New Zealand Standard

Timber Piles and Poles for Use in Building

Superseding NZS 3605:1992

NZS 3605:2001

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COMMITTEE REPRESENTATION

This Standard was prepared under the supervision of the Timber Piles and Poles Committee (P 3605) for the Standards Council established under the Standards Act 1988.

The Committee consisted of representatives of the following:

Building Industry Authority
Building Research Association of New Zealand
New Zealand Forest Research Institute
New Zealand Timber Industry Federation
New Zealand Timber Preservation Council Inc.

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AMENDMENTS

No	*Date of issue*	*Description*	*Entered by, and date*

CONTENTS **PAGE**

RELATED DOCUMENTS

Reference is made in this Standard to the following:

NEW ZEALAND STANDARDS

NZS 3603:1993 Timber structures Standard

NZS 3604:1999 Timber framed buildings

NZS 3631:1988 New Zealand timber grading rules

NZS 3640:0000 Timber preservation (in preparation)

BRITISH STANDARD

BS 1990:- - - - Wood poles for overhead and telecommunication lines

Part 1:1984 Specification for softwood poles

LATEST REVISIONS

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards and referenced overseas Standards are the latest revisions or include the latest amendments. Such amendments are listed in the annual Standards New Zealand *Catalogue* which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of Standards New Zealand.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6020.

FOREWORD

This Standard updates NZS 3605:1992 *Specification for timber piles and poles for use in building* by incorporating technical and editorial changes and items by way of clarification.

Several options are provided by which piles and poles may be shown to comply or may be deemed to comply with the strength requirements. These are:

(a) Visual grading to limit the size and frequency of strength-reducing characteristics either in their entire length or in critical parts;

(b) Proof testing of all poles or piles to loads related to their length and intended application;

(c) Testing of batches of house piles on an annual basis.

NZS 3605:1992 will be withdrawn one year after the publication of NZS 3605:2001.

NOTES

NEW ZEALAND STANDARD

TIMBER PILES AND POLES FOR USE IN BUILDING

1 SCOPE

1.1 House piles

This Standard sets performance criteria and provides a means of compliance for anchor, braced, cantilever and ordinary timber piles required by NZS 3604. These piles are referred to in this Standard as "house piles" and their requirements are given in section 4.

1.2 Construction piles and poles

This Standard provides a means of compliance for naturally round timber piles and poles to meet the design data assigned in NZS 3603. Requirements here are given in section 5.

2 DEFINITIONS

2.1

For the purposes of this Standard the following definitions shall apply:

BENDING CAPACITY. The 5 % lower probability limit of the maximum bending moments of piles of a particular category when those piles are tested by loading to failure under the arrangement of support and load application described in Appendix B. (The bending capacity of a pile corresponds to the product of its section modulus, its characteristic bending stress in accordance with NZS 3603, and such modification factors as are appropriate to the design of house foundations).

CHECK. A separation of fibres along the grain forming a fissure but not extending through the pile or pole.

CONSTRUCTION POLE OR PILE. A naturally round timber member used as a structural building component.

DEBARKING. The removal of bark and cambium layer by any means including peeling and shaving.

DEFECT. A naturally-occurring feature of the pile or pole that adversely affects its strength or utility value.

END SPLIT. A lengthwise separation of fibres extending completely across the end of a pile or pole.

HOUSE PILE. A round or square timber member which supports a structure to transfer axial and/or lateral loads to the ground and not extending above ground level more than 3 metres.

KNOT. A section of a branch embedded in the pile timber, including decayed, intergrown and partly intergrown, loose, spike, loose-spike and tight encased knots.

PEELING. The removal of bark and cambium layer generally by machines fitted with cutter heads which follow the natural contours and irregularities of the pole or pile. Maximum depth of wood removal is not to exceed 6 mm at any point.

PITH. The central core of a stem, consisting of soft tissue.

SHAVING. The removal of bark and cambium layer by machines fitted with cutter heads which do not follow the natural contours of the pole but remove nodal swellings sufficient to produce a uniform taper.

