Request by

Ristek Oy
Kimmo Köntti
Teollisuustie 7
FI-15540 Villähde
kimmo.kontti@ristek.fi

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Contact person

Eurofins Expert Services Oy
Ari Kevarinmäki
Kemistintie 3, Espoo
P.O. Box 47, FI-02151 Espoo
AriKevarinmaki@eurofins.fi

Task

Statement for nail plate LL10

General

This statement is based on the testing of the nail plate according to the standards EN 14545:2008 and EN 1075:2014. The tests have reported in VTT's research report no VTT-S-09770-08. The characteristic properties have been determined from the test results according to standards EN 14545:2008 and EN 14358:2016.

The structure of the nail plate is according to Figure 1. The nail plate is manufactured from pre-galvanised steel strips S350GD+ Z275 (EN 10346). The yield strength of the steel plate is at least 350 N/mm^2 and the tension strength at least 420 N/mm^2. The nominal thickness of steel plate is 1,0 mm, the minimum thickness is 0,95 mm and the design core thickness without zinc coatings is at least 0,91 mm.

On the basis of the above-mentioned research data, Eurofins Expert Services Oy regards that LL10 nail plate may be used in load carrying joints of softwood timber structures in service class 1 and 2. The nail plate connections shall be designed and manufactured according to EN 1995-1-1 and EN 14250. The thickness of timber shall be at least 42 mm.

The strength values of the statement are given as the characteristic values X_k of Eurocode 5 (EN 1995-1-1). The design values X_d are calculated by formula

$$X_d = \frac{k_{mod} X_k}{\gamma_M}$$

where k_{mod} is the modification factor for service class and duration of load, that is used in the calculation of anchorage strength and

γ_M is the partial coefficient for material properties according to the actual National Annex of Eurocode 5 (EN 1995-1-1).

Symbols

The symbols used in the statement are defined as follows:

x-direction main direction of plate,
y-direction perpendicular to the main direction,

a	angle between the *x*-direction and the force *F* (see Figure 2),
b	angle between the grain direction and the force *F*,
$f_{a,0,0}$	the anchorage strength for a = 0° and b = 0°,
$f_{a,90,90}$	the anchorage strength for a = 90° and b = 90°,
$f_{t,0}$	the tension capacity per unit width of the plate in the *x*-direction (a = 0°),
$f_{c,0}$	the compression capacity per unit width of the plate in the *x*-direction,
$f_{v,0}$	the shear capacity per unit width of the plate in the *x*-direction (a = 0°),
$f_{t,90}$	the tension capacity per unit width of the plate in the *y*-direction (a = 90°),

$f_{c,90}$ the compression capacity per unit width of the plate in the *y*-direction,

$f_{v,90}$ the shear capacity per unit width of the plate in the *y*-direction (a = 90°),

k_1, k_2, k_v, a_0 and g_0 constants.

