

## 1.0 INTRODUCTION

**1.0.1** The moisture levels of concrete and timber elements can be critical for both the durability of a building's structure and materials and the health of its occupants. It is important to ensure that the correct moisture levels are achieved at completion of the building and maintained throughout its service life. This involves:

- ensuring that the moisture content of timber is low enough to optimise its durability and stability – timber that is too damp in use may not be sufficiently durable, and timber that dries in place will shrink, which can affect the level of finishes achievable
- allowing the water used in concrete floor slabs to escape before fixing floor coverings, especially impervious floor coverings such as vinyl sheet flooring, or materials affected by moisture, such as timber strip or wood-based flooring, carpet, waterproofing membranes and roof membranes.

**1.0.2** This bulletin does not cover the measurement of moisture in:

- concrete masonry
- aerated concrete panels or blocks
- wood fibre boards
- plasterboard
- fibre-cement
- plywood
- laminated veneer lumber (LVL).

## 2.0 MAXIMUM MOISTURE LEVELS

### 2.1 ACCEPTABLE SOLUTION E2/AS1

**2.1.1** To assist compliance with the New Zealand Building Code (NZBC) clause E2 *External moisture*, Acceptable Solution E2/AS1 gives the following moisture contents and relative humidities:

- For timber framing at the time of installing interior linings, the acceptable moisture content is the lesser of:
  - 20% for insulated buildings or 24% for uninsulated buildings, or
  - as specified in NZS 3602:2003 *Timber and*

*wood-based products for use in building.*

- For timber weatherboards and exterior joinery at the time of installation – 20%.
- For reconstituted wood products – 18% at all times.
- For concrete floors at the time of laying fixed floor coverings – a relative humidity reading of less than 75%.

**2.1.2** The requirements of E2/AS1 may be modified by the specific moisture content required at the time of installation by the supplier of that particular system or material – for example, a sheet lining supplier.

### 2.2 IN-SERVICE MOISTURE CONTENTS FOR FRAMING TIMBER

**2.2.1** The construction moisture content maximums given above assume that moisture levels will reduce throughout the timber's in-service life. In addition to these requirements to comply with E2 *External moisture*, maximum in-service moisture contents are given in NZS 3602:2003 to meet the durability provisions of NZBC clause B2 *Durability*. These are:

- H1.2 treated framing – 20% maximum (this also applies to framing with a higher hazard class treatment)
- untreated, kiln-dried pine (only permitted in unlined/unoccupied buildings) – 18% maximum in service
- untreated Douglas fir framing (as permitted by B2/AS1 in low-risk buildings) – 18% maximum in service.

### 2.3 INDUSTRY REQUIREMENTS

**2.3.1** In addition to the maximum permitted moisture contents given in Acceptable Solutions and other documents, some manufacturers of particular materials or the standards applicable to them (for example, AS/NZS 2589:2007 *Gypsum linings – Application and finishing*) may require lower moisture contents for framing substrates to ensure the performance of these products. End-users should therefore check manufacturers' requirements for moisture contents of framing before fixing interior linings, and designers should identify the specific requirements in the contract documents.

TABLE 1. RECOMMENDED MOISTURE CONTENT (%)<sup>1</sup> AT TIME OF INSTALLATION OR, IN THE CASE OF FRAMING TIMBER, AT TIME OF ENCLOSURE

	Use category and level of finish <sup>2</sup>	Air-conditioned or centrally heated buildings	Intermittently heated insulated buildings <sup>3</sup>	Unheated buildings
1	Timber to which linings are attached to achieve a level of finish 4–5 <sup>4</sup>	8–18%	12–18%	12–18%
2	Enclosed framing (including roof trusses) to achieve a level of finish 0–3 <sup>4</sup>	12–18%	12–24%	12–24%
3	Loadbearing lintels and beams	8–18%	12–20%	12–20% <sup>5</sup>
4	Weatherboards, exterior joinery and finishing timbers	14–18%	14–18%	14–18%
5	Flooring exposed to ground atmosphere	10–14%	12–16%	14–18%
6	Interior joinery and finish, furniture corestock	8–12%	10–14%	12–16%
7	Flooring not exposed to ground atmosphere	8–12%	10–14%	12–16%

(Modified from NZS 3602:2003 Table 4 provided by Standards NZ under licence 001145.)

