ERGONOMICS AND SAFETY IN SECONDARY WOOD PROCESSING

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ABSTRACT

The main goal of the project was to initiate a pilot program in ergonomics for the secondary wood products industry. Case studies were conducted at three Midwest secondary wood product companies in 2000 and 2001. Purdue researchers helped these companies implement the National Institute of Occupational Safety and Health (NIOSH) 7-step program using the following work plan:

1) Administer a short, work site questionnaire to employees regarding ergonomic hazards;
2) Videotape problem jobs and conduct work site analysis;
3) Provide recommendations for musculoskeletal hazard prevention and control;
4) Provide ergonomic training and education for selected employees;
5) Provide advanced ergonomics training to ergonomics team and safety and health staff in a "train-the-trainer" format to transfer ergonomics expertise;
6) Monitor the progress of the in-house driven ergonomics program and act as a facilitator to accomplish ergonomics goals; and
7) Disseminate information through scientific and trade publications and an industry-wide conference sponsored by industry associations.

This report uses one of the companies, a producer of hardwood flooring and mouldings, as a case study to illustrate how the work plan was implemented. In the case study illustrated here, the three areas that posed the highest risk were identified to be the Bundling area, the Flooring area, and the Rough Mill.

Out of the five employees interviewed in the Bundling area, the body part with the most reports of pain or discomfort was the lower back (3 of 5 reported back pain), with the hand/wrist being the next highest (2 of 5). Out of the 10 employees interviewed in the Flooring area, the body part with the most reports of pain or discomfort was the hand/wrist (5 of 10 reported hand/wrist pain), with the elbow/forearm being the next highest (3 of 10). Out of the seven employees interviewed in the Rough Mill, the body part with the most reports of pain or discomfort was the hand/wrist (4 of7 reported hand/wrist pain).

The primary risk factors for the Bundling area were associated with the lifting of awkward and heavy loads (resulting in lower back strain) and manual materials handling leading to hand and wrist strain. In the Flooring area the risk factors were the high levels of repetition and manual materials handling affecting the forearm, elbow, hands, and wrists. The primary risk factors for the Rough Mill area were related to vibration of the material being handled as it was fed into the planer and the handling of long boards (up to 16 feet in length).

Controls for the risk factors ranged from good work practice, administrative controls, and engineering modifications. An example of a good work practice was training employees to understand the mechanics of material handling when carrying long or heavy loads. Administrative controls included worker rotation to different jobs and more frequent rest breaks. Engineering controls included removable or telescoping stacking bars for the carts so that the employees did not have to lift boards over the bars and the provision of scissor lift tables.

Based on the case study results, the NIOSH 7-step process provided structure for this company to implement ergonomic controls as a part of their overall health and safety program. Long-term medical surveillance is recommended to see if implementation of the suggested controls' is effective in minimizing and preventing musculoskeletal disorders among workers at this company. If so, this model could be used to prevent similar injuries and illnesses across the secondary wood products industry.

INTRODUCTION

Ergonomics, also known as human factors design, is the science of designing the job and the workplace to foster the safety and efficiency of the worker. Ergonomic-design research and development has been broadly applied by the military and in the transportation industry for many decades. However, ergonomics principles have only been applied in many manufacturing sectors during the last decade. Human-factors based workplace design is now being pursued by many companies in an effort to minimize recordable safety incidents and employee absences. Repetitive motion disorders are now broadly recognized as a real workplace health issue. Unfortunately, the efficiency and productivity benefits associated with ergonomics-based workplace design continue to be ignored by many companies.

Overexertion (e.g., lifting) and repetitive motion (e.g. carpel tunnel syndrome) injuries accounted for one third of the lost-time work-related injuries recorded by the Bureau of Labor Statistics in 1997 (with over 600,000 total accident cases). Approximately one half of these accidents involved lifting (~297 ,000 cases). Pushing and pulling activities and repetitive motion injuries each accounted for another 75,000 cases. Records indicate that over 60 percent of the overexertion injuries affected the back. Overexertion-type injuries led to absences that averaged 6 to 7 days in duration while repetitive motion injuries resulted in average worker absences of 17 days! (National Institute of Occupational Safety and Health 2001). Workers suffering from carpel tunnel syndrome, the most familiar repetitive motion disorder, were absent from work for 25 days on average (median) - a longer absence than for those suffering from fractures and amputations (Occupational Safety and Health Administration 1999).

