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ROMI-RIP 2.0 User's Guide: a ROugh MIII RIP-First Simulator

R. Edward Thomas

Abstract

The ROugh MIll RIP-first simulator (ROMI-RIP Version 2.0) is a computer software package for IBM-compatible personal computers that simulates current industrial practices for rip-first lumber processing. This guide shows the user how to set up and examine the results of rip-first simulations of current or proposed mill practices. ROMI-RIP accepts cutting bills with as many as 600 combined solid and/or panel part sizes. Plots of processed boards are easily viewed or printed, as are detailed summaries of processing data (number of rips and crosscuts) and yields for each grade.

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1. Introduction

Version 2.0 of the ROugh MIll RIP-first simulator (RR2.0) is the most recent rip-first, rough-mill analysis tool from the USDA Forest Service. The RR2.0 install disk contains sample runs, all required programs, and the *1998 Data Bank for Kiln-Dried Red Oak Lumber* (Gatchell et al. 1998) which includes more than 3,000 digitized boards, and sample simulations. A digitized board is a real board whose dimensions and defects are expressed in x,y coordinates. An included custom datafile creation utility allows you to create board samples corresponding to your lumber supply. RR2.0 processes the board data according to your rip-first processing specifications. Outputs, including part counts and yields, graphs, and processing requirements, are available from each run. This guide will show you how to install and run RR2.0 as well as design simulations to answer questions related to rough mill processing.

RR2.0 was developed to be compatible with the ROMI-CROSS crosscut-first simulator (Thomas 1997) and to address the limitations of the earlier version of ROMI-RIP (Thomas 1995a, b). The earlier version of ROMI-RIP was limited in several ways. ROMI-RIP 1.0 (RR1.0) could cut only one part quality for the entire cutting bill. RR2.0 can process Clear Two Face (C2F), Clear One Face (C1F), and Sound Two Face (S2F) parts at the same time. RR1.0 did not have a part scheduling and replacement mechanism. RR2.0 allows the user to define the maximum number of part sizes to process at once, and how to replace part sizes as requirements are met. Unlike RR1.0, RR2.0 can produce glued-up panels that are specified in the cutting bill. For our purposes, a panel is made of two or more solid parts that have been edge glued together. Other RR2.0 features include a selective-rip arbor, the ability to cut to sizes specified to the nearest 1/16-inch or millimeter, adjustable rip and chopsaw kerf sizes, and the ability to process cutting bills with as many as 600 part sizes.

The minimum computer system requirements to run RR2.0 are:

- An IBM[1] 486, Pentium, or compatible computer
- 2 Mb of Random Access Memory (RAM)
- A hard disk with at least 20 Mb free space
- Windows 95 or later (Windows 95 is a trademark of Microsoft Corp.)[1]
- A high-density 3.5-inch floppy drive
- A printer (optional but recommended)

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[1] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

To avoid confusion and make this user's guide easier to understand, several conventions have been adopted for displaying Windows 95 and RR2.0 prompts and input. For all prompts and buttons ***Times italicized bold*** is used; for all user input, **Avant Garde bold** is used.

2. Installing ROMI-RIP

The installation program included with RR2.0 installs all programs, support files, samples, and a copy of the *1998 Data Bank for Kiln-Dried Red Oak Lumber* on your hard disk. This database is described in Appendix II. The boards in the data bank are graded according to 1998 NHLA Rules (Natl. Hardwood Lumber Assoc. 1998).

2.1. Running the Install Program

To install place the RR2.0 install diskette in the 3.5-inch drive of your computer. Click on ***Start*** and then ***run***. This opens the Windows 95 Run window (Fig. 2.1a). At the **Open** prompt, enter **a:install** or **b:install** then click on ***OK***. This starts the RR2.0 installation program.

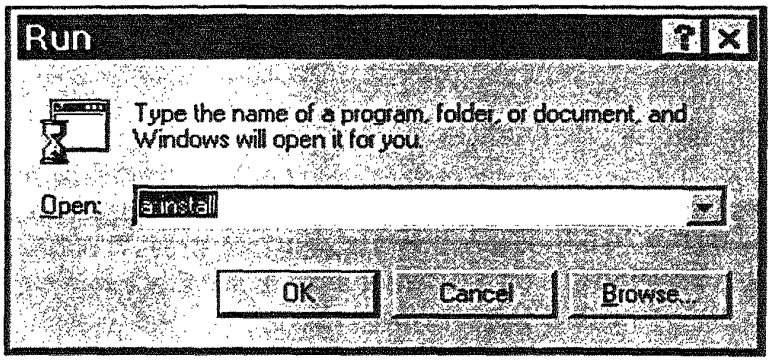


Figure 2.1a. Window showing specification of install program.

When the install program begins, it displays the screen shown in Figure 2.1b. Press any key to begin. The program begins by determining the hard drives available on your machine. If the computer has a CD-ROM drive with no disk in it, you may encounter an error such as CDR-101: Not ready reading drive D:. If this occurs, press F at the Abort, Retry, Fail prompt. The installation will continue normally.

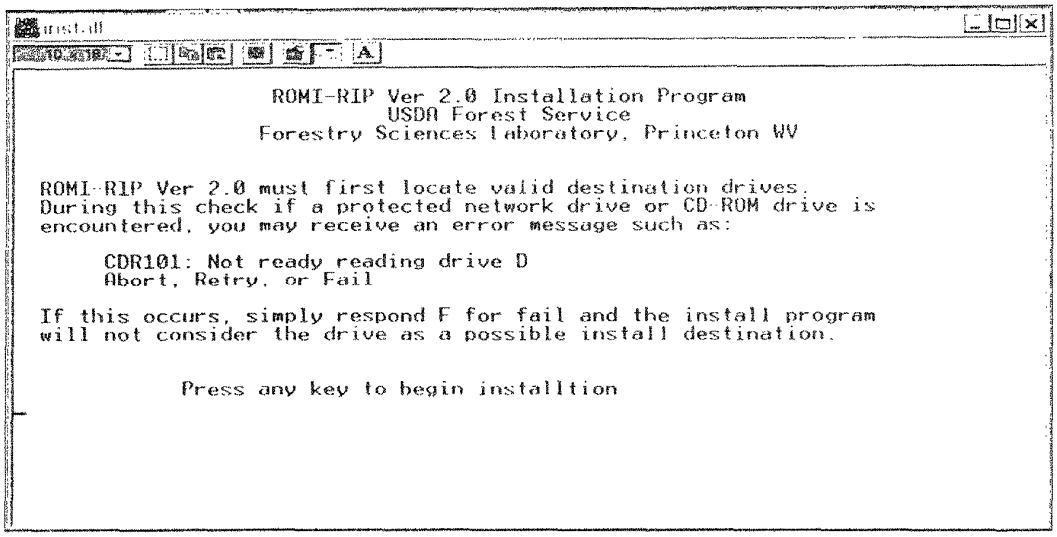


Figure 2.1b. RR2.0 system check screen.

2.2. Confirming Install Destination

Figure 2.2 shows the install destination screen with the default destination of drive C: and subdirectory \RIP-2. If this destination is acceptable, press *C* and proceed to Step 2.4. If you want to install RR2.0 on a different drive or subdirectory, press *M* and proceed to Step 2.3. Press *A* to stop the installation.

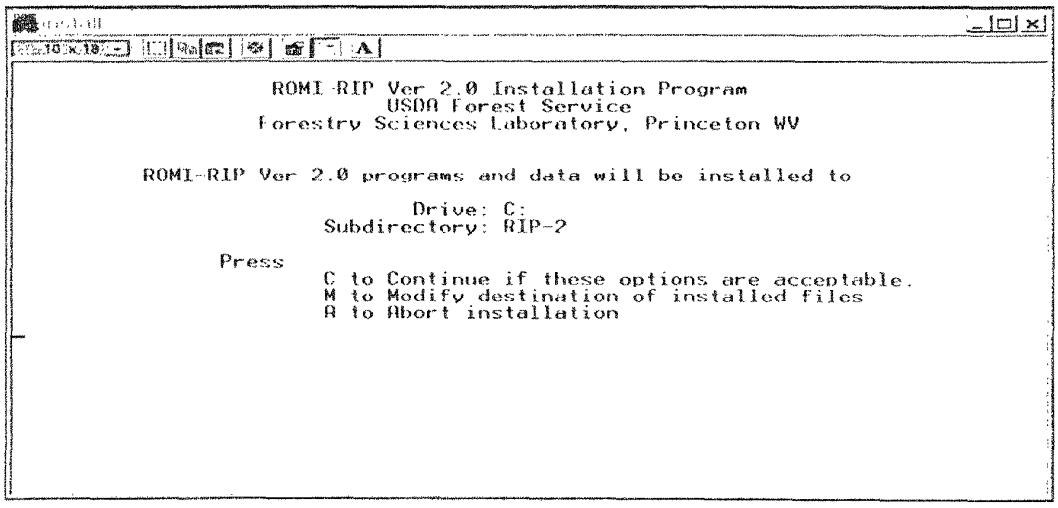


Figure 2.2. Install destination screen.

2.3. Modifying Install Destination

This step allows you to customize the install location of RR2.0. First, choose a new destination drive from the menu. As shown in Figure 2.3, the system check found two hard drives, C: and D:; we will enter 1 to select drive C:.

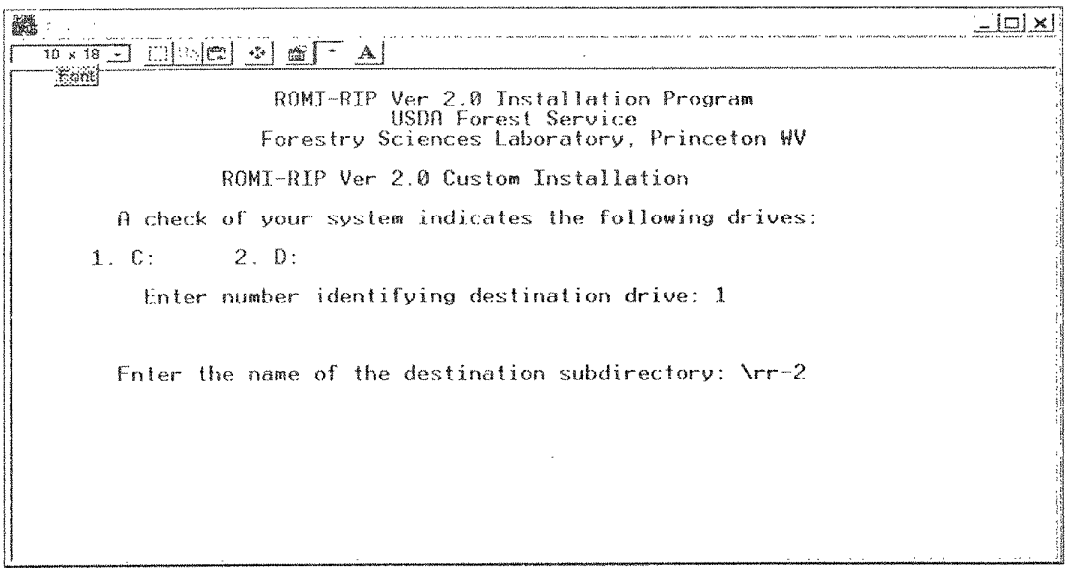


Figure 2.3. Destination modification screen.