Notes:

<sup>1</sup> Allowable ranges of moisture content are specified on the basis that 90% of pieces shall be within the specified range, and the remainder shall be within a further 2% moisture content above or below. The moisture contents of individual boards shall be normally distributed within the range allowed. In special circumstances, for example, flooring exposed in rooms with a large window area, the upper moisture content limits may need to be reduced.

<sup>2</sup> Some material manufacturers may require lower moisture contents at the time their materials are fixed to the timber.

<sup>3</sup> Buildings periodically heated by open fires, electric heaters and so on, such as most domestic buildings, that have floor, wall and roof insulation to at least 1978 standards.

<sup>4</sup> Levels of finish are defined by AS/NZS 2589:2007.

<sup>5</sup> 20% maximum recommended to reduce the risk of deflection where loads are applied before the timber has dried to its in-service moisture content.

**2.3.2** Table 1 gives BRANZ's recommended guidelines for moisture contents of various building elements with different levels of heating, where relatively stable performances of timber are required. This is modified from Table 4 of NZS 3602:2003.

## 3.0 MEASURING MOISTURE IN TIMBER ON SITE

**3.0.1** As the moisture content of timber changes, so do its electrical properties. Changes in moisture content can therefore be monitored by measuring the changes in electrical resistance (how the timber reduces the current flow through it) or electrical capacitance (how much charge the timber can store). Two common types of instruments that use these characteristics to measure relative amounts of moisture in timber on site are:

- resistance meters – see sections 4.0 and 5.0
- capacitance meters – see section 10.0.

## 4.0 RESISTANCE METERS

### 4.1 HOW RESISTANCE METERS WORK

**4.1.1** The resistance-type meter is the one most commonly used for measuring moisture content (MC) in framing and other construction timbers, especially in the range of 8–25% MC.

**4.1.2** As wood becomes drier, its electrical resistance increases. From green wood (100% MC), the change is slight until fibre saturation point is reached. This is the point when all free water has been removed from within the cells, leaving only the moisture contained within the cell walls. This occurs when moisture content has reduced to approximately 30%. Below 30%, small changes in moisture (1% or less) result in quite large changes in resistance until the moisture content reaches about 6%. Below 6%, the changes become difficult to measure because the resistance is so large.

**4.1.3** To measure the moisture content, electrodes are inserted into the timber a set distance apart, and the electrical resistance of the material between them is measured. This reading is directly related to the moisture content of the timber being measured. Several factors affect this relationship, and these have been standardised in the moisture meters commonly available in New Zealand to enable simple and relatively representative moisture content readings.

**4.1.4** Measuring the moisture gradient can be a useful guide to estimating how long timber will take to dry. The moisture gradient (wet to dry) of timber will usually be from the centre to the exterior face. However, if kiln-dried timber is allowed to become wet (such as by being exposed to wet weather), this gradient will be reversed. The moisture gradient can be measured by taking readings at varying depths. For a 100 mm member, readings at 15 mm, 30 mm and 45 mm will give a very good indication of how well

the timber is drying. Timber that is dry in the centre will dry more quickly than timber that is wet in the centre.

### 4.2 MODELS OF RESISTANCE METERS AVAILABLE

**4.2.1** Resistance meters range from the simplest dial or LED type to more elaborate meters with digital display, integrated temperature and timber species corrections. Most currently available meters have digital or LED displays. Some models also have the ability to store and download readings to a printer or computer.

### 4.3 ELECTRODE TYPES

**4.3.1** Sliding hammer electrodes are the most suitable for measuring the moisture content of framing timbers as the readings can be taken from deep inside the timber. Electrodes for measuring up to 100 mm timbers should be at least 50 mm long.

