

Note for COST E55 participants  
 From André Jorissen  
 Subject Ductility of timber connections  
 Date March 12, 2009

Dear all,

This document contains some additional notes on joint ductility which can be discussed during our meeting in Trondheim within two weeks.

Ductile behavior is important for:

- Energy dissipation (dynamic loading, e.g. earthquakes)
  - Robustness: warning system when a structure is locally overloaded. In this regard, load re-distribution possibilities should be regarded.
- Load re-distribution can be achieved after sufficient absolute displacements through “plasticity” and “softening”. Both phenomena are shown in figure 1.

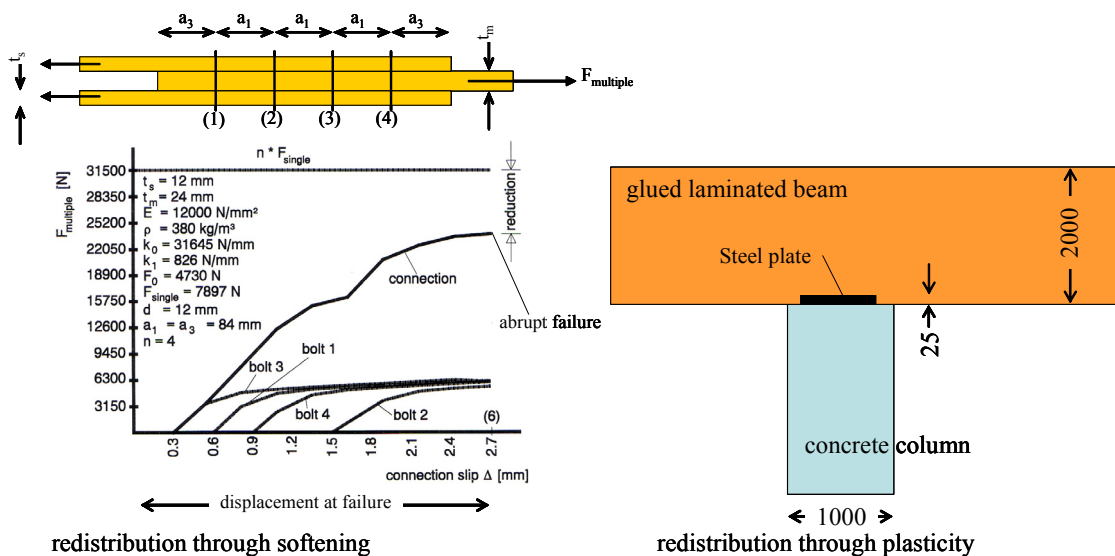


Figure 1: Redistribution through softening and through plasticity.

Regarding ductility we only want to discuss the redistribution possibilities through plasticity. In this regard the multiple fastener connection shown in figure 1 is not ductile while the support, also shown in figure 1, is ductile. Actually, we want load slip curves as shown in figure 2.

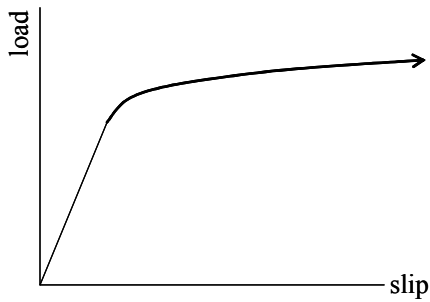


Figure 2: Load-slip curve which enables load re-distribution through plasticity.

Regarding timber connection, this type of load slip curve can only be obtained by connection systems where no or very limited tension perpendicular to the grain is developed:

- Single dowel type fasteners
- Multiple nails or staples
- Toothed plates
- Axially loaded screws
- Bearing

The axially loaded screws can be used for reinforcing multiple dowel type fasteners (larger diameters) through which these connections become very ductile (resulting load-slip curves from figure 2) as shown during the Helsinki meeting in March 2008 by Blaß [1].

As stated before, the final outcome of our discussions on joint ductility should contain:

- Definition of ductile behavior

Figure 3 shows different ductility definitions based on the load slip curve [2].

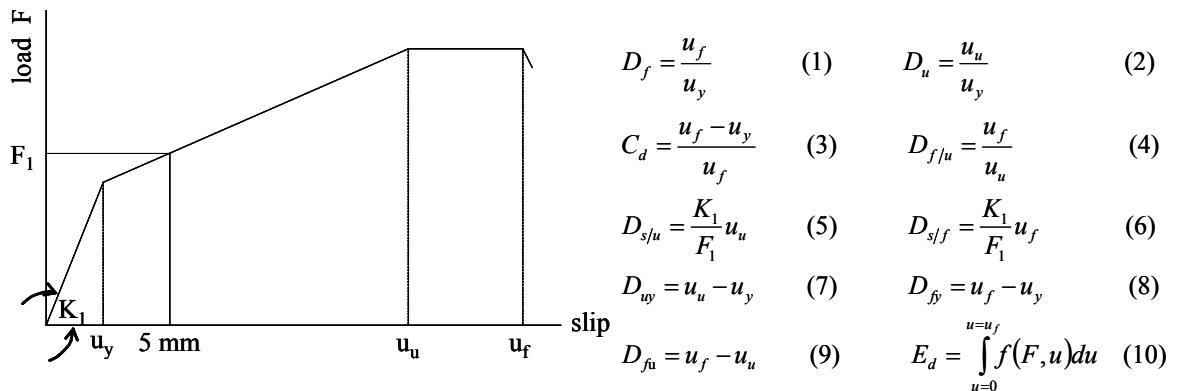


Figure 3: Different ductility definitions [2]

Since the definition should refer to load redistribution possibilities, load-slip curves can be of major importance in defining ductility.

- Practical guidelines for structural design

In this regard, a draft content of a final document on ductility can be discussed.

Reminder: all participants should prepare themselves on the discussions. In this regard, it was asked to prepare at least two slides on at least one topic. Regarding ductility aspects you are encouraged to prepare these slides and send these to [a.jorissen@shr.nl](mailto:a.jorissen@shr.nl), [a.j.m.jorissen@bwk.tue.nl](mailto:a.j.m.jorissen@bwk.tue.nl) and [jochen.koehler@ibt.ethz.ch](mailto:jochen.koehler@ibt.ethz.ch) before March 20.

#### Literature

- [1] Blaß, H.J. *Ductility Aspects for Joints*. Presentation at the COST E55 Workshop, Helsinki, March 2008.
- [2] Stehn. L and Björnfot, A. *Comparison of different ductility measurements for nailed steel-to-timber connections*. Proceedings of WCTE 2002, Shah Alam, Malaysia.