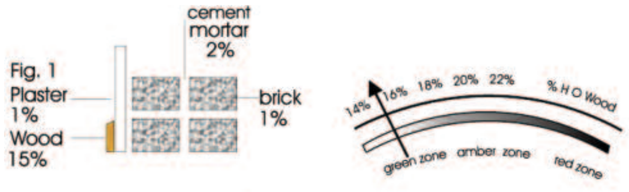

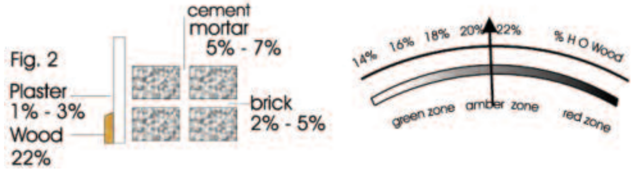

This diagram illustrates the different moisture contents of different building materials, all in moisture equilibrium. The upper example shows the air-dry (safe) condition; the lower example a wet (dangerous) condition. The figures on the right are WME readings on a Protimeter moisture meter.
It can be seen that knowing the percent moisture content of a building material (other than wood) does not tell you whether that material is wet or dry.

Stethoscope
The moisture meter with its accessories is to the engineer, the architect and the surveyor what the stethoscope is to the doctor; it is a tool giving indications, which cannot be gained from the unaided senses. Of course, it requires understanding for correct diagnosis. **The man who claims to identify the cause of dampness without using the Protimeter 'Compleat' Kit may get the answer right - but he is much more likely to get it wrong.**

Recommended Reading

The book: "Dampness in Buildings" This book explains the nature of dampness in buildings, how to diagnose a dampness problem before it gets out of hand, and how to deal with it. It covers problems of rising dampness and condensation (and how to distinguish them), that are often not fully understood. The book stresses the need to use a moisture meter to obtain reliable and comprehensive information. Dampness in Buildings will be of immediate use to surveyors, architects and builders, housing managers and health inspectors.

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PROTIMETER

Damp Detection

How to measure moisture in buildings

HOW TO MEASURE MOISTURE IN BUILDINGS

Wood-moisture-equivalent or per cent moisture content?

Dampness is hazardous before you can see it.

It is important to note that materials do not become visibly damp, and do not feel damp to the touch until they are quite dangerously damp. Wood, for example, does not feel damp below 30% moisture content (i.e. around 97 or 98 per cent relative humidity), although rot will start to develop at 20% moisture content. Thus dampness is hazardous long before it can be detected by the unaided senses. This is why it is so essential to use a moisture meter for surveying for damp, and making judgements about its severity.

I do not think that damp could have been detected by the human eye or by any placing of hands against walls or the like, but I am abundantly satisfied that it could have been detected by the use of a Protimeter moisture meter placed in the right position. So I hold that damp is detectable..
(Extract from the Judgement by JUDGE JOHN NEWEY QC. in the case of Fryer v Bumey in the Official Referee's Court on November 10th 1981 as reported by Estates Gazette, 10.782).

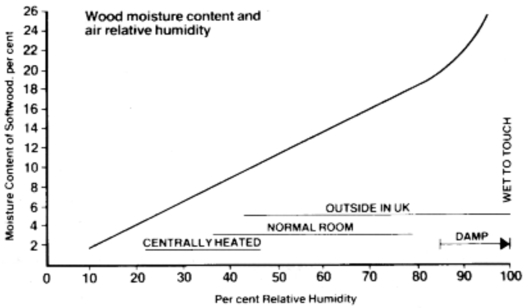
PROTIMETER READINGS ARE MEANINGFUL

Relative Humidity
Since moisture content is a poor measure of the dampness in buildings (see overleaf), what alternative is there? The theoretical ideal is to cover the suspect damp area with a waterproof tent of polythene. foil or with a box, and have a humidity measuring device under it. Water evaporating from the wall, into the small amount of air trapped in the tent or box, will raise its relative humidity until it is in equilibrium. Then by measuring the relative humidity it is possible to say exactly how damp the wall is, regardless of the humidity in the room as a whole. Obviously this is a laborious and impractical process for surveying a building, for it would take several hours at each point.

Protimeter Readings
Fortunately this is not the only method. The relative readings of a Protimeter moisture meter measure only the free water in a material; therefore they closely indicate the relative dampness of different materials. Although they do not measure relative humidity, their indications are a fairly good representation of it. A high reading on such a meter (in the absence of contaminating salts or carbonaceous materials) indicates a damp condition of approximately equal significance in wood, brick, plaster or wallboard, regardless of their very different moisture contents. Contaminating salts are discussed below. Carbonaceous materials are present in some breeze blocks and in the black colouring of some wall papers: They conduct electricity and will give readings on a moisture meter but the very high readings being obtained all over a wall or in black areas only of some wall paper will at once show that the instrument is not measuring moisture.

Wood-Moisture-Equivalent
Indeed, the instrument measures moisture in wood and wood-moisture-equivalent (WME) in building materials other than wood. It is possible, therefore, to mark on the scale of a Protimeter moisture meter indications of 'safe', 'intermediate' and 'danger which correspond reasonably well with the humidity equilibrium of most non-metallic or non carbonaceous materials on which they may be used. The instruments do this by a colour code: Green indicates the 'safe' condition in an ordinary indoor, inhabited environment. Red indicates a humidity equilibrium in excess of about 85 per cent and a hatched or amber area indicates the 'borderline' region.

