WoodWisdom-Net

WoodExter - Service life and performance of exterior wood above ground

Final Report

Jöran Jermer

SP Technical Research Institute of Sweden

Project Objectives and Main Tasks

Vision

To take the first steps towards application of performance-based design for wood-based building components in Europe with respect to durability.

Objectives

- **Main objective**: to prepare tools to facilitate performance-based design with respect to durability

- **Additionally**: to generate more knowledge about wood durability in a number of “stand-alone” projects.

Partners

R&D partners

SP Technical Research Institute of Sweden (co-ordinator)

LTH Lund University, Sweden

VTT, Finland

FCBA, France

HFA Holzforschung Austria

TUW Technische Universität Wien, Austria

BRE Building Research Establishment, United Kingdom

Universiteit Gent, Belgium

Norwegian Forest and Landscape Institute

Universität Göttingen, Germany

Partners

Industry partners

CEI-Bois initiative “Building With Wood”

Swedish Wood Preserving Association

Södra Timber AB, Sweden

Bitus AB, Sweden

Kebony ASA, Norway

Association of Austrian Wood Industries

Adler-Werk, Austria

Synthesa Chemie GmbH, Austria

Project Highlights and Final Results

Most important result:

- A Guideline and tool for the design of wooden constructions with respect to durability and service life

Moreover, new knowledge generated concerning:

- Exposure conditions and risk of decay
- Performance of coating systems
- Effect of decay on micro-mechanical properties of wood
- Use of micro-molecular techniques (PCR) as early indicators of decay
- Decay indicators from field testing

Basic philosophy behind the Guideline

- A ***limit state*** which shall not be exceeded during the service life must be clearly defined. We have chosen onset of decay during a service life of 30 years as the limit state

- Various factors affecting the performance are considered with respect to

  a) Exposure (geographical location, local climate, sheltering, distance from ground, detailed design, use and maintenance of coatings)

  b) Resistance (material properties; different materials have different resistance against decay, e.g. preservative-treated sapwood>larch heartwood> sapwood of all species)

Basic philosophy behind the Guideline

The design condition is then expressed in terms of

Exposure ≤ Resistance

Mathematically expressed as:

$$I_{Sd} = I_{Sk} \cdot \gamma_d \leq I_{Rd}$$

I_{Sd} = design value of exposure index

I_{sk} = characteristic value of exposure index

I_{Rd} = design resistance index

γ_d = accounts for consequence class

This approach is familiar in structural design.

How to use the Guideline – example 1

Object:

Marina **decking** in Helsingborg (south-west coast of Sweden)

Consequence class:

•High

Exposure:

•Nordic climate zone

•Severe local conditions

•No sheltering

•>300 mm above sea level

•Poor detailed design

Material:

• Larch (resistance class C)

Design Guidelines for wood in outdoors above ground applications

Design condition $I_{sd} = I_{sk}\gamma_d \leq I_{Rd}$

Parameters	Value
k_{s1}	1
k_{s2}	1
k_{s3}	1,5
k_{s4}	0,9
I_{so}	1
c_a	1
I_{sk}	**1,35**
γ_d	0,8
I_{Sd}	**1,08**
I_{Rd}	**1**
NOT OK	

Consequence class, γ_d

- 1 Moderate
- 2 Medium
- 3 High

Local conditions, k_{s1}

- Light
- Medium
- Heavy
- Severe

Basic exposore index, I_{so}

- Continental Europe
- Nordic Climate zone
- Atlantic Climate zones, South of latitude 50
- Atlantic Climate zones, Latitude 50-55
- Atlantic Climate zones, North of latitude 55
- Mediterranean climate zone
- OWN VALUE

Own value:

Sheltering, k_{s2}

- e>0.5d
- e=0.15d-0.5d
- e<015

Distance from ground, k_{s3}

- > 300 mm
- 300-100 mm
- < 100 mm

Resistance class, I_{Rd}

- 1
- 2
- 3
- 4
- 5

Rating of details, k_{s4}

- Decking
- Cladding

For cladding only

- Uncoated
- Coated

- Excellent
- Good
- Medium
- Fair
- Poor

How to use the Guideline – example 1

Thus, the answer is: NO!

Decay was observed already after 5-6 years mainly because of poor detailing!