**4.3.2** Short-probe electrodes (10–12 mm) can only be used to take readings near the surface.

**4.3.3** The electrodes must be insulated. Insulated electrodes ensure that the resistance reading is made at the tips of the electrodes (within the timber) rather than at the surface of the timber where the resistance may be different. As the reading occurs at the tips, it will accurately reflect the moisture in the body of the timber between the electrodes. Insulated electrodes also allow readings to be made in timber with a paint or other surface film, through linings or in timber that has only been wetted on the surface.

### 4.4 CHECKING ACCURACY

**4.4.1** Moisture meters must remain accurate. Accuracy (or calibration) can be checked by testing the meter on a calibration test card supplied by the supplier or service agent. The electrode probes are placed across the test pads on the card and the readings compared with those shown on the card. The meter should be serviced by a supplier if a test against the card shows any deviation.

**4.4.2** The meter must be calibrated to AS/NZS 1080.1:2012 *Timber – Methods of test – Method 1: Moisture content*. This has established a standard relationship between resistance and moisture content for particular timber species at a specific reference temperature.

### 4.5 SPECIES CORRECTIONS

**4.5.1** With every species of timber, there is a different relationship between electrical resistance and moisture content. Meters measure the resistance for a standard timber, and then corrections are applied to establish the moisture content for the species being measured. Some moisture meters have built-in species corrections so that the displayed reading has already been corrected.

**4.5.2** The corrected figures were established by Scion (formerly the New Zealand Forest Research Institute).

AS/NZS 1080.1:2012 provides a list of moisture corrections for an extensive range of timbers.

**4.5.3** Timbers such as rimu that have large quantities of extractives present in the heartwood require separate correction figures for heartwood and sapwood.

#### 4.6 TREATMENT CORRECTIONS

**4.6.1** The chemicals present in timber treatments will seriously affect the readings of a moisture meter. Electrical currents flow much more readily through a sample containing soluble salts and will give a higher reading (lower resistance, suggesting wetter timber), but timber containing non-soluble chemicals (for example, creosote) will give a lower reading (higher resistance, suggesting drier timber). At higher moisture levels, readings for treated timber become less reliable, and therefore, the readings in the tables have been limited to a maximum of 24% MC. Correction figures for other treatments can generally be provided by the timber preservative supplier.

**4.6.2** A sample of corrected figures for radiata pine is given in Table 2. The readings highlight the importance of identifying timber type and treatment in order to interpret the results.

#### 4.7 TEMPERATURE CORRECTIONS

**4.7.1** Resistance will also vary with temperature (Table 3). Meters that comply with AS/NZS 1080.1:2012 are calibrated at 20°C, and again, corrections are available for various timber temperatures.

**4.7.2** Temperature corrections should be made before correcting for timber species. The timber temperature can be worked out by measuring the air temperature at the time of taking the moisture readings, but care should be taken to avoid testing during extremes that could occur at different times of the day, such as in early morning frost or late afternoon sun.

**4.7.3** Thermometers are available that will measure the surface temperature of the timber, but this may not reflect the inside temperature of the timber at the depth where the probes are measuring.

**4.7.4** Adhesives have a lower resistance than timber and this will affect the accuracy of the reading when resistance meters are used with plywood and particleboard. While NZS/AS 1884:2013 *Floor coverings – Resilient sheet and tiles – Installation practices* requires a moisture content of less than 16% before flooring can be laid over plywood, particleboard and fibre-cement, no measurement regime is specified.

### 5.0 USING A RESISTANCE MOISTURE METER ON SITE

**5.0.1** To measure moisture content of timber, E2/AS1 references the Scion bulletin *Measuring the moisture content of wood* published in 1996, which contains more detail on the testing regime for timber framing.

#### 5.1 BEFORE TAKING READINGS

**5.1.1** Identify the timber species to be measured. Most framing will be radiata pine, either treated or

TABLE 2. CORRECTED % MOISTURE CONTENTS FOR RADIATA PINE

Meter reading % MC		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Corrected reading for radiata pine	Sapwood untreated	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Sapwood boron <sup>1</sup>	11	11	12	12	13	13	14	15	16	16	17	18	19	20	21
	Sapwood CCA <sup>2</sup>	10	11	12	12	13	14	14	15	16	17	18	19	19	20	21
	Sapwood LOSP <sup>3</sup>	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28

(Sources: FRI Bulletin No. 200 and AS/NZS 1080.1:2012 Table E1 provided by Standards NZ under licence 001145.)

