Code of Practice for the Installation of Remedial Damp Proof Courses in Masonry Walls

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Note: Throughout the text numerical references are given in square brackets (e.g. [15]) the full details of which are listed in Section 12.

INTRODUCTION

This Code of Practice is issued by the Property Care Association (formerly the British Wood Preserving & Damp Proofing Association) hereinafter referred to as "the Association". This Code of Practice deals with the treatment of rising damp in masonry walls of existing buildings and is based on current best practice. It recommends the procedures to be used for diagnosing rising damp and lays down the standards of workmanship required for installing remedial damp-proof courses and for making good afterwards. The Code includes references to other causes of dampness that can occur in buildings and stresses the importance of eliminating these as well as rising dampness. It does not constitute or provide a work specification.

The systems described (Section 8) are chemical injection processes approved by independent BBA certification. Other (non-chemical) systems may also be used by specialist contractors in which case most sections of this Code of Practice will still be applicable. However, users/specifiers of non BBA-certified systems should seek verification that the materials/processes are able to provide adequate control of rising damp over long periods of time.

In all cases the requirements of the Building Regulations and/or any local building bylaws must be observed, and where necessary the advice of the Local Authority Building Inspector should be taken. This Code of Practice should be read in conjunction with technical leaflets [22-27] which are issued by the Association from time to time and BS 6576 [9].

Treatment of walls below ground level (under water pressure) do not fall within the scope of the methods covered by this Code of Practice; for further guidance see [1, 18]. Information is also given on associated matters and, where appropriate, references made to other documents, legislation, etc.

2. DEFINITIONS

For the purposes of this document, the definitions in BS 6100 : Part 5 [8] apply with the following amendments/additions:

Rising Damp
Capillary migration of water in masonry from below, to above, ground level.

Damp-proof Course (dpc)
A continuous physical or chemical barrier to rising damp in walls.

Precautionary Notices
Notices providing warnings about hazards associated with the use of damp-proof course materials and any associated chemicals and precautions to be observed by other trades, clients and the public.

3. HEALTH AND SAFETY

3.1 **General Measures**

3.1.1 **The Health and Safety at Work etc. Act 1974 (and its subsequent amendments)**
Requires every employer to be responsible, in so far as reasonably practicable, for the provision of a safe working environment, the provision of appropriate safety equipment and instruction, training and information on the Safe Use of Plant, Equipment and Materials necessary for the job.

Employees in turn have an obligation to make proper use of the safety equipment provided and to act upon the information and training given to ensure their own safety and that of others who may be affected by their acts or omissions [28].

Particular note should be made of recent Regulations passed under this Act which may be relevant to remedial damp proofing works [29, 30, 31, 32, 35, 36].

3.1.2 **Precautionary Notices**
These should be conspicuously displayed during treatment and, if appropriate, for a period of time following completion.

3.1.3 **Guidance on Safe Practice & Storage**
General advice is given in [25]; more specific advice for individual products is available in manufacturers' Material Safety Data Sheets. The peripatetic nature of most remedial works (i.e. variable site locations) should be taken into account when making risk assessments (see [33, 34]).

3.2 **Fire Precautions**
3.2.1 Where flammable products are being used, appropriate measures should be taken at all times to reduce fire risks to a minimum. Such measures should include the provision of fire extinguishers of a suitable size and type, which must be available to and within easy and safe access of the operators. All such appliances should be maintained in accordance with the manufacturers instructions and as laid down in BS 5306. [3].

3.2.2 All electrical equipment should comply with the current edition of the IEE Regulations. Items should be properly maintained at all times and handled with care to avoid damage.

3.2.3 For flammable materials in transit and storage (including temporary site storage facilities) appropriate fire and security precautions should be taken (see [25]).

3.2.4 Electrical circuits and installations must be properly and adequately safeguarded.

3.3 **Obligations to other persons, the environment and other properties at risk**
Where deemed appropriate (under Clause 3.1.1 above) neighbours/ owners of adjoining or nearby properties must be notified direct if it is considered there may be a hazard to health from work being carried out. Information should include the type of hazard (e.g. flammability), method of application (and any potential risks therefrom) and some recommendations on precautions to be taken before, during and after dpc installation (including details of adequate ventilation and minimum property re-entry times).