After selecting the drive, you are prompted to enter the name of the installation subdirectory. This subdirectory may be a new one or an existing one. When entering the name of the subdirectory, give the complete path of the subdirectory starting with the root directory. For example, to install RR2.0 in the subdirectory \RR-2 at the prompt, enter:

\RR-2

Figure 2.3 shows this entry. After you enter the new destination, the screen in Figure 2.2 is displayed with the new destination drive and subdirectory. Refer to Step 2.2 to continue.

2.4. Software Installation Phase

After the install destination is confirmed, the computer checks whether the install subdirectory exists or needs to be created. If the subdirectory exists, you are prompted whether to continue. If you press *N*, the installation is cancelled. If you press *Y*, RR2.0 is installed to the directory. As the files are decompressed and copied, the filenames scroll across the screen. When the install program prompts you, remove disk 1 from the floppy drive and insert disk 2. The installation may take 10 to 20 minutes to complete. ROMI-RIP seeks confirmation before overwriting existing files. RR2.0 is packaged on two disks. The install program asks for the next disk to be inserted in the floppy drive.

The screen in Figure 2.4 is displayed when all RR2.0 files have been copied to your system. Click on the *X* in the upper right-hand corner of the window to continue.

```
  Inflating: INITVARS.TCL
  Inflating: OUTPUT.TCL
  Inflating: PART-GRD.TCL
  Inflating: ROMI-RIP.TCL
  Inflating: DOWN.XBM
  Inflating: EXCL.XBM
  Inflating: ICON.XBM
  Inflating: LEFT.XBM
  Inflating: RIGHT.XBM
  Inflating: UP.XBM

C:\RR-2>echo off
File not found

C:\RR-2>


Removing compressed files in destination directory


     If you plan on using a laser printer to print board plots,
     please refer Appendix I of the ROMI-RIP Version 2.00 User's
     Guide before running ROMI-RIP.
```

Figure 2.4. Screen displayed when all software has been copied to your system.

2.5 Configuring Windows 95

The next step is setting up a Windows 95 shortcut that allows you to run RR2.0 by clicking on an icon in the main window. First, right click on a blank area of the screen. From the popup window select ***New*** and then ***Shortcut*** from the popup window to the right (Fig. 2.5a). Depending on the software and features of your computer, the second popup may more or fewer menu items.

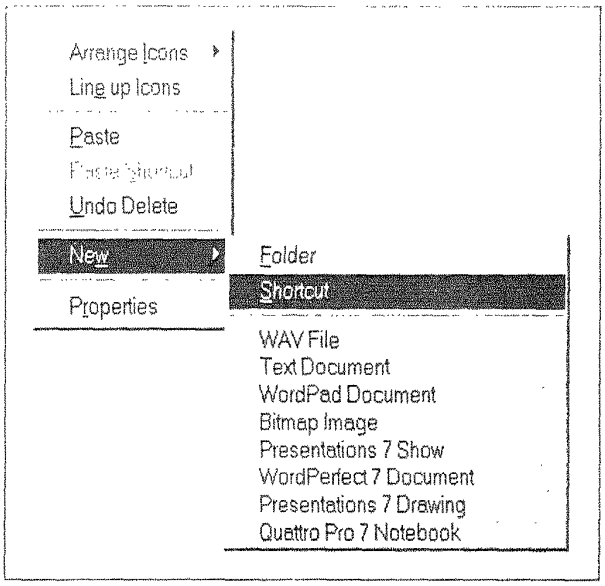


Figure 2.5a. Popup windows for creating a shortcut.

In the Create Shortcut window shown in Figure 2.5b, I have entered the command line that will run RR2.0. The format of the entry is the letter of the hard drive you installed RR2.0 on followed by the subdirectory name and RIP.EXE. If you accepted the default installation drive and subdirectory, enter: **C:\RIP-2\RIP.EXE**. In Figure 2.5b, I have specified **C:\RR-2\RIP.EXE**, which corresponds to my install drive and directory. Click on ***Next*** when you have completed the ***Command*** line entry.

The next step is to enter a name for shortcut. This name is displayed alongside the RR2.0's icon on the screen. In Figure 2.5c I have entered ROMI-RIP Ver 2.0. You can enter any name you like. Click on ***Finish*** when you have entered a name; you should see an icon for ROMI-RIP on your screen.

To complete the installation, repeat the steps for creating a shortcut for the view.exe and makefile.exe programs. When this is completed, RR2.0 will be installed and you should see three icons for the RR2.0 system on your screen.

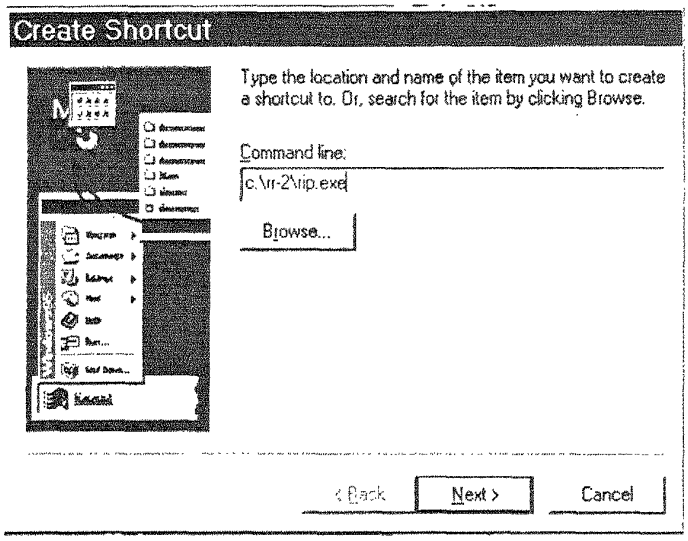


Figure 2.5b. Create Shortcut window.

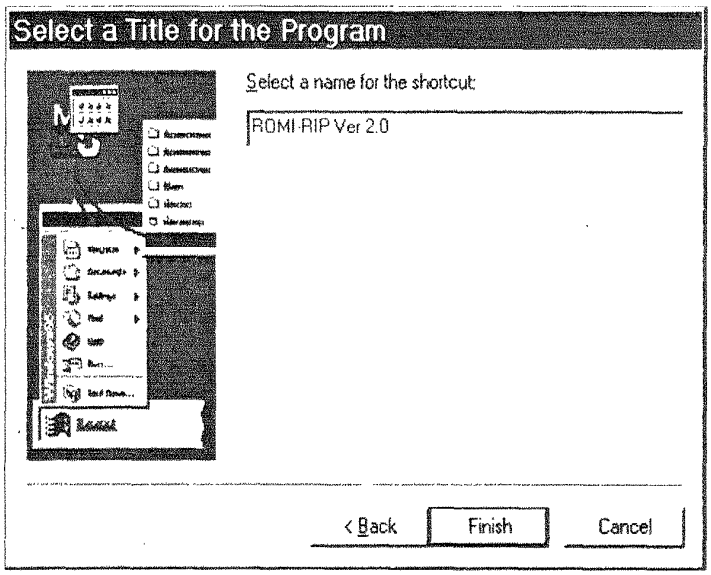


Figure 2.5c. Shortcut name entry window.

2.6 Changing Windows 95 Display Size

On some computer systems, the display settings used by Windows 95 do not allow you to view the entire RR2.0 screen. To correct this, you must change the settings used on your computer. Select (in order) ***My Computer***, ***Control Panel***, ***Display***, and ***Screen Size*** from the Windows 95 main window.

3. Running ROMI-RIP

To run RR2.0, click on the RR2.0 icon you created. You will see the main window shown in Figure 3a. At the top of the screen are the command buttons that control the operation of RR2.0 and allow you to configure analyses. The text area in the middle of the window displays current simulation settings: arbor type, saw spacings, optimization settings, salvage part sizes, and kerf sizes. Click on the scroll bar to see the complete list of settings. The status area at the bottom of the window displays the names of the currently selected data, cutting bill, part grade, and output files. If there are unsaved edits to the cutting bill, a check appears in the ***Cutting bill settings are unsaved?*** box.

An important addition to this version of ROMI-RIP is online help, which includes a set of examples and explanations. Online help is available for all RR2.0 main topic areas. Figure 3b shows a sample of the main RR2.0 help window. You can move through the help display by using the scroll bar. Select ***Exit*** to close the Help window and return to the RR2.0 main window.

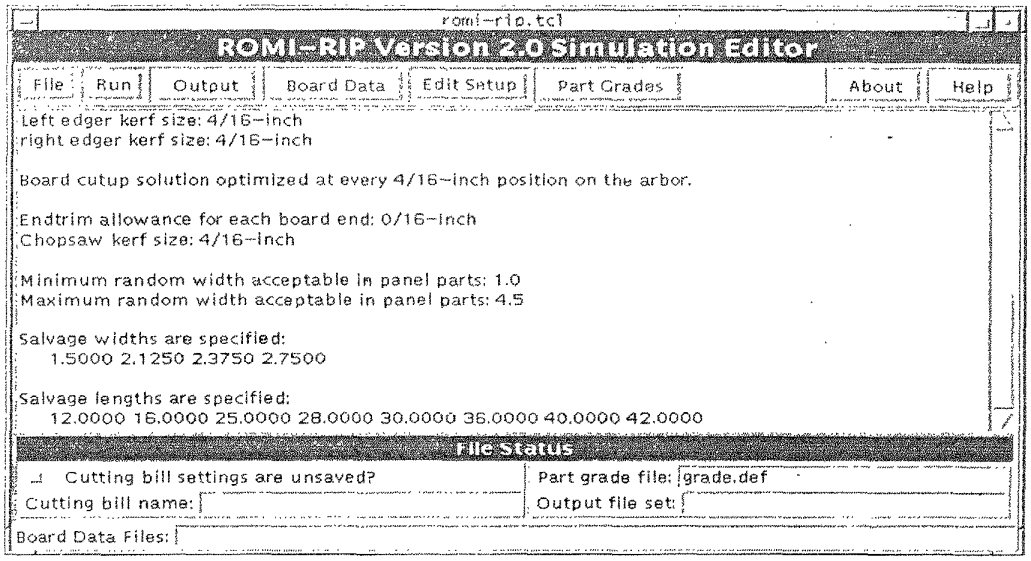


Figure 3a. ROMI-RIP 2.0 main window.