SHORT CROOK. A deflection from straightness affecting a maximum of 1.5 m of the length, the parts on either side of the short crook remaining straight.

SPIRAL GRAIN. A type of growth in which the wood fibres take a spiral course about the bole of the tree instead of the normal vertical course.

SWEEP. A deviation from straightness in a curve of large radius, which occurs in:

(a) One direction in a plane (single sweep);

(b) Two directions in one plane (reverse sweep);

(c) Two planes (double sweep).

TIMBER SOURCE. A plantation or grouping of plantations accepted as having similar timber properties, especially wood density.

WANE. The presence of original under bark surface, with or without bark, on any face of a sawn pile.

3 INTERPRETATION

3.1
In this Standard the word ‘shall’ identifies a mandatory requirement for compliance with the Standard. The word ‘should’ refers to practices which are advised or recommended.

3.2
The full titles of reference documents, cited in this Standard are given in the list of Related Documents on page 2.

3.3
Clauses prefixed by "C" and printed in italic type are intended as comments on the corresponding mandatory clauses. They are not to be taken as the only, or complete interpretation of the corresponding clause, nor should they be used for determining in any way the mandatory requirements of compliance within NZS 3605. NZS 3605 can be complied with if the comment is ignored.

3.4
The term "normative" identifies a mandatory requirement for compliance with NZS 3605.

3.5
The term "informative" identifies information provided for guidance or background which may be of interest to the Standard's users. Informative provisions do not form part of the mandatory requirements of the Standard.

4 ROUND OR SQUARE HOUSE PILES

4.1 Form

4.1.1 *Cross section*
Piles shall have a round or square cross section provided:

(a) Round piles shall have a minimum diameter of 140 mm except:

(i) Within 200 mm of either end where the minimum diameter may be 120 mm, or

(ii) Within a pointed end that is formed to facilitate driving.

(b) Square piles shall have a minimum dimension of 125 mm.

4.1.2 *Length*
The maximum length shall be 3.6 m.

C4.1.2
Preferred pile lengths are multiples of 300 mm.

4.1.3 *Straightness*
Round piles shall meet the requirements of 5.2, square piles shall meet the warp limitations for No. 1 Framing grade timber in NZS 3631.

4.1.4 *Grade*

4.1.4.1
Anchor piles shall meet the strength requirements of 4.3.1. All other house piles need only meet the grade limitations of 4.1.4.2 for square piles or 4.1.4.3 for round piles.

4.1.4.2
Square piles shall meet the grade limitations for No. 1 Framing grade timber in NZS 3631.

4.1.4.3
Round piles shall meet the grade limitations of 5.6.1.

4.1.5 *Growth rings*
Square sawn piles, of pinus species, 3 m or more in length, shall have not less than 4 growth rings between the pith and the sawn face nearest the pith, whether or not the pith is contained within the cross section.

C4.1.5
This is intended to limit the distortion possible in long piles containing wood from close to the pith.

4.2 Durability
House piles shall be radiata pine, or other pinus species, treated to H5 of NZS 3640. Where a timber pile is cut, notched, bored or otherwise processed after treatment the processed area shall be well dried (no visible wetness and dry to touch) and be brush-treated with a liberal application of either creosote, zinc naphthenate, TBTO (bis-(tri-n-butyltin) oxide) or TBTN (bis-(tri-n-butyltin) naphthenate). The surface shall not be cut for fixings and other purposes closer than 150 mm to the finished ground level.

4.3 Strength

4.3.1 *Anchor piles*
Anchor piles shall either:

(a) Sustain without signs of distress a proof test bending moment of 5 ±0.25 kNm when testing in accordance with Appendix B; or

(b) Be proof tested annually in batches of 100 piles to a bending moment of 6 ±0.3 kNm as described in Appendix A.

4.3.2 *Other piles*
House piles, other than anchor piles, that comply with 4.1.4 are deemed to be of adequate strength.

