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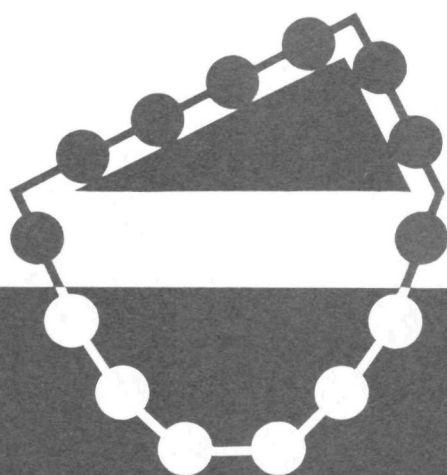
**AFDELING DER CIVIELE TECHNIEK**

Rapport 4 - 81 - 2 - N - 16

Proposal for a RILEM-Recommendation for:  
Testing methods for joints with mechanical  
fasteners in load-bearing timber structures.  
Annex 1B: Nails.  
RILEM Committee 3TT.

januari 1981

Prof. ir. J. Kuipers.



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**HOUTCONSTRUCTIES**

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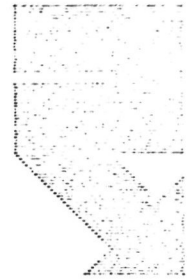
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RECOMMENDATION TENTATIVE 3TT-1B



*TENTATIVE RECOMMENDATION 3TT-1B*

3TT-1B

*JOINT COMMITTEE RILEM/CIB-3TT: TESTING METHODS FOR TIMBER*

Testing methods for joints with mechanical fasteners in load-bearing timber structures.

Annex 1B: "Nails".

The text presented hereunder are drafts which are published in order to be submitted to comments. The final draft will be drawn by the committee above from this draft with regard to the possible comments.

Comments to be sent to: J. Kuipers, Stevin Laboratorium, Stevinweg 4, 2628 CN Delft, The Netherlands; before December 31st, 1981.

FOREWORD

Final Recommendations 3TT-1: "Testing methods for joints with mechanical fasteners in load-bearing timber structures" were published in Vol 12 No 70 1979 of this journal. It was foreseen that Annexes should be produced for testing methods for joints with specific fasteners. A first Annex 3TT-1A was published as a tentative recommendation in 1978 and it is expected that this will be finalized in 1981. This is the second Annex 3TT-1B about testing methods for nails.

B.0 INTRODUCTION

This annex was produced in order to encourage the use of standard test methods for determining the strength properties of joints with different types of nails, used in load-bearing timber structures.

Standard rules for the determination of characteristic strengths and for allowable loads will be developed by CIB-W18.

## B.1 DEFINITIONS

(Space for definitions if necessary.)

## B.2 SCOPE

2.1. These Recommendations are an Annex to the Recommendations 3TT-1: "Testing methods for joints with mechanical fasteners in load-bearing timber structures". Both documents 3TT-1 and 3TT-1B belong together and must be used together.

B.2.2. This annex gives preferred test methods for determining

- a) maximum load and load-deformation characteristics of laterally loaded nailed joints, both for wood-to-wood joints as for wood-based sheet materials or metalplates nailed to wood;
- b) maximum load and load-deformation characteristics for axially loaded nailed joints (withdrawal testing);
- c) mechanical properties of nails and timber

B.2.3. The maximum loads and load-deformation characteristics may be determined for various angles between the direction of the applied force and the direction of the grain of the timber.

## B.3 FIELD OF APPLICATION

These recommended test procedures apply to joints with all types of nails (plain shank, round, square, twisted, grooved, etc.), driven by hand or automatically into the wood.

They may also be applied to e.g. wood screws, lag screws, steel pins, etc..

. If this is so, it should be mentioned in the title of the Recommendation.

## B.4 MANUFACTURING AND CONDITIONING OF TEST SPECIMENS

## B.4.1. Manufacturing.

Test specimens shall be made in the same way as in practice i.e. hand-driven, pneumatic, etc..

## B.4.2. Conditioning.

The test specimens shall be manufactured with the timber at a moisture content of  $18 \pm 2\%$  and afterwards shall be conditioned to an equilibrium state for the moisture class specified for the test. See CIB-Structural Timber Design Code Clause 2.2 <sup>1)</sup>.