Sixty percent of lost-workdays caused by musculoskeletal disorders (MSDs) are associated with manual materials handling and manufacturing jobs yet only 28 percent of the industrial workforce is employed in these two job classes (Occupational Safety and Health Administration 1999). Since manual material handling and manufacturing jobs represent a very large portion of all jobs in the solid wood products industry, implementation of ergonomics improvement programs can produce substantial benefits.

The benefits derived from ergonomic improvements made in the mill/plant include not only a lower absentee rate but healthier, more energetic workers; reduced worker compensation costs (as much as 60 to 80 percent over 5 years, Government Accounting Office. 1997); reduced turnover rates; higher productivity rates; improved quality; and improved employee morale. Respondents to a -1993 Occupational Safety and Health Administration (OSHA) survey indicated that their average productivity improvement after implementing ergonomic-based workplace redesigns was 7 percent. Respondents to a 2001 Liberty Mutual Insurance survey expressed satisfaction with the return on investment (ROI) they received from their ergonomics investments with 86 percent indicating these investments produced a positive ROI. Sixty-one percent of the respondents indicated their ROI's were at least $3 for every $1 invested in workplace ergonomics and safety (Liberty Mutual Insurance 2001).

Overall, the U.S. wood products industry has not been very attentive to ergonomic opportunities; there has been little research done on the topic. The proportion of mills that appear to be without even basic ergonomics-oriented enhancements such as adjustable-height stacking carts (scissors lifts) is high. A few individual companies have instituted ergonomics programs. One company, Woodpro Cabinetry with 97 employees in Cabool, Missouri, spends about $5,000 annually on its ergonomics program and has reduced its annual worker's compensation costs by $42,000 per year in just 3 years. Many of the changes have been based on employee ideas and have been simple to implement - lowering tables and rotating jobs, for example (OSHA 1998).

As is the case with many industrial manufacturing opportunity areas, it seems that placing focused attention and training emphasis on ergonomics and safety can yield impressive yet inexpensive results. A particularly compelling study of 16 wood-processing companies was conducted in Finland (including sawmills, flooring mills, and plywood plants; Varonen and Mattila 2002). Eight of the companies received advice and training to improve their safety performance using ergonomic principles and eight matching companies did not. The change (drop) in the accident rate for the eight companies that received the training was greater, to a statistically significant degree, than was the rate of the eight control companies (Varonen and Mattila 2002).

CASE STUDY

The secondary wood products company that participated in this case study is henceforth referred to as "the Company." The Company, a producer of flooring and moulding products, identified for us the three operations posing the greatest health and safety concerns. They were: Bundling, Flooring, and the Rough Mill.

1. QUESTIONNAIRE ADMINISTRATION AND TASK ANALYSIS

Purdue researchers visited the Company to collect data in the Bundling, Flooring, and Rough Mill areas. The research team performed Symptoms Surveys of 22 workers in these three areas. The goal of the surveys was to determine if there were any trends concerning pain, injury, and time spent on the job among the employees.

The research team also conducted a Task Analysis of the five job types in these departments (bundler, flooring chop saw operator, flooring end matching, rough mill infeed and rough mill offbearer.) The task analysis helped identify potential risk factors that should be analyzed further. The task analysis forms used were taken from the National Institute for Occupational Safety and Health (NIOSH) Publication: Elements of Ergonomics Programs, A Primer Based on Workplace Evaluations of Musculoskeletal Disorders.

Results of the Symptom Surveys - Bundling:

Five employees were surveyed in the bundling area. Three of these employees reported having experienced extreme pain within the past year associated with on-the-job activities. Two of the three employees reported pain in their lower back and hand/wrist areas. There does not appear to be any correlation between the injuries in the bundling area and the amount of time spent on the job. The lower back pain appears to be caused by lifting, while the pain in the hand and wrist area may be caused by repetitive flexion and extension of the wrists. The employees believe that adjustable tables may help to alleviate some of this discomfort and pain.

Results of the Symptom Surveys - Flooring:

There were 10 employees surveyed in Flooring. The jobs of highest concern were end- matching and chop saw operation. Four of the five workers in End Matching reported experiencing pain during the previous year. There were multiple reports of elbow/forearm and hand/wrist pain. One of two chop saw operators reported hand/wrist pain. A worker in End Matching commented that the pain may be due to flipping and moving the boards. There may be a correlation (negative) between pain and time spent on the job with junior employees reporting higher incidence rates of pain than experienced employees. Both the chop saw operators and the workers in End Matching believe that a lift table would make their job easier and lead to a decrease in pain.