C4.3
The lateral load capacity of timber pile foundation systems are set out in NZS 3604. The most heavily loaded are anchor and braced piles which are required to have a capacity of 160 Bracing Units (BUs). Driven cantilever piles are required to have a capacity of 70 BUs. At the maximum permitted height for these piles and considering the seismic response of timber pile foundation systems, the bending moment demand is 6.0, 4.7 and 4.4 kNm respectively for anchor, driven cantilever, and braced piles. 125 mm square sawn timber piles meeting No. 1 Framing quality are sufficient for a bending demand of 4.8 kNm. Hence the anchor piles need special care in their selection and proof testing is considered to be the only means to guarantee their strength. Ordinary piles carry vertical loads only and therefore have minimal required bending capacity.

4.4 Branding
Piles shall be branded to meet the requirements of NZS 3640 including the provision that the brand shall be placed one third of the length from the top and facing the top. Anchor piles shall be branded with the letter A. The A shall be placed within 50 mm of the treatment brand (facing the top). Alternatively, the A can be incorporated with the treatment brand.

C4.4
Plants registered with the Timber Preservation Council (TPC) will also need to meet any other requirements of the TPC. In such cases and as allowed by the TPC the A may be incorporated within the overall brand. An example of branding is shown in figure 1.

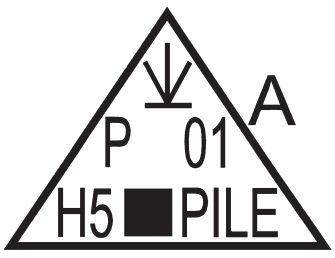


Figure 1 – Example of branding

5 ROUND CONSTRUCTION PILES AND POLES

5.1 Species

Species shall be:

(a) Radiata pine, or other pinus species, treated to H5 of NZS 3640;

(b) Limited to those for which characteristic stresses are given in NZS 3603.

C5.1

Piles and poles not meeting the requirements of 5.1 will only be acceptable on demonstration of the required durability and structural strength. The use of such species however is outside the scope of this Standard and such demonstration would need to be to the approval of the territorial authority as part of the building consent process.

As evidence of correct preservative treatment, either:

(a) Piles or poles should carry the Woodmark® symbol which signifies that the plant has a quality assurance plan and is registered with the NZ Timber Preservation Council. This will ensure that the risk of strength reduction from inadequate wood preparation or air seasoning is minimal (most material is steamed rather than air dried before treatment); or

(b) The specifier should demand evidence that procedures of wood preparation, air seasoning and treatment have been to the standard expected in NZS 3640.

5.2 Form

The form of piles and poles shall be:

(a) Poles shall be free from short crooks and any sweep shall be in one plane only;

(b) Piles and poles with a sweep in one plane in one direction measured by a straight line adjoining the edge of the butt to the edge of the tip shall have a deviation not exceeding 12 mm per metre for piles and 6 mm per metre for poles (see figure 2, diagram 1);

(c) Piles and poles with a sweep in two planes (double sweep) or in two directions in one plane (reverse sweep) measured from the mid-point at the tip to the mid-point at the butt shall have a deviation not exceeding 6 mm per metre for poles (see figure 2, diagram 2);

(d) Piles and poles shall be free from short crooks that deviate from straightness, relative to the axis below the crook, by not more than 65 mm for piles and 25 mm for poles in any 1.5 m length (see figure 2, diagram 3);

(e) For driven piles the sweep limitations shall be those for poles.

Diagram 1 – Measurement of sweep in one plane and one direction

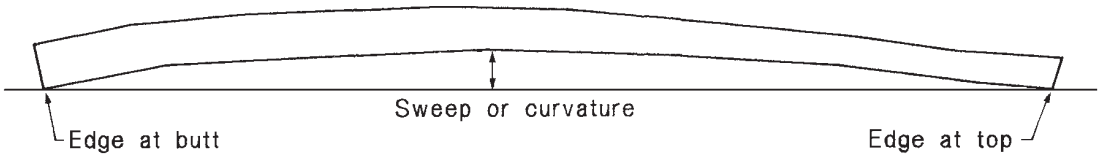


Diagram 2 – Measurement of sweep in two planes (double sweep) or in two directions in one plane (reverse sweep)