. See remarks at same place in annex A

At least one week should be waited after the manufacturing before testing is started.

1)

CIB-code moisture classes are as follows:

moist. class	temp.	relat. humidity
1	$20 \pm 2^{\circ}\text{C}$	normally $\leq 0.65$ always $\leq 0.80$
2		normally $\leq 0.80$
3	all other climatic conditions	

B.5 SAMPLING

- B.5.1. The materials from which the test specimens will be made must be sampled in accordance with ISO 0000 <sup>2)</sup>.
- B.5.2. For determination of maximum loads and load-deformation characteristics species and quality of the timber shall be as specified for the test.

Who is able to provide us with a proposal for W18?

B.6 TESTING JOINTS WITH LATERALLY LOADED NAILS.

B.6.1. Test specimens.

B.6.1.1. Wood to wood joints.

B.6.1.1.1. Test specimens shall be made as symmetrical 3-member joints

- a) according to fig. 1 for one-section action and
- b) according to fig.2 for two-section action of the nails.

B.6.1.1.2. The penetration length into the central member in the case of one-section nails and into the second sidemember in the case of two-section nails shall be chosen so that the yieldpoint of the nail will be reached at or before the max. load occurs.

N.B. 1) For European softwoods in combination with "normal European nails" this means a penetration  $l_h \geq 8d$ .

N.B. 2) This penetration length can be estimated as

$$l_h = 1.4d \sqrt{\frac{\sigma_v}{\sigma_s}} \approx 1,1.$$

B.6.1.1.3. The thickness  $t_c$  of the central member must be chosen

- a)  $t_c = 8d + 3d = 11d$  for one-section nails with overlapping placing in the central member (fig. 1)
- b)  $t_c = 8d (=t_s)$  for two-section nails.

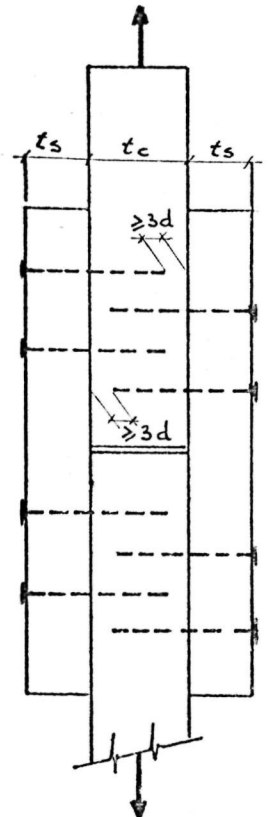


Fig.1 1-SECTION

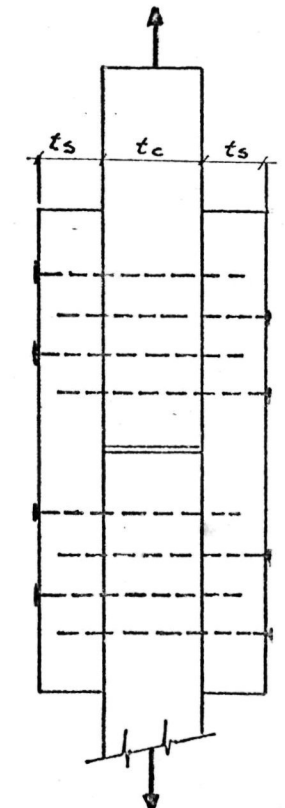


Fig.2 2-SECTION

<sup>2)</sup> to be prepared by CIB-W18

B.6.1.1.4. The thickness  $t_s$  of the side members, the mutual nail distances  $d_{//}$  and  $d_{\perp}$  as well as the end and edge distances shall be chosen so, that the crushing strength of the timber rather than e.g. its shear strength or cleavage is determining the maximum load.

N.B. For European softwoods in combination with "normal European nails" this means

$$t_s \geq 7d \quad d_{//} \geq 10d; \quad d_{\perp} \geq 5d.$$

B.6.1.1.5. The number of nail-sections in each contact surface between the members and placed in a row parallel to the force-direction shall be at least 3.

B.6.1.1.6. For determination of the joint strength parallel to the grain normally tension tests should be tested.

a) If a test specimen following fig. 3a is used, attention may be given to the fact that the weakest of two joints is found; this has effects on the main value and on the standard deviation.

b) If a specimen according to fig. 3b is used the separation of the side members, in combination with pulling out of the nails, shall not be hindered by the loading-equipment.

c) If compression test specimens are used the total length of the specimen should be at least 3 times the overlapping length of the joint, fig. 4.