Notes:

<sup>1</sup> H1.2 level of boron treatment only.

<sup>2</sup> From the H3.2 level of treatment. Care should be taken where timber with higher levels of treatment than H3.2 is being measured, as the higher concentration of CCA salts will lower resistance and offer higher readings. H3.2 corrections given are for CCA-treated timber only – they are not applicable to copper quaternary or copper azole treated timber.

<sup>3</sup> Indicative values only – must be used with caution.

TABLE 3. TEMPERATURE CORRECTION TABLE FOR RESISTANCE-TYPE METERS

Meter reading (%)	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Timber temperature (°C)	Moisture content corrected for temperature (%)																			
5	7	8	9	11	12	13	14	15	16	17	19	20	21	22						
10	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22					
15	6	7	8	9	11	12	13	14	15	16	17	18	19	20	22					
20	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22			
25		6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
30		6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	
35			6	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22

(Adapted from AS/NZS 1080.1:2012 Table D1 provided by Standards NZ under licence 001145.)

untreated. If the timber is treated, the treatment type must also be identified by sighting timber markings or delivery docket.

**5.1.2** Check the meter and ensure that the batteries are charged, the leads are undamaged and the electrodes are undamaged and correctly connected. If the meter has not been used for some time, it is advisable to check it against the test card.

## 5.2 TAKING THE READINGS

**5.2.1** Always take a number of readings to ensure that a representative sample is tested. Test those areas of framing to which internal linings are to be attached, such as wall framing, ceiling battens, rafters and floor joists.

**5.2.2** The following steps outline the procedure for taking readings:

- a) Insert the probes into the timber the required distance and at least 500 mm from an end of the timber (end grain will dry, or absorb moisture, faster than other areas and may not reflect the true state of the timber). Samples taken near the middle of the widest side of members reduces the depth the probes need to be driven in.
- b) Insert the probes parallel to the grain (Figure 1).
- c) Immediately read and record the % MC and the temperature – see Figure 2 for a sample recording chart. (The reading will drift lower with time.)
- d) Carefully remove the probes without bending them. (Use the sliding hammer attached to longer probes.)
- e) Use Table 3 to correct the reading for the variation in temperature. Do this before correcting for the timber species.
- f) Use Table 2 to correct the reading for the type of timber being measured.
- g) If an indication of the moisture content of a

particular room or similar defined area is required, it will not be necessary to take samples from the whole building. However, a similar number of samples as stated in 5.3.1 (b) and 5.4.2 (b, c and d) should still be taken. Increase this sampling proportionately for larger buildings.

h) Take samples from throughout the building, with at least half the samples taken in areas of restricted drying.

**5.2.3** An acceptable moisture content for close-in is when 90% of the test samples indicate moisture contents within the required range (see section 2.0), with the remaining readings just above.

## 5.3 TESTING PRESERVATIVE-TREATED FRAMING

**5.3.1** Take these steps when testing any preservative-treated framing:

- a) Insert insulated probes to approximately one-third depth (for 50 mm thick studs, insert 15–17 mm deep from the wide face).
- b) Test 10 studs, six ceiling battens and six lintels from throughout the works.

## 5.4 TESTING KILN-DRIED UNTREATED FRAMING

**5.4.1** Untreated framing cannot be used as part of an Acceptable Solution for new work (the exception being Douglas fir used in low-risk building and meeting the requirements of B2/AS1 paragraph 3.2.2.2), but finishing timbers may be untreated kiln-dried.