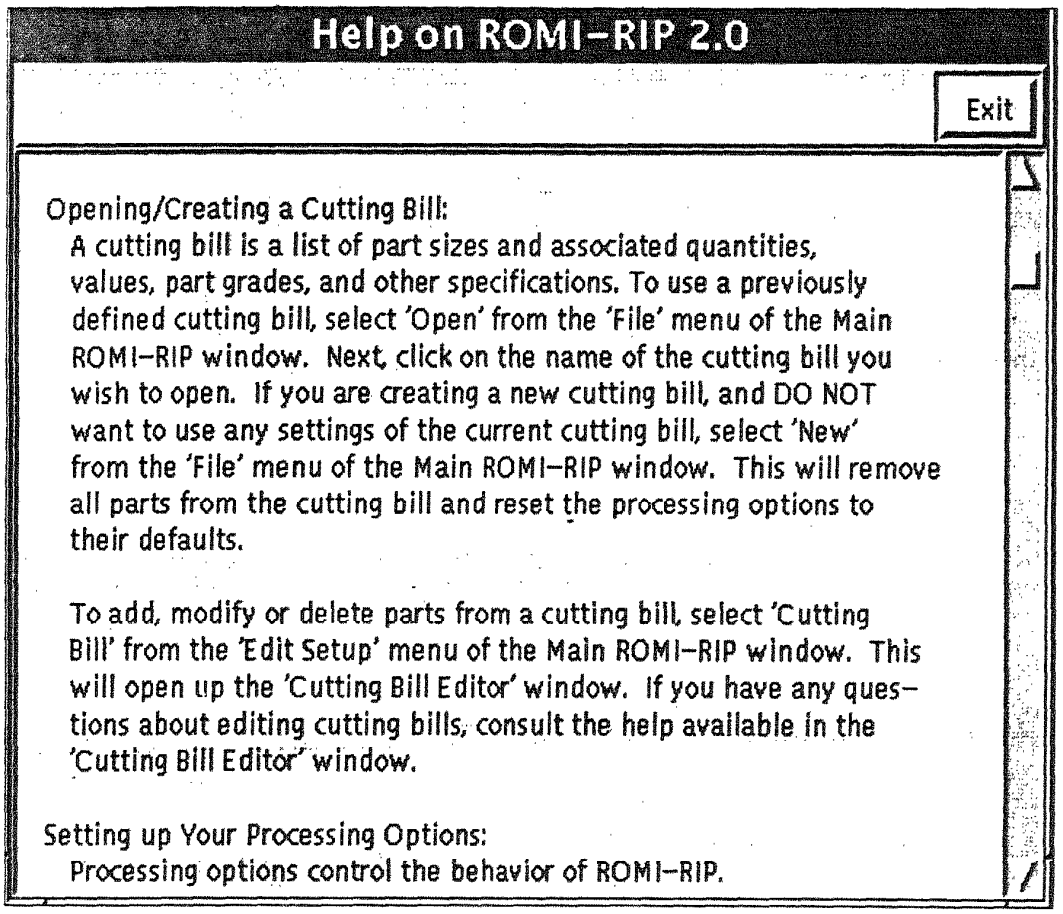


Figure 3b. Sample RR2.0 help window.

For every RR2.0 analysis there are several paramters, including: cutting billl, processing options, part qualities, lumber data, and output options, that must be specified. RR2.0 uses files to keep track of these. All RR2.0 files are managed using the standard Windows 95 file options: ***New, Open***, ***Save***, and ***Save As***. An example of these options using the part quality editor File menu is shown in Figure 3c. Select ***New*** to start with an empty or default file. If you have unsaved edits to the file, you are asked if you wish to continue and lose your changes. To open a file, select ***Open*** and then enter the name of the file or select the file from the list of files in the browse area (Fig. 3d). Selecting ***Save*** stores and changes to your currrent work. If you have not specified a name for your file, such as when working with a new file, you are prompted to enter a filename (Fig. 3d). Select ***Save As*** to store your work under a different name (Fig. 3d). The remainder of this user's guide shows you how to configure the options and files for your ROMI-RIP analyses. To exit RR2.0 at any time, select ***File*** and then ***Exit***.

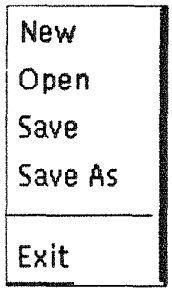


Figure 3c. Sample RR2.0 file menu.

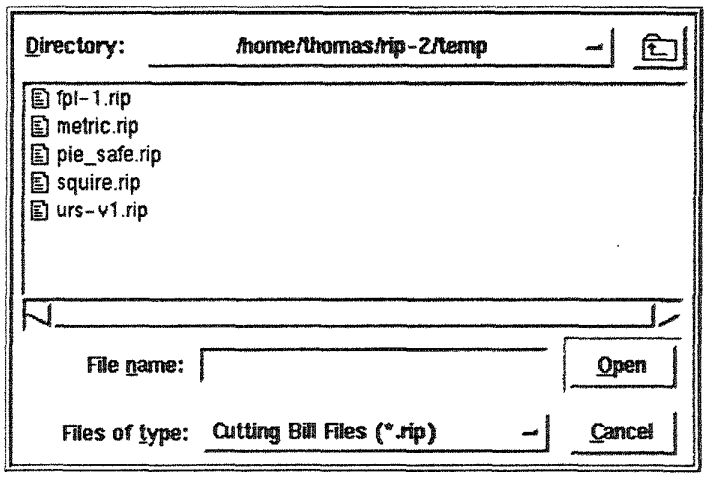


Figure 3d. Sample RR2.0 File Select window.

4. How to Use RR2.0: An Example

It is important that the steps for a RR2.0 simulation are performed in the correct order. For example, part qualities must be defined before specifying cutting bill parts. You also need to define your cutting bill before setting up the arbor. However, if you need to make only minor changes, the order in which you perform them is less important. This section will lead you through all these steps by showing you how to set up an analysis for a sample cutting bill. To become familiar with RR2.0, you may want to work along with the example. In any case, the basic sequence of steps in setting up any RR2.0 analysis are:

1) Select or define a part quality definition file
2) Select or create a cutting bill
3) Set up the arbor
4) Set up the chopsaws
5) Set up the overall processing and control options
6) Specify the salvage part sizes (if any)
7) Define output options
8) Select board data to process
9) Run and analyze simulation results

Some steps need to be taken only once, despite the number of simulations that are run. For example, if you use a common part quality definition for all cutting bills, enter it only once and use it for each run. Also, if you use the same processing options for every cutting bill, you need define them only once. One of the strengths of RR2.0 is that you can examine many alternative processing options with several mouse clicks.

4.1 Selecting or Defining Part Grades

A powerful feature of RR2.0 is the ability to process multiple part grades. RR2.0 allows the user to specify a range of defect types, sizes, acceptable distances from part edge, and whether each defect is acceptable on the face, back, or both faces. Users can define as many different part grades as required. In the absence of low grade material, a higher grade is substituted automatically. This does not waste high-quality part areas in low-quality parts. This is accomplished by optimizing for the highest quality parts in the first pass, the next highest quality in the second pass, and so on. During each pass, the parts with the highest priority and part quality are marked for removal. Any remaining area is downgraded according to adjacent quality areas. For example, an area too short for any part with a quality of 1 adjacent to an area with a quality of 3 would be downgraded to quality 3. In the absence of adjacent areas with a lower part quality, the entire area is downgraded to the next available quality. A strip is processed by the chopsaw when parts have been placed in all usable quality areas.

The first step in choosing or editing a part grade file is to select Part Grades from the RR2.0 main window (Fig. 3a). Next, the Part Grade Editor shown in Figure 4.1a will appear. The information shown in the middle of the window is the default part grade file, GRADE.DEF. We want to define our own set of part grades. To do this, select ***File*** from the Part Grade Editor window (Fig. 4.1b) then ***Open*** from the popup menu. The File Select window will appear (Fig. 3d). Select the entry box, and enter **testmap**. Select ***Open*** after you have entered the name. This creates a new part grade definition, shown in Figure 4.1c, named **testmap.def**. If we had wanted to use a preexisting part grade file, we would have double-clicked on its name and selected ***Open***.

For every part grade file there are two grades that cannot be changed: Clear Two Face (C2F) and scrap. Also, you cannot assign any part to be cut from scrap. RR2.0 uses scrap internally to identify all board areas that do not meet any part grade definition. Part grades are named using a numbered grade code. Several defects can be attached to each grade code. In Figure 4.1c, C2F is assigned grade code 1 and scrap is assigned 0. As part grades are added, the Part Grade Editor automatically assigns them the next available code.

editgrades

Part Grade Editor

File | About | Help

Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
2	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	YES
5	BACK	4	Decay	OFF	0.5000	1.2500	NO
5	FACE	4	Decay	OFF	0.5000	1.2500	NO
5	BACK	9	Sawline	OFF	0.5000	1.2500	NO
5	FACE	9	Sawline	OFF	0.5000	1.2500	NO
6	BACK	1	Mechanical damage	ON	0.1250	10.0000	NO
6	FACE	1	Mechanical damage	ON	0.1250	10.0000	NO
6	BACK	12	Unknown Defect Code	ON	0.7500	10.0000	NO
6	FACE	12	Unknown Defect Code	ON	0.7500	10.0000	NO
7	FACE	1	Mechanical damage	ON	0.5000	1.0000	NO
7	BACK	1	Mechanical damage	ON	0.5000	1.0000	NO
7	BACK	2	Void	ON	0.5000	1.0000	NO
7	BACK	3	Pith	ON	0.5000	1.0000	NO
7	BACK	5	Shake	ON	0.5000	1.0000	NO

Figure 4.1a. Part Grade Editor window showing default part grade file.

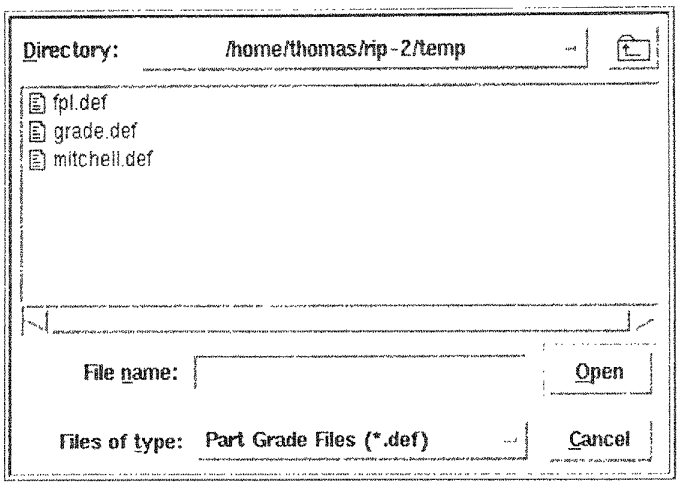
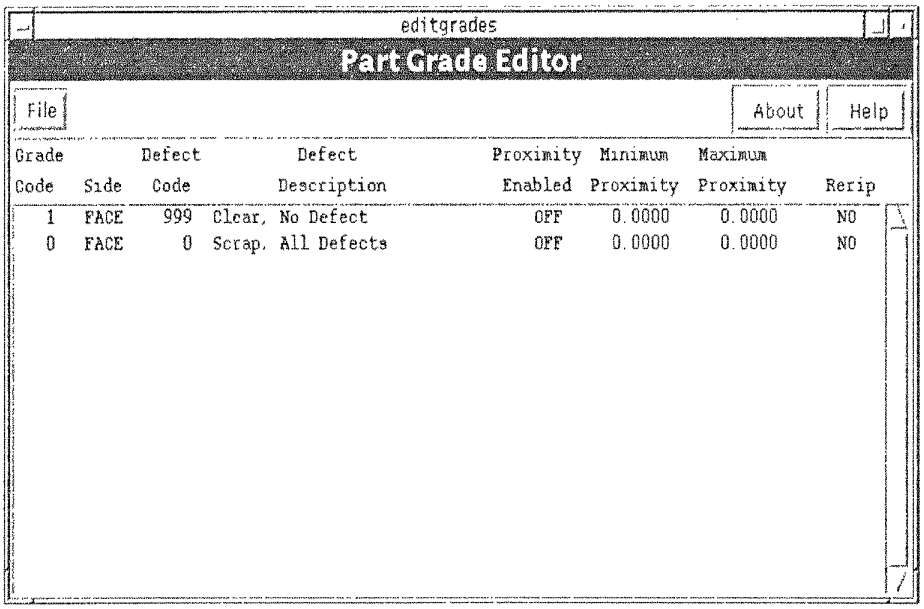


Figure 4.1b. File select window for Part Grade Editor.



Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
0	FACE	0	Scrap, All Defects	OFF	0.0000	0.0000	NO

Figure 4.1c. Part Grade Editor window showing newly created grade file.

For our sample analysis we need the following part grades:

- Clear two face (C2F)
- Clear one face (C1F) with sound knots less than1/2 inch surface area allowed on backside
- Sound two face (S2F) with sound knots less than 1 inch surface area on both faces, pin worm holes, and shot worm holes
- Clear two face (C2F) rerip/salvage

A part grade is composed of one or more rules. Each rule specifies that a defect or category of defects is acceptable on a single part face. To create a new part grade or rule, double-click anywhere in the part grade display area. To edit or delete a part grade or rule, double-click on the desired rule. The Part Grade Menu should be displayed (Fig. 4.1d). The part grade that was selected is displayed at the top of the Part Grade Menu. If you are adding a new grade or rule, ignore this.

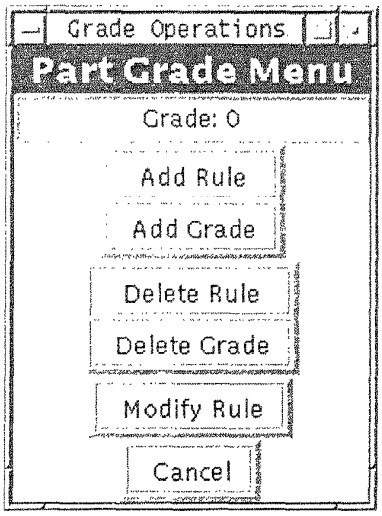


Figure 4.1d. Sample Part Grade Menu window.

Some of our work is already done, as C2F always is defined automatically. To create a C1F part grade, we need to define it as two separate grades: once with the defects located on the face and once with the defects located on the back. For S2F part grades you need create only one grade. However, each defect is defined once for each face.

4.1.1 Clear-One-Face Part Grades

The first step is to select ***Add Grade*** (Fig. 4.1c). The Add New Grade & Rule Window is displayed (Fig 4.1.1a). We now need to indicate that we want to allow sound knots with 1/2 square inch or less in surface area. Select the square icon to the right of the defect type box to obtain the Defect Selection window (Fig 4.1.1b). Scroll down the list and double-click the desired defect type, which then appears in the Add New Grade & Rule window (Fig. 4.1.1c). This defect is defaulted to appear on the face, and this is what we want. Select ***Save*** to make this grade permanent (Fig 4.1.1c).

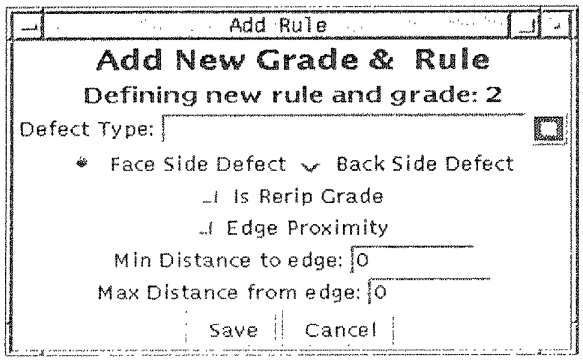


Figure 4.1.1a. Sample Add New Grade & Rule window.

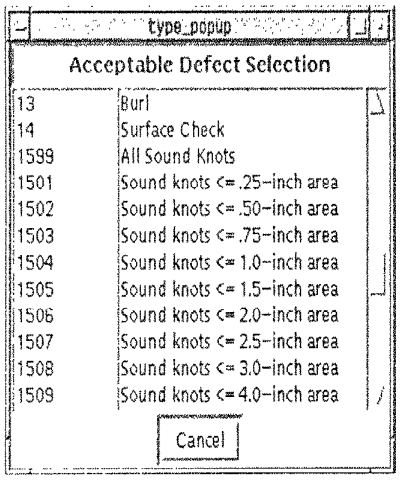


Figure 4.1.1b. Defect Selection window showing sound knot defects.

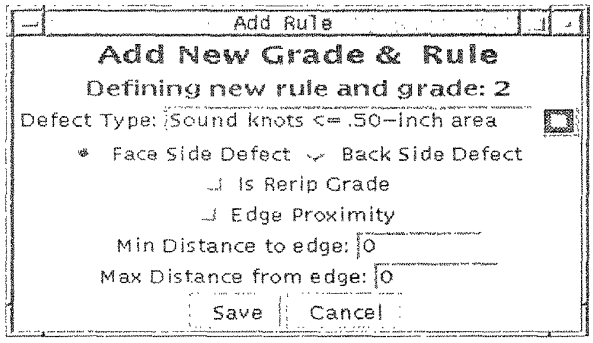
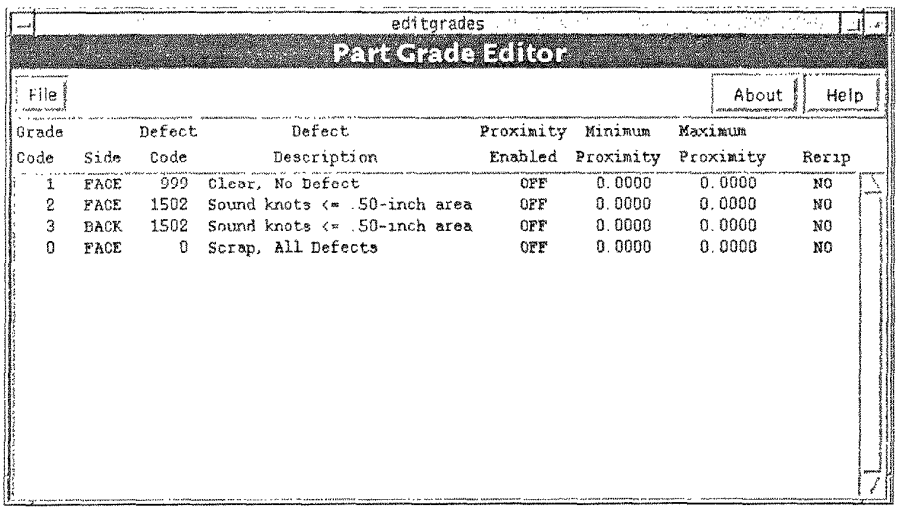


Figure 4.1.1c. Add New Grade & Rule window after defect selection.

Since this is a C1F grade, we need to make two grades, with the second one having defects located on the back face. Repeat the previous steps by bringing up the Part Grade Menu and selecting ***Add Grade***. Select the sound knots with 1/2 square inch or less in surface area. This time, select ***Back Side Defect*** and then ***Save***. You should now have two grades that define the C1F part quality. The Part Grade Editor should look like the example in Figure 4.1.1d.



Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
2	FACE	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
3	BACK	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
0	FACE	0	Scrap, All Defects	OFF	0.0000	0.0000	NO

Figure 4.1.1d. Part Grade Editor window showing definition of our two C1F part grades (grades 2 & 3).

4.1.2. Sound-Two-Face Part Grades

In most cases, Sound-Two-Face (S2F) part qualities are easier to define than C1F part qualities as only a single grade needs to be defined. For the S2F grade described we need to define three defects for each face. First, bring up the Part Grade Menu and select ***Add Grade***. Next, click on ❑ beside the Defect Type box and select Sound knots <= 1-inch area. Make sure that the ***Face Side Defect*** box is on and select ***Save***. The first rule of our S2F grade is now defined. We see this as Grade Code 4 in Figure 4.1.2a.

editgrades

Part Grade Editor

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Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
2	FACE	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
3	BACK	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
4	FACE	1504	Sound knots <= 1.0-inch area	OFF	0.0000	0.0000	NO
0	FACE	0	Scrap, All Defects	OFF	0.0000	0.0000	NO

Figure 4.1.2a. Part Grade Editor window shows definition of first rule of S2F grade (grade 4).

We now need to add a similar rule to allow sound knots with surface areas less than 1 inch on the back side. First, double-click on the line with a 4 in the Grade Code column. You should now see the Part Grade Menu with "Grade 4" displayed above the menu buttons (Fig. 4.1.2b). Select ***Add Rule*** and the Add Grading Rule window will appear. Next, click on ❑ beside the Defect Type box and select ***Sound knots <= 1-inch area***. Make sure that the ***Back Side Defect box*** is on and select ***Save***. You should see Grade Code 4 with two rules, one with a sound knot on the face and one with it on the back.

To complete the definition of our S2F Grade repeat the steps described earlier and add rules for pin worm hole and shot worm hole for both face and back. The Part Grade Editor should look like Figure 4.1.2c.

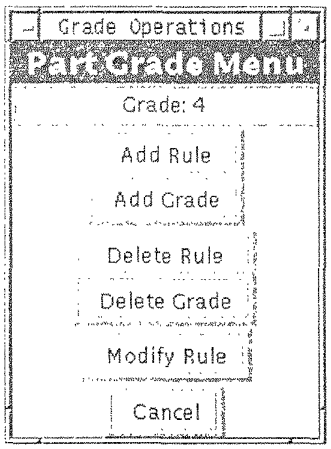
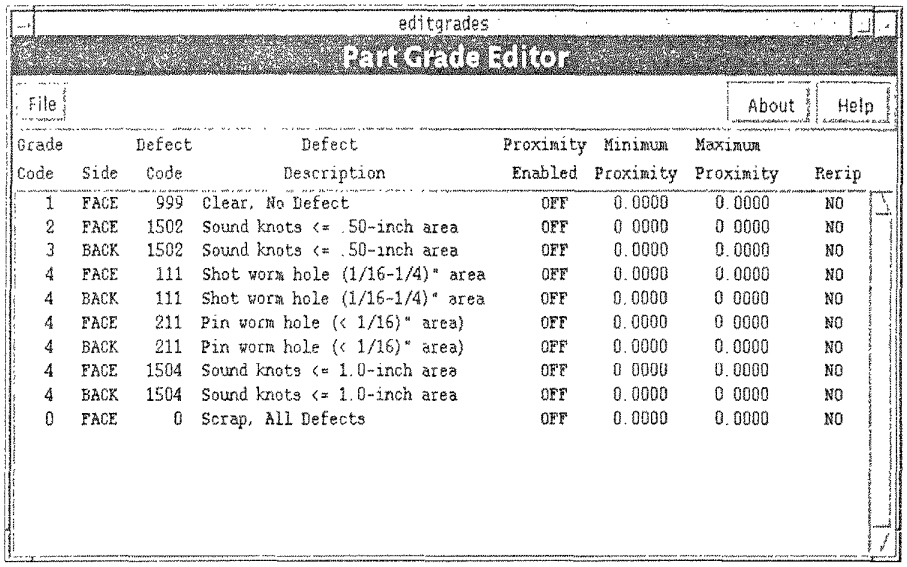


Figure 4.1.2b. Part Grade Menu showing selection of grade 4.



Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
2	FACE	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
3	BACK	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
4	FACE	111	Shot worm hole (1/16-1/4)" area	OFF	0.0000	0.0000	NO
4	BACK	111	Shot worm hole (1/16-1/4)" area	OFF	0.0000	0.0000	NO
4	FACE	211	Pin worm hole (< 1/16)" area)	OFF	0.0000	0.0000	NO
4	BACK	211	Pin worm hole (< 1/16)" area)	OFF	0.0000	0.0000	NO
4	FACE	1504	Sound knots <= 1.0-inch area	OFF	0.0000	0.0000	NO
4	BACK	1504	Sound knots <= 1.0-inch area	OFF	0.0000	0.0000	NO
0	FACE	0	Scrap, All Defects	OFF	0.0000	0.0000	NO

Figure 4.1.2c. Part Grade Editor window showing completed definition of the S2F part grade.

4.1.3. Rerip/Salvage Part Grades

The last grade we need to define is a rerip or salvage part grade. Open the Part Grade Menu and select ***Add Grade***. Since we want our salvage parts to be C2F, we select the defect type ***Clear, No Defect***. Since this is a C2F defect and we only define defects that are acceptable, we need only define a single rule for the face or back, not both. The completed part grade definition for all our grades should look like Figure 4.1.3. Select ***File*** and then ***Save*** from the Part Grade Editor window to store the completed part grade definition. Select ***File*** and then ***Exit*** to return to the main RR2.0 window.

editgrades

Part Grade Editor

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Grade Code	Side	Defect Code	Defect Description	Proximity Enabled	Minimum Proximity	Maximum Proximity	Rerip
1	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	NO
2	FACE	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
3	BACK	1502	Sound knots <= .50-inch area	OFF	0.0000	0.0000	NO
4	FACE	111	Shot worm hole (1/16-1/4)" area	OFF	0.0000	0.0000	NO
4	BACK	111	Shot worm hole (1/16-1/4)" area	OFF	0.0000	0.0000	NO
4	FACE	211	Pin worm hole (< 1/16)" area)	OFF	0.0000	0.0000	NO
4	BACK	211	Pin worm hole (< 1/16)" area)	OFF	0.0000	0.0000	NO
4	FACE	1504	Sound knots <= 1.0-inch area	OFF	0.0000	0.0000	NO
4	BACK	1504	Sound knots <= 1.0-inch area	OFF	0.0000	0.0000	NO
5	FACE	999	Clear, No Defect	OFF	0.0000	0.0000	YES
0	FACE	0	Scrap, All Defects	OFF	0.0000	0.0000	NO

Figure 4.1.3. Part Grade Editor window showing all part grade definitions for simulation example.

4.1.4. Part Grades: An Additional Feature

A feature not used in the previous examples allows you to define defect types that are acceptable a specific distance from the edge. This is useful for moulding and millwork parts where defects are acceptable so long as they are not in an area that will be machined. To enable this feature in part grades, select the desired rule and enter the minimum and maximum acceptable distances from the edge (Fig. 4.1.4). Then select ***Edge Proximity*** to activate your settings. If there is no maximum acceptable distance, enter the maximum strip width on which it will be used.

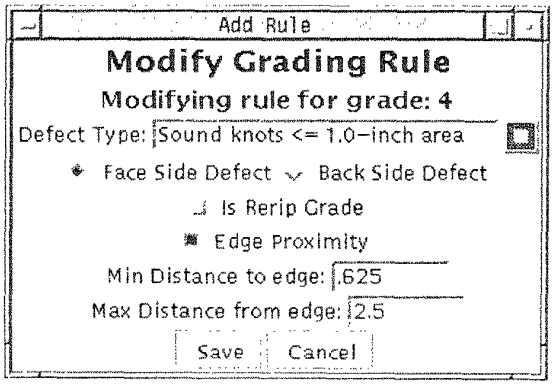

Figure 4.1.4. Modify Rule window showing sample edge proximity settings.

4.2. Cutting Bill Setup

Once part grades have been defined or the part grade file selected, you are ready to begin working with the cutting bill. To choose or create a cutting bill, select ***File*** from the RR2.0 main window (Fig. 3a). From the File Select window select ***Open***, click on the entry box, and enter example1 (Fig. 4.2a). Select ***Open*** after you have entered the name. If we had wanted to use an existing cutting bill, we would have double-clicked on its name in the File Select window and selected ***Open***.

Select ***Edit Setup*** then ***Cutting Bill*** from the RR2.0 main window to add, modify, or delete parts in a cutting bill (Fig. 3a). This brings up the Cutting Bill Editor window (Fig. 4.2b). Since we just created a new cutting bill, there are no parts. For our example we will enter the cutting bill parts shown in Table 4.2. To create a part, double-click in the part information area in the Cutting Bill Editor window (Fig. 4.2b). You will see the Cutting Bill Menu (Fig. 4.2c), which allows you to add, modify, and delete parts from the cuttting bill.

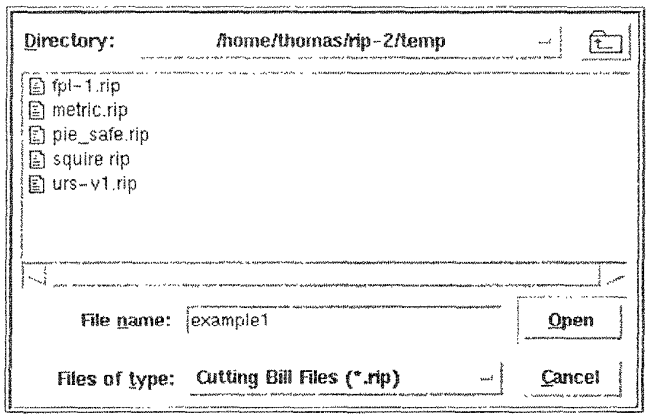

Figure 4.2a. File Select window showing entry of cutting bill name.

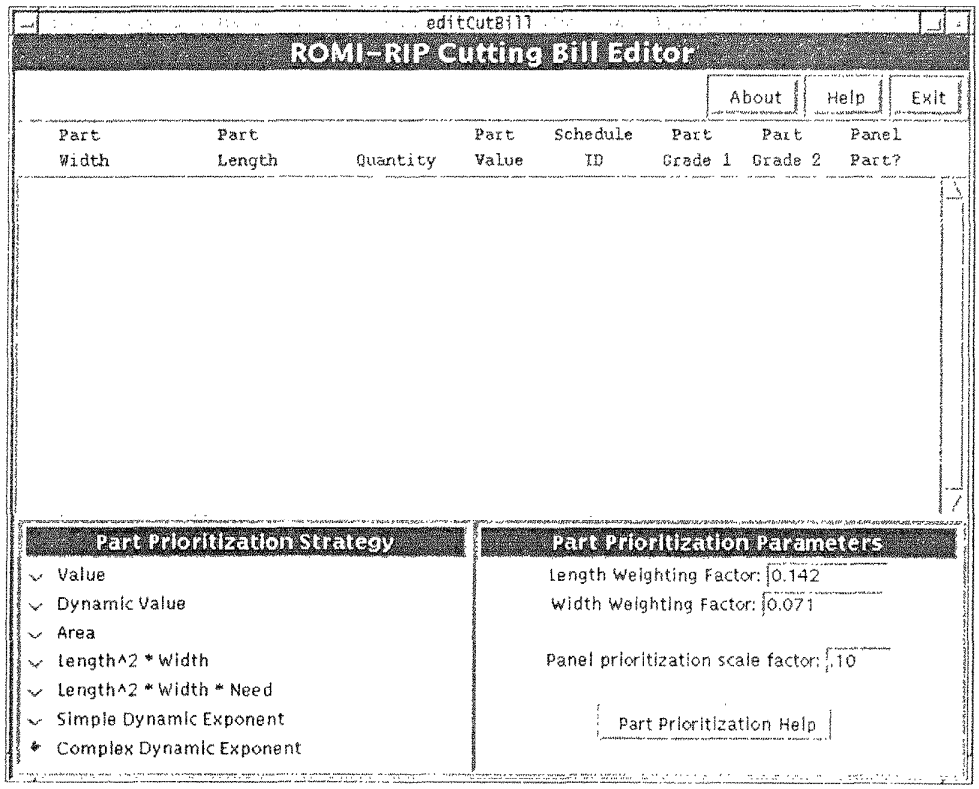

Figure 4.2b. Cutting Bill Editor window.

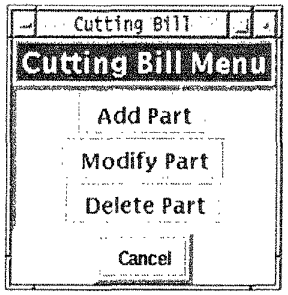

Figure 4.2c. Cutting Bill Menu winow.

Table 4.2. Sample cutting bill.

Part Number	Part Quality	Quantity	Part Type	Width	Length
1	C2F	100	Solid	1.75	12.25
2	C2F	350	Solid	1.75	15.00
3	C2F	500	Solid	1.75	27.75
4	C2F	200	Solid	2.25	13.00
5	C2F	350	Solid	2.25	20.50
6	C2F	700	Solid	2.25	28.25
7	C2F	150	Solid	4.50	21.00
8	C1F	500	Random Length	3.00	Min: 16.00 Max: 96.00
9	S2F	25	Panel	5.00	14.50
10	S2F	200	Panel	5.25	12.25
11	S2F	100	Panel	5.25	15.00
12	C2F	150	Panel	5.875	24.75
13	C2F	200	Panel	8.875	18.75
14	C2F	50	Panel	8.875	50.50
15	C2F	200	Panel	8.875	24.75

4.2.1. Solid Parts

To add a solid part to the cutting bill bring up the Cutting Bill Menu window (Fig. 4.2c) and select ***Add Part***. The Add Cutting Bill Part window (Fig. 4.2.1a) is displayed. Starting with the first part in the sample cutting bill shown in Table. 4.2 we will begin entering cutting bill parts. To enter the width, click on the ***Part Width*** entry box and enter 1.75. Since this has a fixed length, make sure that the ***Part has fixed length*** button is on. Next, select ***Fixed Length*** and enter 12.25. To specify the number of parts required, select ***Required Qnty*** and enter 100. Since this part is C2F and the default part grades are C2F (part grade 1), we do not have to enter anything for part grade. Select ***Save*** at the bottom of the screen to complete the entry and store this part in the cutting bill (Fig. 4.2.1b). You will see the first part listed in the Cutting Bill Editor window (Fig 4.2.1c).

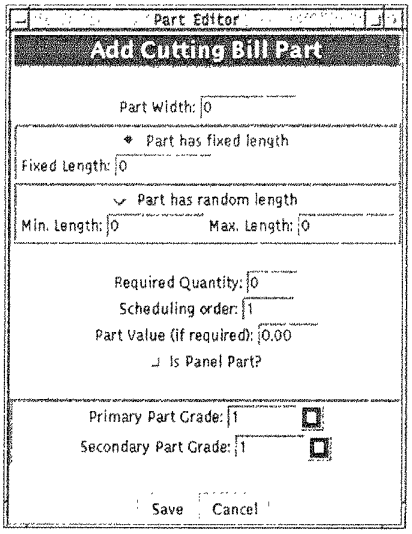

Figure 4.2.1a. Blank Add Cutting Bill Part window.

