Wood Architecture in Slovenia for sustainable development: panorama of the most representative construction sites

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1. Introduction

This presentation will present a book "Contemporary Slovenian Timber Architecture for Sustainability" authored by dr. Manja Kitek Kuzman and dr. Andreja Kutnar, which was published in 2014 by Springer. In this book the authors, architect and wood scientist, successfully joint wood science, environmental impact assessment and architecture in delivering all important aspects of timber architecture for sustainable development.

Wood is an abundantly available renewable resource, in Slovenia and many areas of the world. The Slovenian climate is varied, and the building techniques used to adapt to the demands of those climates are many. The case studies selected present a distinctly Slovenian perspective, but are also examples of the best practices in sustainable building.

2. Slovenian Forests

The most typical feature of the Slovenian landscape is its forests (Fig. 1), which cover as much as 58 % of the national territory (Report of the Forest Service of Slovenia for 2012). In terms of relative forest coverage Slovenia is third in the European Union, after Finland and Sweden. The most important wood species as reported by Slovenia Forest Service (2014) are beech (Fagus silvatica L.) and spruce (Picea abies L. Karst.), each account for 32 % of Slovenian forests. Oak (Quercus robur L., Quercus petraea Liebl., Quercus cerris) and fir (Abies alba Mill.), each with 7 % share are third and fourth most important wood species in Slovenian forests. Other important wood species with considerably lower populations are Scots pine (Pinus sylvestris L.); ash (Fraxinus excelsior L.), Manna ash (Fraxinus ornus), birch (Betula spp.), cherry (Prunus avium L.), black alder (Alnus glutinosa), hornbeam (Carpinus betulus L.), mountain elm (Ulmus spp.), mountain maple (Acer spicatum), maple (Acer spp.), mountain ash (Sorbus aucuparia), chestnuts (Castanea sativa Mill.), linden (Tilia spp.), larch (Larix decidua Mill.); whitebeam (Sorbus aria), black locust (Robinia pseudoacacia L.), and aspen (Populus tremula L.).

Forest ownership in Slovenia is very fragmented. Private forest ownership (314,000 forest owners) accounts for 75 % of Slovenian forests and are usually quite small (on average 3 ha) (Slovenia Forest Service 2014). Furthermore, most of these estates are not of economic interest to the owners, which represents a serious obstacle to optimal timber production and utilization of forest potential. The state owns 22 % of the forest and municipalities own the remaining 3 % (Slovenia Forest Service 2014).
According to the Slovenian Forest Service, in 2009 the growing stock increased by 1.6 % over 2008; the amount of average growing stock per hectare increased similarly. According to forest management plans, the growing stock was 327,458,500 m$^3$ in 2009, while volume per hectare was 276 m$^3$/ha (Fig. 2). For 2012 the Slovenian Forest Service reports 337,816,717 m$^3$ of growing stock and volume per hectare 285 m$^3$/ha (Table 1.). The annual increase in growing stock was 8,419,974 m$^3$ in the same time period, with a potential annual harvest of 5,748,834 m$^3$. However, in recent years the average harvest has been between 3.4 and 3.9 million m$^3$ and was comprised of approximately 55 % softwood and 45 % hardwood.
Table 1. Slovenia’s forests in numbers (Report of Slovenia Forest Service for the year 2012)

<table>
<thead>
<tr>
<th>Amount</th>
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<tbody>
<tr>
<td>Surface area of forested land</td>
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<tr>
<td>Forested area of Slovenia</td>
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<tr>
<td>Number of naturally occurring tree species</td>
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<tr>
<td>Growing stock</td>
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<tr>
<td>Annual growth of growing stock</td>
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<tr>
<td>Potential annual harvest (2012 forest management plans)</td>
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<td>Hardwoods</td>
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<tr>
<td>Softwoods</td>
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3. Wood-based Building Materials and Sustainability

The woodworking industry in Slovenia has always been important. Cabinet, furniture, millwork and custom woodworking manufacturers tap the local skills heritage. Slovenia produces a full product range from mechanical and chemical processing in addition to energy production. The mechanical branch comprises milling, plywood and particleboard manufacturing, and fabrication of furniture and timber components for the construction industry. Pulp and paper, cardboard, and packaging materials produced by the chemical branch. The production of biofuel from biomass uses waste and residues from forestry and related industries.

Key products of the Slovenian wood-processing industry are:
- pre-fabricated wooden houses,
- builders’ joinery and carpentry of wood,
- plywood, veneered panels and similar laminated wood;
- fiberboard of wood or other ligneous materials;
- decorative veneer sheets and veneer sheets for plywood and sawnwood;
- particleboard and similar boards of wood or other ligneous materials;
- packaging materials of wood;
- furniture of dining rooms and kitchens; wooden furniture for kitchens,
- living quarters and public institutions;
- wood marquetry and inlaid wood; wooden frames for paintings etc.;
- and casks, barrels, vats, tubs etc.

4. Buildings in Sustainable Development and Beyond

Sustainable building and construction assemblies are designed to conserve energy and other resources, enable material recycling, reduce emissions of toxic substances, be in harmony with the local climate, building tradition, culture and environment and to continually improve the quality of living, while maintaining environmental balance at local and global levels.

Sustainable design principles emphasize reducing the impact of building construction, location and utilization on the environment by minimizing the impacts of material choice, site choice, and energy use across all phases of the buildings lifetime (e.g., construction, occupancy). While Restorative Environmental Design (RED) (Fig. 3) is the next evolution of “green” design. In principle, the goals of RED are to reduce environmental impacts of new buildings, and to ensure buildings provide healthful benefits to the occupants. Restorative Environmental Design brings together the ideas of sustainable design, such as reducing carbon footprints and sourcing local, sustainably produced materials, with biophilic design, which fosters the human connection to nature through the built environment. Wood is an ideal material for RED because it satisfies both general tenets of the design paradigm: sustainability and when it is used in appearance applications wood provides a connection to nature.
Creating healthy indoor environments like offices, classrooms, living rooms, dining rooms, and bedrooms is an important aspect of creating healthy environments for building occupants, as people spend most of their time indoors and our physical surroundings are known to affect us. The studies, which incorporate the healthful benefits of materials and design in buildings, are meeting increasing global interest. In Slovenia there are currently studies exploring the health effects of using wood as a material for building interiors, especially as furniture, wall claddings, flooring and decorative purposes, which proves that research in Slovenia goes beyond the basic sustainable construction paradigm and is inclusive of both ecological concerns and improvements to human wellbeing. It is in line with the global trends in the field, creating contemporary timber architecture of the future (Fig. 4).