How to use the Guideline – example 1

Question:

Will the decking last without onset of decay >30 years?

By using a special software tool, developed by WoodExter, we can find the answer.

How to use the Guideline – example 2

Object:

Cladding on family house build in 1979

Consequence class:

•Small

Exposure:

•Nordic climate zone

•Local conditions Medium-Heavy

•No sheltering

•100-300/>300 mm above ground

•Medium detailed design

Material:

Spruce (resistance class D)

How to use the Guideline – example 2

Question:

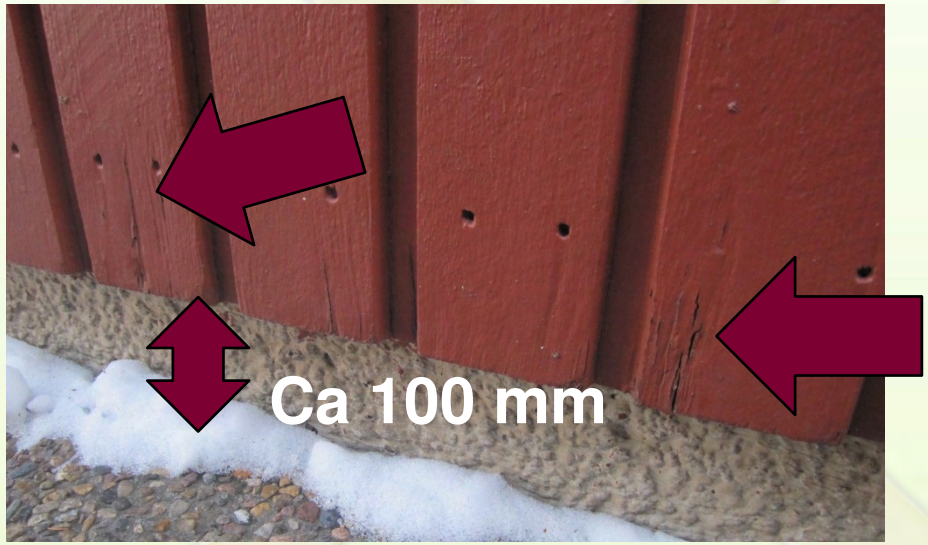
Will the cladding last without onset decay >30 years?

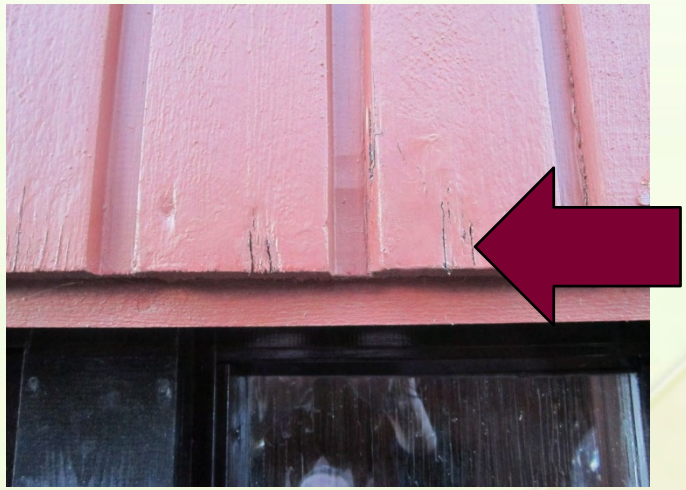
By using the same software tool, we can find the answer.

How to use the Guideline – example 2

Thus, the answer is: NO!

Decay was observed after 15-20 years on severely exposed parts with poor sheltering!





Expected Impact and Target Groups

- The Guideline is expected to

  -be tested in practice and further improved by specifiers/architects/researchers.

  -serve as a discussion document in the process of introducing performance-based engineering design for wood-based building components with respect to durability.

- Progress regarding durability indicators and performance of coating systems will be further elaborated in CEN committees.
- WoodExter projects with promising results will continue within the framework of other projects.

Added value from transnational cooperation

In general, very positive experiences

- Competence added to the project
- Extended networking
- Different experiences with building with wood – different codes, traditions
- Beneficial for ”reality checks” of design model
- Stronger CEN input

but…..

- Management somewhat more difficult