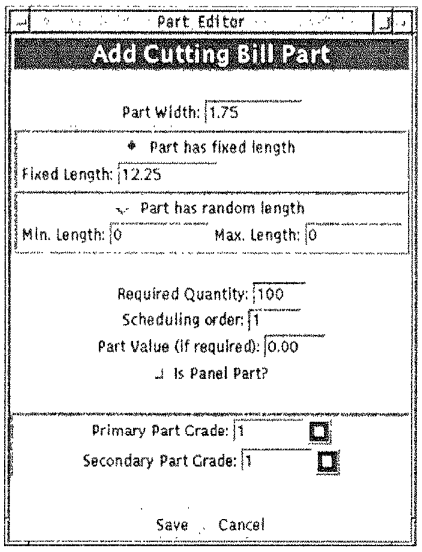

Figure 4.2.1b. Add Cutting Bill Part window showing information entered for first part.

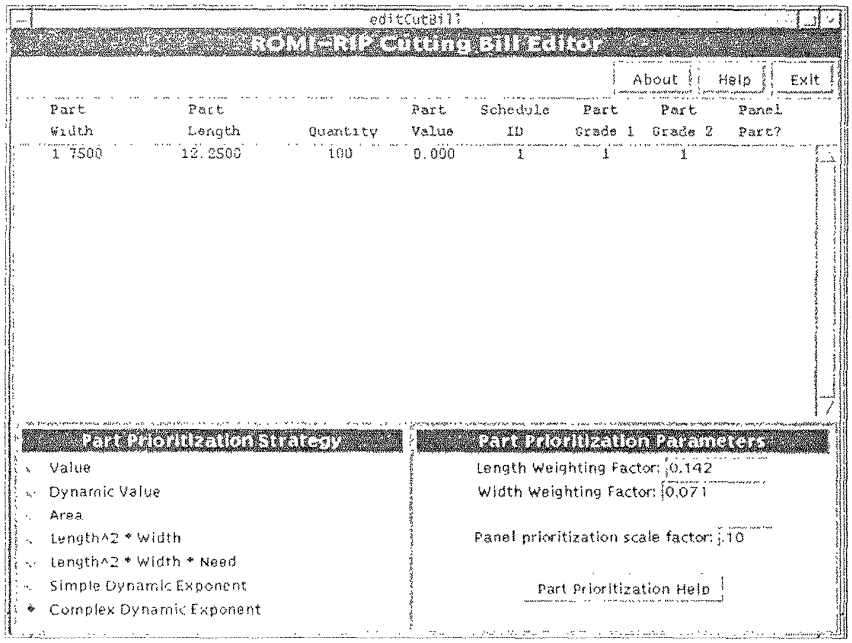

Figure 4.2.1c. Cutting Bill Editor window after entry of first part.

Continue with this example and enter parts 2 through 7. These are entered in the same manner as the first part. When you are finished, the Cutting Bill Editor shown in Figure 4.2.1d should be displayed.

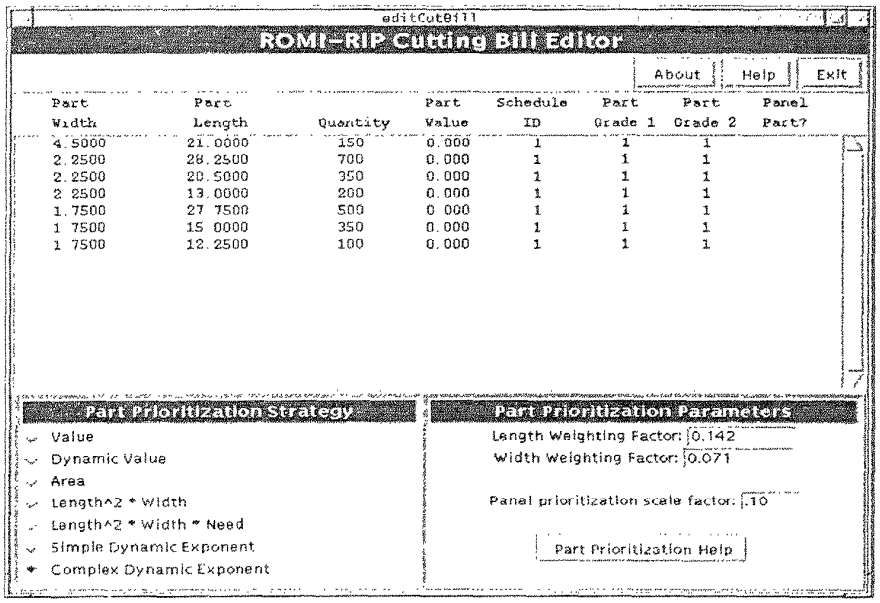

Figure 4.2.1d. Cutting Bill Editor showing entry of first seven parts in sample cutting bill.

4.2.2. Random-Length Parts

Entering random-length parts is much like entering solid parts except that a range of lengths is specified. As an example we will enter part 8 of the cutting bill (Table 4.2). First, bring up the Cutting Bill Menu (Fig. 4.2c) and select ***Add Part.*** At the Add Cutting Bill Part window, enter the width and required quantity as before. Note that the required quantity for random-length parts refers to an amount in lineal feet. Next, select ***Part has random length*** and enter the minimum and maximum lengths. Part 8 also is cut to our C1F part grade, so we need to modify the primary and secondary part grades. Recall that our C1F grade was stored under two codes: 2 for defects on face and 3 for defects on the back. To modify the grades, select ***Primary Part Grade*** and then *2* from the Part Grade Selection window (Fig. 4.2.2a). Next, select ***Secondary Part Grade*** and then *3* from the same window. The completed entry in the Add Cutting Bill Part window should look like the example in Figure 4.2.2b. Select ***Save*** to complete part entry.

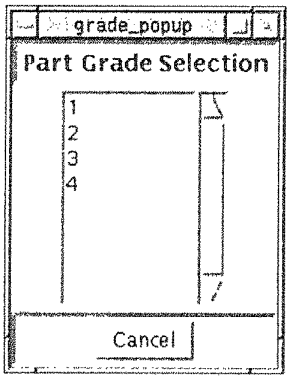

Figure 4.2.2a. Part Grade Selection window.

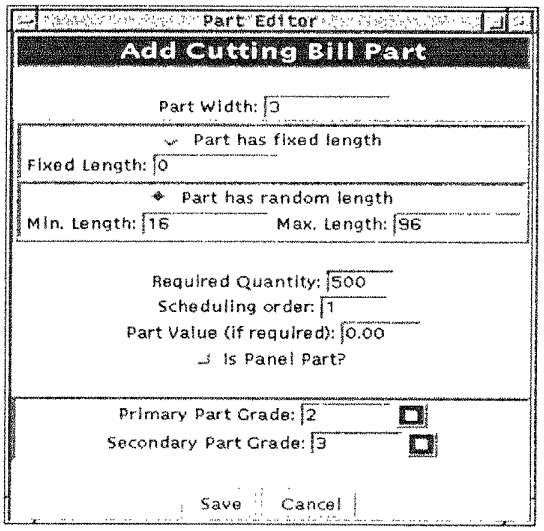

Figure 4.2.2b. Add Cutting Bill Part window showing completed entry of a random-length part (part 8).

4.2.3. Panels

To enter a panel part in the cutting bill, bring up the Cutting Bill Menu (Fig. 4.2c) and select ***Add Part***. But, before proceeding, save your work by selecting ***File***, and then ***Save*** from the main RR2.0 window (Fig. 3a). For this example we will enter cutting bill part 9 (Table 4.2). As before, enter the part's width, length, and quantity. Select ***Is Panel Part*** near the bottom of the Add Cutting Bill Part window to specify that this part is a panel (Fig. 4.2.3a). Part 9 is to be cut from our S2F part grade, which is represented by grade code 4 (Fig. 4.1.3). To specify this, select ***Primary Part Grade*** and then ***4***. You also should specify the ***Secondary Part Grade*** as grade 4. The completed panel entry is shown in Figure 4.2.3a. Select ***Save*** to complete the entry and store this part in the cutting bill.

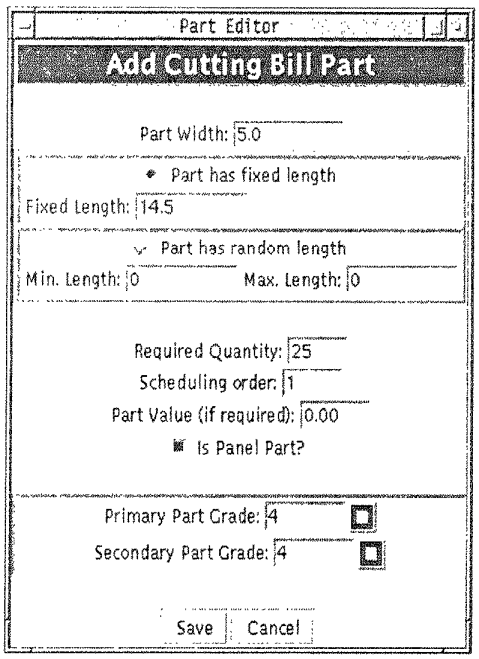

Figure 4.2.3a. Add Cutting Bill Part window showing completed entry of a panel (part 9).

Continue with this example and enter parts 10 through 15 from Table 4.2. When you are finished, the Cutting Bill Editor window should look like the example in Figure 4.2.3b.

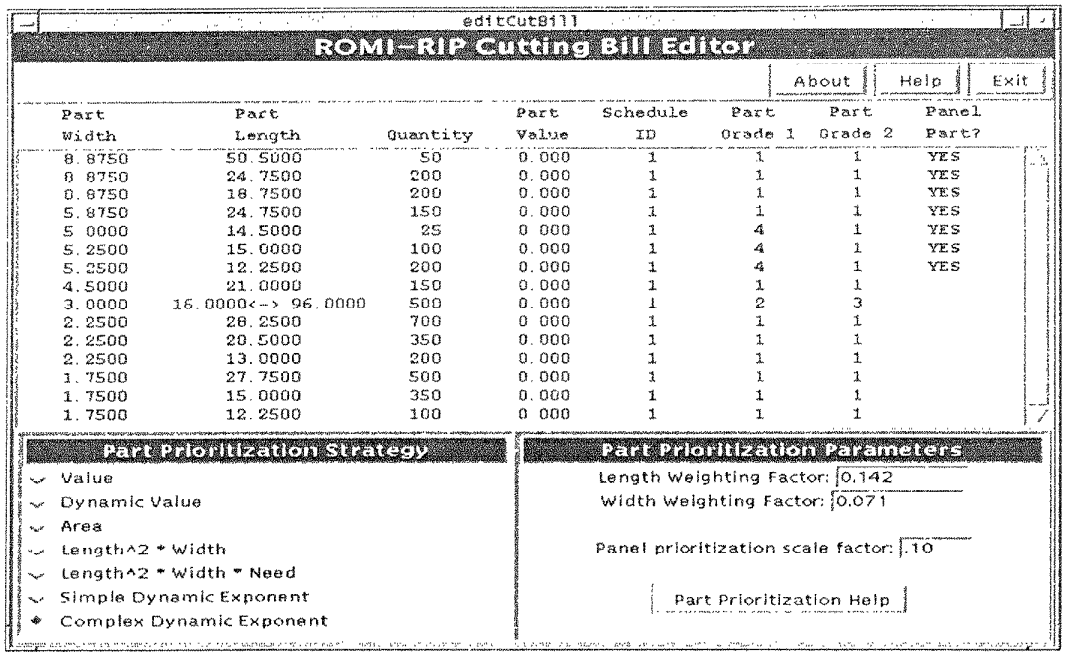

Figure 4.2.3b. Cutting Bill Editor window after entry of all 15 parts.

