What?s going on here?

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In his latest article on damp in buildings, Michael Parrett looks at the problems caused by blockages under suspended floors and external through-wall air vents

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Until relatively recently, Building Regulations never required a vapour barrier or damp proof membrane to be installed to a solid or a timber suspended floor. Therefore, both floor types can be vulnerable to moisture activity within the subfloor void in older properties.

If rubble and arisings are very close to the joists or boards in timber suspended floors, then often dampness will wick through this waste material. This will introduce moisture directly into the timber elements, eventually leading to wet rot(in well-ventilated subfloors) or dry rot (where ventilation has been reduced).This problem can also be caused by blocked external vents. If there are lead water mains under timber suspended floors, any leaks may soak into rubble and arisings, increasing the humidity in the subfloor void.

Rubble and arisings may be piled up against external and intercessionary walls running upwards through the floor above. This can bridge the damp proof course from the inside and may provide all the symptoms of rising damp, potentially resulting in the incorrect recommendation for a retrofit chemical injection. Fire hearths, particularly from the 1800s to the Edwardian era, may also intercede floors. The supporting fender walls may be seen by looking underneath a timber suspended floor. Often these do not contain a physical horizontal damp proof course and the core may be filled with earth and gravel. If the fire hearth and its fender walls are surrounded by rubble and arisings, they act like a wick to take moisture up into the chimney breast and its reveals.

Signs of damp in timber

The timbers may be soft or crumbling if there is advanced decay. There may also be visual patterns of degradation with signs of ?cuboidal? cracking where the floor begins breaking down into distinct cube patterns indicating wet or dry rot. Timbers, certainly soft woods, will start to decay above 20%-22% of moisture content. Electrical resistance moisture meters are accurately calibrated to timber and a normal moisture content of below 12%-14% would be acceptably dry.

Usually, wood-boring activity is a sign of high moisture. Any fine ?dart holes? may be evidence of the common furniture beetle; the death watch beetle can be avoided if the moisture content in oak timbers is kept below 18%.
When surveying a recently refurbished but empty property, look under the floor to establish whether or not there are high moisture readings: a future problem might be festering away.

Figure 1: General builder?s rubble and arisings placed under the timber suspended floor following property refurbishments

Figure 2: Blocked external low level through-wall vents to the sub-floor. The resultant increased moisture activity led to an outbreak of the dry rot fungus *serpula lacrymans*

and extending *mycelium hyphae* fungus

Testing for dampness

Taking moisture meter readings from the timber skirting boards is a standard action. But in a timber suspended floor, electrical resistance measurements should also be taken on the floor itself. Floor coverings such as wood laminate and tiles make this difficult because they are not easily lifted for access. Carpeting is less of a problem because the two sharp pins of the electrical moisture meter can be pushed through to make contact with the timber floors. An alternative is to use a capacitance radio frequency meter to determine, in a non-invasive way, whether there are high readings in the timber suspended floor.

An electrical resistance meter can be used to check for moisture activity by measuring the bottom of the timber door linings (unlike skirting boards, they rarely get changed). This would indicate moisture in the subfloor void or the wall to which the door lining is attached. An understairs cupboard can be a good place to view the original timber suspended floor because it may not have any floor coverings. It might even be possible to lift a floor board or drill a hole and view the subfloor void using an endoscope.

Figure 3: Deep void below a solid suspended floor full of earth and rubble that needed excavation to remove the threat of excessive dampness and resultant condensation. Water droplets were found to the underside of the solid floor, which did not have an impermeable vapour barrier

Blocked low level through-wall air vent. The physical damp proof course is just above the vent. The abutting solid concrete patio is in contact with the bottom edge of the vent, sufficient for rainwater to penetrate through the air grill. Rain splash from the hard external surface will introduce dampness into the solid masonry wall above the height of the horizontal damp proof course

Solid suspended floors

Often called ?block and beam? suspended solid floors, these are usually constructed of prestressed inverted concrete T beams infilled with concrete blocks and screeded over. These are more difficult to test for moisture than timber, but an easy way is with a hygrometer inserted into a purpose-made humidity box and sealed to the floor. This traps a pocket of air under the box and ideally measurements are taken over 7 days or so to produce a moisture profile.

BS 8203:2009 Code of practice for installation of resilient floor coverings says that the moisture profile emitted from the solid floor should be no higher than 75% relative humidity. Readings above 85%-90% suggest either water leakage into the floor or moisture transfer from the subfloor void due to a lack or failure of a damp proof membrane. A high moisture profile would warrant boring through the solid suspended floor and inserting a hygrometer and temperature probe, leaving this in place for 40-60 minutes to reach moisture equilibrium with the subfloor air.

Concrete, block and beam floors, timber suspended floors and brickwork are all vapour-permeable, so they need an impermeable barrier to stop moisture transferring through them. A sign of high moisture activity is a serious condensation problem in the habitable spaces above those floors. This is often misdiagnosed as being caused by the occupiers? lifestyle but it may be a building defect causing a build-up of moisture in the subfloor void that transfers to the rooms above.

In its gaseous state, moisture moves from a centre of high concentration to one of low concentration. For example, if there is 90% relative humidity under a solid suspended floor and 50% relative humidity in the habitable space directly above, then moisture will move into the habitable space (even when the property is not occupied).