Results of the Symptom Surveys - Rough Mill:

The final group of employees is composed of wood offbearers and machine operators in the rough mill. Four of the seven employees in the rough mill area reported hand and/or wrist pain. The employees felt that handling the heavier woods caused the majority of this pain. The operators also reported that more training could help improve work practices and lead to a decrease in pain.

Results of the Task Analysis

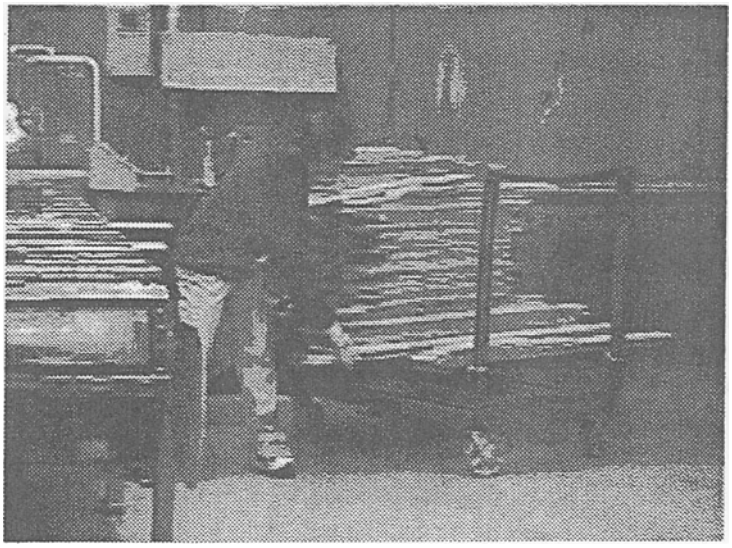
All Company employees are given orientation training when they first start any job. They are also given some safety training, though according to the employees, this is not as thorough as it should be. A Company task, force is working to improve this training. Questions -l2 and 13 from NIOSH's task analysis forms were not applicable; all other questions were addressed.

Figure 1. A bundler placing a bundle of finished products onto a cart

Bundler:

The Bundler's job involves bending and twisting of the back, crouching, bending and twisting of the wrist, extended reach of the arms, raised elbows, static loading, and the finger pinch grip (Figure 1). It does not, however, involve a clothes-wringing motion. There are no mechanical devices that can be used to help with the loads and movements. The only mechanical device used is a handsaw. This saw weighs 12 to 16 pounds, is used 300 to 400 times a day and hence imposes a considerable strain on the hands and wrists. Most of the tasks need both hands, but some hand rotation is possible. The pushing and pulling forces are not always kept minimal. The method with which the carts are stacked increases the amount of pushing and pulling in awkward positions (Figure 2). The required forces are not considered acceptable by the employees, though the maximum weight of the bundles has been restricted to 75 pounds. It is difficult to hold and handle the material. There are no fixtures, jigs, or vises used. All of the gloves fit well and are acceptable. The workers seem to have lost their fear of sharp edges and have become careless with the handsaws. There is little job rotation, but there are several tasks involving different parts of the body. The job is self-paced.

Figure 2. Flooring End Matching - feeding the end matcher.



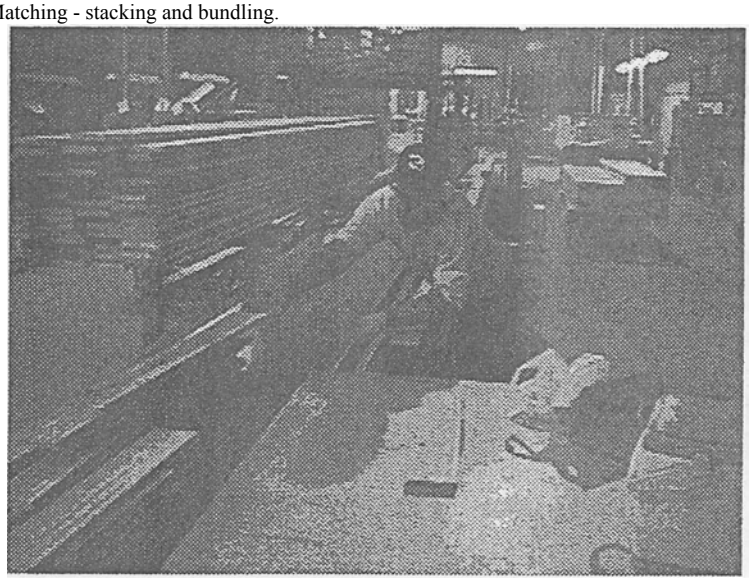
Flooring Chop Saw Operator:

The Flooring Chop Saw Operator's job involves bending and twisting of the back and wrists, extended reaches; raised elbows, arid a finger pinch grip during the material handling tasks. There is little or no crouching, static loading of the muscles, and no clothes wringing action. The tasks can be done with either hand and most of them require coordinated movements of both hands with a little pushing and pulling motion. Employees consider the pushing and pulling forces to be acceptable. The material can be held but the sharp edges of the saw pose a hazard. There are no fixtures/jigs/vises in use. The gloves fit well. There is no job rotation. The job is self-paced.