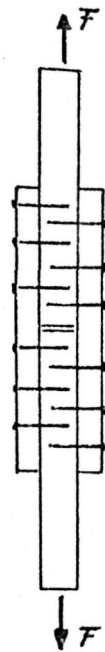


Fig 3a

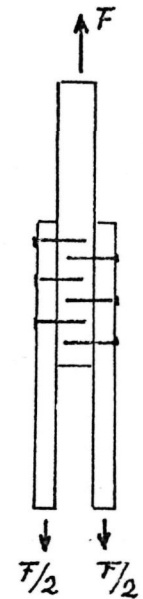


Fig 3b

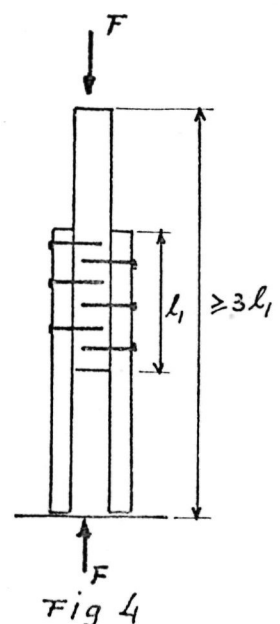


Fig 4

B.6.1.1.7. For measuring the strength perpendicular to the grain test specimens according to fig. 5 a or 5 b shall be used.

B.6.1.1.8. For measuring the strength with another angle to the grain a test specimen as in fig. 6 shall be used.

B.6.1.2. Sheetmaterial-to-wood-joints.

B.6.1.2.1. Test specimens shall be made as symmetrical 3-member joints, with a wooden central member.

B.6.1.2.2. The penetration length of the nails into the central member shall be chosen so that the yield-point of the nail will be reached at or before the max. load occurs.  
N.B. See B.6.1.1.2.

B.6.1.2.3. The thickness  $t_c$  of the central member shall be  $8d + 3d = 11d$  (fig. 1)

B.6.1.2.4. The thickness  $t_s$  of the side members is equal to the thickness of the sheet material.

B.6.1.2.5. The number of nail sections in each contact surface between the members and placed in a row parallel to the force direction shall be at least 3.

B.6.1.2.6. See B.6.1.1.6.

B.6.1.2.7. See B.6.1.1.7.

B.6.1.3. Steel-to-wood joints.

B.6.1.3.1. If a steel plate with a thickness less than the nail diameter  $d$  is used see Annex 3TT-1A.

B.6.1.3.2. For test specimens for steel-to-wood joints with steel parts thicker than the nail diameter  $d$ , see B.6.1.2.

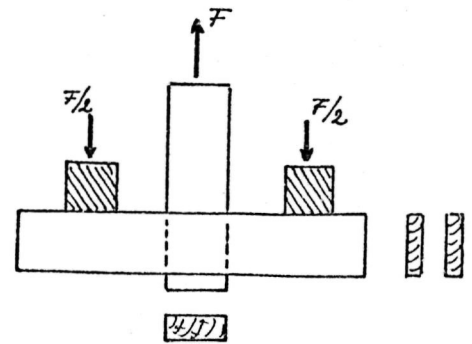


Fig 5a

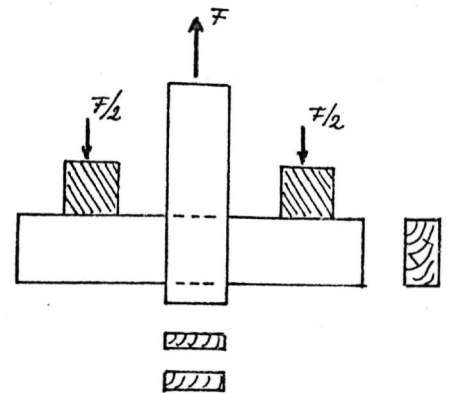


Fig. 5b

. Something to be said about the nail diam?

$$d = 0.7 \sqrt{\frac{\sigma_s}{\sigma_v}} \cdot t_s ?$$

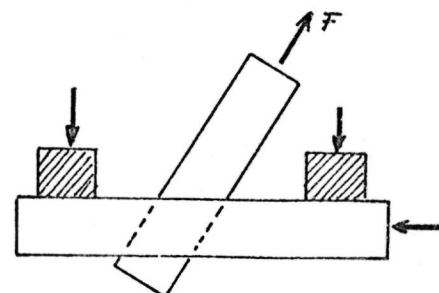


Fig 6



B.6.2. Number of tests.

