ODC 82--015.5 REPRINT 2026

SEESAW: A VISUAL SAWING SIMULATOR (Part 2)

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Reprinted from:

"Proceedings of the Conversion Planning Conference, Rotorua, 8–11 April 1986"

J. A. Kininmonth (Comp.)

Ministry of Forestry, FRI Bulletin 128: 107–116 (1987)

SEESAW: A VISUAL SAWING SIMULATOR

PART 2: THE SEESAW COMPUTER PROGRAM

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ABSTRACT

A program for simulating the sawing of logs, using interactive computer graphics, is described.

KEYWORDS: Pinus radiata, conversion planning, computer simulation, sawing, conversion, timber grades, sawpattern, pruned log reconstruction, computer graphics.

INTRODUCTION

SEESAW is a program which simulates the sawing of pruned logs, using interactive computer graphics. It runs on a relatively inexpensive stand-alone microcomputer.

Information about data acquisition, application, and preliminary results is provided in the companion paper (Park 1987). A prototype of SEESAW has been previously described (Forest Research Institute 1984).

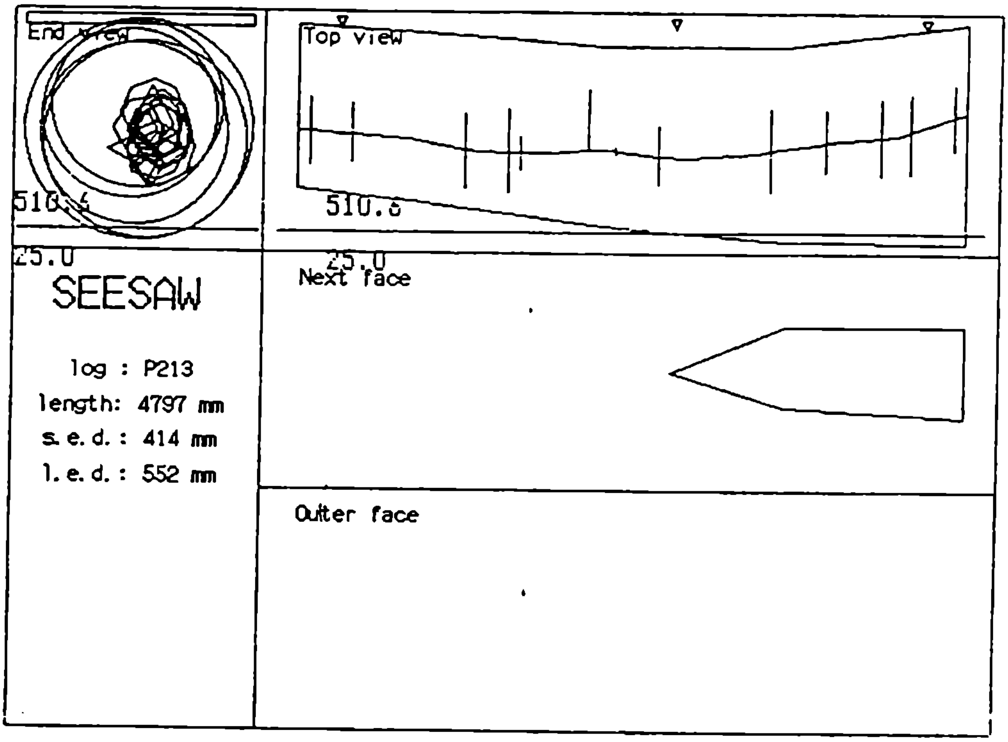
This paper provides a general description of SEESAW's operation and capabilities, as well as some hardware and software details.

The black and white figures included in this paper are dot-matrix reproductions of the screen images. Accordingly, many details that are clear in the eight-colour display are obscured in these figures. The resolution (or number of dots), however, corresponds exactly to that of the display.