4. TRAINING

4.1 All staff must have received training commensurate with their duties. Training in the safe and effective use of damp-proof course systems should be given in accordance with the PCA Guidance Note [20].

4.2 For surveyors one such standard of training and competence is the level achieved by passing the CSRT (Certificated Surveyor in Remedial Treatment) examinations [21].

4.3 For operators, one such standard of training and competence is the level achieved by passing the Institute of Wood Preserving & Damp-proofing examination for technicians which is based on the syllabus given in the PCA guidance note [20].

Note: General advice on training and training courses is available from the Association

5. STANDARDS AND CODES

5.1 **Advisory Documents**
The following are directly relevant to remedial damp-proofing:
BS6576: 2005 - Code of Practice for diagnosis of rising damp in walls of buildings and installation of chemical damp-proof courses.
BS8215: 1991 - Code of Practice for Design and Installation of Damp-proof Courses in Masonry Construction.
BRE Digest 245 - Rising Damp in Walls.

Details of these and some other useful documents concerned with damp proofing are given in Section 12. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

6. INSPECTIONS

6.1 **General Considerations**

6.1.1 Inspections should not normally exceed the instructions received from the client. However, a note should be made of any other relevant problems which are observed, and these should be reported in writing.

6.1.2 Inspections must only be undertaken by staff who have been adequately trained in the identification of dampness in buildings and are competent to specify appropriate remedial measures. Such staff must have a good working knowledge of all traditional styles of building construction.

6.1.3 Particular emphasis is to be placed on the role of dampness in initiating and sustaining fungal decay and influencing insect attack. Staff should include consideration of these matters when specifying the damp-proof course installation and formulating the remainder of the remedial specifications.

6.1.4 The Surveyor should be adequately equipped. This will normally include moisture meter(s), floorboard lifting tools, torch, mirror, portable ladder, measuring equipment and a note book. Additional surveying aids may be required in accordance with the company's practice and of any special features of individual surveys.

6.1.5 Fitted carpets, skirting boards, etc. and furniture should not be disturbed or removed without the permission of the owner and/or his agent.

6.1.6 The Surveyor must have and use the personal protective equipment identified by any risk assessments

carried out under the Management of Health and Safety at Work Regulations and/or the COSHH Regulations [29,31].

6.1.7 Adequate site notes (including plans) are of prime importance and, in addition to the damp survey findings, the following should be recorded and retained:

a) The type (e.g. domestic, industrial) and style of construction and history of the building
b) The scope of the survey
c) The likelihood of concealed or built-in timbers
d) The extent of any structural deterioration and the repairs required (as assessed at the time of inspection).

Note: If the structure being inspected is considered to be dangerously unstable immediate action must be taken to notify the owners or their agents and to ensure public safety [34].

6.2 Structural Considerations

The surveyor should check that the property is suitable for treatment by a remedial damp-proof course installation technique. Most types of wall structure are amenable to treatment but the following may present difficulties which require special techniques to be adopted:

- walls of exceptional thickness(>600mm)
- rubble filled walls
- stud walls
- walls of impermeable materials (e.g. flint, granite)
- walls bonded in irregular or very narrow mortar courses
- perforated or unusually bonded brick walls constructed of local materials (e.g. clay or chalk 'cob'.)

Newer brickwork with a failed conventional dpc may have an alkaline mortar which could prevent effective treatment with some of the currently available water repellent chemical systems (particularly type 'C', 8.1.2).

Common cavity fill insulation materials (e.g. urea formaldehyde foam, mineral wool etc.) would not normally be damaged by dpc systems. Walls with cavities containing polystyrene should not be treated with solvent based chemical dpc fluids although expanded polystyrene may be installed in a treated cavity wall after the solvent has evaporated. It should be noted that solvent-based products may also cause damage to polyethylene and bitumen membranes, and some flooring materials and adhesives.

6.3 Damp Inspection Procedures and Diagnosis

6.3.1 General

When inspecting a structure for signs of rising damp it is essential to consider the possible presence of other sources of dampness. Even if the instructions given are limited to the detection of rising damp, other problems should be highlighted if they are present and reasonably obvious to a specialist surveyor [26].

