Dowel-type connections perpendicular to the grain

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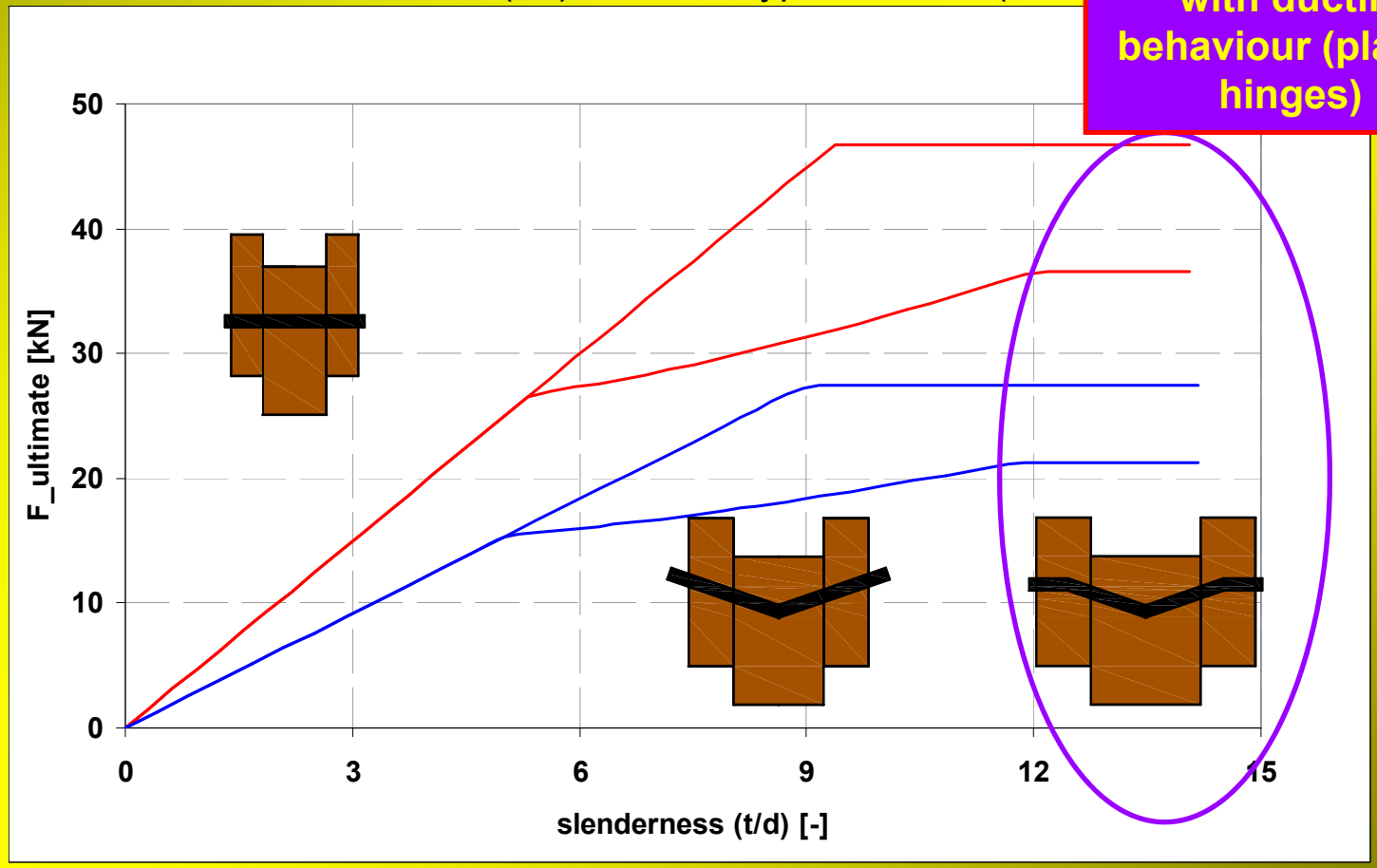
cost
Building European Science
Action E55:
Modelling of the Performance of Timber Structures

