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Executive Summary



Structural analysis software is a fundamental tool used by structural engineers to predict the behaviour of structures and buildings or elements within them. Software developed by the timber industry differs from Structural Analysis software as they are generally for residential design and for the determining of element's sizes or spans, utilising locked assumptions. Timber Industry residential software generally has little application in non-residential or commercial building applications.

For the timber industry to compete in the non-residential or commercial building sector, structural engineer's tools such as Structural Analysis software are required to be readily available and up to date with timber information and be able to conduct code compliance checks. To achieve this outcome the following activities are recommendations to be carried out by FWPA:

- Facilitate common structural software to ensure they contain up-to-date timber properties information.
- Assist in making existing timber design/analysis software programs known to structural engineers.

If after a period of time, the take up of existing timber design/analysis software programs is still unacceptable, FWPA may consider developing a generic code compliance module for incorporation into industry leading commercial Structural Analysis software.

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Introduction

The following report discusses elements required for structural design software to encourage greater specification and acceptance in the use of timber in both residential and non-residential buildings.

Background

Structural analysis software is used by structural engineers to predict the behaviour of structures, buildings or elements within them. Structural analysis software outputs are responses such as stresses, strains and deflections developed from assumptions provided by the user.

The output from structural analysis software is then used to determine element sizes by further calculations, evaluation and compliance to timber engineering standards.

Structural analysis software differs from other software developed by the timber industry for residential design as this residential design is generally for the determining of element's sizes or spans utilising locked assumptions. Structural analysis software does not use locked assumptions as these are set by the user, generally an experienced structural engineer.

Survey of Structural Engineers

In late 2010, a survey of 30 structural engineering firms across Australia was conducted for FWPA. It found that most structural engineering consulting firms used one of several generic structural analysis packages and/or materials specific software. The two most popular were found to be Microstran, used by 53% of firms, and SPACE GASS, used by 47% of those surveyed. Many structural engineering firms had both programs. Refer to Figure 1 for a breakup of the software used.

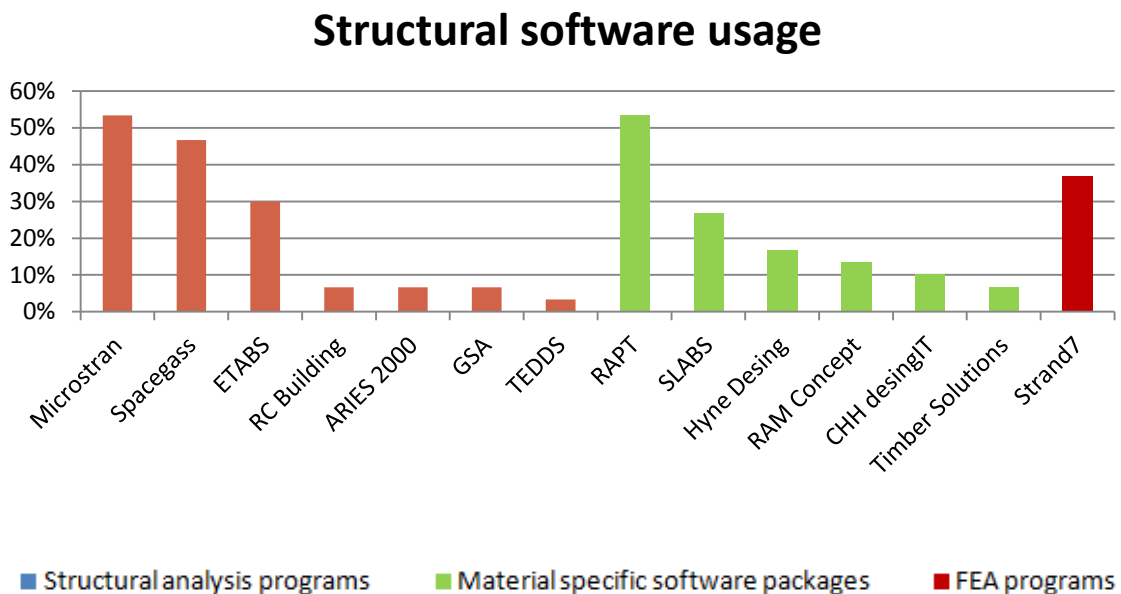


Figure 1: Breakdown of Software Programs used by Structural Engineers

The most popular material specific software was RAPT for concrete, used by 53% of those surveyed. Structural design software produced by timber companies' i.e. Hynes Design, Carter Holt Harvey Wood Products' Design IT and FWPA's Timber Solutions were found to be used by engineering firms for domestic residential applications.

70% of the engineers surveyed said that they were either likely or very likely to specify more timber if common Structural Analysis software incorporating current timber and engineered wood product properties provided a check against compliance. The later issue was identified as the number one reason more timber design was not carried out.