Visual observations both externally and internally are important and may provide much of the information needed to arrive at a preliminary diagnosis. Nevertheless, a full understanding of the distribution of dampness in a structure will normally require the use of various moisture measuring techniques. Surveyors should be familiar with the use of such equipment and interpretation of results therefrom; in particular, the fact that electrical moisture meters give only qualitative readings in masonry which may be affected by salts etc. [22]. Quantitative estimates can be made using gravimetric or chemical methods and, in general, moisture contents in excess of 5% (w/w) in mortar joints at the base of a wall will indicate the need for further investigations [12].

The following sections describe the common causes, and basic diagnostic features, of various types of dampness.

6.3.2 Penetrating Damp (above ground)

Structural defects may lead directly or indirectly to the presence of dampness on internal surfaces. Typical examples are faulty rainwater goods, and gaps around doors/windows [16]. Also plumbing leaks, especially in concealed pipes, should be considered if no external defects are found. Lateral penetration of rainwater may also occur through permeable brickwork, open mortar joints or cracked rendering, especially on exposed elevations.

If a dpc is present it should be checked for continuity and possible bridging by high ground levels/paths, abutting walls, etc.

Penetrating damp above ground level may be confused with rising damp where it occurs at low levels on external walls. Moisture profiles will generally be fairly uniform over the affected area, perhaps increasing towards the source of ingress (i.e. through the depth of the wall). Hygroscopic salts are not usually found unless they were already present in the structure (see 6.3.5). Hygroscopic salts can be introduced by seawater flooding, so when inspecting coastal properties enquiries should be made about any history of flooding in the area [17].

Penetrating damp below ground level is discussed in detail in a separate PCA Code of Practice [18].

6.3.3 Condensation

Condensation is particularly prevalent in or near kitchens and bathrooms; the classic underlying cause being warm, damp air coming into contact with cold surfaces. Physical features to note are liquid water on non-porous surfaces, often associated with mould growth (e.g. *Aspergillus sp, Penicillium sp.*). The distribution of condensation is usually towards areas of poor air circulation or where cold surfaces arise.

Condensation at low level may be confused with rising damp, although the moisture will usually be superficial and hygroscopic salts absent. The removal of wall coverings and/or plaster will often reveal a dry substrate underneath.

The special case of interstitial condensation (i.e. within a wall) poses particular diagnostic problems which may necessitate structural investigations to identify the cause.

More detailed guidance on the detection and treatment of condensation is given elsewhere [13, 14, 23].

Note: 'One-off' measurements of atmospheric temperature and relative humidity combined with surface temperature readings may allow a surveyor to demonstrate that conditions are suitable for condensation to occur at the time of inspection. However, to build up an accurate picture of the role of condensation, more detailed information will need to be collected over an extended period.

6.3.4 Rising Damp

Rising damp is normally indicated by high free-moisture content in the base of a wall, reducing with increasing height. Often a 'tide-mark' is visible, typically up to 1m above floor level, occasionally higher. Hygroscopic salts (particularly chlorides/nitrates) are almost invariably present in ground water and therefore will be found in walls and plaster suffering from rising damp. These salts normally concentrate in a band in the upper area of dampness and may cause electrical (conductivity) moisture meters to give spurious readings [22].

If a positive diagnosis of rising damp is being obscured by other faults the surveyor should recommend that the client remedies them first and then allows a period of time to elapse before further checks are made.

6.3.5 Hygroscopic/Deliquescent Salts

Hygroscopic and deliquescent salts have the ability to absorb atmospheric water vapour. Consequently, depending on the relative humidity conditions prevailing, structures which contain such salts may

be intermittently 'damp' even though no external source of liquid moisture is present. Ground salts, such as chlorides and nitrates, will normally be present as a result of rising damp or penetrating damp below ground level. However, widespread problems with chlorides in walls may indicate:

a) the use of unwashed sand during construction

b) overuse of chloride-based mortar additives,

c) salt-water exposure (e.g. sea-water, de-icing salts on roads).

If necessary, plaster etc. samples should be taken to establish if hygroscopic salts are present before deciding on appropriate action [12, 27]. Where possible, samples should not be taken from areas adjacent to chimney breasts etc. since hygroscopic salts may accumulate as a result of soot deposits and flue condensation thereby complicating diagnosis.

6.3.6 **Special Factors**

Dampness problems in buildings may be more or less obvious depending on a number of seasonal and other variables (e.g. water table height, wall temperatures, rainfall frequency etc.). All of the above problems will normally leave signs of their historical presence even if the building has since dried out. In such cases, the client should be advised that the building was 'dry' at the time of inspection, but problems may re-occur in the future.