**5.4.2** The regime when testing framing is as follows:

- a) Insert probes to approximately one-third depth.
- b) Test 10 studs, six ceiling battens and six lintels from throughout the works.
- c) Test five interfaces of framing in contact, such as

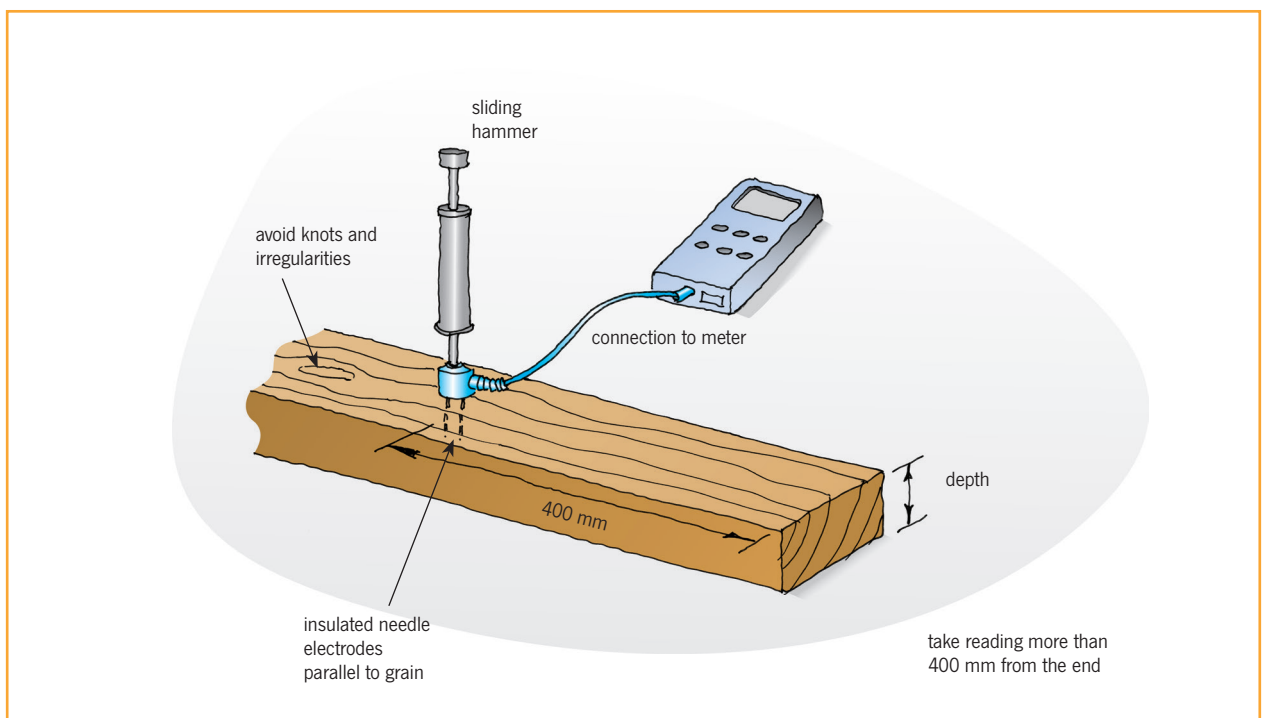


Figure 1. Measuring moisture in framing.

double joists and solid lintels (50 mm insulated probes will be required to penetrate to the interface of 50 mm thick members).

d) Test three surfaces of bottom plates in contact with flooring, especially concrete slabs.

## 5.5 KEEPING RECORDS

**5.5.1** Records of moisture readings should be kept for future reference. A sample form recording these readings is shown in Figure 2. It should include:

- date
- job details
- make and model number of meter
- stage (whether or not the building is closed in, why timber moisture content is being checked)
- area (for example, subfloor lounge, ceiling framing to family room)
- other relevant information (weather, finish to be achieved, specified or estimated equilibrium moisture content in use)
- meter reading for each location tested
- timber temperature
- reading corrected for temperature
- reading corrected for species and treatment
- total of all readings. Check why variations occur if they are large or if widely inconsistent figures are obtained. Divide the total by the number of readings. This will give the average moisture content for the area measured.