DISPLAY LAYOUT AND PROGRAM OPERATION

The display screen is divided into five panels (Figure 1). In the first panel an end view of a log on the sawmill carriage is portrayed. The second panel gives the top view of this log. In the third panel information about the log is displayed; in panels four and five the current flitch faces, if any, are shown. (Note that there is a difference

FIG. 1: The five-panel display provides the end and top views of a log



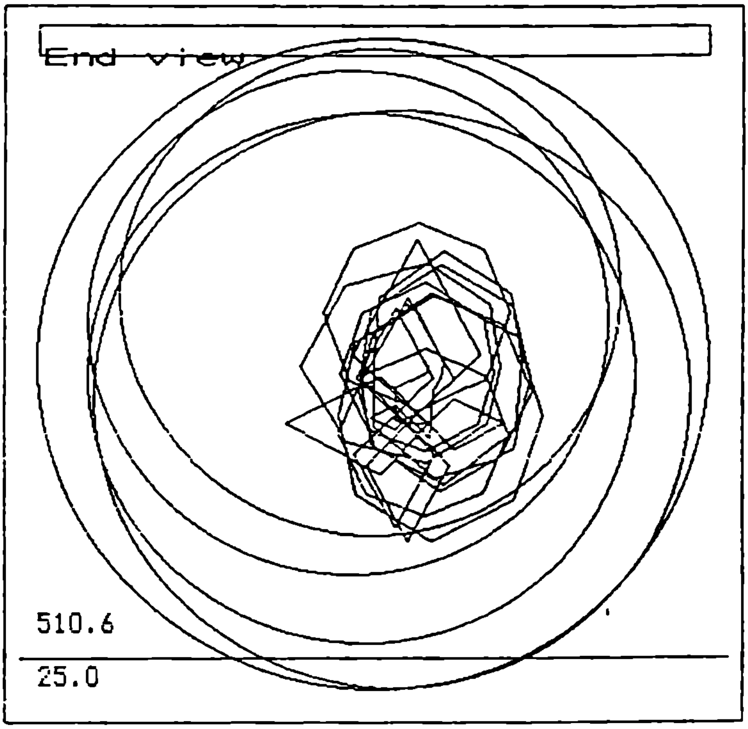
between the horizontal and vertical scales.) It is possible to extend any of the panels to fill the whole screen (Figure 2).

Special-function keys are used to control most of the program operation, leaving only a limited amount of log-positioning and board-grading information to be entered through the main keyboard. Operations in the program can be performed in almost any order, and it is always possible to back-track by "undoing" operations.

LOG DESCRIPTION

The external log profile is represented by a number of circular cross-sections. Within the log, the defect core includes pith and the branch whorls. Whorls are represented by polygons, which have been determined by measuring the extent of defects in two perpendicular directions (Figure 2). Defects are then shown on any surface intersecting these polygons. This simplification is required because of the nature of the available data. In the future, more detailed defect descriptions may be used.

FIG. 2: Full-screen display of a panel, showing log cross-sections and defect polygons



LOG POSITIONING

Before sawing commences, it is possible to alter the position of the log on the carriage. The log can be rotated at any angle and displaced lengthwise by any amount. It is also possible to saw either the small end or the large end first.

