

KD EXPERT: A COMPUTER-BASED TRAINING PROGRAM IN LUMBER DRYING

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INTRODUCTION

The increasing demand for high quality products requires significant processing changes when compared to the traditional manufacturing of construction lumber. The drying operation is clearly one area where major modifications will have to occur in order to meet new quality requirements.

In addition to improved technology, the lumber drying sector will also have to rely on a well established quality control program in order to guarantee high grade recovery and therefore determine the success of the operation.

With all the technological advances that the lumber drying activity has been experiencing over the years, specialized training in lumber drying has certainly become a priority.

In order to address this training need, Forintek Canada Corp. in conjunction with Softwords Research International Ltd. have designed a computer-based training program in lumber drying. Due to its user-friendly characteristics, no previous experience in either computers or kiln drying is required.

KD Expert was developed with the NATAL Authoring Language in combination with Softwords own expert shell system, OCAM1. The program combines NAPLPS graphics technology with NATAL's interactive graphics capabilities. The expert system technology allows the user to simulate situations in which process variables must be adjusted so that drying degrade can be avoided.

It is hoped that the instructional material of the program associated with the simulation capabilities, may serve as a valuable learning tool to anyone interested in lumber drying.

THE KD EXPERT PROGRAM

The main parts of the program are illustrated in Figure 1. There are six sections, namely:

1. How to run the course
2. Test
3. Lessons
4. Simulation
5. Glossary
6. Report

In the first part, the user is presented with a brief summary of the other parts. Whenever possible, an example illustrates the purpose and characteristics of each part.

The "Test" section is divided into: a) pre-test and b) post-test. The pre-test is intended for those with some wood drying experience willing to evaluate their overall knowledge. The post-test on the other hand, was designed to be taken at the end of the training program. In both tests, questions are randomly selected

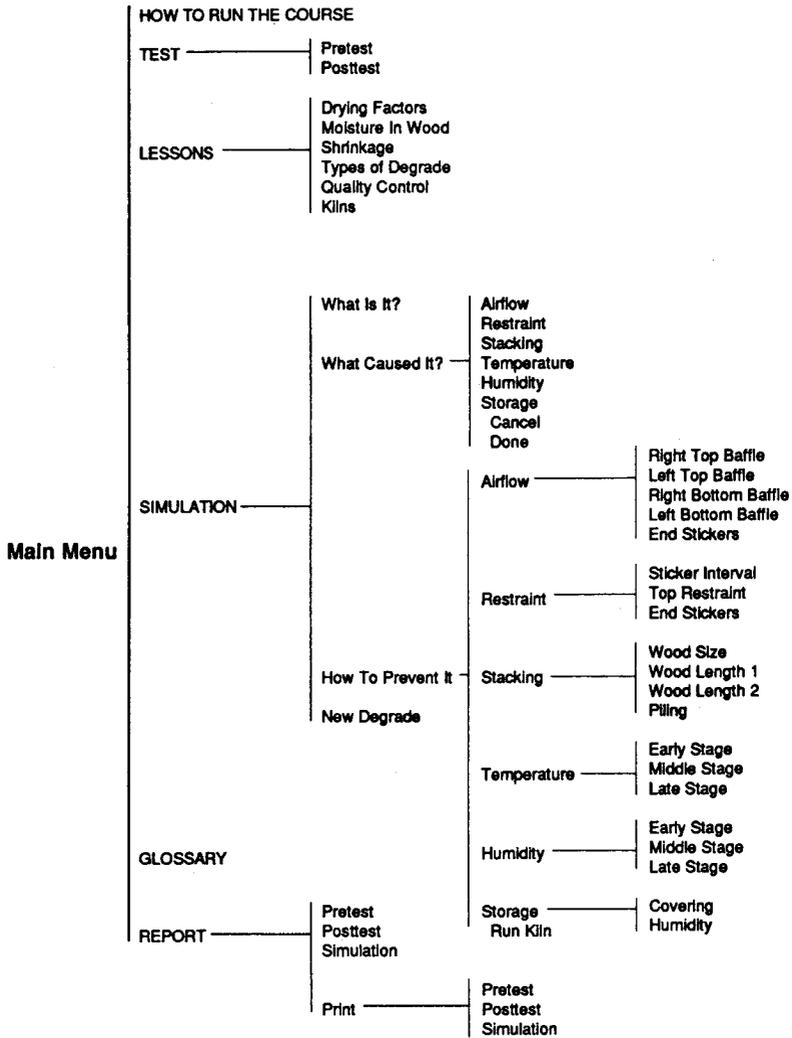


Figure 1. Main parts of KD Expert program.

and there is enough flexibility so that the tests can be interrupted and resumed at any time. Also, in either type of test, it is possible to select a particular topic on which to be tested. The feature allows the user to concentrate on specific areas where, for example, a greater emphasis may be needed.

