<td>Printed and Grain Sides</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Smooth Sides</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
</tr>
<tr>
<td>Grained Goat</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>Glace Kid</td>
<td>1.03</td>
<td>1.04</td>
<td>1.04</td>
</tr>
<tr>
<td>Suede Calf</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>Suede Kid</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>Suede Yeayll</td>
<td>1.10</td>
<td>1.10</td>
<td>1.10</td>
</tr>
<tr>
<td>Suede Split</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>Rounded Butt and Square Shoulders</td>
<td>0.95</td>
<td>0.95</td>
<td>-</td>
</tr>
</tbody>
</table>

**LINING Leathers**

<table>
<thead>
<tr>
<th>Type</th>
<th>Black</th>
<th>Brown</th>
<th>Colours</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.I. Calf</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>E.I. Kips</td>
<td>1.01</td>
<td>1.01</td>
<td>1.01</td>
</tr>
<tr>
<td>Goat</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Sheep</td>
<td>1.05</td>
<td>1.05</td>
<td>1.05</td>
</tr>
</tbody>
</table>
• 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.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Average Waste</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
<td>1.00</td>
</tr>
<tr>
<td>1</td>
<td>5%</td>
<td>1.05</td>
</tr>
<tr>
<td>2</td>
<td>10%</td>
<td>1.11</td>
</tr>
<tr>
<td>3</td>
<td>15%</td>
<td>1.18</td>
</tr>
<tr>
<td>4</td>
<td>20%</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Table of Leather Grades
ADDING THE AREA ALLOWANCE

An Area Allowance is also an added option which can be used in case of any discrepancy in Area Measurements.
ADJUSTING FOR AVERAGE SIZE OF ORDER

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 coefficients for this.
SUMMATION

The summation of all the above allowances will help compute the Clicker’s Standard Featage i.e. the Leather Consumption Norm for that particular Footwear Style.
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.
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.**
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
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
LOGIC FLOW DIAGRAM

1. Scan individual patterns
2. Convert image file to JPEG file format
3. Edge detect scanned input patterns and save as image files
4. Convert image files to DXF file format
5. Use GUI to select, move, flip or rotate pieces
6. Interlock pieces for optimization of material resources
7. Calculate sheer area as well as interlock area (i.e., with first wastage) of each piece
8. Compute second and third wastage
9. Sum up all areas (including 1st, 2nd & 3rd wastage) of the individual pieces to arrive at the consumption norms for a particular style
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
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
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
• 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
Input dxf file

Edge Detection
Pattern Nesting
Calculations

Enter the Style
Enter the size
New Material\nUsed
Upper or Lining
Sum of parallelogram area
Number of components per unit
Average spread of leather

Type of Upper Leather
Color of Upper Leather
Grade of Leather
Unstitchable Area
Average Waste
Add Allowance for discrepancy in area measurement
Trimmer's Area
Actual Area
**Consumption Norm Value**

**Clicker's Standard footage**

<table>
<thead>
<tr>
<th>Style</th>
<th>Cow</th>
<th>Type/Spec</th>
<th>Colour</th>
<th>Material</th>
<th>Size</th>
<th>Grade of Leather</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Upper/ Smooth Sides</td>
<td>Black</td>
<td>Cow</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale Area per Pair</td>
<td>1.9 SQ. FT.</td>
</tr>
<tr>
<td>Number of parts per Shoe</td>
<td>7</td>
</tr>
<tr>
<td>Average Area of Pattern per Pair</td>
<td>0.271 SQ. FT.</td>
</tr>
<tr>
<td>Average Size of Skin</td>
<td>12 SQ. FT.</td>
</tr>
<tr>
<td>Second Waste</td>
<td>22.77143 %</td>
</tr>
<tr>
<td>Basic Allowance</td>
<td>2.335 SQ. FT.</td>
</tr>
<tr>
<td>Allowance For Shape and Type</td>
<td>0.023 SQ. FT.</td>
</tr>
<tr>
<td>Grade of Leather</td>
<td>1</td>
</tr>
<tr>
<td>Cuttability Allowance</td>
<td>0.117 SQ. FT.</td>
</tr>
<tr>
<td>AREA MEASUREMENT ALLOWANCE</td>
<td>0.097 SQ. FT.</td>
</tr>
<tr>
<td>Allowance For Average Size of order</td>
<td>0 SQ. FT.</td>
</tr>
<tr>
<td>SIZE COEFFICIENT</td>
<td>0 SQ. FT.</td>
</tr>
<tr>
<td>Clicker's standard footage (per pair)</td>
<td>2.57 SQ. FT.</td>
</tr>
</tbody>
</table>

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THANK YOU