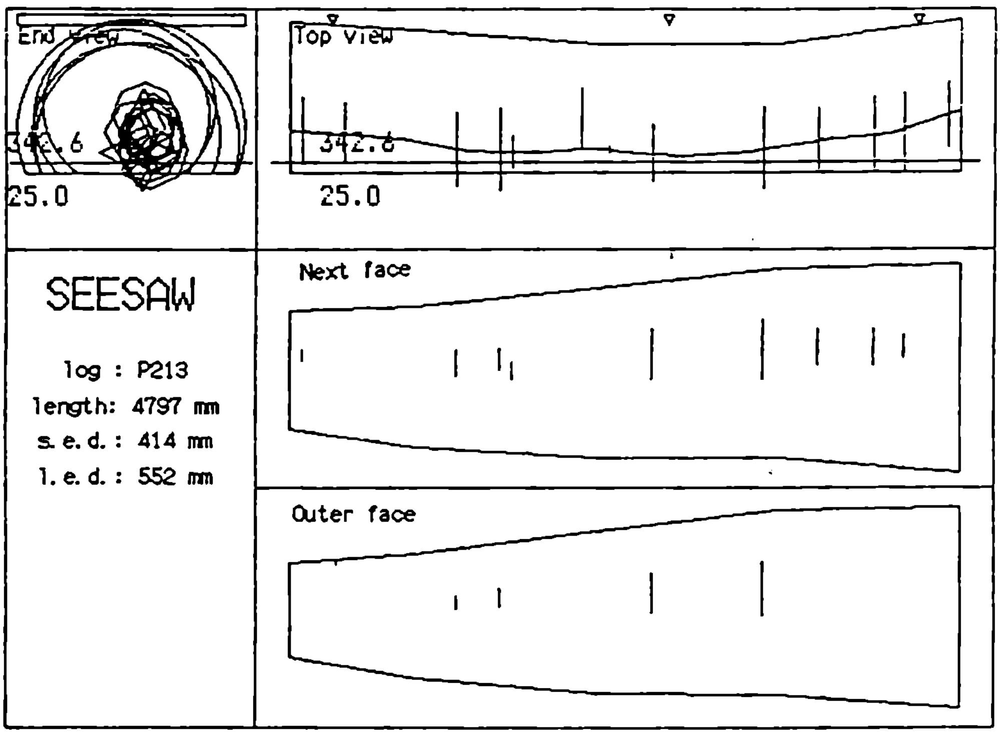
The position of the log is automatically adjusted so that it is always in contact with both the front knee and any one of the other knees on the sawmill carriage. (The knees are represented by the small triangles which are visible in the top view of Figure 1.) For simplification purposes, any skewing of the log needed to achieve this contact does not affect the plane of the cross-sections, which are always perpendicular to the sawing plane. This may appear somewhat strange on the display because of the widely differing diameter and length scales used, but the practical effect is negligible.

The front knee can be displaced vertically to simulate taper sawing.

SAWING

In the sawing mode, the sawline (which is represented by the horizontal lines through the log in Figures 1, 2, & 3) can be moved either up or down by pressing function keys. The step sizes assigned to the keys can be changed by the user. (Currently, three different step sizes are used.)

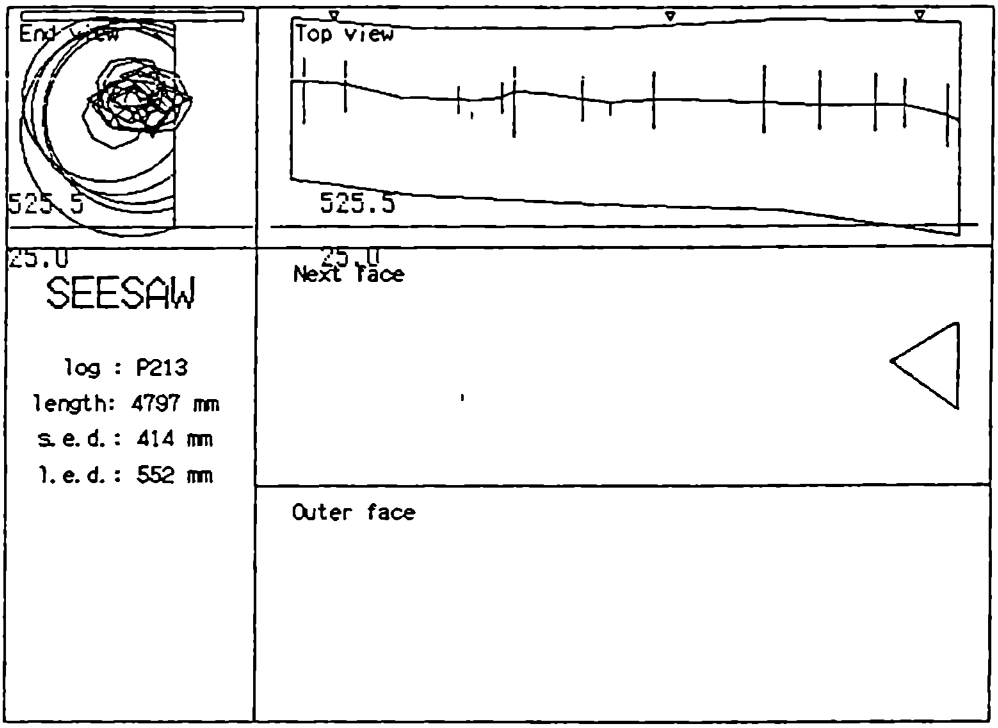
FIG. 3: Display in the sawing mode, indicating defects in the flitch faces