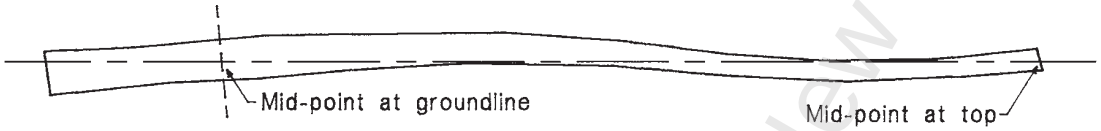
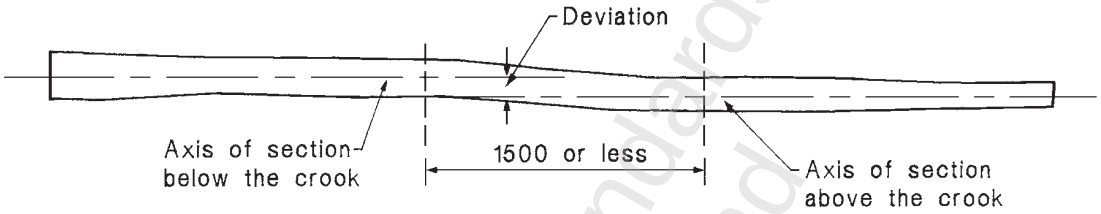
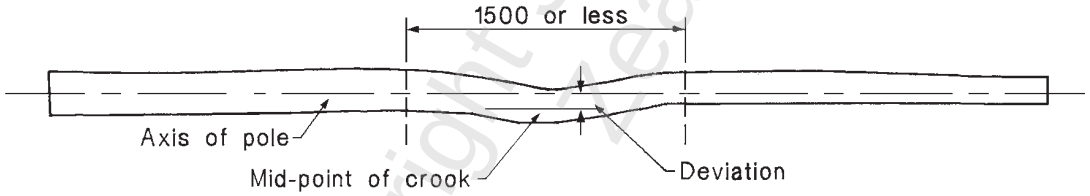


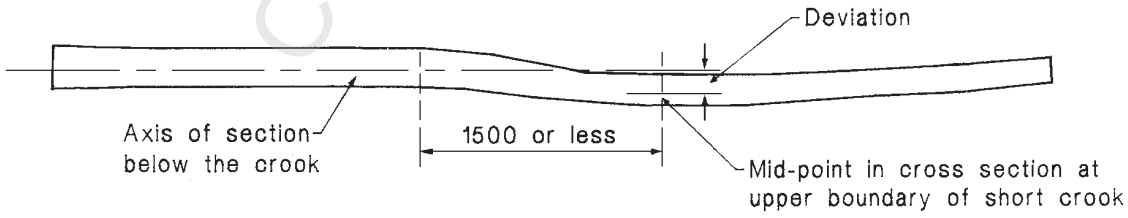
Diagram 3 – Measurement of short crook (three cases shown)



Case 1 – Where the reference axes are approximately parallel



Case 2 – Where the axes of sections above and below the crook coincide or are practically coincident



Case 3 – Where axis of section above short crook is not parallel or coincident with the axis below the crook

NOTE – The three cases shown under diagram 3 are typical and are intended to establish the principle of measuring short crooks. There may be other cases not exactly like those illustrated.

Figure 2 – Measurement of sweep and short crook in round construction piles and poles

5.3 Dimensions

The length and diameter of construction poles and piles shall be as specified by the designer as part of a specific engineering design.

C5.3

Poles are normally supplied according to small end diameter (SED), in increments of 25 mm. For driven foundation piles the taper should be larger than average. Table 1 gives recommended values of large end diameter (LED) for specified SED, suitable for piles. For construction poles a minimal taper is usually desired. Table 2 gives recommended values of LED for specified SED for construction poles.

The small end of the poles should be measured by taking the average of the smallest and largest diameter measurements.

The pole peeling machinery may inadvertently bevel the small end of a pole, thus reducing its specified size by at least one increment. Because the critical section of a pole is rarely at the small end, it is recommended that where such a bevel occurs, the pole circumference up to 300 mm from the small end should be used to determine the effective SED of the pole.

