HELSINKI UNIVERSITY OF TECHNOLOGY
Wood Technology

Puu-28.3050 Wooden Structural Joints Exam *9.5.2007*

Please follow these instructions:

- *The participant may take only his or her ID certificate, calculator, previously given EC5 standard and writing material to the exam.*
- *Paper handed out by the supervisor is the only acceptable stationary to be used in the exam.*
- *All paper handed out must be returned.*
- *Previously given EC5 standard must also be returned.*
- *Please fill the course evaluation form.*
- *Identity of the participant will be verified when he or she hands in the answers.*
- *This exam has four exercises, 10 points of each, max. 4 x 10 = 40 points.*
- *Good luck!*

1. Answer true (T) or false (F)

i. The purpose of the design is to get a low probability of failure, i.e. a low probability of getting action values higher than the resistances.

ii. For timber structures, the designer must pay special attention to finding out the critical load cases as they depend on the material load-duration factors and fire resistance. At the ultimate limit states, the combination is related to the use of k_{mod} factor.

iii. The strength and stiffness properties of timber are highly dependant on the angle between load and grain.

iv. Structural timber must be strength graded in order to ensure that its strength and stiffness properties are well distributed.

v. As with solid timber, the elastic properties and strength of plywood are correlated with density.

vi. Combustibility (sensitivity to fire) of wood-based beam is dependent on the surface /volume-ratio. The lesser this is the more easily ignition starts and faster the flames spread.

vii. Fungi and environmental poisons are two main biological agents responsible for timber degeneration in service.

viii. The deformation of timber structures changes during their lifetime, due to variable loads, moisture variations and creep.

ix. Parallel to the grain, tensile strength of wood is usually larger than the compressive strength.

x. Mechanically jointed beams are stiffer than an otherwise similar but glued beams.

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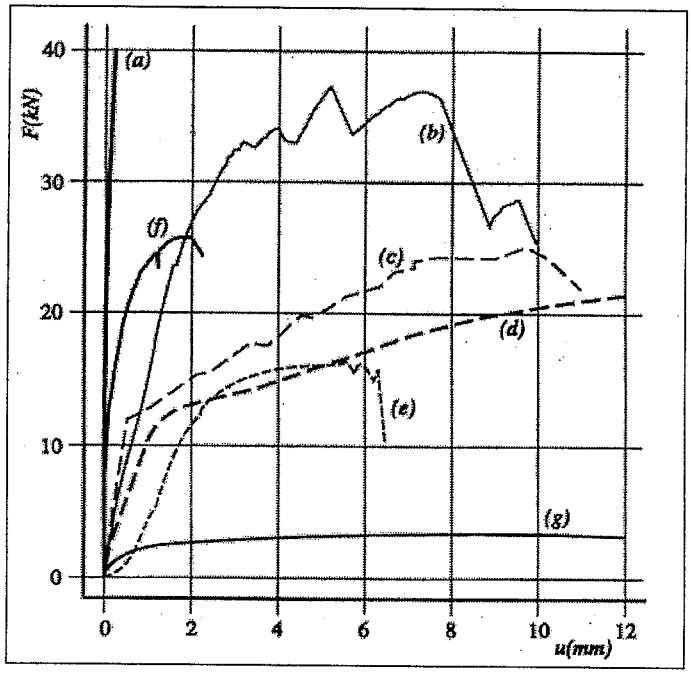
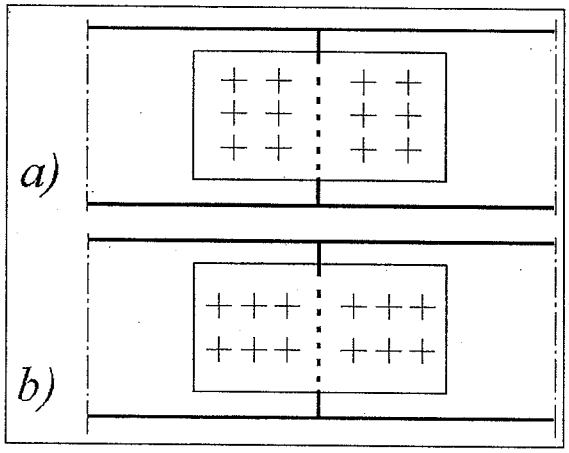
2. Examine figures and answer shortly to the questions.

i. Figure below shows experimental load-slip curves of different fasteners where the load is defined per shear plane. Which of these joints behave like nail, dowel, bolt or punched plate joint? Why?



ii. Figure below shows two nailing patterns of plywood-to-timber tension splice joint. If postulated that spacing of nails is adequate in these otherwise similar joints, which of joints has more capacity due to EC5? Why?