The distances from the saw to both the carriage knees and the log outer face are displayed on each side of the sawline. The shape of any new log face which would result from a potential cut is continuously shown in the fourth panel, while any outer log face is displayed in the fifth panel (Figure 3). Surface defects, resulting from intersections of the saw plane with whorl polygons and/or pith, are also shown. The effects of saw kerf and overcutting are taken into account.

After positioning the sawline, the cut can be simulated by pressing another key. The details of the resulting flitch are recorded internally for any later edging, docking, and grading, and the display is updated. At any time, the log can be turned in 90-degree steps and sawing continued on another face (Figure 4). Cuts can be undone by pressing the "uncut" key.

FIG. 4: Turning the log in the sawing mode



Typical time-periods for each operation, using the full display, are 0.6 seconds for stepping the sawline, 2.7 seconds for simulating a cut, and 2.9 seconds for turning the log. Faster times can be achieved when an individual panel is displayed, because less redrawing is required.

EDGING

It is possible to alternate between the sawing and edging modes at any stage of the process. In the edging mode, the program operator can select and edge any of the flitches which have been produced. The position of the flitch in the log is displayed, along with its two faces (Figures 5 & 6). The surface defects of each face are shown on the screen, and the outline of the other face is superimposed in a different colour in order to show any wane present.