4.2.4. Modifying and Deleting Parts

To modify or delete a cutting bill part, select the desired part in the Cutting Bill Editor window by double-clicking on it. This brings up the Cutting Bill Menu window (Fig. 4.2c). Select ***Modify*** to bring up the modify part window, or ***Delete*** to remove the part from the cutting bill. Be careful when deleting parts: once a part is deleted and the cutting bill file saved, the part cannot be retrieved.

4.2.5. Part Scheduling and Replacement

A scheduling problem exists when the number of different part sizes in a cutting bill exceeds a rough mill's sorting capacity. Decisions have to be made as to which parts will be processed first and the order in which the remaining parts will be processed as initial part requirements are met. RR2.0 allows this scheduling with the ***Scheduling order*** variable (Fig. 4.2.3a) associated with each part. Parts with a level of 1 are cut first. Parts with a level of 2 are used to replace level 1 parts as their requirements are met. Parts with larger level values are entered in sequence. The total number of parts with a level 1 is the total number of different sorts that are available.

4.2.6. Part Prioritization

When processing to a cutting bill, the goal is to cut all the required part sizes from a minimal amount of lumber while generating a minimal number of excess parts. This problem is made more difficult by variations in lumber grades and dimensions. To solve these problems in simulation, seven part prioritization strategies are available that range from simple to complex (Thomas 1996). The simple methods prioritize parts based on their areas. Complex methods generate part priorities based on each part's size and current required quantity. The complex methods are dynamic in that a part priority is updated continually as parts are cut and the current quantity decreases. As the quantity requirements for a part size are met, emphasis shifts to other part sizes. The decision on which combination of parts to cut from a board is based on maximizing the total weighted area of parts for each board.

You can select the type of prioritization at the bottom of the Cutting Bill Editor window (Fig. 4.2b). If you select a value-based part prioritization strategy, you must give each part a value. This is controlled by the part value variable (Figs. 4.2.3a, b). Select ***Part Prioritization Help*** for more information about each prioritization strategy and how to edit the weighting factors.

4.3. Processing Options Setup

So far we have set up part grades and a sample cutting bill to use those grades. The next step is setting up the options that will be used to process the cutting bill. Again, before proceeding, save your work by selecting ***File***, and then ***Save*** from the main RR2.0 window (Fig. 3a).

There are four processing option areas. The first is concerned with arbor setup, including the arbor type, spacings, and rip and edger kerf widths. The second area deals with chopsaw options such as kerf size and endtrim allowance. The third area, Process Control, handles options such as updating part counts and priorities, and acceptable sizes of random-width parts for panels, and allows part sizes to be entered in millimeter or inch units. The fourth area allows you to specify salvage options and part sizes.

For our example we will use the following processing options:

- 24-inch wide Selective-Rip arbor with the following saw space sequence:

Spacing Sequence Number	Width	Is Movable?
1	3.0000	
2	3.0000	
3	1.7500	
4	1.7500	
5	4.5000	Yes
6	2.2500	
7	2.2500	Yes
8	1.7500	

- 1/8-inch thick rip and chop saw kerfs
- 1/4-inch edgings removed from both board edges
- No endtrim allowance
- Primary operations avoid producing excess parts. (An excess part is a part whose requirements have been met.)
- Random width strip parts are acceptable in panels
- Minimum random width acceptable in panel parts is 1.5 inches
- Maximum random width acceptable in panel parts is 4.0 inches
- Continuous part count tallying
- Salvage parts cut to cutting bill requirements if possible, otherwise salvage widths are: 1.000 1.375 2.000
- Salvage lengths are: 12.000 20.000 30.000

4.3.1. Arbor Selection and Setup

To modify arbor settings select ***Edit Setup*** and then ***Arbor*** from the RR2.0 main window (Fig. 3a). This brings up the Arbor Setup window shown in Figure 4.3.1a. The first step is to choose the Selective-Rip arbor type. Select the popup icon, ☐, to the right of the arbor type box. The Arbor Selection window (Fig. 4.3.1b) is displayed. Double-click on ***Selective Rip*** to complete arbor selection.

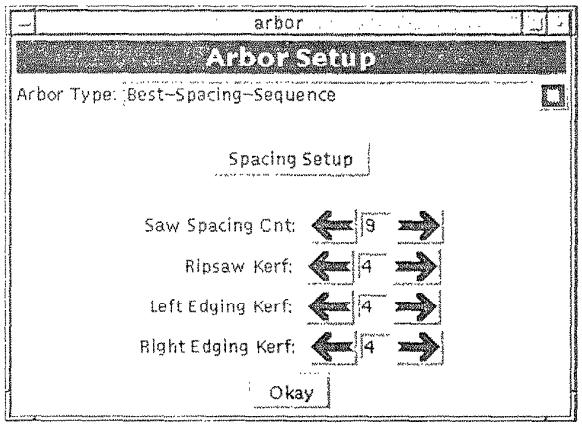

Figure 4.3.1a. RR2.0 Arbor Setup window showing default arbor settings.

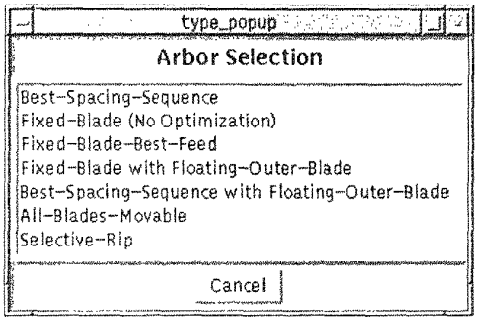

Figure 4.3.1b. Arbor selection window.

We are now ready to define saw spacings. To specify an arbor with eight saw spacings, click on the ***Saw Spacing Cnt*** arrows until you see the number 8 in the box. Next, select ***Spacing Setup*** to bring up the Saw Spacing Design window (Fig. 4.3.1c). Double-click on a saw spacing width to bring up the Saw Spacing Width Selector window (Fig. 4.3.1d). To choose a width for the selected spacing double-click on the desired width or enter the width in the spacing box. Select ***Okay*** to return to the Saw Spacing Design window. Repeat this step for the remaining seven spacings. For more information on designing saw spacing sequences see (Gatchell 1996) and (Mitchell 1998).

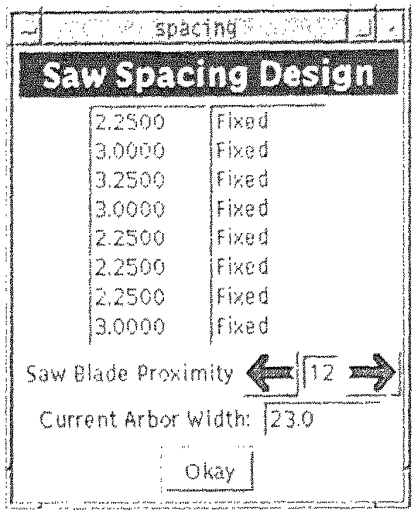

Figure 4.3.1c. Saw Spacing Design window showing default spacings and settings.

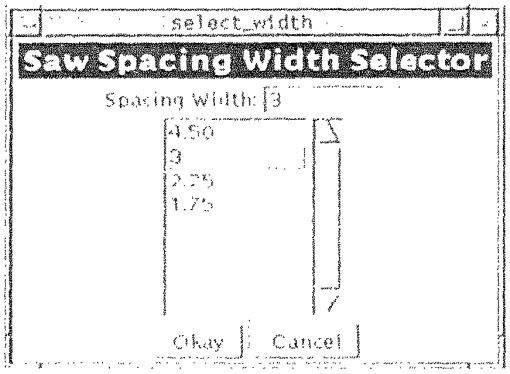

Figure 4.3.1d. Saw Spacing Width Selector window showing selection of 3.0-inch width.

For our selective-rip arbor, spacings five and seven need to be movable. Double-click on ***Fixed*** for these spacings to toggle them to movable. In addition, the minimum clearance between movable and fixed blades needs to be set to 1 inch. Click on the ***Saw Blade Proximity*** arrows, until the proximity setting reads 16 for 16/16 inch or 1 inch. At this point, the saw spacing settings have been completely defined and the Saw Spacing Design window should look like the example in Figure 4.3.1e. Select ***Okay*** to return to the Arbor Setup window to complete the arbor configuration.

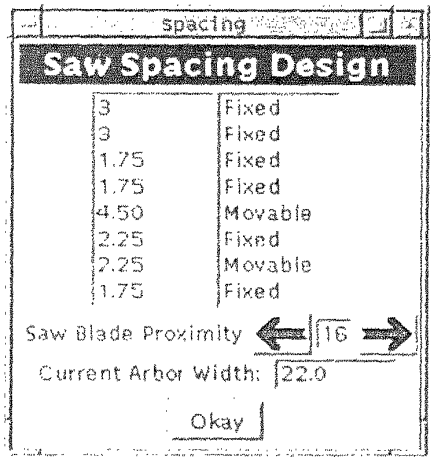

Figure 4.3.1e. Saw Spacing Design window showing settings for sample cutting bill.

The next step in configuring the arbor is to change the rip kerf to 2/16 inch. Click on the ***Ripsaw Kerf*** arrows until 2 appears in the window. Finally, verify that the left and right edger kerfs are set to 4/16 inch. The Arbor Setup window should look like the example in Figure 4.3.1f. Click ***Okay*** to close the Arbor Setup window and return to the RR2.0 main window.

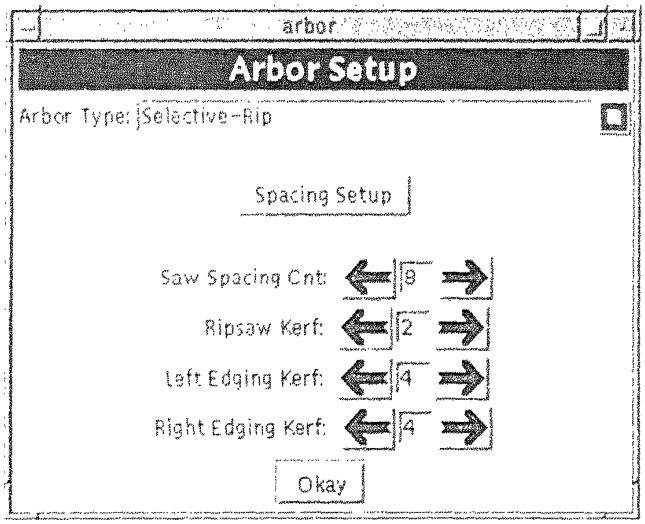

Figure 4.3.1f. Arbor Setup window showing settings for sample cutting bill.

4.3.2. Chopsaw Setup

To modify chopsaw settings select ***Edit Setup*** and then ***Chopsaws*** from the RR2.0 main window (Fig. 3a) to bring up the Chopsaw Setup window (Fig. 4.3.2a). There are only two settings that can be configured for chopsaws: kerf and endtrim allowance. Click on the arrows beside the entry boxes to adjust these settings (Fig. 4.3.2a). For our example we want to use a 1/8-inch chopsaw kerf size and no endtrim allowance. Figure 4.3.2b shows these settings. Select ***Okay*** to store the settings and return to the RR2.0 main window.