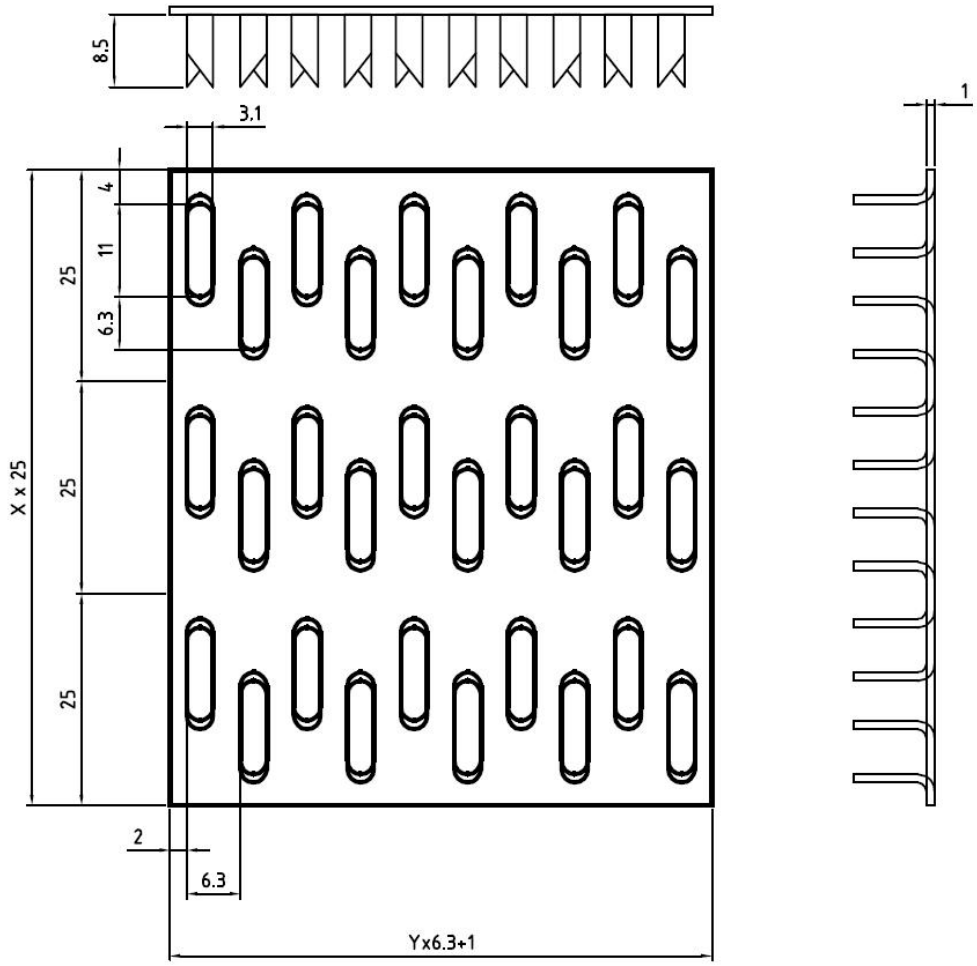

Figure 1. Structure of LL10 nail plate.

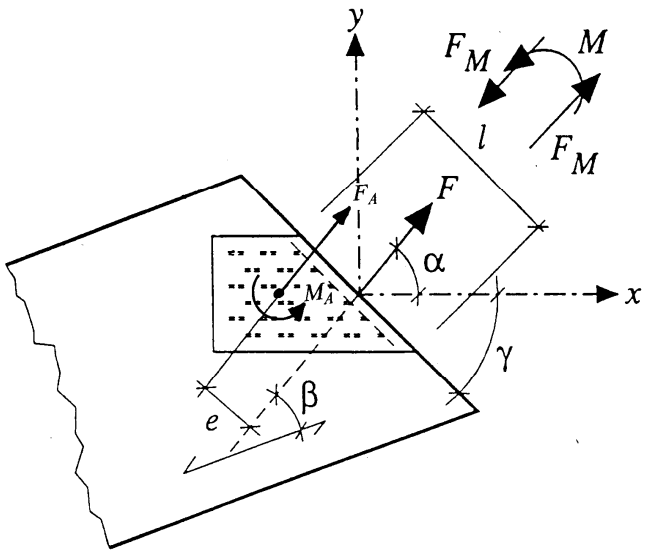

Figure 2. Geometry of nail plate connection loaded by a force *F* and moment *M*.

Anchorage

The characteristic anchorage strength $f_{a,a,b,k}$ is calculated according to Clause 8.8.4 of EN 1995-1-1.

The anchorage parameters of LL10 nail plate are as follows for sawn timber of strength class C24 according to EN 338 and for glued laminated timber of strength class GL30c according to EN 14080:

$f_{a,0,0,k}$ = 3,21 N/mm^2
$f_{a,90,90,k}$ = 1,75 N/mm^2
k_1 = -0,010
k_2 = -0,002
a_0 = 60°

For anchorage strength with other strength class of sawn timber, the characteristic value $f_{a,a,b,k}$ should be multiplied by the factor k_r given by

$$k_r = \sqrt{\frac{\rho_k}{350\ \mathrm{kg/m^3}}}$$

where ρ_k is the characteristic density of sawn timber.

For anchorage strength with other strength class of glued laminated timber, the characteristic value $f_{a,a,b,k}$ should be multiplied by the factor k_r given by

$$k_r = \sqrt{\frac{\rho_k}{390\ \mathrm{kg/m^3}}}$$

where ρ_k is the characteristic density of glulam.