WOOD MOISTURE EQUIVALENT is the moisture level in any building material as if it were in close contact and in moisture equilibrium with wood expressed as a % moisture content of wood. Therefore any reading above 20% anywhere and in any material is in the red zone and indicates a hazardous condition, which must be investigated.



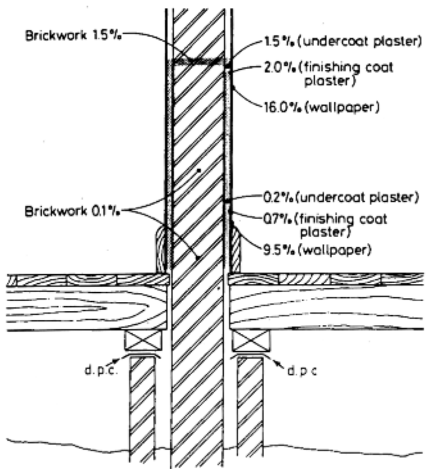
The graph shows the approximate relationship between the relative humidity (r.h) of air and the moisture content of typical softwoods. The horizontal lines show the typical range of humidities met in various circumstances. Wood kept in these environments will gradually come into equilibrium at the moisture content levels indicated on the vertical scale. 75% rh. is 'safe' in building materials.

It is equivalent to 16-18% moisture content in wood. Graphs could also be drawn for every other building material, but the materials are so immensely variable that such graphs would probably be different for every sample of mortar, plaster, concrete or wall board, and all would be very different from wood. If several different materials are built into the same wall the effect of this will become obvious (see diagram Fig. 1 and Fig. 2) overleaf.

A word about salts
The problem, which formerly prevented a purely instrumental diagnosis of the causes of damp, is the effect of salts in the material: Salts left by rising damp, by penetration of water from an old flue, or by leaching out of old walls over many years can cause electrical moisture meters to over-read the moisture level.
This disadvantage has now been overcome by the introduction of the Protimeter Salts Detector. This instrument will tell if salts contaminate a surface or not. If not, then a high Protimeter reading means a high level of moisture.

But even if salts are present, it is possible using a Protimeter moisture meter and Protimeter Deep Wall Probes to obtain true moisture readings. The diagram overleaf, taken from BRE digest 245 (which also appears in our book 'Dampness in Buildings' by permission of the controller of HM Stationery Office) shows why: Salts will not significantly affect Readings taken inside an affected wall at just above skirting level. Conversely, if the Protimeter instrument shows the inside wall to be dry, the problem cannot be one of rising damp; indeed, it may be one of surface moisture - possibly condensation.

Concentration of salts in a party wall in which rising damp has persisted for 80 years: The figures show the percentage by weight of chloride plus nitrate. The shaded area is heavily contaminated. (Redrawn from Building Research Establishment Digest 245, revised 1987)



THE DISADVANTAGES OF % MOISTURE CONTENT VALUES.

To obtain them it is necessary to take samples, a process, which is somewhat destructive. It is carried out either by drilling and collecting the spoil removed by the drill, or by removing whole bricks, or large parts of them, with hammer and chisel. Obviously brick removal is a very drastic process taking much time and effort and causing immense disturbance and mess. It is only possible to do this at a few points so that it is impossible to map out dampness areas. Such a procedure is obviously not practicable for survey purposes. Fewer disturbances are caused by drilling, and in principle it is possible to obtain quite a large number of samples and make some attempt to map out damp areas. It is necessary to drill at a regular speed with a freshly sharpened bit to minimise heating, which would cause rapid loss of water from the small sample of brick dust, and to collect the sample immediately into an airtight container Measurement of the moisture content in the sample thus obtained requires either full laboratory equipment (thermostatically controlled oven, balance sensitive to one milligram, drying tins and desiccator); or the use of an acetylene pressure type instrument like the Speedy (now manufactured within the Protimeter Group). It is absolutely essential to keep such an instrument in perfect condition, the washers regularly renewed and only fresh carbide powder used, or low readings will be obtained as a result of leaks. Although drilling is less destructive than removal of bricks, it causes damage to walls and decorations, which would be unacceptable for survey purposes in most situations. In addition it is relatively slow; half a dozen readings obtained in an hour would be quick work. Obviously, this is not a suitable method for survey work, and although it can be used to determine the moisture content of drilled samples taken from deep inside a wall, irrespective of the presence or absence of hygroscopic salts, **it cannot be used to obtain surface readings in walls, nor can it be used to obtain moisture readings in wood.**

..and when you have done all this - % Moisture content is not meaningful

(for materials other than wood):
Materials are infinitely variable in their composition. The weight of (dry) mortar will vary according to the ratio of sand and cement - so will concrete with the added distortions introduced by differing types of aggregate. The clay for brick making varies from region to region; "plaster" can be a large number of different mixes. The % moisture content of a material is the amount of water in it divided by its weight, when dry:

$$\frac{\textbf{Wet weight - dry weight}}{\textbf{Dry weight}} \textbf{ x 100 \% m.c.}$$

It follows that for the same amount water the greater the dry weight, the smaller the % m.c. Or, to put it another way: A heavy material has much lower moisture content than a light material, which has the same amount of water in it. **As a result, lime mortar is dry at 5%, yet cement mortar at 5% is wet. Some bricks are dry at 2%, while others are wet at 2% m.c. - And most plasters are wet at 1%.**