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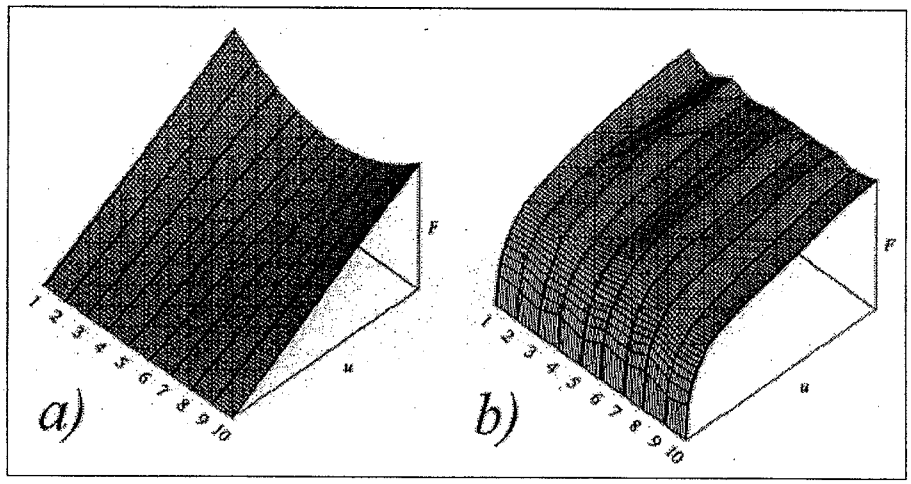
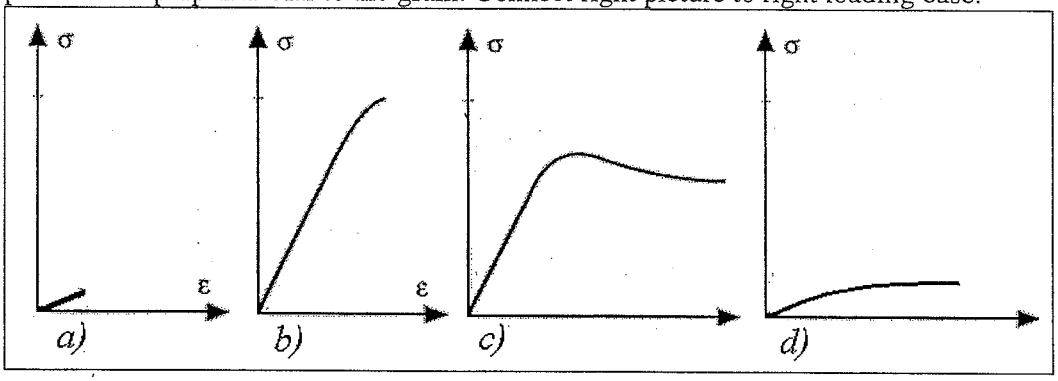
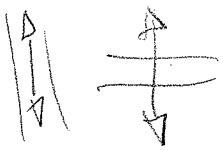
iii. Figure below shows two different behaviours of fasteners in multiple fasteners joint. Explain why pictures are different and what theories exist behind these pictures .



iv. Figure below shows stress-strain curves for clear wood in tension and compression both parallel and perpendicular to the grain. Connect right picture to right loading case.





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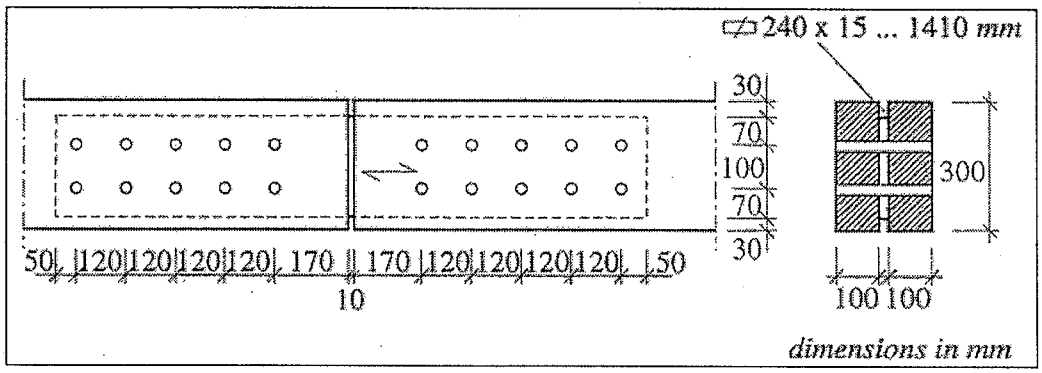
3. Figure below describes dowelled steel-to-timber joint. Examine capacity of joint when:

- Dowels are steel, d = 16 mm and $F_{u,k}$ = 420 N/mm^2
- Wood is glued laminated timber with density ρ_k = 380 kg/m^3
- Service class is 1 and duration class short-term

Strength of the metal plate is adequate.



4. Figure below describes dowelled timber-to-timber joint.

i. Examine capacity of joint when:

- Dowels are steel, d = 12 mm and $F_{u,k}$ = 360 N/mm^2
- Wood is structural timber (softwood) with density ρ_k = 380 kg/m^3
- Service class is 2 and duration class short-term

ii. Estimate instantaneous slip, when permanent load is 8 kN and variable load is 10 kN.