Flooring End Matching:

The Flooring End Matching job involves highly repetitive motions including the bending and twisting of the back and wrist (Figures 2 and 3). These are normally fast paced motions. There is extension of the arms, raised e1bows, and material handling is done using a finger pinch grip. There is little or no static loading and crouching. There are some pushing forces but the employees consider these acceptable. The material can be held without slipping but not easily. Sharp edges are present Fixtures are used when needed. Gloves fit properly but not all employees wear them. There is some job rotation within the end-matching area, but all jobs involve very fast and highly repetitive motions. The pace is dependent on the infeed rate of the machine.

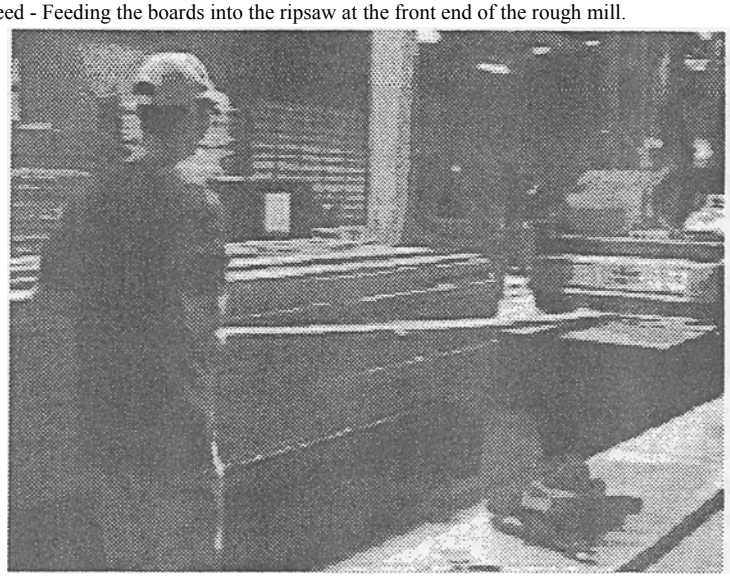
Figure 3. Flooring End Matching - stacking and bundling.



Rough Mill Infeed:

The rough mill infeed job involves twisting and bending of the back and wrist with some arm extension (Figure 4). The boards are handled using a finger pinch-grip. There are no raised elbows, crouching, static loading; or clothes-wringing actions involved. The tasks can be done with either hand - this is dependent on which side of the infeed cart the employee is located. When possible, the employees use both hands. There are some pushing and pulling forces. However, there are times when employees use these forces unnecessarily. The employees consider these forces acceptable. The material can be held without slippage, but it is not easily grasped nor is it free from sharp edges. The employees do not always use the roller bar, which functions as a support for the boards during infeed. Some employees prefer to remove the bars. Some employees had misfitting gloves. There is some voluntary job rotation, but no officially scheduled rotation. The job is usually self-paced but sometimes it is paced by the rate of work of the Offbearers.

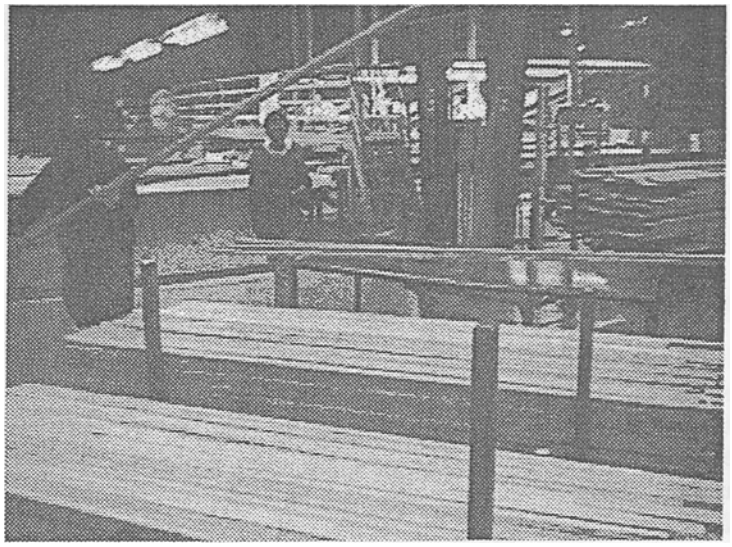
Figure 4. Rough Mill Infeed - Feeding the boards into the ripsaw at the front end of the rough mill.



