CROSS LAMINATED ROUND-WOOD PANEL: DESIGN GUIDELINES IN THE STATE OF SÃO PAULO

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ABSTRACT: This paper aims to present a preliminary proposal for a cross laminated solid wood panel better suited to the State of São Paulo forestry resources and timber industry. At first, the main features of the State of São Paulo's forestry and timber industry were analysed in order to create an overall picture of the possibilities and restraints offered by the local forestry sector. After, a preliminary proposal for a cross laminated round-wood solid panel was developed. Then, the proposal was analysed and topics for further research on the theme were presented. It was found that a better suited cross laminated solid wood panel in the State of São Paulo should favour the use of young Eucalyptus round-wood in a labour intensive production process.

KEYWORDS: Solid Timber; Panel Design; Eucalyptus; Forestry; Timber Industry

1 INTRODUCTION

In the last 10 to 15 years, wood utilisation in construction has been through meaningful changes, especially in the field of mid to high-rise buildings. These changes have occurred as a result of development and diffusion of new timber products that enable fast and high performance wood construction. Perhaps, the most representative among the recent developed timber products is Cross Laminated Timber (CLT), a solid timber panel made from soft-wood lamellae, stacked and glued together in a cross layer arrangement.

During the aforementioned period, European CLT production has grown from 25 thousand cubic meters on 2000, to 340 thousand cubic meters in 2010 [1]. However, CLT was developed in Central Europe and therefore, it is a solution created in an specific context, taking into account the possibilities and restraints offered by European forestry and timber industry, such as softwood timber availability and capital intensive production system. These features relate to the main forest resources and established economical and technological context in Europe, respectively. Hence, CLT solution may not suitable for places with rather different natural and socio-economic circumstances. In this cases, local context should be carefully evaluated in order to adapt the concept of a cross laminated solid wood panel into local sustainable solutions.

This paper aims to present a preliminary proposal for a cross laminated solid wood panel better suited to the State of São Paulo (located in the southeast of Brazil) forestry resources and timber industry.

2 METHOD

At first, the main features of the State of São Paulo's forestry and timber industry were analysed in order to create an overall picture of the possibilities and restraints offered by the local forestry sector. The information was retrieved from reports of the statistics research institutes in the country. Hereafter, taking into account the information gathered previously, a preliminary proposal for a cross laminated round-wood solid panel was developed.

3 RESULTS

3.1 FORESTRY RESOURCES

The State of São Paulo has 24,819.696 hectares (IBGE, 2010) with about 22 % of it covered by forests [2], most of it native forests. Even though planted forests accounts only for 4.5% of São Paulo's forest cover rate, it supplies most of the industry due to its extremely high annual growth, ranging from 37 m3/year/ha (for Pine species) to 40 m3/year/ha (for Eucalyptus species) [3].

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About 86% of the planted forest's area in the State of São Paulo is cultivated with Eucalyptus species and the last 16% are cultivated with Pine species [4].

3.2 TIMBER INDUSTRY

Wood species distribution in planted forests in the State of São Paulo reflects timber industry demand: i.e., the largest amount of Eucalyptus round-wood harvested is processed by the paper and pulp industry and the smaller Pine volume harvested is processed by milling industry especially veneer and plywood production [4].

However, regarding the direct jobs in each industry, an opposite trend can be noted: despite its bigger size, pulp and paper industry accounts about half of the direct jobs of the smaller saw-mill industry in the State of São Paulo [4]. This suggests labour intensive practices are employed in sawn mill segment.

3.3 CROSS LAMINATED ROUND-WOOD PANEL

Figure 1 shows the cross section of the proposed panel. Instead of utilising softwood lamellae as the main component, the proposed panel consists predominantly of young Eucalyptus round-wood: half-sawn (100 mm diameter) and quarter-sawn (200 mm diameter), which carry the main vertical loads. In addition, Pine plywood (20 mm thick) is employed in the core of the panel as the cross layer and it is responsible for taking the horizontal loads as well as providing dimensional stability and airtightness. At least, pressure treated pine sawn timber (20 mm thick) is fixed along the edges of the panel in order to create a protected perimeter against insects attack. All the pieces are fixed together by means of gun driven nails, thus creating a labour intensive production system.

After the cross laminated round-wood solid panel is completed, it can be insulated and cladded conventionally, i.e., with mineral wool and gypsum boards, or in an alternative fashion, utilising wood-cement composite (Figure 2) or even wattle and daub. The panels can be employed as large vertical elements, in the height of the building, in order to speed up the assembling time, lowering construction costs.

Figure 2: Sectioned building element perspective view

4 CONCLUSIONS

The material selection corresponds to the possibilities of São Paulo's forestry sector, highly oriented towards paper and pulp industry segment, as it have been accessed throughout the survey. Hence, a large amount young Eucalyptus round-wood is employed as the main component of the panel, followed by a smaller quantity of Pine plywood and pressure treated Pine sawn timber. Furthermore, production process employs labour-intensive system, thus avoiding investments in expensive production machinery for automation.

As this is still a relatively new topic in Brazil the work presented a preliminary proposal aiming to solve exclusively the problems pointed out by the analysis of São Paulo's forestry sector. Further studies on the subject that can be developed includes cost estimation, production system design, mechanical performance, thermo-acoustic performance, etc., improving the proposed solution or even developing new solutions for solid wood panels suited to the local context.

ACKNOWLEDGEMENT

The author acknowledges the financial support provided by CAPES IAU-USP Post-graduation program scholarship during the research.

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