A special case of particular relevance is where hygroscopic salts are present in plaster but the walls are otherwise dry and a remedial dpc has already been installed by another company. Under these circumstances the client should be advised to request a re-inspection of the dpc/plaster work by the original company (where possible) before making further recommendations.

Where the structure is statutorily Listed or is in a Conservation area, the local authority should be consulted before treatement is carried out.

7. REPORTS

7.1 **General**

Following the inspection, a report should be submitted to the client confirming the instructions received, areas top which access could not be gained and describing the surveyor's observations and recommendations [26]. If appropriate, any quotation submitted for remedial damp-proofing works should be free from ambiguity and bear a direct relationship to the work detailed in the report. All necessary preparatory and other associated works (e.g. replastering) should be detailed including clear instructions defining who is responsible for such works. In the case of treatment of Party Walls, clients should be made aware of the requirements of the Party Walls etc Act 1996 to obtain agreement of neighbours prior to commencement of works [37].

7.2 **Structural Timbers**

In all cases where the presence of moisture is identified the condition of associated structural and other timbers should be ascertained where possible. If circumstances preclude a detailed inspection it should be noted in the report that timbers in such areas may be at risk from fungal decay/insect attack and further inspection recommended. This is particularly relevant in the case of suspended timber floors in contact with walls in which rising damp is found or suspected (see Section 8.2.7).

7.3 **Associated Works**

The overall success of damp proofing works may depend ultimately on a number of factors which are often the responsibility of others (e.g. flooring, plastering, etc.). In as far as is practical, the report should identify these areas and give recommendations concerning appropriate specifications.

Note: Further advice on report writing, etc. is available from the Association [26].

8. PRODUCTS AND INSTALLATION MEASURES

8.1 **Selecting a suitable system**

8.1.1 **General**

In most circumstances, any one of the systems described in this Code (see 8.1.2) can be applied equally effectively. However, there are a number of points which are relevant and should be considered in the final selection of a system:

a) Where treatment in 'soft' or friable substrates is to be carried out the use of high pressure injection systems is not recommended.

b) Thick walls, (particularly of a random structure) and cavity walls containing absorbent insulation materials, when treated with solvent based systems, may dry slowly causing prolonged odour and fire hazards.

c) Alkalinity

d) Safety etc. (See sections 3.1; 3.3).

If there is any doubt about the suitability of a particular system, the manufacturer of that system should be contacted for advice.

Note: It should be emphasised that hygroscopic dampness in walls may not be significantly reduced by the installation of a dpc (see 9.2, 9.4).

8.2 **Pre-Installation Measures**

8.2.1 The installer should confirm that the owner and/or occupier of any adjoining property has been advised and any necessary Party Wall Agreement obtained before starting work [36].

8.2.2 Precautionary Notices should be posted prominently at all entrances to the treatment area.

8.2.3 Trace the line of the proposed dpc on the external walls around the outside of the building (removing external renders where present) and check its position matches that of the dpc on the inside of the walls. In accordance with BS 8215 [11], the dpc should be placed at least 150mm above external ground level. If the dpc is consequently high with respect to internal floor levels consideration should be given to reducing external ground levels or implementing special waterproofing measures to deal with lateral penetrating damp below the dpc [1].

8.2.4 Disconnect electrical fittings from the supply and note the locations of any pipework (water, gas).

8.2.5 Expose the internal dpc line by removing plaster, skirting boards and any other obstacles to effective treatment (see also 8.2.6). Any timber that is in sound condition may be put on one side for reinstatement at a later date; decayed timber should be discarded.

8.2.6 Plaster affected by hygroscopic salts should be removed up to a line not less than 300mm above the last detectable signs of dampness and/or salt contamination (using an electrical moisture meter) or 1m above the dpc, whichever is the higher.

Note: Where plaster appears to be in sound condition the extent of plaster removal may be minimised by the client electing to delay any decision to replaster until the drying period is complete. In such cases the contractor should offer clear advice to his client on the risks arising of possible damage to decorations in the future (see 9.2; 9.3).