Table 1 – Round construction piles (Informative)

Minimum large end diameters corresponding to specified small end diameters. (Taper of not less than 6 mm/m.)

Length	Minimum large end diameter for a small end diameter of, (mm):							
(m)	125	150	175	200	225	250	275	300
1.2	132	157	182	207	232	257	282	307
1.5	134	159	184	209	234	259	284	309
1.8	136	161	186	211	236	261	286	311
2.1	138	163	188	213	238	263	288	313
2.4	139	164	189	214	239	264	289	314
2.7	141	166	191	216	241	266	291	316
3.0	143	168	193	218	243	268	293	318
3.3	145	170	195	220	245	270	295	320
3.6	147	172	197	222	247	272	297	322
4.0	149	174	199	224	249	274	299	324
5.0	155	180	205	230	255	280	305	330
6.0	161	186	211	236	261	286	311	336
7.0	167	192	217	242	267	292	317	342
8.0	173	198	223	248	273	298	323	348
9.0	179	204	229	254	279	304	329	354
10.0	185	210	235	260	285	310	335	360
11.0	191	216	241	266	291	316	341	366
12.0	197	222	247	272	297	322	347	372

Table 2 – Round construction poles (Informative)

Maximum large end diameters corresponding to specified small end diameters. (Taper of not more than 8 mm/m.)

Length	Maximum large end diameter for a small end diameter of, (mm):							
(m)	125	150	175	200	225	250	275	300
1.2	135	160	185	210	235	260	285	310
1.5	137	162	187	212	237	262	287	312
1.8	139	164	189	214	239	264	289	314
2.1	142	167	192	217	242	267	292	317
2.4	144	169	194	219	244	269	294	319
2.7	147	172	197	222	247	272	297	322
3.0	149	174	199	224	249	274	299	324
3.3	151	176	201	226	251	276	301	326
3.6	154	179	204	229	254	279	304	329
4.0	157	182	207	232	257	282	307	332
5.0	165	190	215	240	265	290	315	340
6.0	173	198	223	248	273	298	323	348
7.0	181	206	231	256	281	306	331	356
8.0	189	214	239	264	289	314	339	364
9.0	197	222	247	272	297	322	347	372
10.0	205	230	255	280	305	330	355	380
11.0	213	238	263	288	313	338	363	388
12.0	221	246	271	296	321	346	371	396

5.4 Handling

5.4.1
Adequate precautions shall be taken against mechanical damage to piles and poles during handling, at all stages of production.

5.4.2
Poles are not acceptable if they contain indentations attributed to loading or handling damage 6 mm or more deep over 20 % or more of the pole circumference, or more than 12 mm deep at any point. Other indentations or abrasions, for example, forklift damage, chain-saw damage, etc., shall not be more than 1/10 the pole diameter at the point of damage up to a maximum of 25 mm deep. Such damage is permitted in an oversized section, where the excess of wood shall be taken into consideration in evaluating the effects of the damage.

5.5 Strength
Construction piles and poles shall be deemed to have attained the characteristic stresses nominated in NZS 3603 for round timbers if they conform with the visual grading requirements as set out in clause 5.6 and:

(a) For normal category to NZS 3603, have a minimum outer zone density of 350 kg/m^3; or

(b) For high category to NZS 3603:

(i) Have a minimum outer zone density of 450 kg/m^3; or

(ii) Withstand the proof testing requirements of 5.7.

NOTE – The outer zone density is the basic density (oven dry weight/volume in green condition) in the outer 20 % of the radius of the pole.

5.6 Compliance – visual grading

5.6.1
Visible growth characteristics or features shall not exceed the following limits:

(a) *Fissures*
Cracks across piles or poles shall not be permitted.

(b) *End splits*
End splits shall not be permitted.

(c) *Knots, 25 mm and over in diameter*
The diameter of individual knots shall not exceed 10 % of the circumference of the piles or poles. The sum of the diameters of knots in any 300 mm length of the pile or pole, measured at right angles to the axis of the pile or pole, shall not exceed 20 % of the circumference of the piles or poles.