Standard/Code Compliance Software

Several structural engineers surveyed considered that a program that takes the actions (i.e. forces and moments) generated by the various structural analysis software (the outputs) and checks compliance to *AS 1720 Timber Structures – Design Methods Standards*, would assist tremendously in increased specification of timber and engineered wood products.

Many engineers expressed uncertainty about *AS 1720*, as they are not frequent users of this Standard, so in turn lacked confidence in specifying timber. A software program that conducts this check against the Standard in a transparent way would substantially reduce engineers' risk in designing with timber and engineered wood products. In time, it would also increase comfort in the specification of timber.

One major structural analysis software provider, Microstran, confirmed that an earlier 'dos' version of their software had a timber code check module included. When this module was removed in the mid 1990's they received very little negative feedback from users, validating their action. An updated module has not been provided since.

Standard/Code checking software can be in a standalone software package or incorporated into the structural analysis software. Feedback subsequent to conducting the survey indicated that usage would be higher if the module was contained within the structural analysis software rather than a standalone package. Consequently the preferred option would be to incorporate the standard/code checking into the major structural analysis programs. Incorporation of a compliance module within industry leading Structural Analysis software is how non-timber materials have dealt with the same issue.

Timber Properties Library

Generally structural engineers have poor knowledge on the availability of common timber sizes and their properties. Some structural analysis programs have timber libraries but they were found to be in the main out-of-date. A few programs require the inputting of timber properties and sizes which is considered a laborious task. It also exposes the engineers to risk as it requires multiple information inputs for each element so mistakes are easily made.

Property inputs for non-wood products are generally embedded within the commonly used Structural Analysis software refer to Figure 2 for SPACE GASS screen shot of a steel property library.

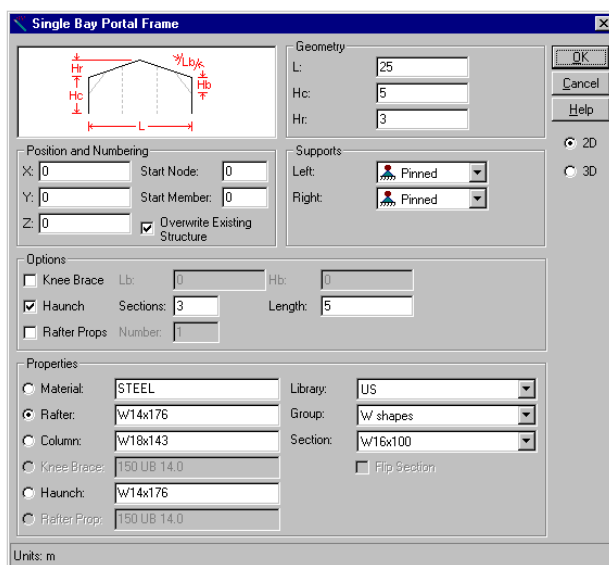


Figure 2: SPACE GASS Steel Property Library Screen Shot

For these reasons a library of the properties of the commonly available sawn timber and engineered wood products would greatly assist increased specification by engineers. This would also assist engineers in comparing the performance of various materials and from this make commercial (i.e. cost) comparisons an area where timber products are starting to have a distinct advantage.

The properties of sawn timber for major timber species are generic and freely available and easy to include. In regard to engineered wood products, the properties included in the library would need to be from published sources, i.e. generic. If not publicly available they are considered propriety information and the responsibility of the manufacturer.

Previous experience with software providers has demonstrated that they do not have the capability (or incentive) to maintain current property libraries so these updates would need to be provided by the timber industry. The likely frequency of updating is at least once a year or when major updates of timber properties occur.

Current Timber Structural Design Software

There are several spreadsheet software providers that offer software to conduct structural analysis of timber elements. They generally fall into two categories, software provided by structural engineering firms such as; Cadecom, TEDD, Structural Toolkit and Timber Man and timber industry software with structural engineering design feature, these mainly being Carter Holt Harvey Wood Products and Hyne. The following briefly describes each software package.

CADEcomp Software Package by CADE Systems Pty. Ltd.

A structural analysis software package that appears to be built around the requirements of timber engineering as opposed to having a timber analysis application attached to it. It caters for simplistic projects up to high complexity calculations. There are also many options including number of spans, loads, load cases, etc and they are generally not restricted allowing for many scenarios to be investigated. All members designed are automatically exported as a DXF (data exchange file) which allows interoperability of drawings between CADEcomp and other engineering software packages.