FIG. 5: Display in the edging mode, showing a skewed sawline

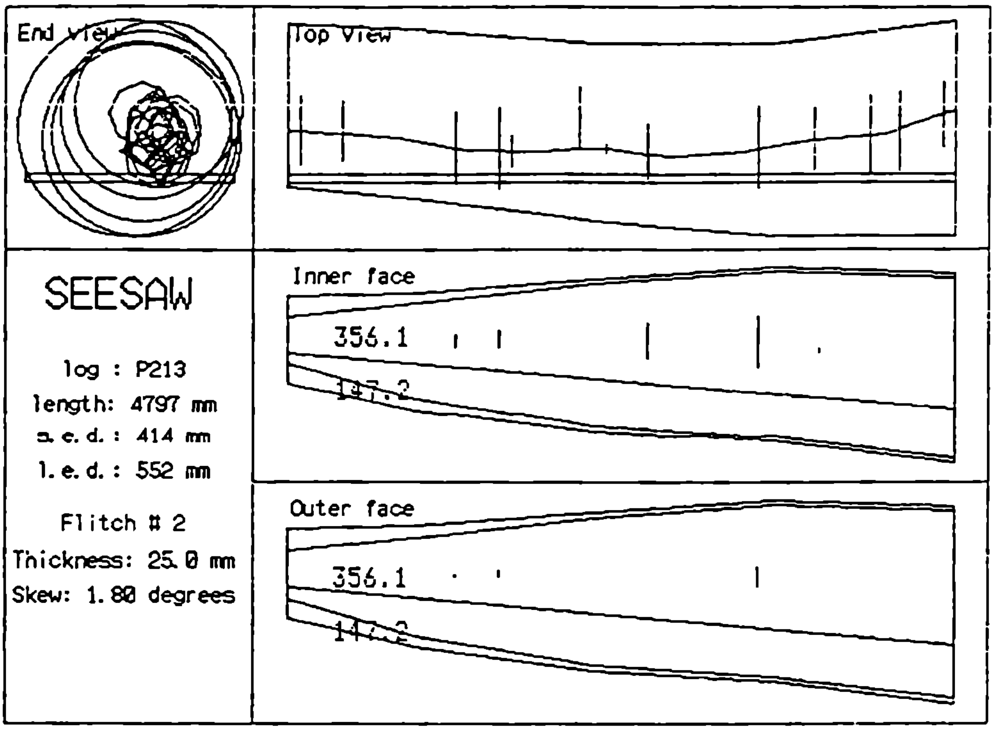
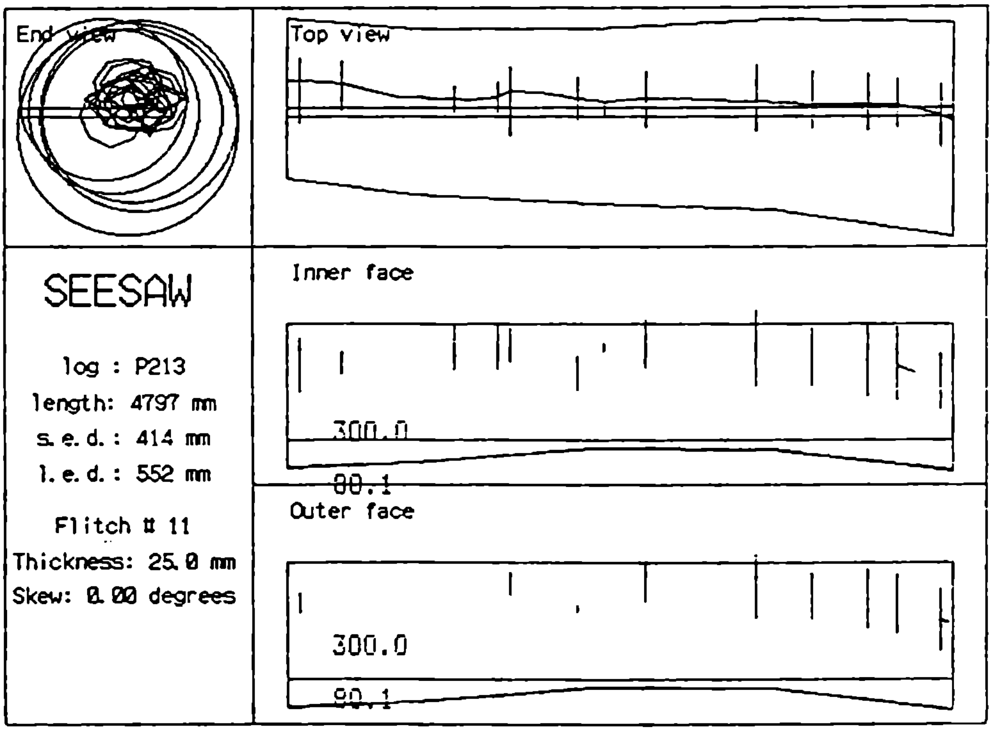


FIG. 6: Edging a flitch with a sawn edge



The edger sawline appears on both flitch faces, and can be moved either up or down in the same way as in the sawing mode. Maximum widths on both sides of the saw are shown. On flitches without sawn edges, the slope of the sawline can be altered to simulate the skewing of the flitch in the edger (Figure 5). Skewing is not permitted for flitches with sawn edges (as in Figure 6) because all edges must be parallel.