8.2.7 Where suspended timber floors exist, inspect joist ends and other timbers in contact with damp walls, (e.g. wall plates, sleeper walls), to ensure that they are free from fungal decay. If such problems are located, inform the client and, if instructed, implement the necessary repairs ensuring that any sound retained or replacement timbers are isolated from the masonry and give consideration to the need for preservative treatments [10,15,19]. Even where there is no evidence of fungal

8.1.2 **Approved Products**

The following PCA members currently produce and/or market products that are Agrément approved for remedial damp-proof coursing:

Group	Active Ingredient	Type	Supplier
A	Methyl ethoxy polysiloxane	Organic Solvent	1, 8,9
B	Poly-oxo-aluminium stearate	Organic Solvent	1,2,6,7,8
C	Potassium methyl siliconate	Aqueous	1,2,3,5,6,7,8,9
D	Silanes & alkyl/alkoxy siloxanes	Microemulsion	1,2,6,9
E	Sodium Silicate	Injection Mortar	1,6,9
F	Silanes & alkyl/alkoxy siloxanes	Thixotropic material	1,3,4,5,6, 7,9,10
G	Potassium methyl siliconate	Thixotropic material	8

1 Biokil Crown Ltd
2 Palace Chemicals Ltd
3 Permagard Products Ltd
4 Remmers UK Ltd
5 Restoration UK Ltd
6 Safeguard Europe Ltd
7 Sovereign Chemicals Ltd
8 Triton Chemicals Manufacturing Ltd
9 Wykamol Group
10 Peter Cox Ltd

decay on the exposed faces of the timbers, the concealed sections should be regarded as being at greater risk. Isolation of such timbers from masonry is therefore highly recommended (suitable methods may include completely re-building the floor line with the guidance in [15]).

Where possible install the proposed dpc below the level of timber joists and check the dpc line is not bridged by sleeper walls etc. If a dpc must be installed above a timber floor the client should be informed (in writing) that the floor is at risk of fungal decay.
Note 1: It is strongly recommended that all timber treatment work be undertaken by specialist contractors.

Note 2: The installation of a chemical dpc, even if installed below joists, does not in itself prevent the development of timber decay. Attention should be given to ensuring adequate sub-floor ventilation [15].

8.2.8 Where necessary, repointing and repairs to any defective (e.g. spalled) masonry along the dpc line should be carried out with a weak (e.g. 1:6) cement:sand mix and be left to cure for at least 4 weeks (check manufacturer's data sheets for more detailed guidance on compatibility of each dpc system with fresh mortars).

8.2.9 With solid floors the dpc should be inserted as close to the floor as possible (unless this would place the dpc less than 150 mm above external ground level). The floor membrane should overlap the dpc line. If the membrane terminates below dpc level the client should be informed of the need to ensure continuity of the dpc/dpm before reinstatements commence [24].

8.2.10 Check that other chemical treatments being applied in the area (e.g. against dry rot) will not affect the dpc material.

8.2.11 Vertical dpcs should be positioned where the horizontal dpc changes level and to isolate treated walls from adjacent untreated areas, e.g. adjoining semi-detached and terraced properties, fireplace areas where access to the back of the fire is not possible. Vertical dpcs should be installed up to a line not less than 300mm above the last detectable signs of dampness or 1m above the dpc, which ever is the higher. In the case of abutting structures (e.g. garden walls) it may be advisable to install vertical dpcs to the full height of such structures.

8.2.12 In basements it may be possible to install a dpc in free standing (non-soil retaining) walls providing the resting water table height is never above floor level (i.e. no hydrostatic pressure) and the water-proofing system used on external walls is returning along dividing walls at least 1m beyond the vertical dpc.
Note: Any chemical dpc is only effective against rising capillary moisture. If any doubt exists concerning water-table height all walls and floors in basements should be waterproofed (see [1, 18]).

8.3 Installation Methods

8.3.1 General

In all cases the installation of a chemical dpc consists of two distinct stages:-

a) Drilling a series of holes in a pattern depending on the thickness and form of construction of the wall(s) and the method of treatment to be employed. In the case of Injection Mortars this process may be replaced by partially raking out mortar joints in 115mm walls;
b) Inserting the chemical damp-proofing material.

8.3.2 Methods

Note: The following descriptions apply to the majority of BBA-certified chemical dpc systems. Nevertheless, prior to using any system the details of application should be checked against each manufacturers' specification.

