Dear Colleagues,

This document contains information and topic guideline for discussion at the Zagreb Cost e55 workshop on moisture induced effects on the structural safety and serviceability of timber structures. As for any guideline the ambitious goal is to direct the work at the workshop to ensure an optimal outcome. However, it is acknowledged that there are issues not covered in this guideline that also have to be discussed as well.
Furthermost this document is meant to inspire the delegates to find the topic of interest on which he/she is prepared to contribute at the workshop. The contribution might be in form of discussion notes that are distributed prior to the meeting or some slides for presenting your ideas and thoughts at the workshop. However, it should be clear that the input should be targeted enough to support and focus the discussions. Please send your contribution to me at least one week before the meeting (September 19th).
At the Helsinki workshop it was decided that work on a proposal for a model code accounting for the effects of the natural varying climate which influence can be considered as actions were a topic that should be perused by the delegates. In the current design code the effects of moisture state and history are included in parameters, e.g. k_{mod} and k_{def}, together with other quantities that also have influence on load carrying capacity and long-term deformation. A goal is then to isolate the "Climate action" from the material resistance formulation, as in the current code, and formulate it as action. The result of this work has the aim to give a more transparent description of especially moisture induced effects in future design codes.
Some of the topics that must be discussed at the work-shop to insure positive outcome of this model code proposal are:

1. Motivation
i. Is there a need for the proposal?
ii. Are there cases for which the current structural code is not able to account for the moisture induced effects?
iii. Will a new code format increase the safety and serviceability of timber structures?
iv. Is a new code format beneficial for the wood industry, will wood products be more competitive as structural members compared to other construction materials?

2. Knowledge input from research.
i. Is the present hygro-mechanical knowledge data base able to provide the information needed for characterizing the moisture action with accuracy and precision appropriately?
ii. What type of information must be provided by the research community?

3. Format of model code.
i. What level of detail is relevant?
ii. Examples and case studies?
iii. Shall only effects of moisture be considered?
iv. Relation to EN1991-1-5 Actions on Structures, General actions-thermal action?

In the appendix to this document are extracted from the Eurocode 5 all the rules and recommendations on moisture and climate in relation to design. From this extract further issues of interest might arise and are of course up for debate at the work-shop.

Extract from EN 1995-1-1:2004(E) Eurocode 5 "Design of timber structures, Part 1-1: General – Common rules and rules for buildings" on moisture induced effects on structural serviceability and safety.

Section 2 Basis of Design

2.2 Principles of limit state design

2.2.1 General

(1)P The design models for the different limit states shall, as appropriate, take into account the following:
- different material properties (e.g. strength and stiffness);
- different time-dependent behavior of the materials (duration of load, creep);
- different climatic conditions (temperature, moisture variations);
- different design situations (stages of construction, changes of support conditions).

2.2.2 Ultimate limit states

(1)P the analysis of the structure shall be carried out using the following values of stiffness properties:

-
- first order linear elastic analysis of a structure, whose distribution of internal forces is affected by the stiffness distribution within the structure …
-

2.2.3 Serviceability limit states

(1)P The deformation of a structure which results from the effects of actions (…) and from moisture shall remain within appropriate limits ….

2.3 Basic variables

2.3.1 Actions and environmental influences

2.3.1.1 General

(1) ..
(2)P Duration of load and moisture content affect the strength and stiffness properties of timber and wood-based elements and shall be taken into account in the design for mechanical resistance and serviceability.
(3)P Actions caused by the effects of moisture content changes in the timber shall be taken into account.

2.3.1.3 Service classes

(1)P Structures shall be assigned to one of the service classes given below:

Note 1: The service class system is mainly aimed at assigning strength values and for calculating deformations under defined environmental conditions.

Note 2: Information on the assignment of structures to service classes given in (2)P, (3)P and (4)P may be given in the National annex.

(2)P Service class 1..