The section on "Lessons" is where the contents of the course are organized. A logical sequence takes the user from very basic concepts of lumber drying to useful discussions related to quality control. The section is quite lengthy but well illustrated so that more complex concepts can be visualized and better understood.

The "Simulation" section is where the expert systems technology is used to a great extent. The basic approach is to change certain process variables in order to avoid a specific drying degrade. When the user simulates a drying process by "running the kiln", the program using the expert system strategy, analyzes the set of pre-established kiln conditions and decides whether or not a particular drying degrade is likely to occur. If it finds something incorrect with the process variables that were selected, the program returns a message pointing out what is wrong as well as some hints as to why the problem has occurred.

The "Glossary" is a very useful part of the KD Expert. It contains more than 130 terms associated with kiln drying. Most definitions are illustrated so that they can be easily remembered in a number of situations. The glossary is especially useful when studying concepts introduced in the "Lessons" section.

The last part shown in the main menu is the "Report" section. This section presents the results by lesson of both the pre-test and the post-test. The user can find very useful information in this section such as where more study in a particular subject is needed.

MAIN LESSONS

- The main lessons contained in the KD Expert program are:

- Drying Factors
- Moisture in Wood
- Shrinkage
- Types of Degrade
- Quality Control
- Kilns

Although independent, the lessons were arranged in a logical sequence so that the user is progressively led from fundamental concepts of wood physics to practical aspects of industrial kiln drying. A detailed view of the lessons structure is presented in Figure 2.

The lessons on "Drying Factors" is divided into four main sections. In the introduction, the user has the opportunity to learn essential terms related to kiln drying which will be extensively used throughout the course. In addition, the lesson presents a very comprehensive discussion on drying stages, drying mechanisms and physical elements influencing water removal in each stage of the drying process.

The main objective of the "Moisture in Wood" lesson is to provide detailed information related to the available technology for measuring moisture content in wood. The user will find information on laboratory procedures for moisture content determination as well as industrial devices used for sorting lumber on the production line.

The lesson on "Shrinkage" discusses basically the causes and effects of shrinkage due to moisture loss. By discussing mechanisms of shrinkage