## 6.0 MEASURING MOISTURE IN CONCRETE ON SITE

### 6.1 MOISTURE IN CONCRETE SLABS

**6.1.1** It is critical that concrete floor slabs are sufficiently dry before any floor finishes are laid.

Failure to allow for adequate drying can result in adhesive failure, bubbling of impervious finishes, warping or rot in timber overlay flooring and lifting of applied finishes. With loose-laid carpet, there is a danger that undue moisture will cause mould or rot. Adhesives used for direct-stick carpet may also be affected by the moisture.

**6.1.2** E2/AS1 cites BRANZ Bulletin 330 *Thin flooring materials* as the Acceptable Solution, but this bulletin was withdrawn in November 2013. AS/NZS 1884:2013 Appendix A requires the relative humidity (measured by hygrometer or in-slab humidity probe) to be 75% or less. Appendix A also describes the methods of test.

**6.1.3** The American Portland Cement Association recommends that a safety margin of several percent (5% is used for hygrometers) should be one of the considerations in establishing relative humidity specification limits.

**6.1.4** For paint finishes, the degree of dryness required will vary with the type of paint.

### 6.2 THE DRYING PROCESS IN CONCRETE

**6.2.1** When concrete floor slabs are poured, they contain a considerable amount of water that must dry out. As there is a damp-proof membrane under the slab, it can only dry upwards into the air. The amount of water used to mix the concrete for a 100 m<sup>2</sup> x 100 mm slab is about 1,700 litres. Some of this water is used up in the cement hydration process, but a week after the floor has been laid, the amount of evaporable water still in the slab is about 1,000 litres.

**6.2.2** A 100 mm thick slab allowed to dry from only one side typically requires 4 months from the closing in

MOISTURE CONTENT					
Job			Date		
Stage			Area		
Timber species/treatment			Meter		
Other notes					
Reading no.	Reading (%)	Reading (°C)	Corrected (T)	Corrected (S)	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
				Total for corrected readings	
				Average reading for series	
Additional comments					

Figure 2. Sample form for recording moisture contents of timber framing.

of the building to achieve a relative humidity of 75 %, although in New Zealand, it can take even longer. The drying time should not be confused with the 28-day cure time – curing and drying are not the same.

### 6.3 SPEEDING UP THE DRYING PROCESS?

**6.3.1** Once the concrete is placed, there is no practical way to speed up the rate it dries at – using fans, dehumidifiers or heaters may make the concrete look dry, but it will only dry out the top few millimetres. Application of a liquid vapour barrier may slow drying or trap moisture within the slab – once applied, the slab will always read as being wet, and failure of the vapour barrier may result in future moisture problems.

**6.3.2** From the time that the slab is protected from the rain and with good drying conditions, a concrete slab will take approximately 1 month to dry for every 25 mm of thickness. This means a 100 mm thick slab will take at least 4 months to dry. Thicker slabs require exponentially longer. The rate will also vary depending on the concrete composition, relative humidity, temperature of the air and the airflow over the slab.

**6.3.3** Drying times can be reduced by minimising the water content of the concrete by:

- using a superplasticiser or water-reducing additive
- reducing the slump of the concrete
- using an alternative to moist curing – see clauses 7.8.2(e) and 7.8.5 of NZS 3109:1997 *Concrete construction*.

**6.3.4** Ways to optimise drying conditions include:

- providing good ventilation once the building is closed in
- not storing materials on the concrete.

### 6.4 OPTIONS FOR MEASURING CONCRETE MOISTURE

**6.4.1** A hygrometer test is the only method given in E2/AS1 for the measurement of moisture in concrete slabs.

**6.4.2** An alternative not included under E2/AS1 but covered by NZS/AS 1884:2013 is the use of in situ humidity probes, as discussed in section 8.0 of this bulletin.

**6.4.3** There are methods of measuring moisture in concrete that test the resistivity of the concrete between two electrodes at the surface. This method is inaccurate because it only measures the moisture content at the surface – the deeper concrete might still be quite wet. Other testing methods exist but they are either destructive, expensive or take too long.

## 7.0 THE HYGROMETER

**7.0.1** Using a hygrometer is a non-invasive method of measuring humidity to give an accurate indication of the amount of moisture being released from a concrete floor slab.