8.3.2.1 High Pressure Injection

Holes (usually 9-16mm diameter) should be drilled, either horizontally or angled downwards in the masonry units, at intervals of approximately 120mm (up to 150mm in porous masonry). In most conventional brickwork this corresponds to a pattern of two holes per stretcher one per header. In very dense brickwork, etc, drilling may be carried out in the adjacent mortar course provided it is capable of accepting high injection pressures.

For solid walls up to 120mm in thickness, drill singly to a depth of 65-75mm; for solid walls greater than 120mm, drill to a similar depth from both sides or drill and inject sequentially from one or both sides ensuring that, after the first series, each incremental drilling is no more than 150mm in depth (100-120mm in brickwork).

For cavity walls treat each leaf as a separate solid wall; if access is only possible from one side, the sequential drilling process can be used. If the cavity is filled with debris at or above dpc level this should be cleared or other measures taken to prevent bridging of the inserted dpc.

For random rubble-filled walls, proceed as for cavity walls then drill into and treat the rubble filled cavity separately (consult manufacturers' recommendations on pressures etc.).

Injection of the dpc material is typically carried out at pressures of 700-900 kPa (100-130 PSI) until fluid exudes back out of the masonry/mortar beds to form a continuous band along the dpc line (and the coverage rates quoted in manufacturers technical data sheets are achieved). When the face of the masonry is not visible (e.g. double injection) a measured volume of fluid (or timed injection) should be pumped based on the initial insertion rates and the relative depth of each newly drilled section. When double (or triple etc.) drilling, seal the injection lance beyond any vertical mortar joints to ensure good pressure retention (sudden drops in recorded pressure usually indicate fluid loss through cracks or fissures).
Note: The above specification primarily relates to solvent-based systems (product types A and B, 8.1.2).

8.3.2.2 Low Pressure Injection

a) Holes (usually 9-16mm in diameter) should be drilled at intervals of approximately 160mm, either horizontally in the masonry units/mortar joints or at an angle (<45°) terminating in a mortar bed joint at the level at which the dpc is to be formed. Drill hole depths should be as detailed in 8.3.2.1 above. If angled drill holes are used in thicker walls some adjustments may be necessary to ensure horizontal continuity at dpc height.
b) Injection of the dpc material is usually carried out at pressures of 150-500 kPa (20-70 PSI). Each hole is injected singly and careful attention paid to the maintenance of an even pressure. Sudden loss of pressure will usually indicate the need to drill a new hole nearby to ensure even migration of the dpc material throughout the wall. the volume of fluid injected should be monitored continuously and compared with manufacturer's recommended dose rates.
Note: The above specification primarily relates to water-based dpc systems (product types C and D, 8.1.2).

8.3.2.3 Gravity Transfusion

a) Holes of up to 25mm in diameter should be drilled at spacings of approximately 175mm and otherwise as described in 8.3.2.2. (a). For drill holes >16mm diameter avoid the use of percussion drills near the opposite face of the wall.
b) For solid walls of up to 120mm in thickness, drill from one side and terminate the holes beyond the centre of the wall and not less than 25mm from the opposite face. For solid walls greater than 120mm in thickness a similar technique is possible but holes should terminate no

c) Transfusion of the dpc material is achieved by dispensing a measured amount of fluid into a container connected to a tube inserted in each hole. If rapid fluid loss is observed either drill an alternative hole nearby or caulk the fissure/crack prior to continuing. Alternatively cover the transfusion tube perforations with sponge-rubber washers. The amount of fluid dispersed must be calculated to comply with the manufacturer's recommendations for the given wall thickness and the units left in position until all the material has been absorbed (2-72 hours).
Note: The above specification relates exclusively to the use of products of type C & D (see 8.1.2).

8.3.2.4 **Injection Mortars**
a) Holes of c. 20mm diameter should be drilled at overall spacings of 115mm and at an angle of depression of c. 30°, finishing in a mortar bed at the level of the proposed dpc. In walls of less than 120mm the mortar joint is raked out to between one third and one half its depth.
b) In solid walls up to 460mm drill from one side to a depth equivalent to the thickness of the wall (at the anle stated above this should result in a hole terminating c.50mm from the distant face). Alternatively, drill to the same depth from both sides at staggered centres of no more than 230mm or to 40mm beyond the centre of the wall at staggered centres of 115mm. For solid walls between 460 and 920mm treat the wall as two separate sections of equal thickness and drill from both sides at opposite centres with 115mm spacings.
c) The drill holes are cleaned out and pre-soaked with water prior to introducing the cementitious slurry by caulking gun or hand pump. The slurry is installed by back-filling each hole, thereby avoiding air gaps, and stopped c.15mm short of the near face of the wall.