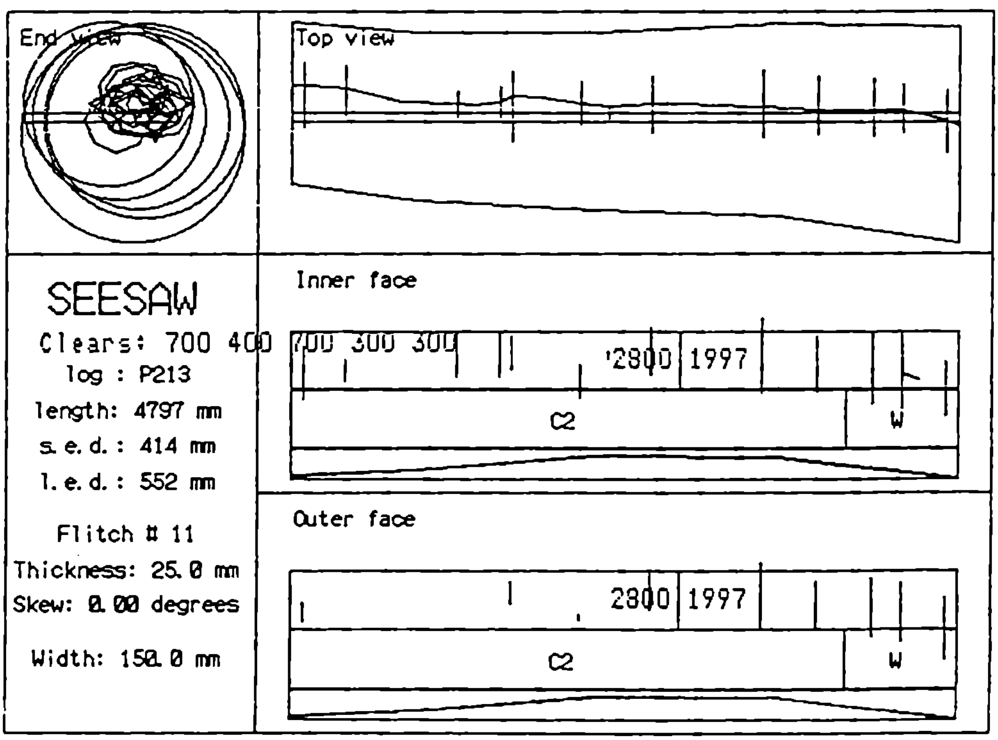
Cutting is simulated by pressing the appropriate key. Pieces are assumed to be produced from the lower edge first, and are outlined in a contrasting colour. The program accounts for saw kerf and overcutting.

Sawline stepping and cutting will take approximately 0.2 and 0.6 seconds respectively, in the full display mode.

DOCKING AND GRADING

The pieces produced by edging can be subsequently crosscut or docked. A vertical docking sawline extends between the edges of the piece about to be processed, and the lengths on both sides of the sawline are shown (Figure 7). The sawline can be moved in fixed steps, or it

FIG. 7: Display in the docking and grading mode



can be moved to the next defect on either the left or the right. (Defects are assumed to have a predefined thickness.) The board length can be adjusted by rounding up or down to a multiple of the step length.

The boards resulting from docking and/or edging are graded visually, and a code is assigned to them. The grade code is displayed at the centre of the board (Figure 7).

SEESAW can also calculate the number and length of clear-cuttings which could be obtained from the board (see the five numbers at the centre-left of Figure 7). These clear lengths are computed according to pre-specified minimum lengths and rounding specifications.

All edging, docking, and grading can be readily reversed. Docking stepping, cutting, and the calculation of clear-cuttings each take less than 0.2 seconds.