Plate capacity

The plate capacity of the joint line is calculated according to Clause 8.8.5.2 of EN 1995-1-1.

The characteristic values of the plate capacity parameters are as follows:

$f_{t,0,k}$ = 184 N/mm
$f_{c,0,k}$ = 79 N/mm
$f_{v,0,k}$ = 99 N/mm
$f_{t,90,k}$ = 121 N/mm
$f_{c,90,k}$ = 81 N/mm
$f_{v,90,k}$ = 73 N/mm
γ_0 = 4°
k_v = 0,54

Slip modulus

The following value may be used as the general instantaneous slip modulus per unit of the effective nail plate area with mean density of timber ρ_{mean} = 430 kg/m^3:

k_{ser} = 9,6 N/mm^3

For advanced design methods, where the loading direction of the plate α [°] is taken into account, the following values of instantaneous slip modulus per unit of the effective nail plate area may be used:

$K_{F,\alpha,ser}$ = 10,5 – 0,04α	N/mm^3	when $\alpha \leq 30°$
$K_{F,\alpha,ser}$ = 8,1 + 0,04α	N/mm^3	when $30° < \alpha \leq 90°$

The instantaneous rotational stiffness of the effective nail plate area ($K_r = K_{F,ser} l_p$) may be calculated by using the general value of the instantaneous slip modulus:

$K_{F,ser} = k_{ser} = 9{,}6$ N/mm^3

This statement shall be valid up until 30.11.2023 at the latest.

Espoo, 9th November 2018

Markku Hentinen
Business Manager

Ari Kevarinmäki
Leading Expert

Appendix — Graphically presented characteristic strength values.

Distribution

Customer	electronically approved
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Characteristic strength values of LL10 nail plate presented graphically.

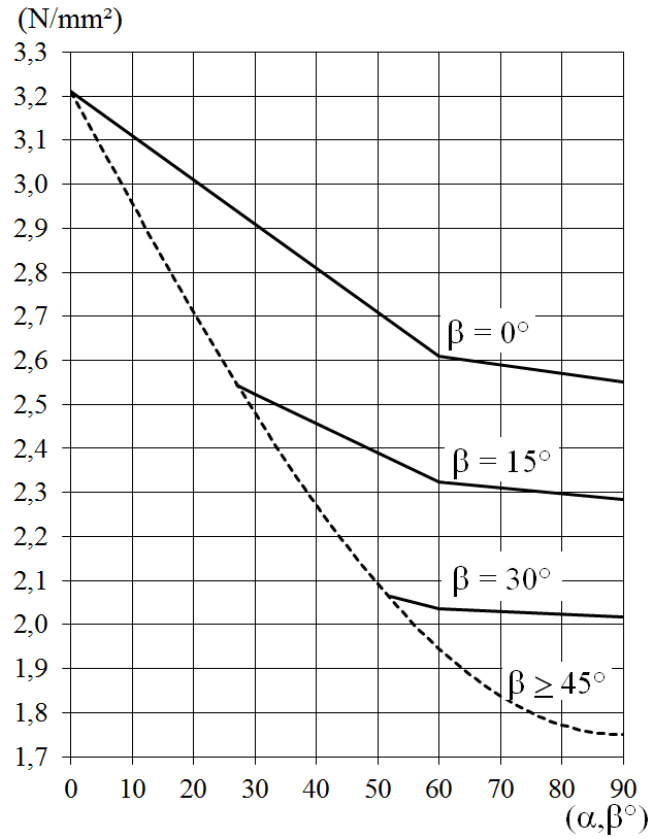

Figure A1. Characteristic anchorage strength $f_{a.a.b.k}$ for solid timber in strength class C24. The minimum curve (dash line) is used for direction angle max(a,b).