Repointing: After pre-soaking the mortar joints the Injection Mortar slurry is mixed to a slightly stiffer consistency suitable for trowel application and care taken to ensure joints are fully back-filled to within c.8mm of the near face.

8.3.2.5 **Ready to use thixotropic materials**

a) Holes of c. 12mm diameter should be drilled horizontally at 100-120mm spacings in the chosen mortar joint, terminating approximately 10-40 mm from the far face of the wall being treated.
Note: Solid walls may be treated from one or both sides. For cavity walls treat each leaf as a separate solid wall; if access is only possible from one side a sequential drilling procedure can be used. If the cavity is filled with debris at or above dpc level this should be cleared or other measures taken to prevent bridging of the dpc.
b) The thixotropic material should be inserted by hand pump, caulking gun or cartridge gun. The delivery tube should be inserted into the full depth of the hole and the hole filled to within 10mm of the surface, thus avoiding air gaps, and achieving the manufacturer's recommended application rate.

9. FINISHING WORK

9.1 **Drying/Curing**
Following dpc installation carrier solvents (Groups A and B; section 8.1.2) may take a few days to several weeks to dissipate depending on wall thickness and environmental conditions prevailing. Once evaporation is complete the dpc should be effective. With water-based systems, curing may occur over similar time periods (Group D) or longer (up to six weeks in thicker walls; Group C and E).

In all cases, irrespective of the speed of dpc formation, 225mm walls will take at least 6-12 months to dry out. The presence of paints or renders will substantially extend the drying period and hence the time before impervious decorations such as wallpaper can be safely applied. Consequently walls should be re-instated with a moisture resistant vapour permeable coating (see 9.4 below).

9.2 **Plastering**
One function of the new plaster is to hold back the hygroscopic salts present in the wall structure due to rising damp, and to prevent them from migrating through to the surface of the new plaster. In all cases, replastering should be delayed as long as possible after the insertion of the dpc and maximum ventilation applied throughout the treated areas of the building during this period. Plasters should be suitable for use in damp situations (e.g. cement-based) but should not be a vapour barrier [12].

Each dpc system manufacturer will give precise details of their recommended replastering specification as part of their BBA Certificate. In general the plaster undercoat (which may incorporate an additive to increase resistance to hygroscopic salt migration) should not be less than 10mm thick. On exceptionally uneven walls it may be necessary to have a greater thickness of plaster, which may need to be applied in more than one coat. The finishing plaster coat should be selected and applied as recommended in BS 5492 [4]. Unless *proprietary* waterproof cementitious coatings or renders are used, plasters should not bridge the finished dpc internally or externally [24]. Non-waterproof renderings may be applied above the level of the dpc, provided that suitable protection is provided, e.g. bell mouths [5]. **Note:** The plaster/render system selected should be compatible with the type and condition of the masonry/mortar [4,5].

9.3 **Dry Lining**
Dry lining systems can be used to provide internal finishes after installation of a chemical dpc. Systems consisting of panels fixed to supports, e.g. treated timber or corrosion-resistant metal battens or framing, and also those consisting of self-supporting panels or arrangements of panels, may be used. Systems which involve directly bonding panels to the walls using gypsum-based bonding plasters or certain other adhesives are not suitable in this type of application.

The dry lining operation should be delayed as long as possible after insertion of the dpc to allow drying out of the treated wall. If this is not possible, ensure adequate ventilation behind the panels during the drying period.

9.4 **Redecoration**
Impervious wall coatings should not be applied until the walls have dried out. This could take 12 months or longer, depending on wall thickness, permeability, heating, etc. A temporary decorative finish is particularly recommended for use during this interim period (e.g. one coat of trade matt emulsion paint).

Dry linings can be decorated with the minimum of delay after installation of the dpc.
Note: In walls grossly contaminated with hygroscopic salts 'dry' conditions may never be fully established and impervious coatings will, therefore, perform badly. In particularly severe cases it is advisable to isolate the affected wall completely from decorative finishes by erecting dry lining or applying plaster finishes on vapour impermeable ('air-gap') membranes.