We surveyed a 1970s, two-storey block of flats in Surrey, with one- and two-bedroom ground and first-floor properties and a communal entrance hall. There was evidence of chronic condensation, i.e. black mould around windows, on external wall surfaces, ceilings, within cupboards and even on partition walls. There were significant amounts of material under the suspended floors that eventually filled three 2.75m skips from below a two-bedroom ground-floor apartment.

A cavernous void underneath the flat was full of material, requiring the whole of the block and beam floor to be removed for access. A hygrometer used on and below the floor indicated a 94% relative humidity at both points, indicating moisture equilibrium.

There are often cases of chronic condensation inside modern buildings with suspended solid floors. Moisture caused by a defect to the solid floor void added to that produced by normal use and occupation ? e.g. cooking, laundry, bathing ? exacerbates a problem that cannot be combated by normal measures. These include adequate heating levels, proper ventilation and humidistat-controlled extractor fans in the kitchen and bathrooms.

The low level through-wall air vent was shrouded with a half brick thick wall because the external ground level is far too high above the location of the air vent. A slate had been placed over the top of the brickwork to prevent rainwater induction. Another vent to the outer brick created a periscopic ventilation system. The failed slate top resulted in substantial rain water penetration through to the internal suspended timber floor

Timber suspended floor and solid fire hearth that had also been over-boarded with timber plywood panels. The dry rot outbreak was due to high abutting ground levels, which had blocked the low level through-wall air vents, and low level dampness penetration through the solid external walls; the sub-floor void was very shallow and a high water table also helped produce the ideal environment

Through-wall air vents

Where air vents do not exist or are blocked around the perimeter walls, the moisture content of the air below the suspended floor can increase. This crucial issue is often not commented on during surveys.

The physical horizontal damp proof course in the walls should always be below the internal finished timber or solid suspended floor. Through-wall air vents are typically just below the physical horizontal damp proof course. Of course, if the external ground levels are either partially or fully covering those vents, then the physical horizontal damp proof course could be bridged.

Raised ground levels around air vents can give rainwater an easy route into the subfloor area, especially during heavy rain or flooding. Often, particularly with solid suspended floors, periscopic vents are used where the outside vent grill is higher than the air vent underneath the suspended floor.

We have found instances where someone has cut into the solid masonry wall to insert a periscopic vent because it has been difficult to lower the ground levels. This may mean that the original ground level is still bridging the physical horizontal damp proof course. Where those air vents have been chopped into the wall, they may have cut through the physical horizontal damp proof course.

Surveyors often suggest increasing the number of low-level vents where dampness is found, but this can cause over-ventilation and a cooling problem within the subfloor void. This is more critical with suspended solid floors because if there is no insulation or a vapour barrier, extra vents will just make the floor slab colder and more attractive to condensed moisture within the habitable spaces.

This means the temperature of the solid floor slab can be permanently below the dew point temperature of the internal air (at which air can no longer ?hold? all its water vapour, which then condenses into liquid water) and therefore the air is going to release its excess moisture and create condensation.

Of course, both timber and solid suspended floors now need a properly prepared oversite with a vapour barrier and insulation to meet Building Regulations, particularly Approved Documents (AD) C and L. In Victorian or Edwardian properties, providing all the causes of low-level wall dampness are resolved, e.g. leaking rainwater goods and blocked drains, there should be no need to alter the original oversite ventilation levels. For newer properties, there is guidance on the subfloor ventilation requirements in AD C and the NHBC Standards Chapter 5.2 *Suspended ground floors*.

If there is a dampness problem, do not rush towards increasing subfloor ventilation on older properties just because it does not meet modern standards. It is more important to identify both the source and the cause, then address these issues.

Purpose-made humidity box, sealed to the solid ground supported floor with hygrometer and temperature probe connected to a data capture device to measure the moisture profile of the solid floor (independent of the atmospheric conditions of the habitable rooms)

A mechanical hair hygrometer sealed to a solid ground supported solid floor after removing a single thermoplastic floor tile. The hygrometer rapidly recorded 100% relative humidity indicating that the solid floor was damp. This explained the timber damp reading of 22.7% to the bottom of the door lining (above the level at which timber will decay)

Resolving problems

The obvious action to address blockages under suspended floors is to clear out the rubble and arisings. This can be arduous, especially when enormous quantities of material are found, as in the Surrey case. Even without removing the whole floor, working between the T beams can be difficult.

Regarding air vents, in addition to ensuring external ground levels are correct, watch out for properties where neglected gardens have become overgrown. We have found vegetation not only blocking vents but actually growing through them into the oversite.

Conclusion

Floor voids are a hidden world that surveyors should illuminate. Unfortunately, many surveyors do not check floors. Next time you survey a property that has either a timber suspended floor or a suspended solid floor and there are signs of damp in the perimeter walls, ask yourself: is this the whole story?

The final article in the series will cover leaking high-level gutters and rainwater pipes, internal water pipes, chimneys, fire hearths and drainage defects

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Further information

- AD C: Site preparation and resistance to contaminates and moisture
- AD L: Conservation of fuel and power
- NHBC Standards Chapter 5.2 Suspended ground floors
- BS 8102:2009 Code of practice for protection of below ground structures against water from the ground
- BS 8203:2001+A1:2009 Code of practice for installation of resilient floor coverings

- BRE Good Repair Guides
- Diagnosing damp. Ralph Burkinshaw and Mike Parrett
- Mike Parrett?s guide to building pathology
- See the first and third features in the series:
  - Residential Building pathology: damp issues
  - Residential: high local water tables and flooding

- Related competencies include Building pathology
- This feature is taken from the RICS *Property journal* (September/October 2015)