CHALMERS

SUSTAINABILITY OF SOCIAL HOUSING IN THE URBAN TROPICS

A Holistic Development Process for Bamboo-Based Construction

CORINNA SALZER

Thesis for the Degree of Doctor of Philosophy
at Chalmers University of Technology
to be publicly presented on June 5th, 2018
at 10:00 AM in room SB-H6, Sven Hultins Gata 6, 412 58 Gothenburg

The seminar will be held in English
Opponent: Professor Mark Hughes, Aalto University

The thesis is available at the
Chair of Sustainable Building
Department of Architecture and Civil Engineering
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden

SUSTAINABILITY OF SOCIAL HOUSING IN THE URBAN TROPICS

A Holistic Development Process for Bamboo-Based Construction

Corinna Salzer

Department of Architecture and Civil Engineering
Chalmers University of Technology, Gothenburg, Sweden

ABSTRACT

This thesis is motivated by a tremendous need for more inclusive, sustainable and disaster resistant social housing in rapidly developing countries such as the Philippines. The 2030 Agenda for Sustainable Development and the New Urban Agenda name the use of local raw materials as one area for action. In the Philippines bamboo is an available, culturally rooted material, which is frequently used by rural and urban low-income groups. However, its current use in buildings does not meet the regulatory, technical and social requirements of urban spaces. The general objective of this thesis is to guide the development, implementation, and continuous assessment of a bamboo-based building technology for social housing in the Philippines, according to the multi-dimensional requirements of sustainability. The conceptual framework of the thesis is aligned to the standards EN 15643 and ISO 15392 on the sustainability assessment of buildings. A localization of the standards has been achieved through a multi-stakeholder participatory process. Beyond stakeholders from within the Philippines, this process builds on a learning exchange with Latin America, where significant knowledge on bamboo-based building exists, as well as Europe, where timber frame construction is established.

Issue-focused research captured the performances in technical, environmental, social, economic and governance dimensions. It was shown that the most common bamboo species in the Philippines is of a structural grade that is suitable for low-rise house construction. With quality selected, treated bamboo culms and climate-adjusted house designs, the construction of reliable and durable buildings was possible, designed to withstand the impacts of their surrounding environment. The walls received a fire resistance rating of 60 minutes and full-scale test houses withstood the storm impacts of four typhoons with 120–213 km/h wind speeds. A thorough life cycle assessment predicted that the building method results in a 74%-reduction in carbon emissions. Furthermore, surveys and physical measurements attested that a higher indoor thermal comfort is achieved. Active participation was applied throughout the research and implementation activities, and acceptance barriers were overcome among involved stakeholders. Beyond savings from a life cycle cost perspective of the buildings, the use of the renewable local material strengthened local economies and created rural-urban linkages.

Sustainability theory was used as a tool for decision-making for the planning, implementation, and continuous improvement of 500 social houses across the Philippines. These were erected by the Base Foundation, an initiative supported by the Hilti Foundation, and its partners. In a continuous improvement process, the achievements and learning obtained in the research and implementation were exchanged in feedback loops over a period of 4 years. Sustainability is shown to be a continuous, balancing process that can be used to transparently discuss and evolve a holistic value proposition. Because adequate housing is only one of many components required for sustainable cities and resilient communities, this thesis aims to contribute to holistic integrated projects and policy advocacy.