(d) *Nodal swelling*
For poles the nodal swelling shall not exceed 20 mm when measured as shown in figure 3.

(e) *Spiral grain*
Spiral grain at the pile or pole surface shall not have a slope greater than 1:10.

C5.6.1*(a)*
Seasoning checks and shakes along the grain are expected and are not recognized as defects.

C5.6.1*(d)*
Producers should be aware that the limitations placed on nodal swelling are cosmetic only if the poles are manually or hydraulically debarked. However, if the poles are mechanically peeled or shaved, there is a loss in strength because the natural reinforcement around

the knots is damaged or removed. Machines such as the "Morbark" which have a planer type cutter head are called machine shavers and generally reduce the pole to a smooth tapering form that handles well and has a good appearance but incurs a strength loss of about 25 %, depending on the amount of swelling initially present. The "Searle" machine which scrapes the bark off with rotating prongs is called a machine peeler and produces a stronger but more rugged looking pole. Pole damage due to debarking incurs a cost penalty in that debarking which reduces strength by, say 25 % implies that the pole diameter will need to be increased by one third this amount (i.e. by 8 %) to compensate for the strength loss and provide a pole with the same overall bending capacity as a manually or hydraulically debarked pole.

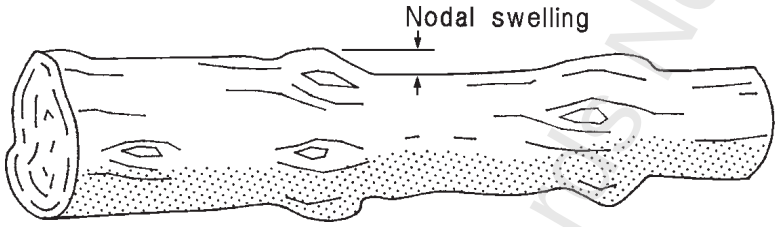


Figure 3 – Nodal swelling

5.6.2
Handling damage shall be within the limits laid down in 5.4.

5.7 Compliance – proof testing
Every pile or pole shall withstand, without signs of distress, the loads prescribed in Appendix C as well as meeting the requirements of 5.6.1(e).

5.8 Durability
Where a construction pile or pole is cut, notched, bored or otherwise processed after treatment, the processed area shall be brush-treated and located as required by 4.2.

5.9 Branding
Construction piles and poles shall be branded to meet the requirements of NZS 3640 including the provision that the brand shall be placed one third of the length from the top and facing the top. All construction piles or poles that meet the requirements of 5.5 for high category, shall be branded with the letter H. The H shall be placed within 50 mm of the treatment brand (facing the top). Alternatively, the H can be incorporated with the treatment brand.

C5.9
Plants registered with the Timber Preservation Council (TPC) will also need to meet any other requirements of the TPC. In such cases and as allowed by the TPC the H may be incorporated with the overall brand. An example of branding is shown in figure 1, except that the letter "A" would be replaced with "H" for high category piles and poles.

APPENDIX A
ANNUAL CERTIFICATION OF STRENGTH OF SQUARE SAWN AND ROUND TIMBER HOUSE PILES

(Normative)

A1 Scope

A1.1
This Appendix sets down the requirements for strength testing of anchor piles as required in 4.3.1.

A1.2
This Appendix requires that the manufacturer conducts tests to devise visual grading rules, which are specific to piles obtained from a particular source, in order that those piles have the required strength. The visual grading rules are to be verified or amended by annual tests of a random sample of at least 100 piles and a certificate issued accordingly.

A2 General

A2.1
Proof strength testing and later re-testing shall be carried out on every timber species used from each timber source milled, such testing to be repeated whenever species or source is varied, otherwise test annually.

A2.2
At least 100 piles shall be selected by random sampling procedures so as to fairly represent the manufacturer's production.

A2.3
Piles shall be at the length and of the dimensions specified by the manufacturers.

A2.4
Piles shall be tested after sawing and grading. If piles are to be steamed as part of the drying/preservation process then the piles to be tested shall be steamed before testing.