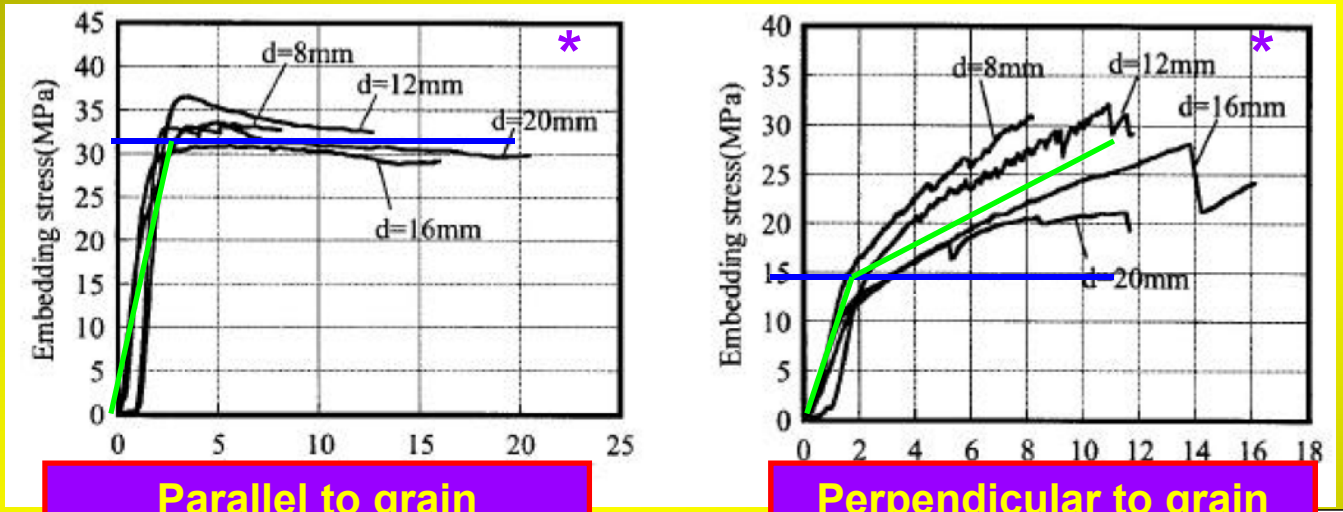
Joint Ductility

- Slenderness ratio (t/d) of dowel-type fastener (Dou



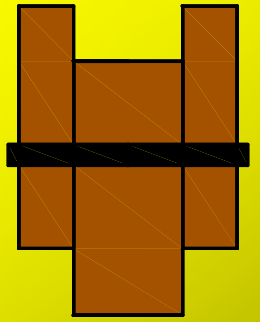
Joint Ductility

- Example: caused by material characteristics (embedment)