Rough Mill Offbearer:

The rough mill offbearer's job involves a lot of bending and twisting of the back, arm extension, and static loading. During the lifting of the boards, the employees sometimes bend their wrists in awkward positions (Figure 5). If the boards are wide, the finger pinch grip is used to lift them. The tasks can be done with either hand, but are usually done with both hands. There are some pulling forces involved, but they are considered acceptable. The boards are awkward to lift (some boards are 16 feet long) and, if they are thick, they can be difficult to grasp. The boards may have sharp edges. The employees sometimes are able to use the table as a lever, but more commonly they have to carry the boards. There are no other fixtures/aides available. The employees' gloves seem to fit well. There is some voluntary job rotation, but this occurs infrequently.

Figure 5. Rough Mill Offbearers - unloading the boards from the rough mill onto carts.



2. PROBLEM JOB EVALUATION USING VIDEOS AND PICTURES

The Purdue research team captured videotape footage and numerous photographs of employees carrying out their tasks in the three high risk areas. This helped them identify health risks and helped illustrate possible improvements during presentations to the company.

3. PROVIDE RECOMMENDATIONS FOR MUSCULOSKELETAL HAZARD PREVENTION AND CONTROL

The research team used the Company's OSHA 200 logs (a form used to maintain a comprehensive record of recordable workplace injuries and illnesses) from 1997 to 2000 to help identify jobs with the highest associated risks. We also looked at the most injured body parts and other injury patterns highlighted in the data. After this, the photographs and video footage were used to identify risk factors in these areas and provide recommendations to reduce the number of new injuries. The risks and recommendations were presented to the Company.

4. PROVIDE ERGONOMIC TRAINING AND EDUCATION

Ergonomic training and education were delivered for the 7-step Ergonomics Control Program Primer developed for the Company in September 2000. This covered the proposed OSHA ergonomics standard, the definitions of work related musculoskeletal disorders, and the steps that would lead to the creation of a proactive ergonomics program. Step 3 of the 7-step Ergonomics Control Program identifies the level of training required for the employees of the Company. Employee training on alternative work procedures, recognition of the symptoms of musculoskeletal disorders, and problem solving using the team approach were included in the training.

5. PROVIDE ADVANCED ERGONOMICS TRAINING

Further ergonomics training was provided in presentations to the Company's Ergonomics Task Force focusing on how to identify risk factors using visual aides and specialized software. The software presented is caned 3D Static Strength Prediction Program from the University of Michigan.

6. MONITOR PROGRESS OF IN-HOUSE DRIVEN ERGONOMICS PROGRAM

Monitoring the progress of the Company's ergonomics program is ongoing. This is being accomplished through further contact in the form of Company visits, mailings (electronic and U.S. Postal Service), and telephone conversations. The Purdue research team has offered to assess any ideas and prevention measures developed by the Company's Ergonomics Task Force.

SUMMARY AND CONCLUSIONS

This study accomplished its goals and objectives. It has helped three secondary wood processing companies implement a proactive ergonomic control program. A training program was implemented to enable the workforce to understand the causes, symptoms, treatment, and prevention of musculoskeletal disorders. Ergonomic and productivity expertise were transferred to each of the companies' worker health and safety staffs. The final goal of sharing and transferring the gained knowledge will be accomplished through publications and presentations to industry groups. It is hoped that this pilot effort will stimulate other companies in the secondary wood products industry to develop and implement ergonomic control programs to reduce the number of work place injuries and illnesses thereby improving employee health and attendance, manufacturing productivity, and product quality.

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APPENDIX: INFORMATION SOURCE

National Institute of Occupational Safety and Health: Safety and Health Topics (logging and forklift safety manuals). http://www.cdc.gov/niosh/toplst.html

North Carolina Ergonomics Resource Center (ergonomics in manufacturing).

http://www.ncerc.com/products.html

Occupational Safety and Health Administration, U.S. Department of Labor: Small Business Safety Management Series (woodworking hazards, ergonomics).

http://www.osha.gov/OshDoc/ Additional.html

Occupational Safety and Health Administration, U.S. Department of Labor: Etools (sawmilling, woodworking, logging safety).

http://www.osha-slc.gov/SLTC/woodproducts/index.html

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ISSN 0193-8495