OTHER FACILITIES

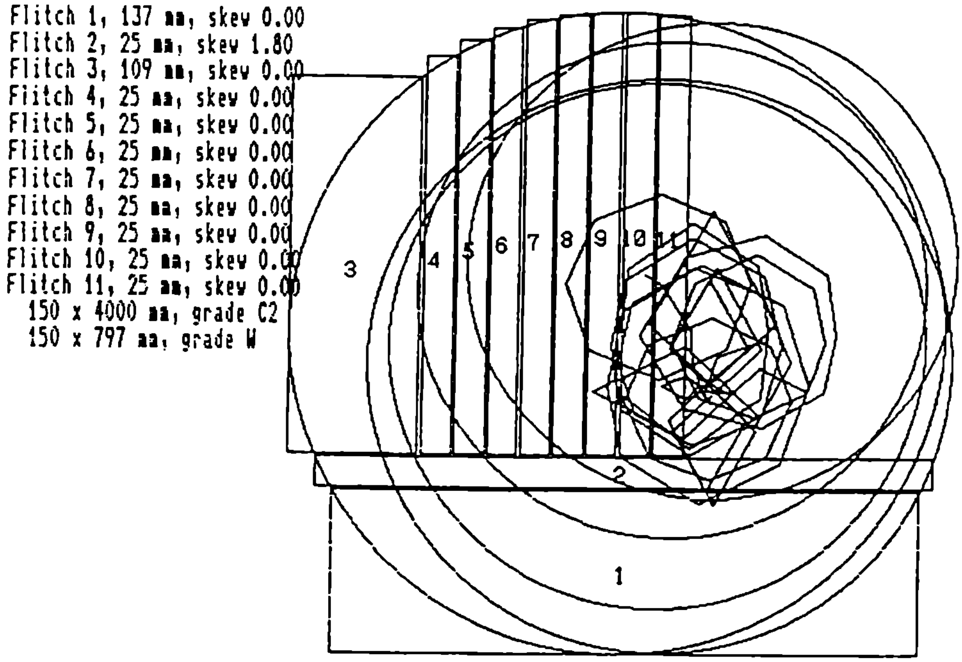
A dot grid can be superimposed on the boards for estimating dimensions. In the docking mode, a number indicating the position of the sawline can be displayed, and reset to zero at any point. This enables length measurements to be carried out. Relevant dimensions are also continuously updated in the information panel.

A diagram showing the flitches which have been cut and a list of the boards with their dimensions and grades can be displayed at any stage of the process (Figure 8).

A number of parameters specifying saw kerfs, sawline steps, dot grid pitch, pith and whorl defects' thickness, and minimum clear-cutting lengths, can be examined and altered at any time. Their initial values, along with the number and spacing of the carriage knees and the colour scheme to be used, are taken from a "defaults" file which can be edited by the user.

Simulation sessions can be interrupted at any stage and saved on a disk for future continuation. At the end of a simulation, the dimensions, grades, and clear-cutting lengths of every graded board can be saved. These can be used directly as input for a program which has been developed for analysing results of sawmill studies (Park and Leman 1983).

FIG. 8: "Progress" display, showing the cut flitches and a list of the boards



HARDWARE

SEESAW runs on a NEC APC microcomputer and requires the colour graphics option, an 8087 arithmetic co-processor, and 256 Kbytes of memory. The computer uses an 8086 processor running at 4.77 MHz. Graphics are managed by a NEC 7220 Graphics Display Controller. Screen resolution is 640 by 480 pixels in eight colours.

SOFTWARE

The program consists of approximately 5000 lines of Pascal code. The MS-DOS operating system and Microsoft Pascal Compiler are used. Few system- or compiler-dependent features have been used, however.

Graphics are accessed through a reduced set of primitives, implemented in a separate program module. Two versions of the graphics module are available. One uses the Graphics Supplement package, which was distributed with MS-DOS 2.0 for the NEC APC; the other uses the GSX-86 Graphics Extension, which was provided with MS-DOS 2.11. Only the first one is being used, at this stage, because some of the graphics operations are slower in the GSX-86 implementation for the APC. The wide availability of GSX would facilitate porting SEESAW to other computers, although some customising may be necessary for improving its performance.

CONCLUDING REMARKS

The feasibility of simulating log sawing using interactive computer graphics has been demonstrated. The standard of performance attained on a microcomputer is very satisfactory.

SEESAW is routinely used, and has proved useful for evaluating pruned sawlogs (Park 1987). Interest has also been expressed in its potential for training purposes.

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