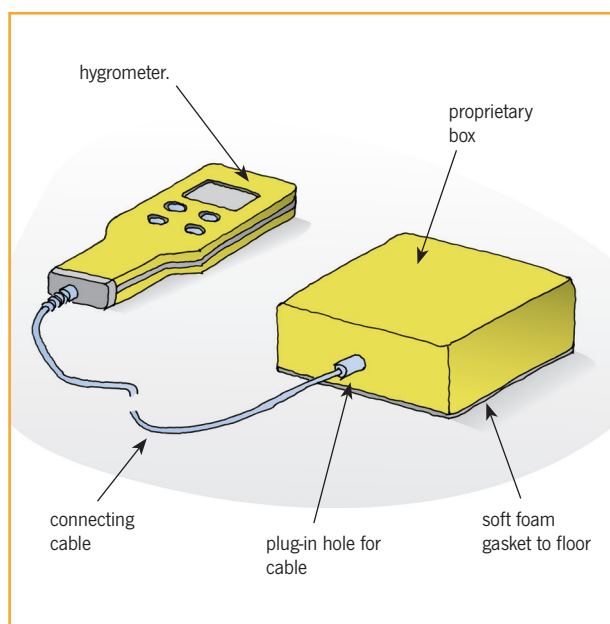


Figure 3. Digital flooring hygrometer.

**7.0.2** Most hygrometers available today are digital PCB or wet-bulb-with-mirror models, which give an electronic readout. They are more robust than the earlier models in which a synthetic hair responded to moisture, causing a needle to traverse a scale on a dial.

**7.0.3** All types incorporate an insulated box that is sealed to the floor, trapping the water vapour that diffuses from the concrete through an opening in the bottom of the box. After 16–32 hours, the pressure of the water vapour in the box reaches equilibrium with that in the floor, and the relative humidity reading is taken from the hygrometer.

**7.0.4** PCB hygrometers are generally cheaper, more robust and faster than wet-bulb hygrometers, but they are less accurate. Wet-bulb hygrometers should be checked regularly in accordance with the manufacturer's recommendations. Analogue (synthetic hair) models should be handled carefully as they can easily be knocked out of adjustment. Tests should be carried out in accordance with the instrument manufacturer's recommendations, and the instruments must be regularly calibrated by an approved authority.

**7.0.5** The hygrometer only gives useful results if the concrete has been drying normally. If an attempt has been made to speed up the drying by using fans or heaters, or if the concrete has been wet by rain or washing, the hygrometer will give a distorted result.

### 7.1 USING A HYGROMETER

**7.1.1** These are the steps for using a hygrometer:

- a) Position the hygrometer on the floor, out of direct sunlight – the additional heat from sunlight will raise the temperature in the box and create a falsely low reading.
- b) Record the position of the hygrometer on a plan of the room.
- c) Stick the bottom edge of the hygrometer box to

the concrete floor with an impervious sealant strip. Record the relative humidity reading at the time of installation.

- d) Leave the hygrometer undisturbed for a minimum of 16 hours.
- e) Read and record the relative humidity reading. The record (there is a sample on page 39 of NZS/AS 1884:2013 Appendix A) must include the:
  - i) project name
  - ii) position of the hygrometer in the room – relative humidity reading
  - iii) time and date the reading was taken
  - iv) signature of the person conducting the tests.
- f) Repeat the process for different positions on the floor – you will save time by using more than one hygrometer. The recommended minimum number of readings is three for areas under 100 m<sup>2</sup> plus one more test for each additional 100 m<sup>2</sup>.

## 8.0 IN-SLAB HUMIDITY PROBES

**8.0.1** In situ probes can effectively measure moisture inside the concrete slab and are useful measuring tools in addition to hygrometers. This is an invasive testing method.

**8.0.2** Using humidity probes is considered a better method of measuring concrete dryness because the relative humidity is measured in the body of the concrete rather than at the surface. To do this, the probe sensor must be positioned at mid-depth of the concrete.

**8.0.3** Relative humidity probes are designed to be either embedded in the slab during concrete placement or inserted into a hole drilled in the slab.

