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Timber structures

Calculation of characteristic 5-percentile values and acceptance criteria for a sample

F : Structures en bois — Détermination des valeurs correspondant au fractile à 5 % d'exclusion inférieure et critères d'acceptation pour un échantillon

D : Holzbauwerke — Berechnung der 5 % Quantile für charakteristische Werte und Annahmekriterien für Proben

French standard approved

by decision of the Director General of AFNOR on March 20, 2007 taking effect on April 20, 2007.

Correspondence

The European standard EN 14358:2006 has the status of a French standard.

Analysis

This document specifies a method for the determination of characteristic 5-percentile values from test results for fasteners and wood-based products.

Descriptors

Technical International Thesaurus: structural timber, computation, estimation, characteristics, materials, mechanical strength, inspection, acceptability, samples.

Modifications

Corrections





English Version

Timber structures - Calculation of characteristic 5-percentile values and acceptance criteria for a sample

Structures en bois - Détermination des valeurs
correspondant au fractile à 5 % d'exclusion inférieure et
critères d'acceptation pour un échantillon

Holzbauwerke - Berechnung der 5%-Quantile für
charakteristische Werte und Annahmekriterien für Proben

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Foreword

This document (EN 14358:2006) has been prepared by Technical Committee CEN/TC 124 "Timber Structures", the secretariat of which is held by SFS.

This document (EN 14358:2006) is based on Annex D of EN 1990:2002, Eurocode – Basis of structural design.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

It is anticipated that the standard will replace the corresponding parts of EN 1058: Wood-based panels – Determination of characteristics values of mechanical properties and density.

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1 Scope

This document specifies a method for the determination of characteristic 5-percentile values from test results for fasteners and wood-based products.

This document also gives corresponding acceptance criteria for a sample.

Structural timber is not covered by this document but by EN 384.

Sampling is not covered by this document, but reference is made to the relevant product standards.

2 Normative references

Not applicable.

3 Symbols

k_n	Factor (see Table 2)
k_s	Factor (see Table 1)
m_i	Test value
m_k	Characteristic value
n	Number of test values
s_y	Standard deviation
u_x	x-fractile in the standardised normal distribution
y	Stochastic value, $y_i = \ln m_i$
$\bar{y}$	Mean value
α	Confidence level (%)

4 Calculation of characteristic values from test results

4.1 The characteristic value of a material parameter or a resistance shall be determined at a confidence level of $\alpha = 75\%$, where the confidence level α is defined as the probability of which the characteristic value is greater than the estimator on the characteristic value.

NOTE The confidence level $\alpha = 75\%$ corresponds to the value recommended in EN 1990.

4.2 The characteristic value of m_k for a material strength parameter or a resistance m modelled as a stochastic variable is defined as the p -percentile in the distribution function for m , corresponding to an assumed infinitely large test series.

4.3 $p = 5\%$ shall be assumed.

4.4 It is assumed that n test values are available and that these may be assumed to originate from a homogeneous population. The test values, which are assumed to be logarithmically normally distributed and independent, are denoted $m_1, m_2, \dots, m_n$.

4.5 The mean value $\bar{y}$ and the standard deviation s_y for the stochastic variable $y = \ln m$ shall be determined as

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n \ln m_i \quad (1)$$

$$s_y = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\ln m_i - \bar{y})^2} \quad (2)$$

4.6 The characteristic value shall be determined as

$$m_k = \exp(\bar{y} - k_s s_y) \quad (3)$$

where k_s is given in Table 1.

NOTE k_s is determined as: $k_s = \frac{k}{\sqrt{n}}$ where k is the α -percentile in a non-central t -distribution with $n-1$

degrees of freedom and the non-centrality parameter $\lambda = u_{1-p} \sqrt{n}$. u_{1-p} is the $(1 - p)$ percentile of the standardised normal distribution function.

4.7 The coefficient of variation shall not be assumed to be less than 0,05.

Use the value $s_y = 0,05$ in equation $m_k = \exp(\bar{y} - k_s s_y)$ in the case where coefficient of variation is less than 0,05.



Table 1 - Factor k_s values

Number of test specimens	Factor
n	k_s
3	3,15
5	2,46
10	2,10
15	1,99
20	1,93
30	1,87
50	1,81
100	1,76
500	1,71
∞	1,65

5 Acceptance criteria for a sample

5.1 If a variable control method is applied to control of material parameters or resistance, such control method shall be composed with a significance level of $\alpha = 75 \%$, where the significance level α is defined as the probability of not accepting a delivery having the required characteristic value.

NOTE The significance level $\alpha = 75 \%$ corresponds to the value required in Clause 4.

5.2 It is assumed that n test values are available and that these may be assumed to be derived from a homogeneous population described by the stochastic variable m . The test values which are assumed to be logarithmically normally distributed, are denoted $m_1, m_2, \dots, m_n$.

5.3 The mean value $\bar{y}$ and the standard deviation s_y for the stochastic variable $y = \ln m$ shall be determined as:

$$\bar{y} = \frac{1}{n} \sum_{i=1}^n \ln m_i \quad (4)$$

$$s_y = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\ln m_i - \bar{y})^2} \quad (5)$$

5.4 The control shall be performed by showing that, for the random sample with n test specimens

$$\exp(\bar{y} - k(n)s_y) > m_k \quad (6)$$

where

m_k is the assumed characteristic value

5.5 If the standard deviation is unknown from prior knowledge, the coefficient $k(n)$ shall be taken as k_s (see 4.6 and Table 1)

5.6 If the standard deviation is known, e.g. from production control of a period of 1 year or more, the coefficient $k(n)$ shall be taken as:

$$k(n) = u_{1-p} + \frac{u_{\alpha}}{\sqrt{n}} \quad (7)$$

where

u_{1-p} is the (1-p) percentile of the standardised normal distribution function (p = 5% shall be assumed);

u_{α} is the α percentile of the standardised normal distribution function ($\alpha = 75\%$ shall be assumed).

The values of $k(n)$ for known standard deviation are given in Table 2

Table 2 - Factor $k(n)$ values

Number of test specimens	Factor
n	$k(n)$
3	2.03
5	1.95
10	1.86
15	1.82
20	1.8
30	1.77
50	1.74
100	1.69
500	1.67
∞	1.65



Bibliography

- [1] EN 384, *Structural timber – Determination of characteristic values of mechanical properties and density*
- [2] EN 789, *Timber structures – Test methods – Determination of mechanical properties of wood based panels*
- [3] EN 1058, *Wood-based panels – Determination of characteristics values of mechanical properties and density*
- [4] EN 1990, *Eurocode – Basis of structural design*
- [5] EN 1995-1-1, *Eurocode 5: Design of timber structures – Part 1-1: General - Common rules and rules for buildings*