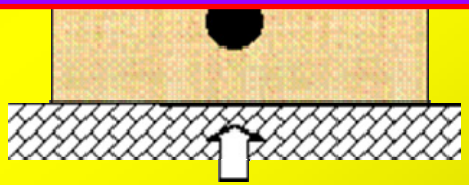
Parallel to grain

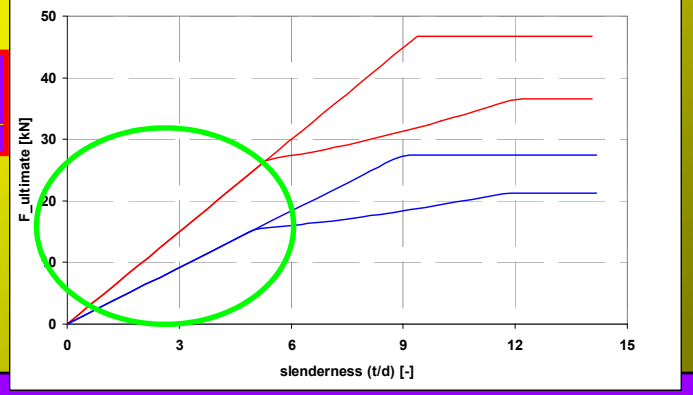
Perpendicular to grain



Rigid, i.e. λ small

Low slenderness → ductility

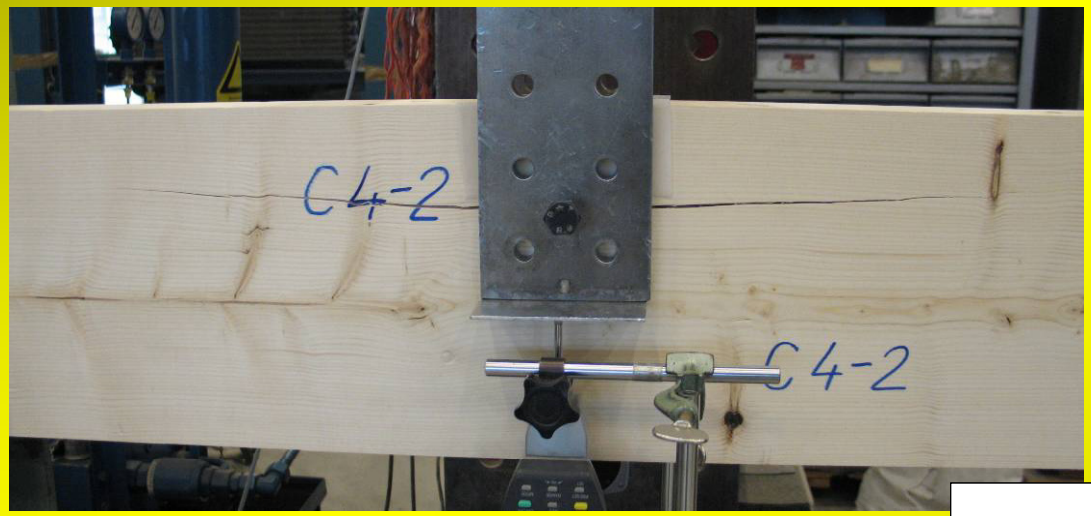


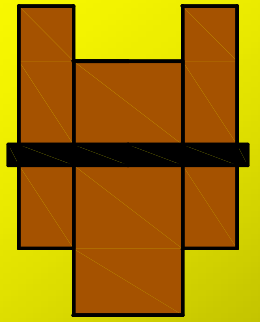


**: Sawata and Yasumura (2002)*

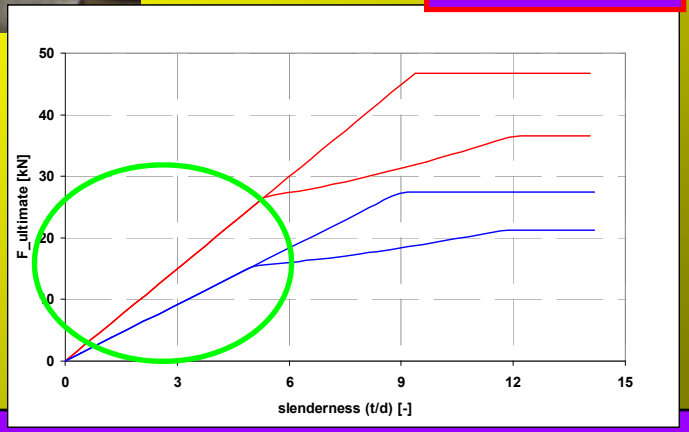
Joint Ductility

- Example: caused by number of fasteners (n=1)