**8.0.4** Use of in-slab humidity probes is permitted by NZS/AS 1884:2013 when used in accordance with Appendix A of the standard. The maximum permitted reading before commencing floor laying is 75%, but a lower reading may be required by some flooring manufacturers or suppliers.

**8.0.5** Relative humidity probes need to be installed and readings taken in accordance with the supplier's instructions.

**8.0.6** Using humidity probes:

- a) Plastic sleeves approximately 16 mm in diameter are inserted into holes drilled in the slab, then capped and left, typically for a period of 16–24 hours or as specified by the probe supplier. Because the sleeve is perforated and the space inside the sleeve is less dense than the surrounding concrete, movement of moisture occurs from the concrete into this space.
- b) Several sleeves are inserted into the slab to ascertain moisture readings over a greater area of the concrete when compared to the humidity box option above.
- c) After the allotted time period, the cap is removed and the hygrometer sensor is inserted into the sleeve to measure the relative humidity in the concrete slab.

## 9.0 RECORDING THE RESULTS

**9.0.1** The advantages of making accurate measurements and keeping records include:

- ensuring that the floor covering will be laid when the moisture content of the slab is at a suitable level – this will minimise the possibility of the floor covering failing
- being able to resist pressure to lay flooring too early by producing accurate readings on the relative humidity of the slab
- if there is a failure of the flooring or the adhesive, unsuitable humidity of the concrete floor slab can be ruled out as the cause.

**9.0.2** Both AS/NZS 2455.1:2007 *Textile floor coverings – Installation practice – General* and NZS/AS 1884:2013 stipulate recording the:

- name of the company performing the test
- name of the client
- physical address
- type of substrate
- testing equipment and the date last calibrated
- date and time of measurements
- location of testing equipment
- results of readings taken
- ambient temperature and relative humidity at time of test.

## 10.0 CAPACITANCE METERS

**10.0.1** A capacitance meter is useful for measuring the moisture level in a number of locations for finished products as it does not penetrate or damage the material in any way. Devices of this type typically measure the moisture content in the top 10 mm of the material. Although capacitance tests provide fast and non-destructive measurements, accuracy is affected by material density and surface moisture, and the meter cannot measure a moisture gradient through a section of timber. Capacitance meters are therefore limited to specialist applications or for providing an initial assessment of moisture levels.

**10.0.2** Although there is no national standard for the calibration of capacitance moisture meters, research work at BRANZ has shown that capacitance moisture meters may be less reliable than resistance moisture meters.

## 11.0 LIMITATIONS

**11.0.1** All moisture content readings should be considered in context as they only indicate moisture based on the resistance or capacitance of the material. Moisture meters are calibrated for clean, new timber, but decayed timber is less dense and may give an inaccurate reading. It is also easy to obtain misleading readings when testing through finishes or close to internal corners.

## 12.0 REFERENCES

### **Ministry of Business, Innovation and Employment**

New Zealand Building Code clause E2 *External moisture* Acceptable Solution E2/AS1

New Zealand Building Code clause B2 *Durability* Acceptable Solution B2/AS1

### **Standards**

NZS 3109:1997 *Concrete construction*

NZS 3602:2003 *Timber and wood-based products for use in building*

NZS/AS 1884:2013 *Floor coverings – Resilient sheet and tiles – Installation practices*

AS/NZS 1080.1:2012 *Timber – Methods of test – Method 1: Moisture content*

AS/NZS 2455.1:2007 *Textile floor coverings – Installation practice – General*

AS/NZS 2589:2007 *Gypsum linings – Application and finishing*

### **Other publications**

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# ISSUE 585 **BULLETIN**



## MEASURING MOISTURE IN TIMBER AND CONCRETE

June 2015

■ The options for measuring the moisture level of construction materials are a moisture meter for timber and a hygrometer or in situ moisture probes for concrete.

■ This bulletin outlines the use of these tools for checking the moisture content of timber and the relative humidity of concrete.

■ This bulletin replaces and updates Bulletin 515 of the same name.