A2.5
Records of strength testing shall be kept by the manufacturer as follows:

(a) Test location;

(b) Initial proof test or subsequent test, with reason for subsequent test;

(c) Date of test;

(d) Timber species;

(e) Description of sampling procedures used;

(f) Pile dimensions;

(g) Number of piles tested;

(h) Number of failures;

(j) Minimum strength requirements;

(k) Pass/fail statement.

A3 Method of test

A3.1
The following method is appropriate for piles up to 3.6 m long.

A3.2
Moisture content shall be above 25 %.

A3.3
Test the piles in bending as described in Appendix B.

A3.4
The proof load shall be applied by applying the load gradually and evenly and maintaining it for not less than ten seconds. Pile supports and loading heads shall be positioned symmetrically about the centre of the pile.

A3.5
The test is successful if the pile carries the load without obvious signs of distress or permanent set.

A4 Verification of visual grading rules

A4.1
Divide the number of piles which failed to sustain the required bending moment by the total number of piles tested, and multiply this figure by 100 to establish the percentage failure.

A4.2
If the percentage failure is greater than 5 % the piles are not of adequate strength and remedial action must be taken.

A4.3
If the failure rate is still greater than 5 % the visual grading rules in use are not adequate, and more stringent rules must be used to grade piles. A change of timber source may be required.

APPENDIX B
TESTING OF HOUSE PILES

(Normative)

B1

Test equipment shall comprise a base with free pivoting or roller supports of full pile width at 1200 ±10 mm centres, and a spreader with 2 pivoting or roller loading heads of full pile width, at 600 ±5 mm centres as shown schematically in figure B1. Other designs of test equipment may be used provided that the required bending moments are applied. For example, a design which has load heads at 300 mm centres will require total loads which are two thirds of those listed in table B1. Apply and indicate loads to ±5 %. The load applied through the loading heads shall act perpendicularly to the axis of the pile and in the same plane as the supports.

B2

Apply the bending force as given in table B1.

Table B1 – Applied total loads for required bending moments

Required bending moment (kNm)	**Total load** (kN)
5.0 ±0.25	33.3 ±1.7
6.0 ±0.30	40.0 ±2.0

B3

For proof testing batches of piles as required by Appendix A, the pile shall be stationary in the testing device and the proof load shall be applied gradually and evenly and be maintained for not less than 10 s.

B4

For proof loading of every pile to 4.3.1, the pile shall pass through the device such that the pile will be subjected to maximum bending moment for not less than 10 s.

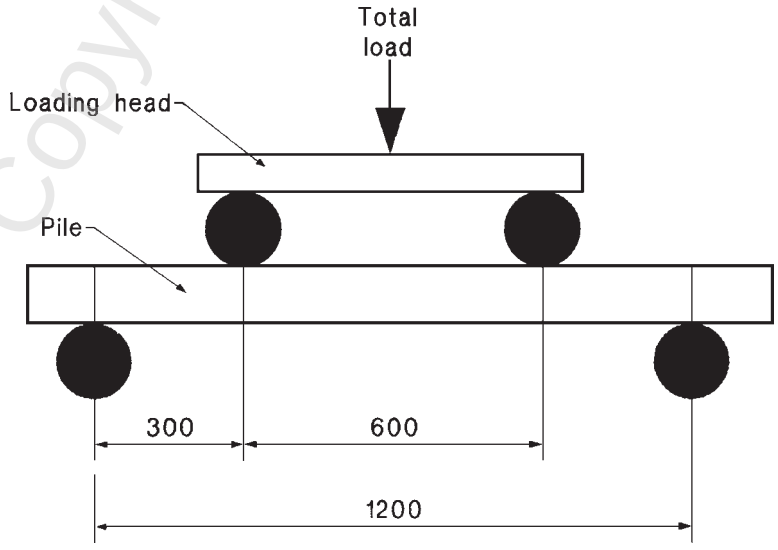


Figure B1 – Schematic plan diagram for testing house piles

APPENDIX C
PROOF TESTING OF ROUND CONSTRUCTION PILES AND POLES

(Normative)

C1 Loading arrangement

Loads shall be applied as shown schematically in figure C1. The pole shall be orientated with its axis horizontal and loads shall be applied horizontally.