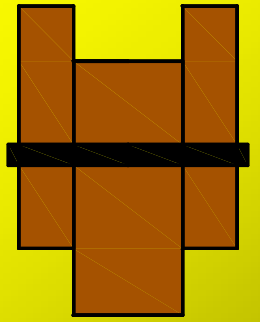
Rigid, i.e. λ small



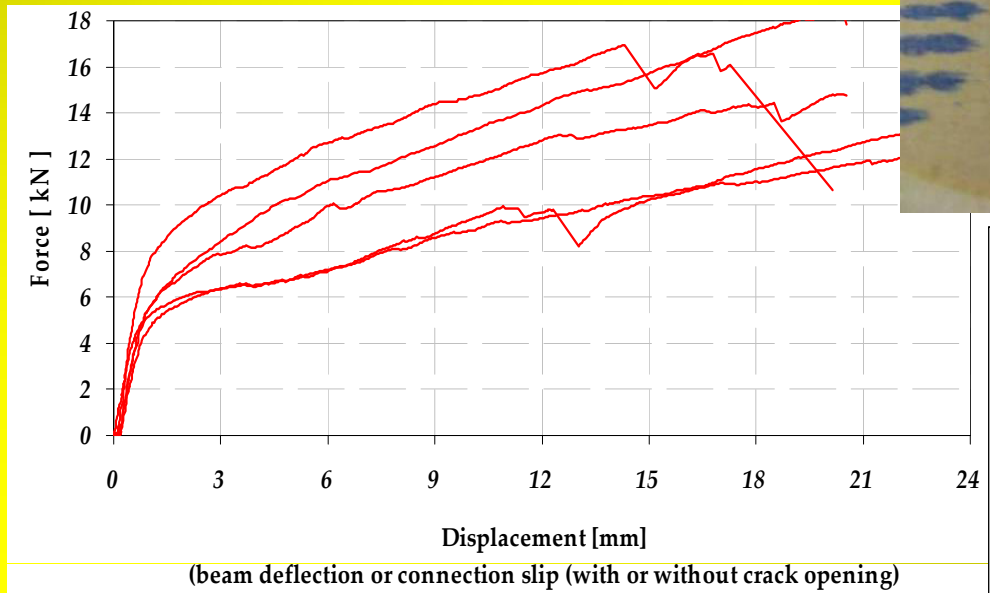
Joint Ductility

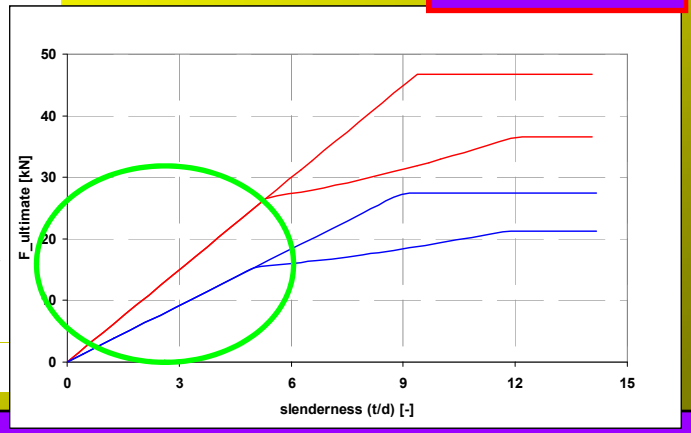
- Example: caused by number of fasteners (n=1)

