STRUCTURAL (PERFORMANCE) CLASS POTENTIAL FOR NORTH AMERICA

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ABSTRACT: Structural Class systems are species-independent grade classification systems for structural lumber. They are used throughout the world to reduce the number of species and grade choices that face the designer of wood construction projects. Structural Class systems offer an opportunity to simplify lumber specification in North America and to encourage more effective quality standardization across product types. This report gives some background information on the development of major Structural Class systems used in Europe and the Pacific Rim countries. The guiding principles of a new ISO Structural Class standard will be applied to develop a potential Structural Class system for use in North America. A Structural Class system tuned for the most commonly used strength and stiffness performance categories used in North America can simplify lumber specification for design engineers and make wood construction more favourable to architects and engineers in their selection of construction systems among wood, concrete, and steel. It is suggested that the time for a structural system class in North American has finally come.

KEYWORDS: Structural Class, Dimension Lumber, Design Values, Strength, Stiffness, Stress Class

1 INTRODUCTION

In 1990 a publication targeting the North American dimension lumber industry asked the question Stress Class Systems: An idea whose time has come [1]? Evidently the answer to that question was no. North America still doesn't have a Structural Class system, which was called 'Stress Class’ in the U.S. The North American lumber market still utilizes a system of lumber classification that supplies design values for at least 8 grades for 51 species or species combinations resulting in well over 400 possible grade species combinations [2,3]. Structural Class systems have become extensively used in Europe and Pacific Rim [4, 5]. An international standard is in the process of being adopted that provides guidance for setting up Structural Classes [6]. Using this standard as a tool it may now be possible to propose a Structural Class system that would support and expand wood construction in North America.

A Structural Class system is not a grading system. Rather, it is a grade classification system that presents an ordered set of design parameters. Consider a set of pigeonholes, each of which has been assigned a set of properties. Each pigeonhole is a class, and the set of pigeonholes constitutes a Structural Class system. Any lumber type can be classified using a Structural Class system, whether it is hardwood or softwood, visually or mechanically graded, solid sawn or composite wood product. The only requirement is that the lumber has the properties specified for the applicable Structural Class.

2 GENERAL METHODS

Structural Class systems are developed by assigning class boundaries for primary properties, usually modulus of rupture (MOR) and modulus of elasticity (MOE), with secondary properties assigned concomitantly. Thus, maximum efficiency is usually obtained in assigning the primary properties, with less efficiency in the assignment of the secondary properties. Historically, methods such as ranking or a mathematical series had been used to establish Structural Class boundaries for the primary properties [7,8]. Practically, the final systems that are set up all represented a series of shifts to boundaries until a consensus was arrived at for each particular Structural Class system’s target market.

3 DERIVATION ASSUMPTIONS

3.1 PRIMARY PROPERTIES

The relationship between bending strength (MOR) and stiffness (MOE) is fundamental to Structural Classes. The
relationship is not only used to lay out primary properties but also serves as the basis for other relationships with derived properties, to quantify the rest of the values for the class system.

The MOE-MOR relationship is typically assumed to be a function of a measured correlation but each distribution can be very different; and while MOE is characterized by both a mean and a lower fractile, MOR is characterized by a lower fractile only. Therefore, database and distribution assumptions can influence the relationship. The MOE-MOR relationship is closely linked to variables of timber grading, sampling and testing embodied in characteristic values. These variables should be identified and normalized in a Structural Class system or it will be difficult to allocate species and grades to classes in a consistent manner.

3.2 OTHER PROPERTIES

The basic assumption is that it is possible to establish species-independent relationships for the purposes of standardization, recognizing that the result will not always be optimal for all timber populations. Derived property options are discussed based on an assumed relationship between bending and axial properties. Structural comparisons between properties and procedures from different countries are complicated by questions of compatibility of data.

The difference in size dependency between visual and machine grading processes can also affect property relationships, since different property modes may be more or less dependent on size effects. This issue needs to be reviewed before finalizing a Structural Class system that includes machine-graded products, and before allocating machine-graded timber to classes in the system.

4 IMPACTS OF STRUCTURAL CLASS SYSTEMS

4.1 SIMPLIFICATION OF DESIGN PROCESS

With the hundreds of combinations of size, grade, and species and structural products, it is no wonder that the engineer can be confused in selecting lumber for the design. A simplified performance class system would greatly reduce the number of options that a structural engineer would have to consider when designing with wood.

4.2 SMOOTHING IMPACT OF RESOURCE CHANGES

The method for establishing design values for visually-graded dimension lumber in North America is based on testing full size lumber in the grade it is produced from the full geographic range of production, and establishing the design value on the lower tail of this sample of the global distribution. The introduction of a Structural Class system in the NDS may provide another avenue to moderate the impact of global resource change by providing performance-based classes that encompass the properties of the material.

5 CONCLUSIONS

Structural Classes are functioning efficiently in Europe. A Structural Class system tuned for the most commonly used strength and stiffness performance categories used in North America can simplify lumber specification to a practical number of selections facing a design engineer, and can make wood construction more favourable to architects and engineers in their selection of construction systems among wood, concrete, and steel. It is suggested that the time for a Structural Class system in North American has finally come.

REFERENCES