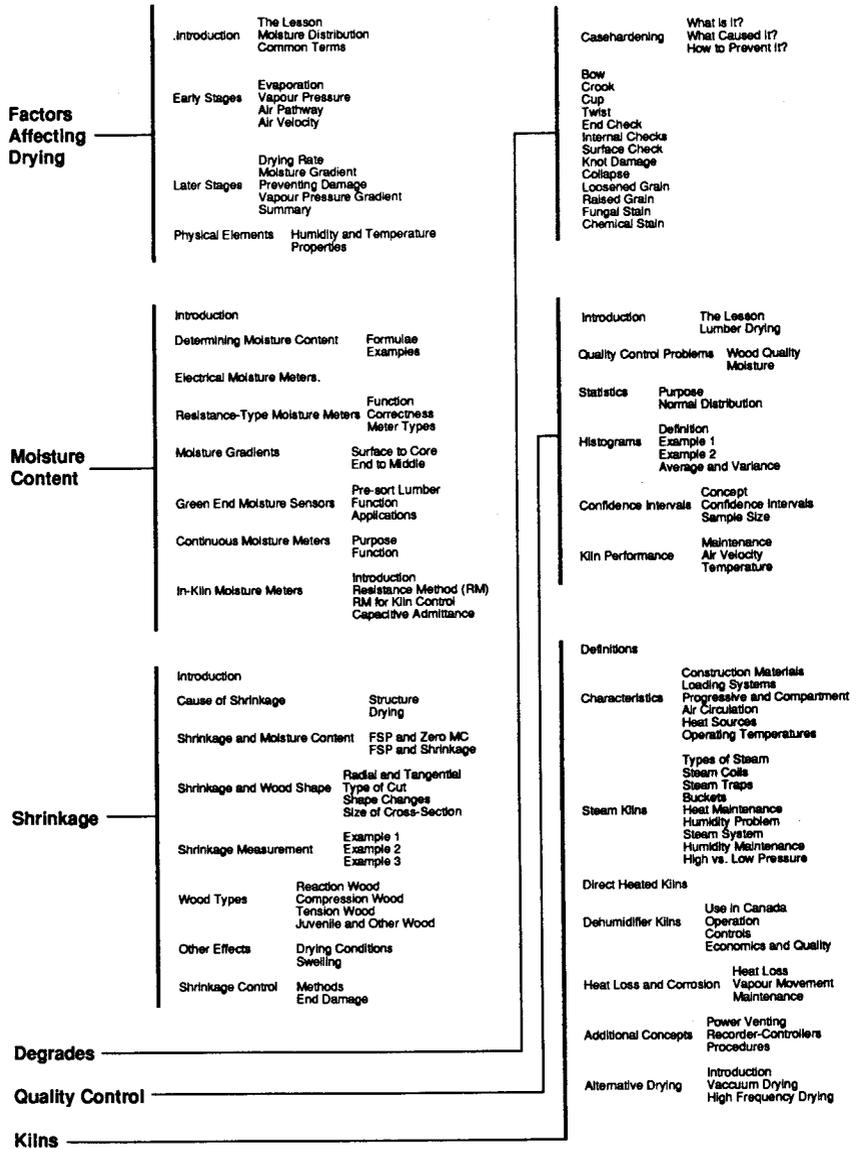


Figure 2. Lesson structure for KD Expert program.

development, the user is given the opportunity to study the consequences of a particular drying schedule on degrade. The lesson ends with a section on shrinkage control which serves as background for the lesson on degrade.

The lesson "Types of Degrade" presents all forms of drying related degrade. The section is fully illustrated so that the user will be able to easily recognize any type of drying degrade. In order to provide a thorough understanding of the subject, the basic strategy of the section is to present information about a particular degrade by answering the following questions:

Drying Degrade

- | | |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| WHAT IS IT? | This will lead to illustrated questions about particular degrades. |
| WHAT CAUSED IT? | This will lead to a submenu listing 6 factors which most contribute to the occurrence of degrades. |
| HOW TO PREVENT IT? | This will lead to detailed information about drying conditions, their effect on degrade and how kiln drying adjustments can prevent or reduce degrades. |

By studying the answers to these three questions, the user will readily relate the new information to the knowledge obtained in the previous sections.

The lesson on "Quality Control" presents information on basic statistics applied to lumber drying operations. The section is well illustrated and the practical examples allow the concepts to be easily understood.

Finally, the section on "Kilns" is intended to provide an overview of what is currently available in terms of equipment for drying lumber under a number of different processes.

SIMULATION

The main purpose of the "Simulation" section of the program is to let the user explore how changes in the drying process will affect the results in terms of quality. The simulation presents scenarios of different drying stages. After selecting a particular drying degrade, the user has to point out probable causes. In order to assist the user, the program presents a list of possible causes for the selected degrade. The program will even help the user select the most important causes. With the causes correctly selected, the user is directed to the section "How to prevent it" where changes in the drying conditions can be made and ultimately the simulation of the drying run can be performed.

From the simulation, it is possible to access the glossary at any time so that a particular concept can be reviewed. This is a very powerful feature since definitions and basic concepts can be found here.

After setting the variables, that is, changing kiln conditions, the user runs the kiln, which means, simulates the drying process under the conditions that were set.

By "Running the Kiln", the program will produce a diagnosis of the drying on the "Explanation" screen and indicate whether or not the selected degrade has been corrected. If not, the program displays an explanation for why the degrade was not corrected by highlighting one or more causes. In addition to viewing the

explanation, the user may obtain more information through the "Further Explanation" option.

The KD Expert training program will hopefully become a very useful tool for those dealing with lumber drying on a daily basis. Powerful graphics capabilities combined with user-friendly characteristics will certainly make the program very attractive to anyone, independent of having previous experience in either kiln drying or computers.