2.3.2 Materials and product properties

2.3.2.1 Load-duration and moisture influences on strength

(1) Modification factors for the influence of load-duration and moisture content on strength, see 2.4.1 are given in 3.1.3

…

2.3.2.2 Load-duration and moisture influences on deformation

…
k_{def} is a factor for the evaluation of creep deformation taking into account the relevant service class;

…
2.4 Verification by the partial factor method

2.4.1 Design values of material property

…
k_{mod} is the modification factor taking into account the effect of the duration of load and moisture content.

…
2.4.3 Design resistances
…
k_{mod} is the modification factor taking into account the effect of the duration of load and moisture content.
…

Section 3 Material properties

3.1 General

3.1.3 Strength modification factors for service classes and load-duration classes

(1) The values of the modification factor k_{mod} given in Table 3.1 should be used.

(2) If a load combination consists of actions belonging to different load-duration classes a value of k_{mod} should be chosen which corresponds to the action with shortest duration, …

3.1.4 Deformation modification factors for service classes

(1) The values of the deformation factor k_{def} given in Table 3.2 should be used.

3.3 Glued laminated timber

…
(4)P Large finger joints complying with the requirements of ENV 387 shall not be used for products to be installed in service class 3, where the direction of grain changes at the joint.
…

3.4 Laminated veneer lumber (LVL)

…
(6)P Large finger joints complying with the requirements of ENV 387 shall not be used for products to be installed in service class 3, where the direction of grain changes at the joint.

3.6 Adhesives

(1)P Adhesives for structural purposes shall produce joints of such strength and durability that the integrity of the bond is maintained in the assigned service class throughout the expected life or the structure.

(2) Adhesives which comply with Type I specification as defined in EN 301 may be used in all service classes.

(3) Adhesives which comply with Type II specification as defined in EN 301 should only be used in service class 1 or 2 and not under prolonged exposure to temperatures in excess of 50° C

Section 4 Durability

4.1 Resistance to biological organisms

(1)P Timber and wood-based materials shall either have adequate natural durability in accordance with EN 350-2 for the particular hazard class (…) or be given preservative treatment …

Section 8 Connections with metal fasteners

8.3 Nailed connections

8.3.1 Laterally loaded nails

8.3.1.2 Nailed timber-to-timber connections

…
(4) …
-…
- Nails other than smooth nails, as defined in EN 14592, may be used in structures other than secondary structures. The design values of the load-carrying capacity should be taken as 1/3 of the values for smooth nails of equivalent diameter installed at right angels to the grain, provided that:
- …
- the connection is not exposed to service class 3 conditions;

- …

Section 9 Components and assemblies

9.2 Assemblies

9.2.1 Trusses

…
(8) All joints should be capable or transferring a force … acting on timber in service class 2, ...

Section 10 Structural detailing and control

10.2 Materials

…
(2)Timber and wood-based components and structural elements should not be unnecessarily exposed to climatic conditions more severe than those expected in the finished structure.

(3) Before being used in construction, timber should be dire as near as practicable to the moisture content appropriate to its climatic condition in the complete structure. If the effects of any shrinkage are not considered important or if parts that are unacceptably damaged are replaced, higher moisture content may be accepted during erection provided that it is ensured that the timber can dry to desired moisture content.

10.3 Glued Joints

…
(2) The adhesive manufacture’s recommendations with respect to mixing, environmental condition for application and curing, moisture content of members and all factors relevant …

10.4 Connections with mechanical fasteners

10.4.3 Bolts and washers

…
(3) Bolts and lag screws should be tightened so that the members fit closely, and they should be re-tightened if necessary when the timber has reached equilibrium moisture content to ensure that the load-carrying capacity and stiffness of the structure is maintained.
…

10.7 Control

(1) …

NOTE 1: The control of the construction is assumed to include:
- …
- checking of materials and their identification e.g.:
    - for wood and wood-based material: … and moisture content;