9.5 **Other Finishing Work**
In general, external holes should be made good with cement:sand mortar (coloured to match) or preformed plastic plugs. Holes drilled internally which will be covered by skirting boards may be left unplugged. Replacement woodwork should be treated with a suitable wood preservative before reinstatement [6,7] and/or isolated from the wall if drying times are likely to be lengthy.

10. PROBLEM SOLVING

10.1 All complaints/requests for re-inspection should be acknowledged in writing.

10.2 The surveyor carrying out the investigation should have available copies of all the information relevant to the job, i.e. the survey report and estimate and details of the actual work carried out, and should be familiar with this information before visiting the site.

10.3 The surveyor should first establish that the locations concerned formed part of the work contracted for and, as far as it is practicable to do so, check that work has been carried out in accordance with the work schedule and with this Code of Practice/BS 6576. Particular points to check are that:-

(a) Dpc installation was at the correct level (with adequate verticals).
(b) External ground levels do not bridge the dpc.
(c) Any retained plaster is sound and that any new plaster is to a specification approved by the company.
(d) Any new plaster has been taken up high enough and that it does not bridge the dpc, unless permitted by the replastering specification or is associated with 'water-proofing' works.
(e) Unsuitable decorations, wallpaper, vapour resistant paint, etc. have not been applied prematurely.

10.4 Check that any recommendations for ancillary work to be carried out by others has in fact been done, with reference to the original survey reports.

10.5 If the above points are in order it is advisable to look for evidence of other sources of moisture ingress. Signs of disrepair should be checked against the original survey report, together with any evidence of new building work or repairs which might have affected the treatment.

10.6 If there is any evidence of mineral salts their location should be recorded and samples taken for subsequent analysis.

10.7 Where evidence of condensation is observed any obvious causes (lack of ventilation, bottle gas/paraffin heaters etc.) should be noted.

10.8 If, after carrying out these checks, no apparent reason can be found for the reported failure of the system, steps should be taken to determine moisture content in the masonry. A calcium carbide-type moisture meter is usually the most convenient instrument to use on site. A moisture content of 5% or more in the mortar joints at the base of the wall would indicate the need for a more detailed analysis in the laboratory [12].

10.9 The final written report to the client should be clear and concise and include any conditions attached to an agreement to carry out remedial work.

11. QUALITY ASSURANCE

Most manufacturers and some contractors are approved under various quality assurance schemes based on the ISO 9000 Series [2].

In addition, following the strict and comprehensive inspection of members at the time of application the PCA also conducts regular inspection visits on its members to ensure that standards are maintained. In particular visits ensure compliance with the objectives, standards, application methods, specifications and use of approved products as detailed in preceding sections. These inspections are carried out by the Association's Technical Officers. By these means, members are kept up-to-date with developments and maintenance of the high standards demanded can be assured.

12. REFERENCES

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3. BS 5306:Part 3:1985 - Code of Practice for Selection, Installation and Maintenance of Portable Fire Extinguishers.

4. BS 5492:1990 - Code of Practice for Internal Plastering

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6. BS 5268:Part 5:1989 - Code of Practice for Preservative Treatment of Structural Timber

7. BS 5589:1989 - Code of Practice for Preservation of Timber

8. BS6100:Part 5 - Glossary of Building & Civil Engineering Terms (Masonry)

9. BS6576:2005 - Code of Practice for the Installation of Chemical Damp Proof Courses

10. BS 8201:1987 - Code of Practice for Flooring of Timber, Timber Products and Wood Based Panel Products

11. BS 8215:1991 - Code of Practice for Design & Installation of Damp Proof Courses in Masonry Construction

BRE
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12. Digest 245 - Rising Damp in Walls

13. Digest 297 - Surface Condensation and Mould Growth

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15. Digest 364 - Design of Timber Floors to Prevent Decay

16. Information Paper IP 19/88 - House Inspection for Dampness

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21. Certificated Surveyor in Remedial Treatment (CSRT) - Examination Syllabus

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26. DP9 - Guidelines to Survey Report Writing

27. DP10 - Hygroscopic Salts and Rising Dampness

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30. a) Provision & Use of Work Equipment Regulations (1998) : Guidance on Regulations (ISBN 0-7176-0414-4)

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