THE GENESIS OF MACHINE STRESS GRADING

by

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During the late 1950's and the 1960's many of the forest product company managers became seriously interested in examining opportunities for raising the value of the product of the log. To much of the log had to be sold at less than the cost of production to suit them. So many of us became interested in products that were not simple commodities. The upshot of that thinking was a variety of products and processes which enlarged the product line of the lumber industry.

An interesting result of this development work was the fact that, not only did the firms directly involved enjoy the fruits of the work, but many others eventually fell heir to these advancements.

It is, in fact, difficult to successfully capture an exclusive market for a new wood product, and it may not even be desirable to do so. The same may be said for a new process. Machine stress grading is an outstanding example of such a case. This process had to be shared. No one organization was capable of supplying the demand that such a development would create if it was at all successful. And without supply it would have been impossible to generate consumer interest. This very fact has been a problem to the growth of MSR.

Machine stress grading was born out of a perceived threat to the competitive position of structural lumber. It has played a role in meeting that threat, but it has also made possible the growth of some advanced systems of wood building construction that are

responsible for the sales of not only lumber, but vast amounts of plywood as well.

I recollect the situation surrounding the concept of machine stress grading very vividly. In the late 1950's the industry was being pressured by the building code agencies and the Federal Housing Administration to define and grade softwood lumber in more specific engineering terms. Some agencies had arbitarily reduced all lumber properties by 10% and others were talking in that vein, as an indication of their dissatisfaction.

Stress rated grades were not unknown, but much structural lumber was not replete with a set of stresses needed by designers, which of course, they now have. The reliability of lumber was under scrutiny and questions were being raised about the justification of the published properties. Some of these issues were valid. Other were not. After all, wood had served the building business pretty well for a long time and was clearly a good and well-established building material. The problems seemed to be internal in the sense that there was plenty of good useful lumber if it could be separated from the "chaff" which was occasionally causing trouble. Now structural failures always get the attention and concern of the engineers who design buildings and the attorneys who try to keep the lumbermen and engineers out of court as much as possible.

In response to these allegations the various grading agencies made an intensive effort to review and rework the stress ratings of all their species and grades. The agencies did this using technical working groups made up of their staffs and the technical people of their member mills, which is how I became involved in the work. The U.S. and

Canadian Forest Product Labs played a large role in this work using taxpayers resources to share the cost of the studies and tests. Since both governments enjoy a large income from the sale of timber from their lands this was a proper investment on their part.

As these wheels began to turn it became evident that some timberlands produced better wood than others and the process of putting numbers on the lumber inevitably was going to enhance the position of some regions to the detriment of others. Lumbermen tend to try to present a solid front and to dislike internal disagreements.

A good example, and a prime example, of this situation was the difference that arose between Douglas Fir from east and west of the Cascade - Sierra Nevada Range, two regions of distinctly different climatic character.

In 1955 the West Coast material was accorded the highest strength and stiffness properties of all Douglas Fir. Material from east of the mountains was lower. Dividing the inland region into two parts, one north of a line roughly east and west through the middle of Oregon, and one south of this line and east of Idaho's easternmost border, the deficiencies of the Douglas Fir in these two regions were distinct. One region, the northern one, contained wood that was 16% lower in stiffness and 4% weaker in strength. The other inland region had wood that was 27% less stiff and 19% weaker than Coast Douglas Fir. This was based on fairly old data which would eventually be called into question. But it was official government data, supposedly quite sound.

As these data were factored into the new assessment it became clear that coast Douglas Fir would enjoy some real advantages over

its sister varieties to the east. Since the bulk of dimension lumber was used on joist and rafter applications, the span ability of the lower stiffness wood would require use of larger pieces as it appeared at this juncture.

This posed some real economic and political problems because the growth of Inland production was positive and those mills carried some clout in agency circles. But lumbermen really were less interested in internal dissention than in resolving the differences as well as possible.

Little testing had been done for a long time. Most of the data available was from old Forest Service work. Potlatch had done a considerable amount of recent testing and so had the Western Pine Association. Much of the old Forest Service data had been based on samples of relatively few selected trees. Recent large sampling by the industry had convinced them that the old data ought to be supplemented. So a large new study was proposed, under Forest Service direction, which was more systematic and more thorough, on several of the most widely cut species.

This study took a couple of years and it showed that Coast Douglas Fir was as good or better than the previous assessment, but it identified a large part of the Inland Douglas Fir to be stronger than the Coast variety and only 8% less stiff. Rocky Mountain Douglas Fir came out better than before but still 24% less stiff, than the coast material, but only 4% less strong.

This was good news and it eventually became the basis for the visual stress rated grades now manufactured. It allowed a large part of the Inland Douglas Fir to be compititive to coast Douglas Fir.

This study was expensive. A persuasive factor in doing it had been the industries own research data on the timber resource. This work spawned Machine Stress Rating.

Potlatch, in its studies, had constructed a simple portable machine which could be taken from mill to mill to make very rapid tests on lumber in inventory and in production and had used it extensively in the Inland region. It had seen service under loan to Oregon State and Colorado State technologists, and students in the Rocky mountain region. It was purely a stiffness testing program because that was the key property to joist and rafter performance.

Out of this experience came several interesting facts. First it was seen that lumber was distinctly different in stiffness according to its grade, something not heretofore recognized as significant. The strength had always been understood to be variable according to grade, that is higher for the higher grades.