Low slenderness → ductility



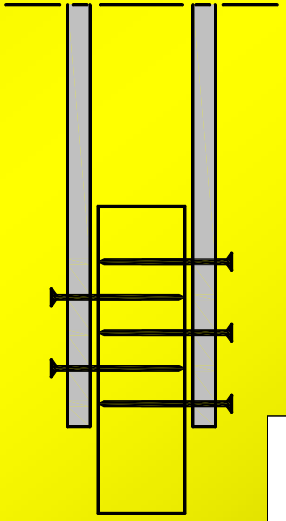
Rigid, i.e. λ small

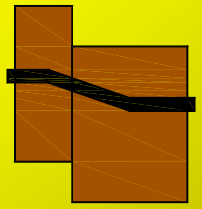




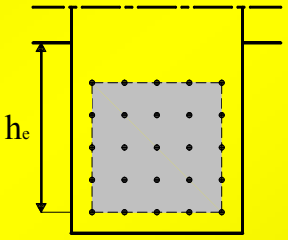
Joint Ductility

- Example: caused by number of fasteners II (n=25) Single shear

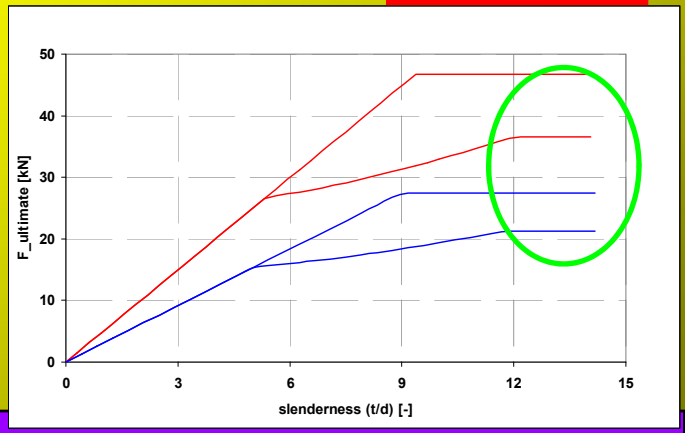




Slender, i.e. λ large



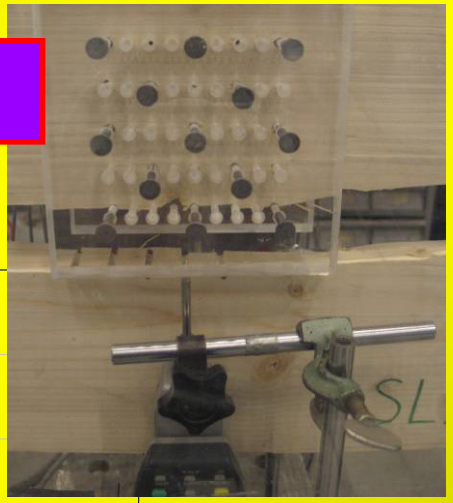
5 x 5 ∅4

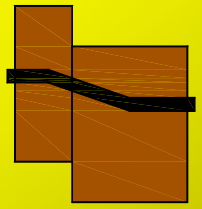


Joint Ductility

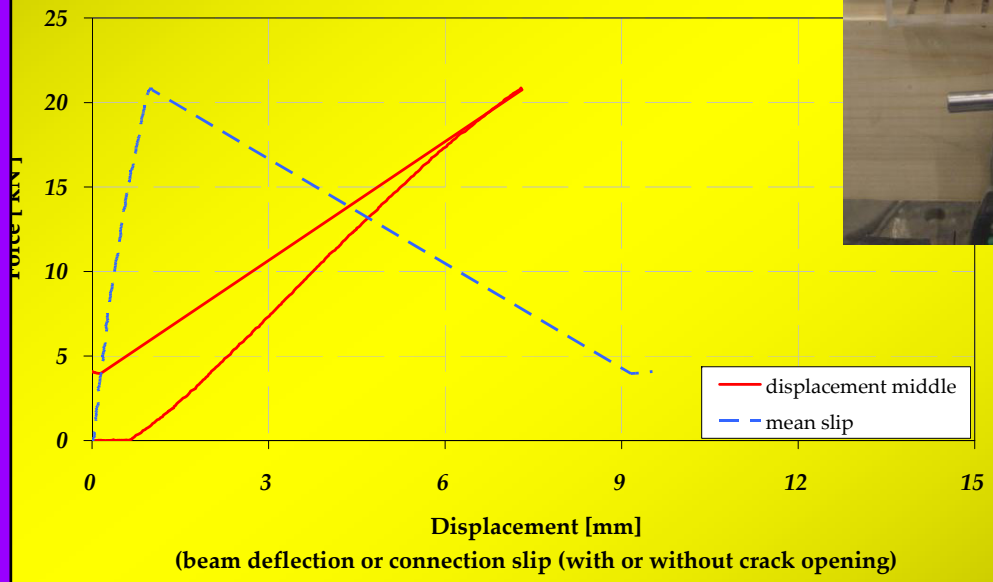
- Example: caused by number of fasteners II (no hinges developed)