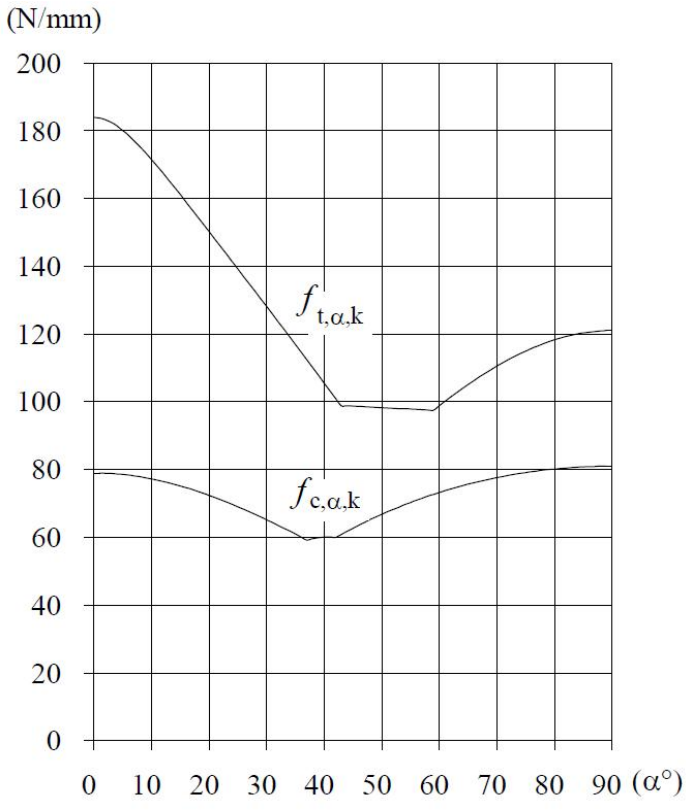

Figure A2. Characteristic plate capacities for tension ($f_{t,a,k}$) and for compression ($f_{c,a,k}$).

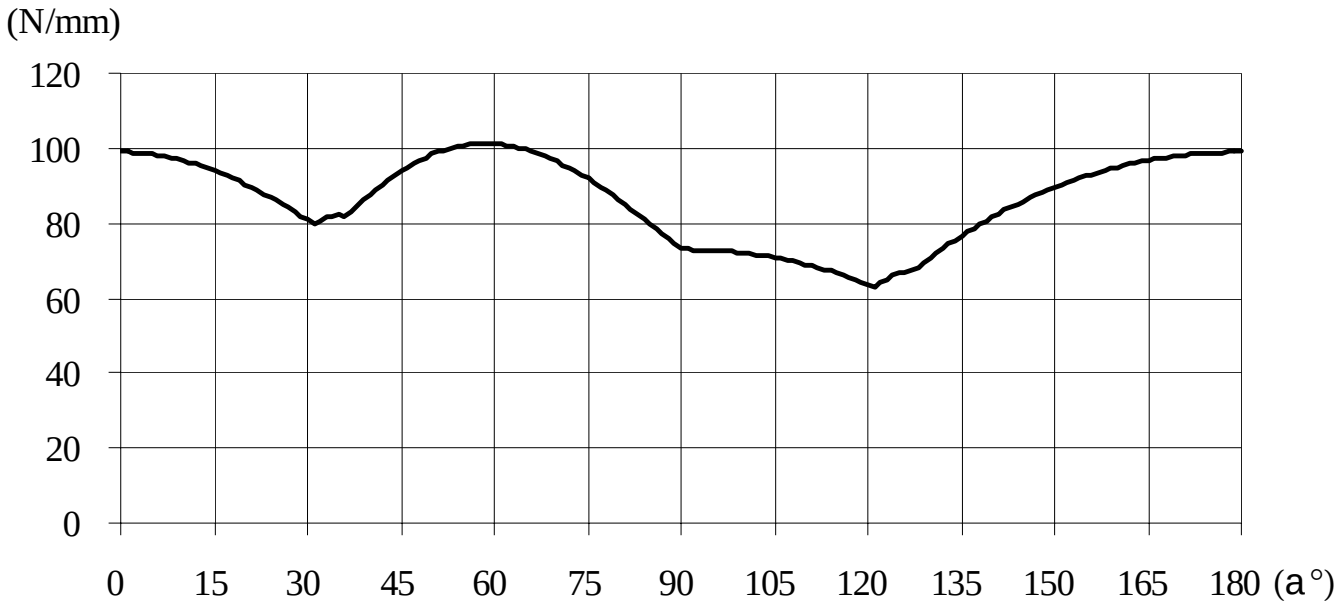

Figure A3. Characteristic plate capacity for shear $f_{v,a,k}$.