It didn't stretch the imagination much to see that if stiffness varied according to grade and strength had the same relationship, one might be used to predict the other. Stiffness could easily be measured very rapidly without damaging the wood in any way, so a grading concept seemed possible. Jim Snodgrass at Oregon State and Lyman Wood at the USFPL both dug out old data on beam tests to also confirm this relationship. So when we presented our story at the Wood Products Clinic in Spokane in 1960 we placed some emphasis on this idea. Meanwhile we had decided to push the research on this notion within the Company.

It is always difficult to claim credit for an invention and this

was no expection. T. K. May of WCLA and Lyman Wood of the USFPL had long had a vision of some mechanical method of lumber grading. Stan Suddarth of Purdue had made an interesting study of this possibility but had not yet published the work at the time. But Potlatch had became excited enough about the prospects of the concept to really fund an intensive program to move it out of the lab and into practice. In the process a great effort had to be made to muster support and in that process we discovered all kinds of similar ideas and enthusiasm among wood products industry people.

Several other organizations got their gears into mesh at about this time. The WWPA lab had been developing a finger joist testing machine which could be readily adapted to measure lumber stiffness, although it was really a proof loader. They eventually produced this as a prototype to the Stress O Matic machine grader.

The Princes Risborough Laboratory in England came out with a prototype grading machine much like the CLT-1 and they must have started on this about the same time we did. The Australian laboratory of the New South Wales Forestry Commission came out with a machine and brought it to a production reality in Australia soon after, and the British discontinued their development in recognition of the fact that the Aussies had done what they themselves had intended to do. They continued their work with machines purchased in Australia. These machines have enjoyed widespread acceptance in Northern Europe but are too slow for use in American mills.

Britain imports much ungraded lumber and grades it after it is received from overseas. Britain and the northern European countries had very limited visual grading technology and adopting MSR was very

logical for them.

The CLT-1 was designed after a prototype produced in the Potlatch laboratory and went into production in 1961, or December 1960. The present CLT-1 is structurally very similar to that one but with an immensely improved electronics package.

After the machines were available the task of writing reasonable grade descriptions, establishing agency procedures for certifying that machines were in proper calibration, and providing quality control services and grade stamps were paramount issues, which required broad collaboration among lumbermen.

Considerable controversy developed within the industry, especially between south and west, with the south only accepting the technique when the issue was forced by consumers in their territory. I can recall some rather heated interviews on this matter, but good humor eventually prevailed. The southern pine industry has some of the best timber anywhere, but it also has some that is pretty mediocre, since it encompasses a huge geographic region. MSR was bound to produce some dislocations in that industry if it came into widespread use. Mills in some regions of the south would suffer from the actual measurement of their wood properties, although most would receive large benefits. But this would be true in the Douglas Fir region, also.

I know some people expected MSR to replace visual grading. That was probably an extreme view. Technically it could do this for structural dimension but practically it couldn't. Most of us soon came to realize its virtues were more specialized, in an industry as diverse and with such a well established visual grading tradition as the North American lumber industry.

There were all sorts of responses to the MSR idea:

It threatened the visual grading establishment.

The bidding of timber sales would require the evaluation of the structural quality of the stand.

It would allow some mills to sell a part of their lumber at prices justified by the better quality.

It would force some mills to have a larger proportion of lower grade lumber, but

It would require good seasoning to obtain the best yields.

Some mills in regions of good lumber quality would have enlarged profit opportunities.

It was too technical. Managers couldn't understand it. Salesmen couldn't understand it. It required a shift in the knowledge base, a reeducation of the sales force.

It would require a technical operating staff. Equipment failures could stop production.

All of these things had answers and all of them are now, 20 years later, more clearly understood and dealt with.

After the shakedown of birth and adolescence MSR has enjoyed steady growth. In Europe it is even more widely used and in Australia and South Africa it is almost the norm.

I am sure Jim Logan and his associates are more up to date and better able to list the pros and cons than I am, but I see a few clear values of the MSR system.

First, it identifies the better grades more clearly and in higher yields than ever before. If you have good lumber you can find it with this system.

Second, it doesn't replace the human grader, it is a tool he can use to extend his perception and his speed. It elevates the technology of grading and most mills have men who can handle the technical job.

Third, it reduces the cost and improves the effectiveness of high production grading. For high speed mills it leviates a bottleneck.

Fourth, it improves lumber uniformity and opens up the market into better structural wood systems.

Fifth, engineers and building officals and a large part of the wood structural product manufacturers acknowlege its superiority and will pay for the higher performance of the better grades. It needs little selling anymore, in terms of its credibility.

I am sure I haven't mentioned all the deserving contributors to this technological advance although I can picture their faces and recall their names. There is a large fraternity of hard workers who have lent their energy and their reputations to this development.

MSR is clearly in place, its use is growing and conditions faced in the years ahead will favor its use to an increasing degree. Everyone who has agressively employed the system has been rewarded for doing so. It has raised the stature of wood in general as a structural building material.

I have not been actively working in the promotion of MSR for over 12 years. It is a great pleasure to be able to look out and see what has happened to that idea that sprang from the work of everyone who ever published their research on wood properties, and from the vision of a few managers who came up with the money to let us work on it. It has found a useful place in reducing the waste of a resource, at a profit to those who opened their doors to it. And in this age, where resource management is under such broad public inspection, this is a contribution for which the industry may enjoy some public credit.