CC1

The requirement to load horizontally is to avoid the complicating effects of self weight of the pole. (Refer to BS 1990:Part 1, Appendix D for testing where the load is applied vertically). The poles are loaded as if they were transmission line poles which may not match the load distribution found in a construction pole. However, experience with proof testing transmission poles, shows that the weakest point between the groundline and the mid-length of the pole will be found.

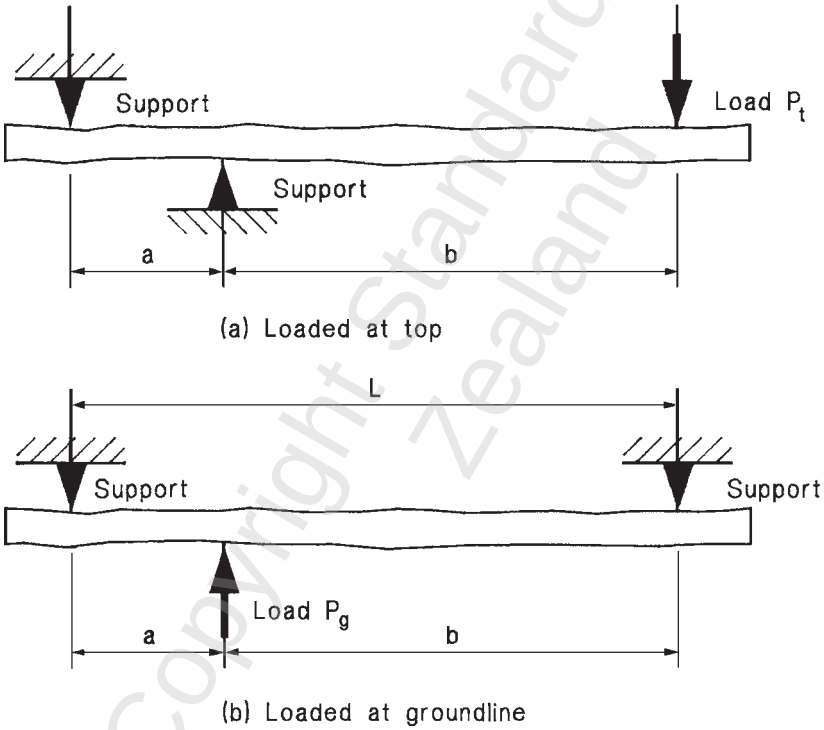


Figure C1 – Schematic plan diagram for proof test loading of round construction piles and poles

C2 Equipment
The equipment used shall:

(a) Have loading and reaction surfaces shaped to minimize damage to the poles;

(b) Apply and indicate loads to an accuracy of 5 %;

(c) Have the load and reaction points positioned to an accuracy of 1 %.

C3 Loading procedure
Load shall be applied to the pole at a rate sufficient to reach the required proof load in not less than 3 s nor more than 30 s, and shall be maintained at the proof load level for 15 s before unloading.

C4 Proof loading arrangement
Poles shall be loaded either:

(a) At the small end with load P_t as shown in figure C1 (a);

or

(b) At the groundline with load P_g as shown in figure C1 (b).

C5 Loads
Proof loads P_t and P_g are calculated from:

$$P_t = \frac{K\phi f_b \pi D^3}{32b} \times 10^{-6} \text{ kN} \quad \text{..... (Eq.C1)}$$

$$P_g = \frac{K\phi f_b \pi L D^3}{32ab} \times 10^{-6} \text{ kN} \quad \text{..... (Eq.C2)}$$

where

ϕ = capacity reduction factor from NZS 3603
= 0.8

f_b = characteristic bending stress given in NZS 3603 (MPa)

D = specified minimum diameter at the groundline (mm)

L = test span (m)

a,b = dimensions shown on figure C1 (m)

K = product of adjustment factors from NZS 3603 for shaving, steaming and moisture condition as appropriate to the pole at the time of test.

NOTES

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