B.6.2.1. The number of tests must be enough to estimate with 75% confid. level the 5% lower percent. value for a certain nail diameter.

B.6.2.2. If strength values for a series of nails with different nail diameters must be determined it is sufficient to test a relevant number of diameters so that interpolation of the results can take place.

B.6.3. Loading procedure.

B.6.3.1. The load shall be applied and deformations recorded as recommended in 3TT-1: clause 7.

B.6.3.2. The deformation of the joint is defined as the mean value of the mutual displacements of the two side members with respect to the central member.

B.6.4. Results.

The deformation and the maximum loads for each test as well as all other relevant information shall be recorded as recommended in 3TT-1: clause 7.

B.7 TESTING OF AXIAL LOADED NAILS I.E. WITHDRAWAL STRENGTH AND PULL-THROUGH STRENGTH.

B.7.1. Test specimens.

B.7.1.1. Withdrawal strength

B.7.1.1.1. Nails shall be driven into the specified wood (species and grade) to a penetration of at least 8 d.

Mutual distances of the nails will be  $d_{//} \geq 10 d$  and  $d_{\perp} \geq 5d$ , the edge distances  $\geq 5d$ .

. or: only half of this value?

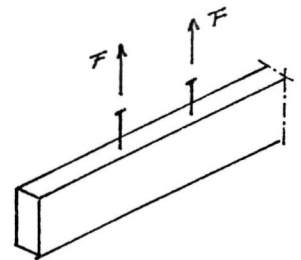


Fig 7

. Must something be said about slant-nailing or toe-nailing?

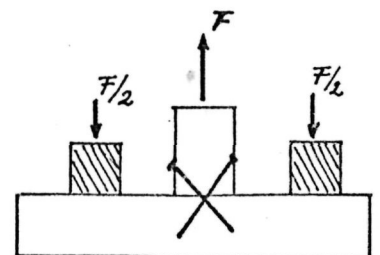


Fig 8

B.7.1.2.1. Test specimens for pull-through strength shall be made with wood or with sheet material nailed to a wooden member (fig. 9) the head of the nail driven like in praxis.

In any case the longest nail of the tested nail diameter must be used.

Mutual distances as well as edge distances etc. shall be at least the values as in B.7.1.1.1.

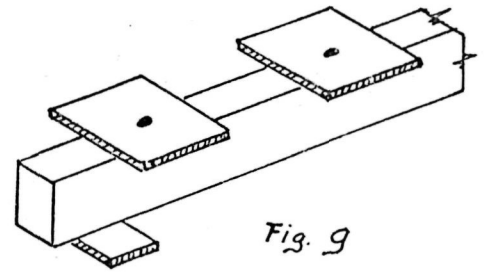


Fig. 9

B.7.2. Number of tests.

See B.6.2.

B.7.3. Loading procedure.

B.7.3.1. The load shall be applied and deformations recorded as recommended in 3TT-1: clause 7, but except that the pre-load cycle at the beginning of the loading sequence may be omitted.

B.7.4. Results.

See B.6.4.

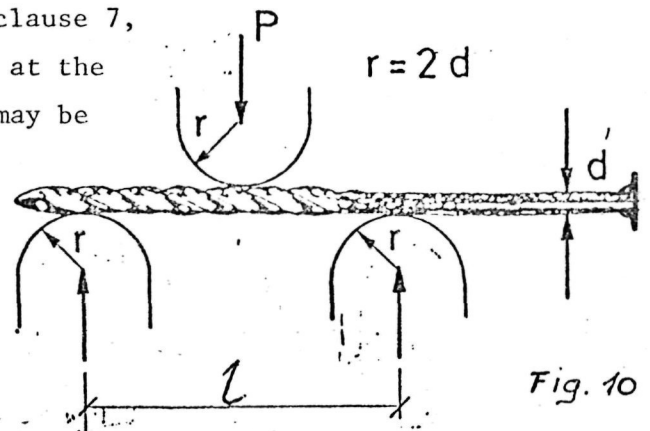


Fig. 10

## B.8 MATERIAL PROPERTIES

B.8.1. Bending properties of nails.