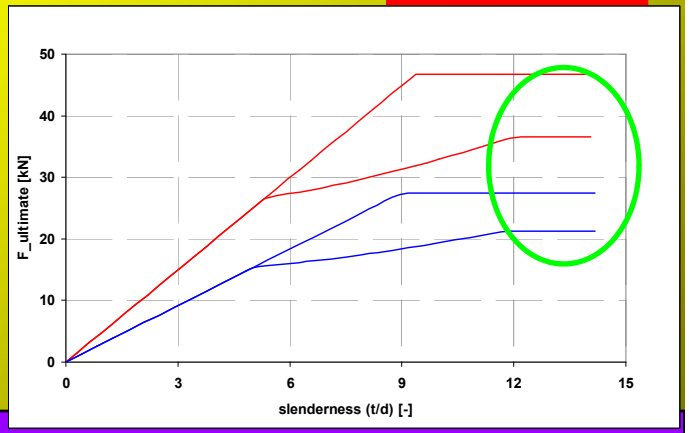
High slenderness → brittle





Slender, i.e. λ large





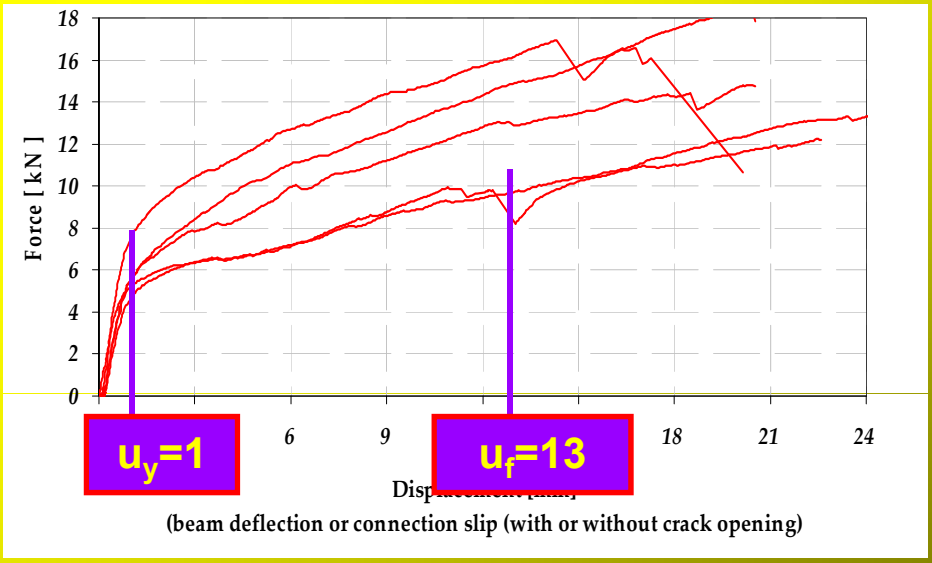
Joint Ductility

- Sufficiently slender fasteners ≠ ductile joint behaviour
- Ductility according to Johnsson (2004):

$$D_f = \frac{u_f}{u_y}$$

- Application: example 2

$$D_f \approx \frac{13}{1} = 13$$



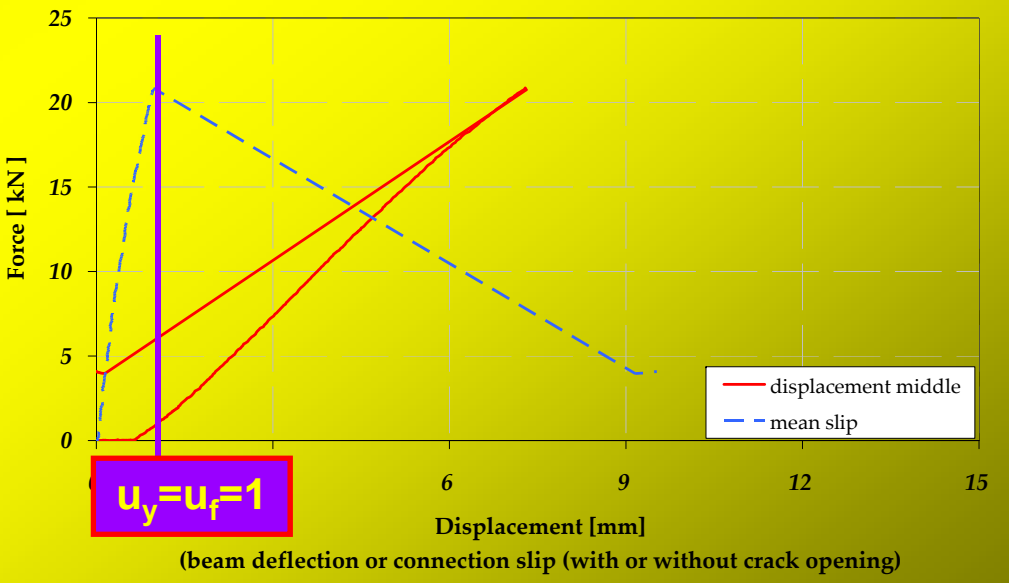
Joint Ductility

- Sufficiently slender fasteners doesn't lead to ductile joint behaviour
- Ductility according to Johnsson (2004):

$$D_f = \frac{u_f}{u_y}$$

- Application: example 3

$$D_f \approx \frac{1}{1} = 1$$



Joint Ductility: conclusions and remarks

- When loaded perpendicular to the grain only two different types of behaviour can occur:
  - Pure brittle
  - Ductile
- Joint behaviour is governed by number of fasteners
  - Number Large → Brittle (independant of number of shear planes)
  - Number small → Ductile
- Applying slender fasteners doesn't lead to ductile joint behaviour
- Ductility according to Johnsson (2004) seems a reasonable measure
  - Pure brittle: $D_f=1$
  - Ductile: $D_f>>1$ (due to strain hardening in compression) → large displacements

Discussion