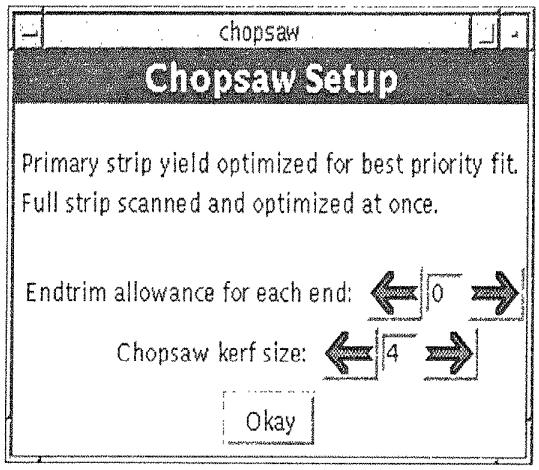

Figure 4.3.2a. Chopsaw Setup window showing default settings.

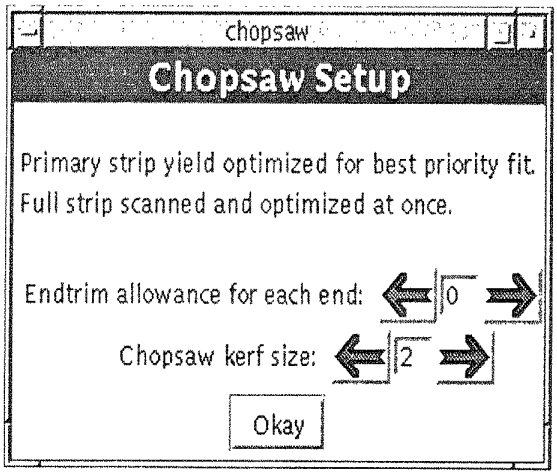

Figure 4.3.2b. Chopsaw Setup window showing sample cutting bill settings.

4.3.3. Process Control

Select ***Edit Setup*** and then ***Process Control*** from the RR2.0 main window (Fig. 3a) to modify processing and control settings. This brings up the Process Control window (Fig. 4.3.3a). There are several settings in this window that we need to adjust and verify that they are set correctly. Our cutting bill uses inch units, so we do not have to change ***Processing units***. However, we are using a dynamic part prioritization strategy and we will be updating part counts and priorities constantly. To do this, set ***Part Priorities adjusted every BDFT*** to 0 by clicking on the left arrow until 0 appears.

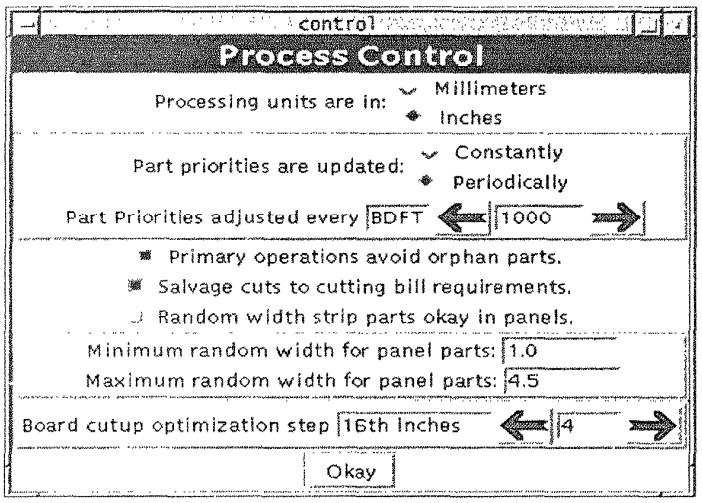

Figure 4.3.3a. Process Control window showing default settings.

The next two settings, ***Primary operations avoid orphan parts*** and ***Salvage cuts to cutting bill requirements,*** are correct for our example. These settings instruct RR2.0 not to cut excess primary parts without first seeing determining whether the area can be salvage ripped to obtain a narrower cutting bill part. For our example we want to allow random-width parts between and including 1.500 and 4.000 inches. To allow this we need to turn on ***Random width strip parts okay in panels***. Next, we need to select the minimum and maximum width entry boxes for panel parts and enter our specifications.

The final setting, ***Board cutup optimization step***, does not correspond a real-world rough-mill setting. For fixed-blade-best-feed and selective-rip arbors, this setting controls how many feed positions are examined per inch of arbor width. For example, a cutup optimization step of 4 would examine one feeding position every 4/16 inch. For a 24-inch-wide arbor, RR2.0 would examine 96, ((24 * 16) ÷ 4), feed positions. For the all-blades-movable arbor the setting controls how many random widths are examined by the arbor. A cutup optimization step of 4/16 would examine widths to the nearest quarter inch, while a setting of 2/16 would examine widths to the nearest eighth inch. We will use a cutup optimization step of 2 for our cutting bill. Note that the smaller the optimization step becomes the longer the simulation run time.

Figure 4.3.3b shows the Process Control window with the edited settings for our sample cutting bill. Select ***Okay*** to store these settings and return to the RR2.0 main window.

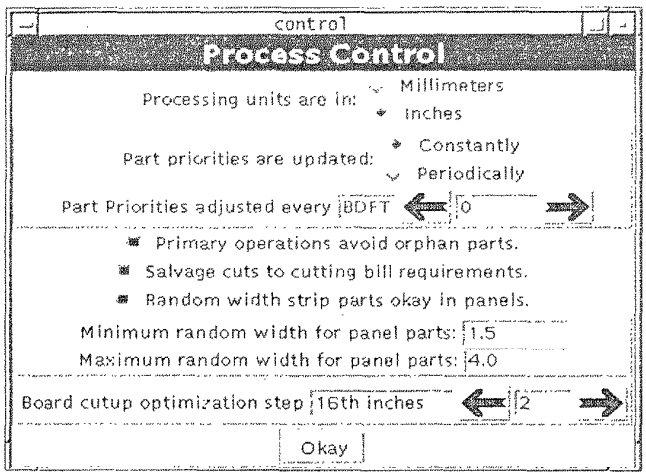

Figure 4.3.3b. Process Control window showing settings for sample cutting bill.

4.3.4. Salvage Part Sizes

To edit salvage part sizes select ***Edit Setup*** and then ***Salvage Parts*** from the RR2.0 main window (Fig. 3a). This brings up the Salvage Length and Width Editing window (Fig. 4.3.4a). There are three options for salvage widths and lengths: 1) use primary sizes, 2) use salvage specific sizes, and 3) use random sizes. In Figure 4.3.4a we see these options for salvage widths and lengths. When cutting to salvage specific or random sizes, you also must edit the sizes by selecting a Edit Salvage Width/Length button.

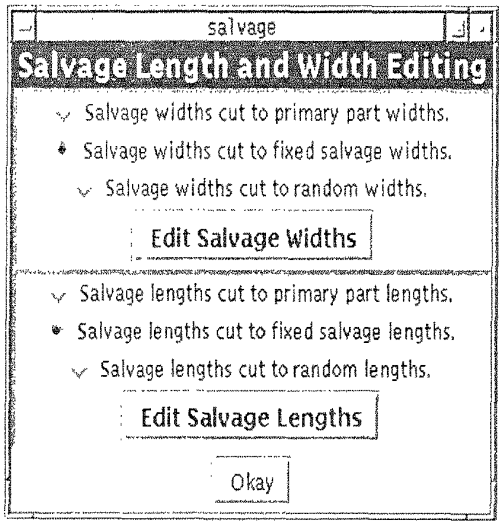

Figure 4.3.4a. Salvage Length and Width Editing window showing default settings.

For our example we will use salvage specific widths and lengths. The first step is ensuring that ***Salvage widths cuts to fixed salvage widths*** and ***Salvage lengths cuts to fixed salvage lengths*** are on. You are now ready to edit salvage widths and lengths. Select ***Edit Salvage Widths*** to bring up the Salvage Width Modification window (Fig. 4.3.4b). Double-click on a width to edit it (Fig. 4.3.4c). The widths that we want to enter are: 1.0, 1.375, and 2.00. To delete a width, edit it and enter 0. The Salvage Width Modification window with our new widths is shown in Figure 4.3.4d.

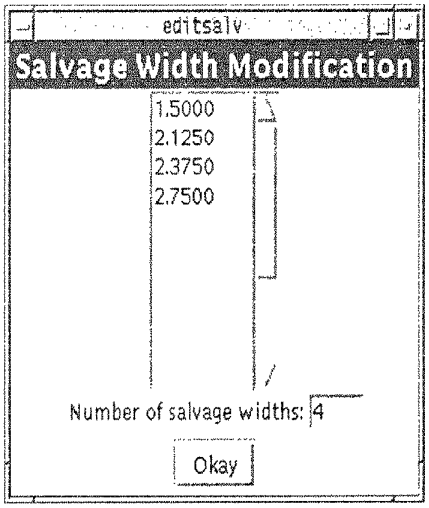

Figure 4.3.4b. Salvage Width Modification window showing default salvage widths.

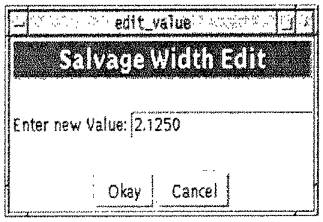

Figure 4.3.4c. Salvage Width Edit window showing modifying a selected width.

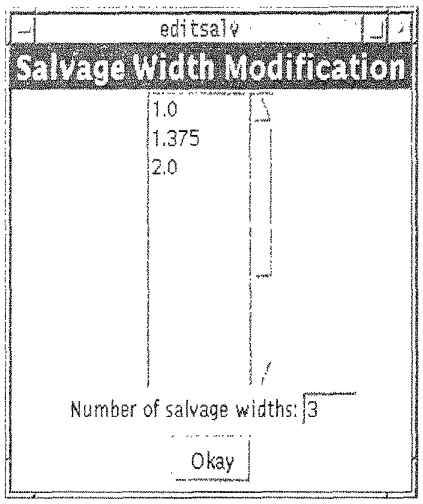

Figure 4.3.4d. Salvage Width Modification window showing salvage widths for sample cutting bill.

Salvage length editing operates like salvage width editing. Select ***Edit Salvage Lengths*** from the Salvage Length and Width Editing window to bring up the Salvage Length Modification window. The salvage lengths we want for our sample are: 12.0, 20.0, and 30.0 inches. Figure 4.3.4e shows the Salvage Length Modification window after these lengths were specified.

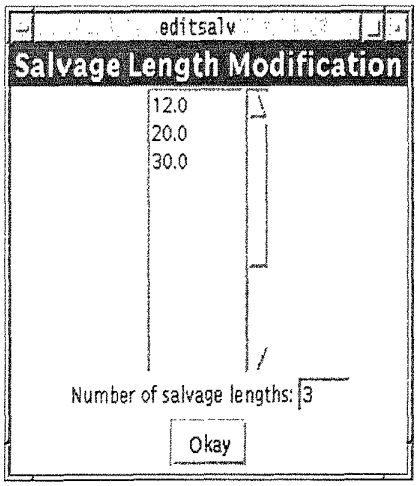

Figure 4.3.4e. Salvage Length Modification window showing entry of sample cutting bill's salvage lengths.

You have now entered all the required information for your cutting bill and processing options. Select ***File*** then ***Save*** from the RR2.0 main window to save your work (Fig. 3a).