The bending strength and/or the yield-point of the nail must be determined by a bending test according to fig. 10.

Values for  $l$ ,  $r$  and for the rate of deflection are given in the table below

d (mm)	$l$ (mm)	r (mm)	defl. w/min.
2 - 3	25	6	3
3.1 - 4.4	38	6	5
4.5 - 6	50	12	6
6.1 - 8	75	12	8

B.8.2. The embedding strength of the timber and of the wood-based sheet materials must be determined following fig. 11.

B.8.3. Test report.

The test report shall include all relevant information recommended in 3TT-1: clause 8.

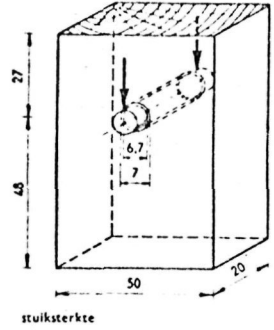
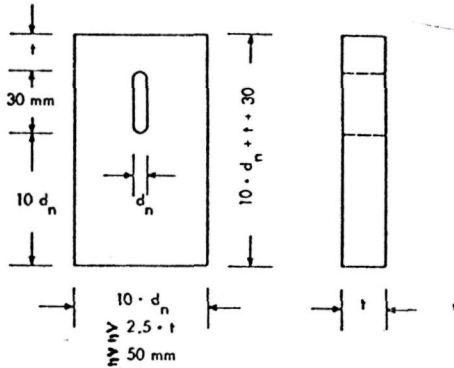


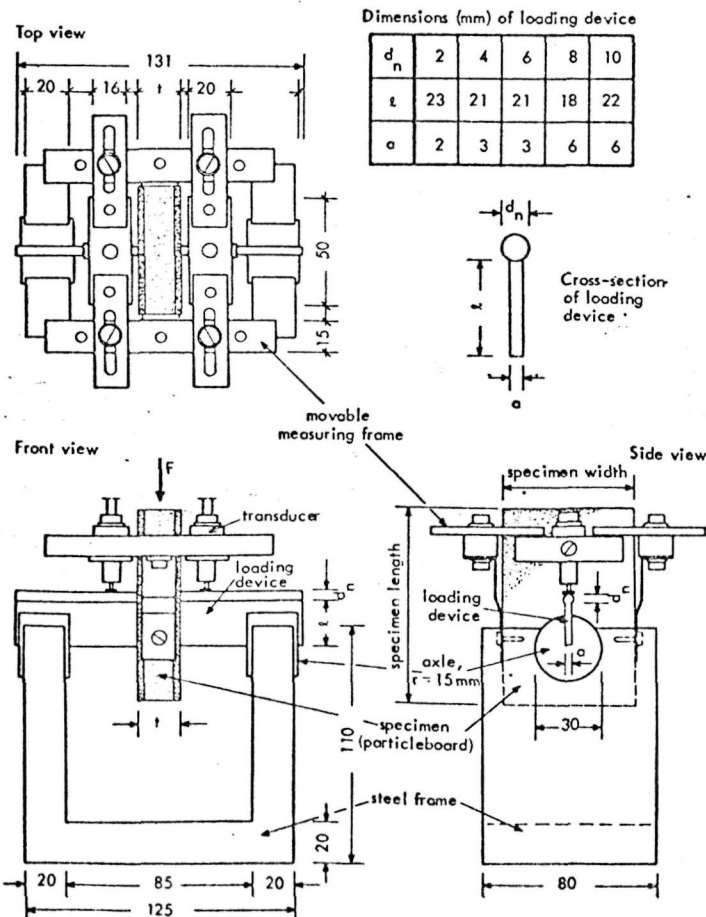
Fig 11<sup>a</sup> (HERON)  
Dutch specimen.

Fig. 11<sup>b</sup>



. a choice between 11 a and 11 b should be made.

(Fig. 44) - Specimen for testing embedding strength of particleboard (Mochler, Budianto, Ehlbeck, 1978).



(Fig. 45) - Test equipment and set-up for determination of foundation modulus and embedding strength of particleboard (Mochler, Budianto, Ehlbeck, 1978).