STRUCTURAL TOOLKIT by Anthony Furr Software (AFS)

Structural Toolkit is a simple structural analysis software package that caters for all materials and also contains limited timber engineering analysis applications attached to it. It provides simplistic element analysis only and is not intended for high complexity projects requiring complex frame type analysis. Its interface is of high quality and very user-friendly and intuitive.

TEDDS by Civil & Structural Computing Pty Ltd

Is a structural analysis software package that caters for a variety of applications. It helps in simplistic projects up to more complex calculations. Although there are restrictions (like number of spans, number of loads, etc) the value is set at such a high number that only projects which are significantly complex run the risk to exceed this limit. Its interface is good and is also user-friendly.

Carter Holt Harvey Wood Products

computeIT for beams - is an all purpose beam analysis package that enables engineers to develop design solutions from a range of CHH engineered wood products. This software's key feature is that it allows designers the flexibility of making design decisions without having an in depth knowledge of timber design standards.

computeIT toolkit - is a series of design tools to allow for the quick and easy design of beam and column members including moment resisting connections, beam and column members subject to combined actions, and purlins and girts. The software includes the recent QuickConnect moment connection developed by the Structural Timber Innovation Company.

computeIT for portal frames - is a fully integrated portal frame design, analysis and specification package that allows engineers to enter site specific information and then interactively design available section sizes and connections for portal frames, purlins, girts and other associated secondary framing. This software is scheduled to be launched shortly.

Hyne Timber

The Hyne Design 7 software has three levels of access being basic, advanced and engineering. The access levels are based on established user skill and competence levels. Each level offers significant improvements in load function and reporting and certification functions.

Discussion

Since conducting the survey on structural engineers on their preference for structural software in 2010, a much wider range of timber engineering and design software has become available in the market place. Much of the newer software is focused on specifically at the structural engineering design and not the traditional size of domestic timber frames.

As a result the current range of software that is available to structural engineers would satisfy much of the market demand for timber engineering design. The issue remains as to why this available software has not been taken up by general structural engineers, as seen in the 2010 survey. Much of this conundrum can be explained as the independent software has been developed by structural engineering companies as a side business, i.e. it's not their core business. Consequently, structural engineers are not aware of this software as these companies do not have the resources to adequately market their software.

Recommendations

The following are the recommended activities that FWPA could invest in.



Updated Timber Properties Library

All software programs have some form of timber properties library however most are outdated or in some cases inaccurate. It is recommended that the timber industry, through FWPA, could provide software providers with up-to-date and accurate timber properties information and commit to providing them regular updates.

For solid timber this will be a relatively easy task as structural timber properties rarely change. The task for structural timber will mostly be confirming properties already in existing libraries and modifying to allow for section dimensions. This last point is because current software provider libraries calculate section dimension without taking into account timber's negative tolerance, e.g. unseasoned timber, and fail to allow for the difference between nominal and actual dimensions.

The more difficult aspect will be providing properties for engineered wood products. There are presently no common grades for engineered wood products providers but as there are only a small number of manufacturers and importers a review every 12 months should be all that is necessary.

The property library will also assist the Engineered Wood sector in encouraging or educating sizing of timber to suit common dimensions.

Standards/ Code (AS1720) Compliance Module

As stated above there are many providers of structural software that would meet the engineers need. The main issue is that structural engineers are not aware of the software. It is therefore recommended that FWPA could inform and educate structural engineers of the available software through its design professionals program; Wood Solutions.

Activity within the Wood Solutions program could include a web page on www.Woodsolutions.com.au that identifies and directs users to the available software. Also whenever Wood Solutions conduct or are involved in seminars or conferences where the audience are structural engineers, the program or display could include timber Structural Analysis software information.

It is also recommended that after a period of time, a survey of structural engineers should be carried out on their software preferences to measure any change in usage, as carried out in 2010. If this survey shows a sizable lack of usage by structural engineers of the existing available software program, FWPA could consider developing a generic timber Standards/Code checking compliance with AS1720 software module that could be incorporated into the two most common structural analysis software identified in the 2010 survey or reevaluated in a later survey.

Recommendations:

- ***Existing timber specific structural design and analysis software should be assisted so that their products are more widely known by structural engineers. This could be achieved through the FWPA's Wood Solutions program.***
- ***The timber industry provides and maintains timber and engineered wood products properties library for all structural software providers.***

Conclusion

Structural analysis software is a fundamental tool used by structural engineers to predict the behaviour of structures and buildings or elements within them. Software developed by the timber industry differs from Structural Analysis software as they are generally for residential design and for the determining of element's sizes or spans utilising locked assumptions.

For the timber industry to compete in the non-residential or commercial building sector, structural engineer's tools such as Structural Analysis software are required to be readily available and up to date with timber information and be able to conduct code compliance checks. To achieve this outcome the following activities are recommendations to be carried out by FWPA:

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